

CAUSALITY, ASPECT, AND MODALITY IN ACTUALITY INFERENCES

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Abstract

Crosslinguistically, expressions of ability exhibit a curious duality of interpretation, in some contexts describing the abilities and potential of an agent, and in others simply describing what the agent did on a particular occasion. In languages that mark grammatical aspect, the alternation between ability and action extends to abilitative uses of the possibility modal, and is governed by aspectual marking (Bhatt, 1999). For instance, imperfectly marked uses of the French modal *pouvoir* ('can') are compatible with pure, potentially unrealized ability interpretations; by contrast, perfectly marked *pouvoir* gives rise to **actuality entailments**, requiring the realization of its complement, and seemingly very little else. An influential line of work seeks to derive actuality entailments in the composition of modality and aspect, treating ability as a type of circumstantial possibility operator, and the perfective aspect as imposing temporal boundaries on eventualities in its scope (Hacquard, 2006, a.o.).

This dissertation lays the groundwork for an account that links both the ability and actuality interpretations to a novel component in the semantics of ability: causal dependence. The main idea is that ability modals describe a complex causal structure, in which the (circumstantial) possibility that an agent S will realize an event $A(S)$ obtains in view of the causal dependence of $A(S)$ on an available choice or action for S . This proposal is motivated by philosophical work on ability, which suggests that abilitative possibilities have stronger truth conditions than pure circumstantial possibilities (Kenny, 1976; Brown, 1988).

I develop the argument for a causal account of ability by comparing actuality inferences to the interpretation of two other types of complement-taking predicates: **implicative** verbs (e.g., *manage*; Karttunen, 1971) and **enough and too** predicates (e.g., *be fast enough*;

Meier, 2003). I show that, in both cases, complement inferences follow from the combination of two things: (i) the presupposition that some prerequisite action for an agent is causally necessary and causally sufficient for the complement, and (ii) a determination of whether or not the prerequisite action occurred. Implicative verbs resolve the prerequisite as asserted content, deriving their characteristic complement entailments as causal consequences. *Enough* and *too* constructions, by contrast, simply indicate that the prerequisite action is available to the agent. Drawing on theories of **aspectual coercion** (Moens and Steedman, 1988, a.o), I argue that perfective aspect interacts with this ‘availability’ assertion by systematically forcing an interpretation on which the agent instantiates the prerequisite. As a result, imperfectively marked *enough* and *too* constructions imply that their complements are possible, but perfectly marked constructions entail their complements as causal consequences of the prerequisite, in the same way as implicative verbs. *Enough* and *too* constructions thus represent a special type of ability attribution, which is specific about the nature of the causal prerequisite for the ability-complement.

Pursuing this analysis, the actuality inferences of ability modals result not just from the composition of modality and aspect, but more specifically from the composition of aspect with the specific type of complex causal possibility conveyed by ability predicates. I formalize causal dependence relations over the structure of a causal model which represents causal connections between events as directed links in a graphical network (Pearl, 2000; Schulz, 2011; Kaufmann, 2013). In such a model, the felicity conditions imposed by causal necessity/sufficiency presuppositions depend crucially on the discourse background. Grammatical aspect then selects for a particular interpretation of the abilitative causal structure by selecting for a particular type of background. I argue that this view of ability is a natural extension of the standard modal theory, and suggest that formal models of causation are one way of representing reasoning about the ‘normal’ developments of situations (*stereotypicality*; Kratzer 2012[1981]).

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Chapter 1

Introduction

“When *I* use a word,” Humpty Dumpty said, in a rather scornful tone, “it means just what I choose it to mean – neither more nor less.”

“The question is,” said Alice, “whether you *can* make words mean so many different things.”

“The question is,” said Humpty Dumpty, “which is to be master, that’s all.”

Lewis Carroll (1871), *Through the Looking-Glass, and What Alice Found There*

1.1 Two ways of *being able*?

Let us begin with an apparently metaphysical question: what is it to have an ability? In the philosophical literature, this question is bound up with the relationship between an individual’s performance of some action, call it *A*, and the evidence that this provides (or fails to provide) for her *ability* to do *A*. One view, espoused by Austin (1961, p.175), takes performance to represent direct proof of ability: “It follows merely from the premiss that [a person does something], that he has the ability to do it, according to ordinary English.”

It is not difficult to see how one might arrive at this view of the relationship between performance and ability. Consider, for instance, the following situation, loosely based on an example from Maier (2018b):

- (1.1) *Context:* Yesterday, for the first time, you ran into Tara at the golf course. You saw her miss a few shots, and then line up the ball from the tee and make a hole in one. Later, you mention seeing Tara to a mutual friend, who asks:
- a. Can Tara make a hole in one?

Since you have seen Tara succeed at making a hole in one, you might well be inclined to answer (1.1a) in the affirmative. A negative response would be disingenuous: after all, she *did* make a hole in one, and therefore it is apparently within her capabilities to do so. Indeed, taking this logic a step further, you saw Tara make a hole in one while intentionally (or agentively) playing golf. Thus, the demonstrated possibility of her making a hole in one is linked to her capabilities, choices, and (deliberate) actions in the golfing context. In other words, the inclination to answer (1.1a) affirmatively follows from a single witnessed hole in one because this performance provides evidence that it is possible for Tara to act as an agent in making a hole in one. From this perspective, it seems to follow, as a matter of “ordinary English,” that Tara *can* make a hole in one, or that she *is able* to do so.

Trouble arises, however, when we ask ourselves if Tara’s performance provides evidence for the claim that she *has the ability* to make a hole in one. Thalberg (1972) argues that performance alone cannot license *have the ability* claims. He presents as a case in point the following story, which draws an intuitively clear line between the evidence comprised by (a singular) performance and what is apparently required to reasonably ascribe an ability to an individual:

“Take as a premise this report of Brown’s performance at the shooting gallery: ‘He hit three bull’s-eyes in a row’. This assertion is categorical enough; so if it entails the proposition, ‘Brown had the ability to hit three bull’s-eyes in a row’, at least some ascriptions of ability are categorical. But is this inference valid? I admit that we are entitled to conclude, ‘Brown *was able* to hit three bull’s-eyes in a row’. I deny, however, that this conclusion is equivalent to asserting that Brown has a certain degree of ability at target practice.

The non-equivalence becomes noticeable if we expand our account of Brown’s

display of marksmanship: ‘Before he hit the three bull’s-eyes, he fired 600 rounds, without coming close to the bull’s-eye; and his subsequent tries were equally wild.’ This amplified record of Brown’s performance in no way compels us to retract our assertion that he *was able* to hit three bull’s-eyes in a row. He was able to do it, but without any regularity. Therefore he does not have this sort of ability at target shooting.” Thalberg (1972, p.121)

The conclusion here is just as clear as the positive answer to (1.1a) seemed to be in the context of (1.1). While Brown *was able* to hit the bull’s-eye three times in a row, the context suggests that this was a one-off performance, or matter of chance, and therefore does not count as evidence for his *having the ability* to hit a triple bull’s-eye. The Brown story, as a counterexample to Austin’s performance-ability thesis,¹ shows that ability, *qua* ability, cannot be ascribed on the basis of a single performance of the relevant action. Instead, *having the ability* to do something seems to require repeatability or “regularity,” as per Thalberg. What this regularity ought to comprise, however, is not immediately clear.

Thalberg’s scenario suggests that the question of ability versus performance is at least as much a linguistic issue as it is a metaphysical one. (1.2) highlights an unexpected contrast between the English predicates *be able* and *have the ability*, insofar as the former is licensed by Brown’s performance at the shooting range, but the latter is not.

- (1.2) *Context*: “Before he hit [...] three bull’s-eyes, [Brown] fired 600 rounds, without coming close to the bull’s-eye, and his subsequent tries were equally wild.”
- a. #Brown had the ability to hit the bull’s-eye three times in a row.
 - b. Brown was able to hit the bull’s-eye three times in a row.

What should we make of this contrast? Superficially, *be able* and *have the ability* would

¹It may not be entirely fair to refer to this concept as an ‘Austinian’ ability. The claim above notwithstanding, Thalberg points out that, within the same essay (*Ifs and cans*), Austin also argues that “There are [...] good reasons for not speaking of ‘I can lift my finger’ as being directly verified when I proceed to lift it, and likewise for not speaking of ‘He could have done it’ as being directly verified by the discovery that he did do it.” (p.172).

seem to have equivalent semantic content, both conveying (roughly) that an agent's properties are such that it is possible for her to perform or participate in some specified action *A*. This intuitive equivalence is supported by the preferred interpretation of a context-free (1.3), where *be able* can be replaced by *have the ability* without any discernable change in meaning. Indeed, (1.3b) shows that denying the “regularity” (presumably) required for *have the ability* results in a pragmatically marked claim.

- (1.3) When he was in college, Brown was able to hit the bull's-eye three times in a row.
- a. (1.3) \sim *When he was in college, Brown had the ability to hit the bull's-eye three times in a row.*
 - b. When he was in college, Brown was able to hit the bull's-eye three times in a row, ??but he never managed to repeat the performance.

Nevertheless, the divergent judgements in (1.2) provide clear evidence that *be able* and *have the ability* cannot, as a matter of “ordinary English,” be semantically equivalent. Thalberg concludes that the problem is rooted in the meaning of *be able*:

“[The story of Brown] reveals the ambiguity of expressions from the ‘being able’ family [...] ‘was able’ sometimes means ‘had the ability’, and sometimes means ‘did.’ ”

Thalberg (1972, p.121)

On this analysis, the issue of performance versus ability is entirely linguistic in nature, rather than metaphysical. Austin's thesis, when contrasted with the judgements in (1.2), does not reflect an underlying inconsistency in the *concept* of ability, but is instead due to duality in the possible meanings of a particular English expression: *be able* has two lexical entries, one corresponding to the ‘did’ interpretation, and one which corresponds to the pure ability interpretation. As per Thalberg, a true ability ascription requires regularity of some sort; (1.2a) follows from the context in (1.2) only because *be able*, on one interpretation, deals directly with the question of performance, and not with ability at all.

1.2 Actuality inferences: ability, actuality, and possibility

If this were the end of the story, the question of ability would not be of any particular interest from a semantic perspective. The availability of a ‘did’ interpretation, in addition to a pure ability interpretation might be unexpected, but lexical ambiguity or polysemy in a single predicate does not on its own pose any broad or generalizable questions about meaning or interpretation. As it turns out, however, the ‘ambiguity’ arises systematically for ability-ascribing predicates, occurring not just with English expressions in the *be able* family (*be unable*, *not be able*, *could not*; cf. Thalberg), but also in the interpretation of ability-ascribing predicates across a variety of languages, most notably in the abilitative uses of possibility modals (English *can* and its crosslinguistic counterparts). The *did* interpretation arising from certain past-tense uses of *be able* and ability modals is known as an **actuality inference**, and was first systematically described by Bhatt (1999).

Like Thalberg, Bhatt first identifies a *did/had the ability* alternation in the interpretation of past-tense uses of *be able*. Bhatt’s observations go beyond Thalberg’s, however: he points out that the default interpretation of *was able* is strongly predicted by the durational or temporal properties associated with a given claim.

- (1.4) Marja was able to swim across Lake Nokomis.
- a. In her twenties, Marja was able to swim across Lake Nokomis.
 ~ *In her twenties, Marja had the ability to swim across Lake Nokomis.*
 - b. Yesterday morning, Marja was able to swim across Lake Nokomis.
 ~ *Yesterday morning, Marja swam across Lake Nokomis.*

The addition of the temporal modifier *in her twenties* to (1.4), as in (1.4a), favours a generic or habitual perspective on the ‘being able’ situation. Intuitively, this is because the duration of Marja’s twenties is understood to be significantly longer than the time that we might reasonably expect to be expended in swimming across Lake Nokomis, which is relatively small (approximately 0.82 km²). This perspective, in turn, favours a ‘pure ability’ interpretation, as indicated in (1.4a).

Modifying (1.4) with *yesterday morning*, on the other hand, favours an episodic perspective on the ‘being able’ situation, and lends itself to a *did* reading, as in (1.4b). As in (1.4a), this preference is associated with temporal contrasts: the duration of a morning is relatively close in length to the expected time for lake-crossing. While this does not wholly rule out a pure ability reading, (1.5) shows that following (1.4b) with the claim that Marja did not actually cross Lake Nokomis yesterday morning is highly marked. Thus, the episodic context pushes an interpretation on which Marja actually crossed Lake Nokomis yesterday morning: this is the **actuality implication** associated with *be able*.

(1.5) Yesterday morning, Marja was able to swim across Lake Nokomis, ??but she swam in Lake Harriet instead.

(1.5) contrasts with (1.6):

(1.6) In her twenties, Marja was able to swim across Lake Nokomis, but she always chose to do laps of Lake Harriet instead.

Successful laps of the larger Lake Harriet (1.36 km²) provide evidence of the regularity required for a pure ability reading. However, the continuation in (1.6) precludes the possibility that Marja actually crossed Lake Nokomis. Thus, we see that the episodic perspective pushes an interpretation on which Marja actually crossed Lake Nokomis, while the generic or habitual perspective does not.

The connection between an episodic perspective and the *did* reading for *was able* is not accidental. It lies at the heart of the phenomenon of actuality inferences as described in Bhatt (1999). In the preceding examples (1.4a)-(1.4b), we were pushed towards an episodic or generic/habitual interpretation based on carefully-chosen temporal modifiers. In a wide range of languages, this contrast in temporal perspective need not be inferred, but is instead overtly marked by **grammatical** or **viewpoint aspect**, with the **perfective** aspect associated with episodic viewpoints, and the **imperfective** with generic or habitual perspectives. Bhatt shows that, in aspect-marking languages like Greek and Hindi, abilitative uses of possibility modals (*boro* and *saknaa*, respectively, marked in bold below) give rise to

actuality inferences under the **perfective aspect**. Moreover, as shown in (1.7), the actuality inference licensed by perfective marking on an ability modal is in fact an uncancellable entailment. (1.7a) and (1.7b) show that denying the actualization of the modal complement – that is, denying that the table was lifted, or the plane flown – results in outright contradiction with the modal claim. This contrasts with the *be able* example (1.5), where denying the actuality inference is pragmatically marked, but not contradictory. In (1.7), and throughout the dissertation, use of the bold typeface in examples is intended to identify the predicate of interest, and should not be taken as an indication of verbal emphasis unless explicitly stated.

(1.7) Greek and Hindi ability modals under perfective marking:

- a. **Boresa** na sikoso afto to trapezi, #ala den to sikosa.
 can.PST.PFV NA lift.NON-PST-PFV.1S this the table #but NEG it lift.IMPF
 ‘I was able to lift this table, #but I didn’t lift it.’ Greek
- b. Yusuf havaii-jahaaz uṛaa **sak-aa**, #lekin us-ne havaii-jahaaz nahĩ
 Yusuf air-ship fly can-PFV.MASC #but he-ERG air-ship NEG
 uṛaa-yii.
 fly-PFV.FEM.
 ‘Yusuf was able to fly the airplane, #but he didn’t fly the airplane.’ Hindi

The **actuality entailments** in (1.7a) and (1.7b) can be contrasted with the interpretation of the same ability modals under imperfective marking. (1.8a) and (1.8b) are compatible with a pure ability interpretation, and in particular an interpretation on which the modal complement goes unrealized.

(1.8) Greek and Hindi ability modals under imperfective marking:

- a. **Borusa** na sikoso afto to trapezi ala den to sikosa.
 can.PST.IMPF NA lift.NON-PST-PFV.1S this the table but NEG it lift.IMPF
 ‘I had the ability to lift this table, but I didn’t lift it.’ Greek
- b. Yusuf havaii-jahaaz uṛaa **sak-taa** thaa, lekin vo
 Yusuf air-ship fly can-IMPV.MASC be.PST.MASC, but 3SG
 havaii-jahaaz nahĩ uṛaa-taa thaa.
 air-ship NEG fly-IMPV.MASC be.PST.MASC.
 ‘Yusuf was able to fly airplanes, but he didn’t fly airplanes.’ Hindi

Bhatt’s data show that, as a linguistic puzzle, the problem of ability with which we began is as much a puzzle about modality and the compositional interaction between modality and aspect as it is about the lexical semantic representation of abilitative predicates. Specifically, we are no longer concerned only with the meaning of English *be able*, but also with what occurs in the combination of ability modals and grammatical aspect to produce actuality entailments under perfective marking, and favour ability interpretations under the imperfective. An expanding body of research into actuality entailments has demonstrated that they arise not only in Greek and Hindi (shown by Bhatt), but also in a wide range of other aspect-marking languages, including but not limited to, French and Italian (Hacquard, 2006, 2009), Spanish (Borgonovo and Cummins, 2007; Vallejo, 2017), Arabic (Alxatib, 2016), Bulgarian (Hacquard, to appear, data attributed to R. Pancheva), and Blackfoot (Louie, 2014). I include here only an additional example from French, as a large fraction of the empirical data provided in this dissertation will be drawn from French.

(1.9) French ability modals under imperfective and perfective marking:

- a. Marja **pouvait** traverser le lac Nokomis à la nage, mais elle ne l’a pas traversé.
 ‘Marja could-IMPF swim across Lake Nokomis, but she did not cross it.’
- b. Marja **a pu** traverser le lac Nokomis à la nage, #mais elle ne l’a pas traversé.
 ‘Marja could-PFV swim across Lake Nokomis, #but she did not cross it.’

(1.9) shows the same alternation between ability and actuality as the Greek and Hindi examples in (1.7)-(1.8). In (1.9a), the French ability modal *pouvoir* (indicated in bold) is in the imperfective aspect. This is compatible with an interpretation on which Marja never crossed Lake Nokomis. On the other hand, the perfectively-marked modal in (1.9b) generates an actuality entailment: we get a contradiction if we go on to deny that Marja actually crossed the lake.²

²Historically, the perfective aspect in French was encoded by the simple past (*passé simple*), but this has increasingly been replaced by the ‘conversational’ or compound past, *passé composé*. The example in (1.9b) employs the compound *passé composé*, composed by combining the appropriate conjugation of the auxiliary *avoir* (have) with the past participle of the main verb. All French examples marked as perfective in this dissertation use the *passé composé* unless otherwise stated.

1.3 Framing the investigation

As the examples in (1.7)-(1.9) show, the actuality inference puzzle is not just about the interaction between ability and aspect, but also involves modality. English *can*, Greek *boro*, Hindi *saknaa*, and French *pouvoir* all belong to the class of **possibility modals**, which – at least outside of their abilitative uses – convey that a particular event or situation *may* be realized, but fall short of requiring that it actually occurs.

It is not difficult to see a connection between possibility and pure ability. On its abilitative reading, for instance, (1.10) conveys, roughly, that Marja’s skill or competence as a swimmer enable her to cross Lake Nokomis. In other words, the event or situation described by the complement of *can* is possible in view of a particular set of properties associated with the subject. Crucially, this interpretation leaves open the question of whether or not the modal complement actually occurs.

(1.10) Marja can swim across Lake Nokomis.

If it is surprising to begin with that actuality inferences arise from dedicated ability predicates like *be able*, the existence of actualized interpretations for possibility modals is even more mysterious. Moreover, since actuality inferences are in fact full entailments for perfectly-marked ability modals in Greek, Hindi, and French, it seems as if, in the semantic composition of perfective aspect with ability modals, the introduction of perfective aspect somehow erases the core possibility contribution of the modal verb. To make matters worse, this effect is not uniform across construals of the possibility modal (that is, across its different flavours). Example (1.11), from Hacquard (to appear), shows that no actuality entailment follows from perfectly-marked *pouvoir* on an epistemic construal.

(1.11) *Jean a (bien) pu partir, mais il est aussi possible qu’il soit resté.*

‘Jean (well) could-PFV leave, but it is also possible that he stayed.’

Thus, adding perfective marking to a possibility modals has the effect of ‘canceling out’ the possibility meaning only for a restricted set of cases. A satisfactory account of the actuality inference phenomenon must not only account for the availability of actuality interpretations

for possibility modals in the first place, but must also explain the limited distribution of these interpretations. As far as the data we have so far seen indicates, this distribution hinges on the connection between ability and possibility. In other words, an account of actuality inferences requires not only a semantic analysis of ability ascriptions, but also an explanation of the three-way interaction between ability, possibility, and the perspective supplied by viewpoint aspect, whether it is grammatically marked, as in Greek, Hindi, and French, or indicated by/inferred from linguistic context, as in English.

The problem can be distilled into three central questions:

(I) What is the semantic content of an ability ascription?

This is the question with which we began, approached now from a linguistic standpoint. Answering this question involves establishing what expressions of ability necessarily encode, in order to explain how it comes about that certain ability predicates are compatible with actualized interpretations, as well as pure, potentially unrealized, ability interpretations.

(II) What is the connection between ability, actuality, and possibility?

The fact that ability modals are employed, across a wide range of languages, as a means of ascribing ability suggests that there is something compatible in the core semantic representations of possibility and ability. A proper treatment of actuality inferences must accommodate this connection, while at the same time establishing a representation for ability that addresses Question I.

(III) What is the role of aspect in actuality and ability interpretations?

Bhatt shows that the distribution of actuality versus ability interpretations is governed by viewpoint aspect. Question III, then, is largely a compositional one. What about the perfective aspect or the associated episodic viewpoint counteracts or flattens the possibility meaning of a verb like *pouvoir*, on its abilitative construal? Similarly, why is this erasure restricted to perfectly-marked modals, leaving imperfectly-marked ability claims compatible with a pure ability interpretation?

By pursuing answers to Questions I-III, this dissertation moves towards an account of actuality inferences. I take as a starting point the premise that Thalberg’s ‘ambiguity’ is not a genuine case of polysemy. While the data from *be able*, in isolation, might favour such an analysis, I believe that both the range and the systematic distribution of actuality inferences present strong arguments for pursuing a unified semantic treatment of ability ascriptions, across both their actuality and pure ability interpretations.

In the first instance, we have seen that the actuality/ability alternation not only extends from *be able* to abilitative uses of possibility modals, but moreover occurs across a wide range of languages. This makes an account from polysemy rather difficult to maintain, since it would require that ability ascriptions, across languages, uniformly have both ‘pure’ ability and ‘actualized’ lexical entries; and moreover, would require that this ambiguity arises and persists, independently, across a range of languages, not all of which are closely related or in contact situations. Given the ubiquity of actuality inferences, a more parsimonious approach is one which derives the surface alternation from a single core meaning shared by ability attributions across languages: in other words, an explanation which treats the actuality/ability alternation as an epiphenomenon of the underlying representation of ability, in composition with the alternation in viewpoint supplied by perfective versus imperfective aspect. In investigating the first question, then – what it is to have an ability – my aim is to establish a representation for this common core of meaning.

A second argument against the polysemy route comes from the systematic distribution of actuality inferences. Bhatt shows that the alternation between actuality and ability interpretations is neither arbitrary nor context-dependent in a fully pragmatic sense: instead, it depends on other semantic components and inputs to interpretation. If we take ability-attributing predicates to have at base two lexical entries, there is no immediately clear reason why viewpoint aspect should govern lexical selection – for instance, why the perfective aspect should exclusively select for the *did* (actualized) lexical entry, and never for the *had the ability* entry.³ The correspondences between the perfective/episodic viewpoint and actuality, on

³On a polysemy account, this might be the result of a semantic clash or incompatibility between the perfective aspect and the pure-ability lexical entry. We would then need to explain how this clash comes about.

the one hand, and the imperfective/habitual viewpoint and ability, on the other, are strong evidence that the phenomenon of actuality inferences involves a compositional component. Specifically, these correspondences suggest that actuality inferences are derived in the process of combining the semantic contribution of the perfective aspect with the ‘common core’ of meaning associated with ability ascriptions.

Prima facie, actuality inferences appear to involve two key players: the semantics of ability/possibility, and the semantics of aspect. The majority of work on the problem has focused on the actuality entailments of ability modals in aspect-marking languages, thus situating the analysis wholly in the interaction between modality and aspect. While both categories are evidently implicated in the puzzle, it turns out that simply composing possibility modals and the perfective aspect on their standard analyses fails to derive actualized interpretations. Consequently, past attempts to derive actuality inferences have for the most part taken one of two approaches. One class of accounts in essence complicates the meaning of the relevant (abilitative) modal element, postulating either a lexical ambiguity (Bhatt, 1999, see Chapter 3), or by enriching the ontology assumed for ability, so that there is more than one basic conceptual type of ability to which a predicate like *can* or *be able* can refer (Mari and Martin, 2007, 2009, discussed in Chapter 7). The other approach leaves intact a standard possibility semantics for ability modals, but instead complicates the details of the compositional interaction with aspect, for instance by suggesting that the relative scope of modality and aspect reverses as we go from ability interpretations to actualized ones (Piñón, 2003; Hacquard, 2006, see Chapter 2).

The account I develop in this dissertation does not belong to either of these categories, but can nevertheless be seen to combine elements of both overall strategies. Building both on Bhatt’s observations and insights from the philosophical literature on ability, I argue that ability modals should receive a semantic treatment that diverges from the analysis of other (epistemic, deontic) construals of the possibility modal. In particular, I propose that these modals, while strongly associated with possibility, have a more complex internal structure than ‘pure’ possibility modals, circumstantial or otherwise. This added complexity has consequences for the composition of ability modals with aspect, and thus the account

I propose ‘complicates’ the compositional side of the puzzle as a consequence of added complexity on the lexical side.

1.4 Causal dependence in semantic representation

The key to my analysis – and its central innovation – is the idea that, alongside aspect and modality, there is a third, previously overlooked element in the derivation of actuality inferences: causality. The semantics I propose for ability ascriptions is similar in overall structure to existing proposals in the philosophical literature (including Brown 1988; Belnap 1991, and, more recently, Mandelkern et al. 2017; Maier 2018b), but is crucially distinguished from these analyses in that it incorporates causal dependence as a component in the underlying semantic representation of ability. It is this component that bridges the gap between possibility and actuality, in particular by tying the ability of an agent S to perform some action A to whether or not there is an intermediate action, H , available to or possible for S such that the occurrence of $H(S)$ causally ‘brings about’ the actualization of $A(S)$.

That causal relationships are, in some way, represented in linguistic meaning is evident from the abundance of language that deals overtly with causation: we can talk, for instance, about the *causes* of global warming, what *makes* climate change happen, or how to *prevent* these things. The majority of past work on causation postulates the existence of a single, unanalyzable atom of causal meaning – a ‘bringing-about’ relation, CAUSE (Dowty, 1979) – which occurs in combination with a variety of other, noncausal sublexical atoms (e.g., Dowty’s BECOME, DO, REMAIN) to produce the meanings of the full range of causal language. I pursue an approach to causal dependence that diverges from this monolithic view, supposing instead that our semantic representations draw on an inventory of basic and – crucially – contrasting causal dependence relations. These relations occur in combination with one another, as well as with noncausal elements of meaning. On this analysis, contrasts in the use and interpretation of verbs like *cause* and *make* are explained in terms of differences between the causal dependencies they encode.

In defining the basic causal relations, and establishing the differences between them,

I employ a tool originally developed for use in computer science: formal frameworks for modeling and representing the type of causal information involved in cognitive processes like planning and decision-making (Shoham, 1990; Spirtes et al., 1993; Pearl, 2000, among others). Within linguistics, such models have primarily been used in the analysis of counterfactual conditionals and ‘backtracking’ reasoning (Henderson 2010; Schulz 2011; Kaufmann 2013; Ciardelli et al. 2018; Santorio forthcoming; see also Hara 2017 on backtracking in evidentials), rather than as an input to lexical semantic representation. However, a causal model comprises a set of simple and manipulable objects that can be configured in different ways to build complex dependency networks. Within such a network, we can identify particular structures or types of structure, and define these in formal terms. The idea behind a causal-modeling approach to causal meaning is then that these relations, ‘labels’ for particular structural configurations, are the basic components of meaning which introduce causal dependencies at the lexical level.

Such an approach has already been shown to be fruitful in the analysis of overtly causal expressions. Using the framework of Schulz (2011) (based on Pearl 2000), Lauer and Nadathur (2018, 2019) develop a compositional analysis of the periphrastic causatives *cause* and *make* in terms of distinct, contrasting, structural relationships: **causal necessity**, where a designated effect cannot occur in the absence of the stated cause, and **causal sufficiency**, where the occurrence of the cause ensures or guarantees the effect. Lauer and Nadathur show that treating *cause* and *make* as encoding different causal dependence relations allows us to explain not only judgements about where they overlap and diverge in use, but also to derive a number of previously unexplained inference patterns tied to the choice of a particular verb, such as the sense of coercion associated with the use of *make* as opposed to *cause* in a claim like “Gurung made the children dance.”

The account of actuality inferences developed in the dissertation contributes to and develops a program of semantic investigation which incorporates the tools and techniques of causal models by extending a causal-dependency analysis from overtly causal language to the meaning of expressions, such as ability-attributing predicates, that are not transparently causal in nature. In so doing, I demonstrate that incorporating causal concepts at the lexical

level has important consequences for compositional interactions, and thus has the power to predict and derive sentence-level patterns of inference, use, and interpretation that have so far resisted explanation on non-causal analyses.

The account is developed in three main stages, each of which isolates and examines a particular aspect of the actuality inference phenomenon. I first develop an account of the semantics underlying actualized interpretations by investigating the lexical semantics of verbs like *manage*. *Manage* belongs to a class of **implicative verbs** (Karttunen, 1971), which are characterized by the entailments they generate to the actualization of their complements. This is illustrated in (1.12), where the attempt to continue an implicative claim by denying the realization of its complement results in a clear contradiction.

(1.12) Marja managed to swim across Lake Nokomis, #but she did not cross the lake.

While implicative complement entailments are strongly reminiscent of the actuality entailments of perfectly-marked ability modals, they differ crucially in that implicative entailments are not affected by aspectual marking. If, following a suggestion from Bhatt (see Chapter 3), we take actuality entailments to represent real instances of ‘implicative behaviour,’ then understanding how the lexical semantics of implicative verbs contributes to their overall inferential profile provides us with a clear view of what semantic components must be present for actuality entailments to go through. I develop an account of *manage* and other implicatives on which their characteristic entailments are not directly encoded in their semantic representations, but instead follow from the fact that their lexical semantics background relations of causal sufficiency and causal necessity between some prerequisite action and the actualization of the implicative complement. Data drawn from Finnish and English support the claim that implicative verbs are exclusively used in contexts with this two-event causal structure. On this account, the primary assertive content of an implicative verb is that the causing action was realized: complement entailment follows as a consequence of the internal implicative structure.

Next, I investigate the semantic differences between implicatives and ability ascriptions

by examining the inferential behaviour of a set of complex predicates which attribute properties to their subjects. ***Enough and too constructions*** (Meier, 2003; Hacquard, 2005) present a unique puzzle in the actuality inference landscape: in some cases, as in the French examples in (1.13), they behave like ability modals, exhibiting an aspect-governed entailment alternation, while in others (e.g., 1.14), they are fully non-implicative, failing to generate actuality entailments regardless of aspectual marking.

- (1.13) a. *Juno **était assez rapide** pour gagner la course, mais elle n’a jamais gagné.*
 ‘Juno was-IMPF fast enough to win the race, but she never won it.’
 b. *Juno **a été assez rapide** pour gagner la course, #mais elle n’a pas gagné.*
 ‘Juno was-PFV fast enough to win the race, #but she did not win it.’
- (1.14) a. *Amira **était assez grande** pour boir de l’alcool, mais elle ne l’a jamais bu.*
 ‘Amira was-IMPF old enough to drink alcohol, but she never drank it.’
 b. *Amira **a été assez grande** pour boire de l’alcool, mais elle ne l’a pas bu.*
 ‘Amira was-PFV old enough to drink alcohol, but she did not drink it.’

I show that the split between cases like (1.13) and (1.14) is systematic, and in particular that the presence of implicative behaviour (actuality entailments) hinges on a causal interpretation of the ‘prerequisite’ relationship between the matrix property (*fast, old*) and the *enough/too* complement. The chief difference between implicative verbs and *enough/too* predicates is that, where implicatives assert directly that their causing actions were realized, *enough/too* attributions only establish their subject’s latent capacity to perform the causing action. Ultimately, I argue that ability attributions, ranging from English *be able* to ability modals, represent the same sort of latent property attribution as causal *enough/too* predicates.

The final step in the analysis focuses on the contribution of aspect, addressing Question III. In particular, I examine the correlation between the perfective/imperfective alternation and the difference between latent property attributions and ‘true’ implicatives. Past work on grammatical aspect has demonstrated that the perfective is not only responsible for an episodic perspective, but is also sensitive to the inherent duration or temporal properties

(*aspectual class* features) of the events or situations in its scope, in particular enforcing or coercing an ‘active’ or eventive interpretation (i.e. of past events or situations as happenings or occurrences; de Swart 1998; Bary 2009). I show that, in the case of causal *enough/too* constructions, the perfective aspect combines with a latent capacity attribution to describe an event in which the capacity was exercised, resulting in an interpretation on which the causing action in an *enough/too* construction was realized. As a result, the perfective in effect ‘unwraps’ or ‘activates’ the underlying causal (implicative) structure of *enough/too* predicates, producing actuality entailments in exactly the same way as implicative complement entailments. If ability attributions share the basic structure of *enough/too* predicates, we expect precisely the same effects.

Ultimately, then, perfective actuality entailments result from the semantic composition of the ‘active’ perfective and an underlying, implicative-style causal structure for ability attributions. This account shows causal structure to be the common thread in the interpretation of implicatives, *enough/too* constructions, and ability attributions. This demonstrates a central role for causal dependencies in semantic representation, even outside the domain of overt causatives, and argues in support of an extended research program which draws on formal causal models as a tool for semantic analysis. In particular, the approach taken here shows how causal dependencies, at the lexical or sublexical level, have an overall influence on the output of composition between aspect, modality, etc. This expands the view of causation in grammatical structures, and paves the way for an integrated study of causation across different areas of linguistic and semantic analysis. In centering my account of the interaction between aspect and modality which results in actuality inferences on the presence of a causal dependence component in the lexical semantics of ability, I aim in this dissertation to address – in a small way – the challenge posed by a recent observation from Copley and Martin:

“It seems to us that linguists who are interested in lexical semantics study causation in lexical semantics; those interested in causation and agency study these topics in argument and event structure; and causation as it pertains to modality,

aspect, and other phenomena has been addressed only in passing.”

Copley and Martin (2014, p.3)

1.5 Outline of the dissertation

The dissertation is organized as follows. Chapter 2 introduces the necessary theoretical preliminaries, and show that a straightforward combination of modality and aspect, on their standard analyses, falls short of deriving actuality inferences. I discuss Hacquard’s (2006) prominent proposal, and argue that the scope-based analysis she suggests is not enough to solve the problem. Finally, I set the stage for the broader investigation by taking a closer look at abilitative modality, and presenting some arguments (drawing primarily on the philosophical literature) for treating ability modals separately from epistemic, deontic or pure circumstantial construals of possibility modals. This discussion provides a preliminary, but incomplete, answer to Question I: what does it mean to have an ability?

Chapter 3 focuses on the semantics of actuality entailments, taking up the problem of complement entailments in implicative verbs. In this chapter, I present a new semantic treatment of implicative verbs, and develop a central role for causal dependence relations in the analysis of ‘implicative’ behaviour. This chapter revises and expands the account of implicative verbs that previously appeared in Nadathur (2016).

Chapters 4 and 5 address the challenges posed by ‘variably’ implicative *enough* and *too* constructions (Meier, 2003; Hacquard, 2005). Chapter 4 is primarily empirical, surveying a range of *enough* and *too* constructions to establish the parameters which dictate the variation of their implicative behaviour. Chapter 5 builds on these empirical patterns to develop a semantic treatment of ‘variable’ implicativity which unifies *enough/too* implicativity with the causal-dependence analysis of ‘true’ implicatives, on the one hand, while explaining how the differences between *enough/too* predicates and true implicatives account for the interaction between viewpoint aspect and the presence or absence of complement entailments. Taken together with the structure of actualized interpretations as developed in Chapter 3, Chapters 4 and 5 address Question II, linking ability, actuality and possibility via causal dependence

relations. Preliminary portions of the empirical and theoretical investigations presented in these chapters previously appeared in Nadathur (2017).

Chapter 6 focuses on the interaction between *enough/too* predicates and viewpoint aspect. In particular, I discuss the interaction between grammatical aspect to the aktionsart or aspectual class of a predicate in its scope and argue that the combination of capacity-attributing predicates like *enough/too* constructions with perfective aspect triggers an operation of ‘aspect shift’ or **aspectual coercion**. This is attributed to selectional requirements of the perfective aspect, which have been independently observed and motivated (Moen, 1987; Moen and Steedman, 1988; de Swart, 1998; Bary, 2009). I look at various types of aspectual coercion, and develop a preliminary formal analysis of the type of aspectual coercion that results in an ‘active’ or ‘eventive’ interpretation of the latent capacity attributions encoded by *enough/too* predicates. I show how aspectual coercion triggered by the introduction of perfective aspect effectively ‘unwraps’ the causal implicative structure embedded in the semantics of a capacity attribution, thus resulting in implicative-style actuality entailments. This provides an answer to Question III.

Chapter 7 returns to ability ascriptions. I show that an *enough/too*-style implicative analysis accounts for both actualized and ‘pure ability’ interpretations, and in addition offers an explanation for several puzzles about the logical consequences and inferential patterns associated with these two interpretations. I then set out the challenges to be addressed in reconciling the proposed causal structure with the standard modal semantics for possibility, and suggest some promising directions to take in pursuing a full formalization of the implicative semantics for ability, as well as in extending the account.

The final chapter summarizes the material presented in the dissertation, discusses the answers provided for the three core questions, and offers some additional thoughts on the role of causal dependencies in the analysis of inferential phenomena in semantic interpretation.

Chapter 2

Setting the stage: modality, aspect, and ability

As Chapter 1 established, actuality inferences, and actuality entailments in particular, are concerned with the inferential and interpretational consequences of the interaction between modality and aspect. Thus, in order to thoroughly investigate actuality inferences, we first need to establish a treatment for modality and temporality in the semantic interpretation system. This chapter introduces the formal and theoretical background for the main investigation presented in the dissertation.

I begin with a brief overview of the standard compositional treatments of modality and aspect, and introduce the formal apparatus of the interpretation system. This background leads up to a formal illustration of the problem posed by actuality inferences and entailments: I show that composing modality and aspect in the most straightforward fashion does not predict the empirical data we are after.

Next, I examine two approaches to solving the problem. First, I introduce and discuss Hacquard's (2006; 2009) prominent scope-based analysis of actuality entailments. Her account is based on the idea that the failure of the naïve approach motivates revising certain assumptions about the process of composing modality and aspect. While Hacquard sheds new light on the critical data, I argue that the assumptions that she adopts to make a

scope-based analysis work ultimately make predictions that are not empirically supported, and in some very specific contexts, overpredict actuality entailments.

In view of this, I turn to the lexical semantic side of the problem, and take a closer look at the use and interpretation of ability modals. Drawing primarily on observations from the philosophical literature on agency and ability (Kenny, 1976; Brown, 1988, among others), I argue that ability modals demand a lexical semantic treatment that distinguishes them in specific ways from non-abilitative possibility modals. I conclude this section by outlining a revised proposal for the semantics of ability ascriptions.

The final section of this chapter summarizes the discussion and relates the main conclusions to the three core questions posed in Section 1.3 of the introduction.

2.1 The basic semantic ingredients of modality and aspect

2.1.1 The interpretation system

I adopt a static interpretation system based on the intensional system presented in Heim and Kratzer (1998). The central assumption of this type of system is that understanding the meaning of a sentence involves determining what conditions must hold – that is, how the world must be – in order for the sentence to be true. In the Fregean tradition, the **truth conditions** of a sentence are built in a compositional fashion, where “the meaning of a complex expression is determined by its structure and the meanings of its constituents” (Szabó, 2008, on *Frege’s principle*). This principle can be formalized by treating different linguistic categories (both lexical and phrasal) as functions or objects of different types, and taking the syntactic structure of a complex expression to provide a set of instructions as to the order and precedence of individual function applications (Montague 1970a,b, 1973; see also Lewis 1972; Cresswell 1973).

Following Heim and Kratzer, I assume a syntactic structure with unary and binary branches. Beyond this, my syntactic assumptions are as minimal as possible, and are largely adopted from those of particular authors where relevant. My focus overall is on the semantic consequences of particular compositions, rather than the syntactic operations that may or

may not be necessary for overt or covert structure.

The basic **interpretation** or denotation **function** is given by $\llbracket \cdot \rrbracket$. This function takes as inputs words or expressions of natural language, and returns their **denotations**: in the system I present here, their denotations are **intensions**, or rules telling us how to identify objects that are picked out by particular expressions. Since, as stated, the core of a compositional system involves assuming that natural language expressions come in a variety of types, we cannot uniquely define $\llbracket \cdot \rrbracket$ as a mapping from one particular subject domain to a specific object domain. Instead, $\llbracket \cdot \rrbracket$ is **type-driven** (Klein and Sag, 1985), in that the type of object it returns depends on the type or types of its inputs. The interpretation function is relativized to an assignment function a , which handles the interpretation of variables in a given model. Ordinarily, this is indicated with a superscript on the interpretation function, $\llbracket \cdot \rrbracket^a$, but I will omit the assignment function where it is not directly invoked in a derivation.

The intensional system involves two ‘basic’ types: individuals and truth values, which correspond to specific semantic domains. In addition, we interpret sentences with respect to a world parameter. Types are built recursively, as follows:

(2.1) **Semantic types.**

- a. e is the type of individuals
- b. t is the type of truth values
- c. If a and b are types, then (ab) is a type
- d. If a is a type, then (sa) is a type
- e. Nothing else is a type

(2.2) **Semantic domains.** Let W be the set of possible worlds.

- a. D_e is the domain of individuals, obtained by taking the union of W of the set of individuals in each world w in W
- b. $D_t = \{0, 1\}$ is the domain of truth values.
- c. If a, b are types, then $D_{(ab)}$ is the set of functions from D_a to D_b .

- d. If a is a type, then $D_{(sa)}$ is the set of functions from W to D_a .

$\llbracket \cdot \rrbracket$ combines objects according to a set of combination rules:

(2.3) **Interpretation rules.**

- a. Terminal nodes:

If α is a terminal node, $\llbracket \alpha \rrbracket$ is as specified in the lexicon

- b. Non-branching nodes (NN):

If α is a non-branching node in a (syntactic) tree, with β its only daughter, then $\llbracket \alpha \rrbracket = \llbracket \beta \rrbracket$.

- c. Variable substitution:

If α is a variable with an index n , then the value of $\llbracket \alpha \rrbracket$ is determined by the assignment function a : $\llbracket \alpha_n \rrbracket^a = \lambda w. a(n)$

- d. Extensional function application (EFA):

If γ has daughters α and β of types (ab) and a , respectively, then $\llbracket \gamma \rrbracket = \lambda w. \llbracket \alpha \rrbracket (w)(\llbracket \beta \rrbracket (w))$

- e. Intensional function application (IFA):

If γ has daughters α and β of types $((sa)b)$ and a , respectively, then $\llbracket \gamma \rrbracket = \lambda w. \llbracket \alpha \rrbracket (w)(\llbracket \beta \rrbracket)$

- f. Predicate abstraction (PA):

If γ has daughters λx and α , where x is a variable of type b and α is of type t , then $\llbracket \gamma \rrbracket^a = \lambda w \lambda u \in D_b. \llbracket \gamma \rrbracket^{a[x \mapsto u]} (w)$

Consider a simple example:

(2.4) Marja swims.

The proper name, *Marja*, picks out an individual from the domain D_e of individuals. As a unary predicate, the intransitive verb *swim* is taken to pick out the set of individuals who swim (relative to a world parameter). We evaluate (2.4) by applying *swim*, denoting

the characteristic function of the set of individuals who swim, to the individual denoted by *Marja*, thus returning a truth value (again, relative to a world of evaluation). I use w^* to indicate the actual or utterance world.

- (2.5) a. $\llbracket \text{Marja} \rrbracket := M$, where $m \in D_e$
 b. $\llbracket \text{swim} \rrbracket := \lambda w \lambda x_e. \text{swim}(x)(w)$
 c. $\llbracket \text{Marja swims} \rrbracket^{w^*} = \lambda w \lambda x. [\text{swim}(x)(w)](w^*)(M) = \text{swim}(M)(w^*)$
 $= 1$ iff $M \in \{x \in D_e \mid x \text{ swims in } w^*\}$

In this case, the truth of (2.4) depends on the utterance world (and whether or not *Marja* swims in this world).

2.1.2 Modality

The main analytical tool in the interpretation of modality is the notion of a **possible world**. A possible world can be thought of as a specification of a particular state of affairs, which represents a potential variation on the actual way of things. For instance, while the world in which I am writing this sentence is one in which (2.6) is true, because I remembered to flip the light switch on the way out this morning, there is an alternate state of affairs in which (2.6) is false, because I forgot to turn the light off.

- (2.6) The light in my kitchen is off.

The state of the light might be the only difference between the real world and the hypothetical alternative in which I forgot to flip the switch, or these two worlds might diverge with respect to other facts as well. We thus have a rather straightforward way of thinking about possible worlds, as determined by the set of propositions (facts) that they validate.

In this framework, modal expressions represent quantifiers over possible worlds. Possibility modals, like English *can* (or *might*, *may*), French *pouvoir*, Hindi *saknaa*, and so on, represent existential quantifiers, requiring that at least one possible world (of those under consideration in a particular context) satisfies the complement or **prejacent** of the modal.

Necessity modals, like *must*, *should*, or *have to*, are universal quantifiers: a necessity claim is true just in case its prejacent holds in all of the possible worlds under consideration.

- (2.7) a. The light in my kitchen might be off.

There is at least one (relevant) possible world where the light in my kitchen is off.

- b. The light in my kitchen must be off.

All (relevant) possible worlds are ones in which the light in my kitchen is off.

As indicated by the parenthetical use of ‘relevant’ in the paraphrases in (2.7), we do not in general want to evaluate modal claims with respect to the whole domain W of possible worlds. In addition to varying in terms of quantificational **force**, modals vary in terms of **flavour**: that is, with respect to the kinds of worlds we include in their domain of quantification when evaluating a claim.

- (2.8) a. Bertha is fourteen years old, so she **cannot** drive a car in the United States.
 b. The climate and soil in San Francisco are such that dahlias **can** grow here.
 c. The light is on in the upstairs window, so Al **must** be home.

A claim like (2.8a) is concerned with what is required or permitted under the law. Thus, the worlds we want to consider in evaluating (2.8a) should be defined by the real-world laws in some way. (2.8b), by contrast, is concerned with certain facts or circumstances of the actual world, and what follows from these facts. In evaluating (2.8b), then, our domain of quantification should be determined in some way by the climate and geological conditions of San Francisco. (2.8c) is yet another type of modal claim, in which we reason about necessity and possibility on the basis of a body of information, presumably that body of information available to the speaker. These distinctions are made explicit in the paraphrases in (2.9).

- (2.9) a. Bertha is fourteen years old, so she cannot drive a car in the United States.

~ In view of the local driving statutes, it is inconsistent with what is legal that Bertha drives a car in the United States.

- b. The climate and soil in San Francisco are such that dahlias can grow here.
~ In view of the climate and geological conditions in San Francisco, it is possible for dahlias to grow here.
- c. The light is on in the upstairs window, so Al must be home.
~ In view of what I [the speaker] know about Al and his energy-saving habits, it follows from the light being on in the upstairs window that Al is at home.

Formalizing the restrictions indicated by the *in view of* phrases is at the heart of the **premise semantics** for modality, introduced by Kratzer (1977), and further developed in Kratzer (2012[1981], 1991), and subsequent work. Since modal expressions like *can* may be used in different contexts with different flavours, Kratzer proposes an underspecified semantics, in which modal force is fixed, but modal flavour is determined on the basis of contextual information. She captures the different modal flavours – **deontic** in (2.8a), **circumstantial** in (2.8b), and **epistemic** in (2.8c) – by relativizing the evaluation of a modal to a set of premises, which in turn determine subsets of W to serve as the quantificational domain.

Consider (2.8b). Intuitively, we are concerned here with what is possible relative to San Francisco’s climate and geology. Thus, we take as our set of relevant premises the propositions that express the climate and geological circumstances. Our domain of quantification then contains any and all worlds in which these propositions are upheld – thus, from the climate conditions in San Francisco, we get a set of worlds which share these conditions. If one of these worlds also validates the modal prejacent – that dahlias grow in San Francisco – then (2.8b) will be evaluated as true. The set of premises determining the domain of quantification is called the **modal base**: since it contains propositions about real-world circumstances, it is a circumstantial modal base.

We can do something similar for (2.8c). Here, the modal claim – that Al must be at home – is evaluated relative to what the speaker knows or believes to be true. In this case, our modal base is **epistemic**, containing propositions expressing this information – including, of course, the information that the light is on in the upstairs window. The worlds we quantify over are those in which these beliefs are upheld. In this case, since *must* is a necessity modal,

(2.8c) will be true just in case all of these belief-worlds are ones in which Al is at home.

Deontic modals complicate the picture. Evaluating (2.8a) seems relatively straightforward: here, we could take as our deontic modal base a set of propositions that state the driving laws of the actual world: e.g., that no individual under the age of fifteen drives a car, that no individual lacking a permit or license drives a car, and so on. The truth of (2.8a) requires that no world in which these laws are upheld (validated) is one in which Bertha drives.

This is intuitive enough, but in order to get the result we want, we also need to carry the information about Bertha's actual age into the worlds being quantified over. If we do not preserve this information, then we might well find a world in which Bertha drives a car, and no laws are violated because she is sixteen, or eighteen, instead of fourteen. From this, it is clear that it is not enough to fix the laws of the actual world to evaluate (2.8a): we also need to fix certain (relevant) circumstances.

To see how best to do this, let us consider another deontic modal claim. Suppose that, despite being underage, Bertha drives a car in the actual world. This should not affect the truth of (2.8a), but it is relevant for the truth of a claim like (2.10), again on the basis of what the law provides.

(2.10) Bertha should pay a fine.

(2.10) should be validated, since one of the laws of the actual world states that underage drivers pay a fine. However, if we try to evaluate (2.10) with respect to a deontic modal base, we will not get this result. This is because we necessarily lose the information that Bertha has driven a car in the actual world: since the law stating that no one underage drives a car must be upheld in all of the deontically-accessible worlds, we have no worlds in the domain of quantification which can both satisfy the relevant legal propositions while preserving the real-world fact that Bertha drives a car (as well as the fact that she is fourteen). Since, in the worlds under consideration, there are none in which she has violated the fine-inducing law, (2.10) will not come out as true.

What this discussion shows is that, in addition to preserving certain circumstances of

the real world in evaluating deontic claims, we also need a means for including worlds which are excluded on the basis of a deontic modal base. In particular, we need to consider worlds in which certain (relevant) facts of the real world can be maintained, even if they violate one of the laws relevant to the modal claim. Kratzer achieves this by introducing a second premise set for the evaluation of modals: the **ordering source**. The ordering source is used to rank the worlds picked out by a modal base in terms of their proximity to some ideal.

Now, we can evaluate (2.10) in the following way. Instead of starting with a deontic modal base, which *a priori* rules out worlds in which Bertha has violated the law, we use a circumstantial modal base, as we did for (2.8b). In this case, we fix facts about Bertha that are relevant for her driving: her age, permit status, and whether or not she actually drives. The deontic premise set we began with – comprising the driving laws – now becomes our ordering source. Worlds that are closer to the legal ideal will be those in which the fewest laws are broken.

All of the worlds compatible with Bertha’s being fourteen and having driven will be ones in which at least one of the driving laws has been violated. However, the circumstantially-accessible worlds that are closest to the legal ideal will (presumably) be those in which no further law-breaking occurs. Thus, since one of the statutes states that underage drivers pay a fine, all of the ‘best’ worlds compatible with the real-world circumstances, from a deontic standpoint, are ones in which Bertha pays a fine. This gets us the desired result with respect to (2.10).

The premise semantics

As we have seen, the flavour of a modal varies according to two premise sets: the modal base and the ordering source. The precise content of, say, a deontic premise set, however, will depend on the world of evaluation. In the evaluation of a claim like (2.11), we are concerned with the laws not as they are in the real world, but as they are in the belief-worlds of Juno.

(2.11) Juno believes Bertha may not drive a car.

Kratzer captures this potential variation by relativizing the determination of a particular

premise set to the world of evaluation. Modals are evaluated with respect to three parameters: a world and two **conversational backgrounds**, functions from a world to a set of propositions. Conversational backgrounds can be of different sorts: both (2.8a) and (2.11) involve a deontic conversational background, but their evaluation will differ because the content of the proposition set determined by this background also depends on the world of evaluation.

In general, we represent the conversational background that determines a modal base with f , and the ordering source background with g . Since, given a world w , $f(w)$ is a set of propositions, and since we can think of a proposition as corresponding to the set of worlds in which it holds, $f(w)$ can be used to pick out a set of worlds. The worlds in which we are interested – those in which all of the propositions in $f(w)$ are true – are just those which are in the intersection of the sets of worlds in $f(w)$. We write the subset of W picked out in this way as $\cap f(w)$.

We can also use the propositions in a premise set to define an ordering on the set of possible worlds.

Definition 2.1. *Let g be a conversational background. Then, for any world w , the ordering relation $\leq_{g(w)}$ is defined:*

$$\forall v, u \in W, v \leq_{g(w)} u \text{ iff } \{\phi \in g(w) | v \in \phi\} \subseteq \{\phi \in g(w) | u \in \phi\}$$

This is a partial ordering, since it is induced by the subset relation. We next define the set of **optimal worlds** with respect to $\leq_{g(w)}$.

Definition 2.2 (Optimal worlds). *Let g be a conversational background, w a world, and $W' \subseteq W$ a set of worlds. Then the optimal worlds in W' with respect to the ordering induced by g and w are given by:*

$$Opt_{g(w)}(W') = \{v \in W' | \forall u \in W', u \leq_{g(w)} v \rightarrow v = u\}$$

In other words, the set of optimal worlds in W' with respect to the ordering induced by

$g(w)$ are just those worlds which are maximal with respect $\leq_{g(w)}$.

We are now ready to define the modal operators MUST and CAN.

Definition 2.3 (Modals). *Let p be a proposition. Let f, g be conversational backgrounds. Then:*

- (a) $\llbracket \text{MUST}(p) \rrbracket^{f,g} := \lambda w. \forall w' \in \text{Opt}_{g(w)}(\cap f(w)), p(w') = 1$
- (b) $\llbracket \text{CAN}(p) \rrbracket^{f,g} := \lambda w. \exists w' \in \text{Opt}_{g(w)}(\cap f(w)), p(w') = 1$

Within this framework, the flavour of a modal depends on the type of conversational backgrounds provided by context. I first introduce some general properties of conversational backgrounds:

Definition 2.4 (Properties of conversational backgrounds). *Let h be a conversational background. Then:*

- (a) h is **consistent** iff, $\forall w \in W, h(w)$ is consistent
- (b) h is **realistic** iff $\forall w \in W, w \in \cap h(w)$
- (c) h is **unique** iff, $\forall v, u \in W$, if $v \in \cap h(w)$ and $u \in \cap h(w)$, then $v = u$
- (d) h is **totally realistic** iff h is realistic and unique.
- (e) h is **empty** iff $\cap h(w) = W$.

For any given modal claim, modal flavour is determined by the particular combination of conversational backgrounds invoked. For instance, we saw earlier than deontic modal claims like (2.8a) and (2.10) are evaluated with respect to a circumstantial modal base and a deontic ordering source. Since a circumstantial modal base fixes facts about the world of evaluation, it is clear that, for any circumstantial conversational background f and world w , we have $w \in \cap f(w)$: in other words, circumstantial conversational backgrounds are realistic. Once we bring in a deontic ordering source, however, we lose reflexivity in the quantificational domain, since there is no reason that w need be in the set $\text{Opt}_{g(w)}(\cap f(w))$ for a deontic

conversational background g . In (2.10), for instance, the real world might well be one in which Bertha evades the fine for underage driving. This does not affect the truth of (2.10): since the actual world is one in which at least two laws are violated (Bertha drives despite being underage, and fails to pay the fine for doing so), it will be strictly less optimal than a world in which only the underage driving law is violated.

Circumstantial modals, however, do not in general ‘filter out’ the reflexive nature of the quantificational domain which results from using a (realistic) circumstantial conversational background to define the modal base. Kratzer (2012[1981]) argues that the ordering source for pure circumstantial modals is empty (that is, is picked out by an empty conversational background g). Thus, it induces a flat ranking, on which the optimal worlds are simply all of the worlds picked out by the modal base. It follows from this that the quantificational domain for a circumstantial modal will always contain the world of evaluation.

Epistemic modals draw on epistemic conversational backgrounds to fix the modal base. An epistemic modal base contains propositions that are held to be true by some individual at a particular world. These propositions, however, need not hold in the world of evaluation, since the epistemic state of the individual in question may contain false beliefs. For Kratzer, epistemic modals are further relativized either to an empty ordering source, or to a **stereotypical** ordering source. If the ordering source is empty, we are concerned with the logic of possibilities and necessities opened up by an individual’s epistemic state. In the case where a stereotypical ordering source is employed, we are instead concerned with what the epistemic state leads us to expect, in the normal course of events. Kratzer offers the following definition for a stereotypical conversational background:

Definition 2.5 (Stereotypical conversational backgrounds). *A stereotypical conversational background is a function h such that for any world w , $h(w)$ represents what is normal in w according to some suitable normalcy standard for w .* (Kratzer, 2012[1981], p.37)

A stereotypical ordering source, then, will rank worlds with respect to how ‘normal’ they are: the most ideal worlds will be those in which nothing unexpected happens. Used in the evaluation of an epistemic modal claim, a stereotypical ordering source will restrict the

domain of quantification to the most normal worlds from the perspective of the individual whose beliefs determine the modal base. As Kratzer notes, the question of what kinds of propositions should be included in a stereotypical premise set is not at all straightforward. I set this issue aside for the time being, but we will see one possible way of cashing out Definition 2.5 in Chapter 5.

Alongside deontic, epistemic, circumstantial, and stereotypical conversational backgrounds, additional types are sometimes invoked. Some examples include **teleological** conversational backgrounds, which are concerned with the goals of a particular individual (often the subject), or **bouletic** conversational backgrounds, which encode an agent's preferences or desires in a particular world. We will primarily be concerned with the types of conversational backgrounds that are relevant for evaluating epistemic, circumstantial, and deontic modalities. I will use the abbreviations EPIS, CIRC, and DEON, respectively, to indicate conversational backgrounds of these three types.

As an illustration of the premise semantics, (2.12c) derives the truth conditions for (2.10). The necessity modal *should* indicates directly that the type of modality we are concerned with here is deontic. I use MUST to represent all necessity modals, indicating the flavour we are interested in with a subscript.

- (2.12) a. Bertha should pay a fine. ≡ (2.10)
- b. (2.10) \equiv MUST_{deontic}(Bertha pays a fine)
- c. $\llbracket (2.10) \rrbracket^{w^*} := \llbracket \text{MUST}(\lambda w. \text{pay-fine}(B)(w)) \rrbracket^{w^*, \text{CIRC}, \text{DEON}}$
 $= \forall w \in \text{Opt}_{\text{DEON}(w^*)}(\cap \text{CIRC}(w^*), \text{pay-fine}(B)(w))$
- d. \sim *All of the most legally ideal worlds based on the (relevant) laws and circumstances of the actual world are ones in which Bertha pays a fine*

The truth conditions paraphrased in (2.12d) match the intuitive truth conditions discussed earlier for this example.

2.1.3 Aspect and temporal interpretation

Tense and aspect both deal with temporal information, but in quite different ways. Tense locates the content of a particular claim in time, while aspect conveys information about “different ways of viewing the internal temporal constituency of a situation” (Comrie, 1976, p.3). In accordance with the now-standard approach, I assume that tense operates on the output of aspect (Klein, 1994; Kratzer, 1998; Bhatt and Pancheva, 2005).

Early theories of temporal interpretation focus on the relationship between two times: the utterance time and a ‘situation’ or topic time. This is sufficient to capture the contrast between examples like (2.13a) and (2.13b), if we take the present tense (indicated on the verb) in (2.13a) to situate the time of Pepa’s hunger as concurrent with utterance time, and the past tense in (2.13b) to situate the hunger time prior to the utterance time.

- (2.13) a. Pepa is hungry.
b. Pepa was hungry.

A claim like (2.14), however, seems to involve more than two times. In addition to the time of Pepa’s hunger and the utterance time, we also have the time of my arrival at home, which is located *within* the hunger time.

- (2.14) When I got home, Pepa was hungry.

The relationship between this third time and the situation time has consequences for the relationship between the hunger time and the *now* of utterance. While the past tense in (2.13b) seemed to indicate that the situation in which Pepa is hungry took place or obtained prior to utterance time, (2.15) shows that (2.14) is compatible with an interpretation on which Pepa’s hunger is ongoing at utterance time. In both (2.14) and (2.15), however, it is clear that the arrival time must precede utterance time.

- (2.15) When I got home, Pepa was hungry, and she’s still hungry, because I haven’t fed her yet.

We thus have two kind of relationships to account for. First, we have the precedence relation between arrival time and utterance time. Secondly, we have an ‘inclusion’ relation between the arrival time and the hunger time, as a consequence of which the hunger time need not be fully prior to utterance time. In order to capture both relationships, the treatment of temporal interpretation needs to distinguish three times: situation time, utterance time (or speech time), and a **reference time** (Reichenbach, 1947; Klein, 1994; Kratzer, 1996). In (2.14), information about the reference time is overtly provided by the fronted temporal adverbial; but as (2.13a) and (2.13b) show, this need not always be the case.

The work of locating these three times with reference to one another is divided between tense and aspect.¹ Following Klein (1994) and Kratzer (1998), I take tense to order reference time with respect to utterance time. Aspect, on the other hand, indicates an inclusion relation between reference time and situation time. Thus, in an example like (2.14), it is (non-overt) aspect that indicates that the arrival time is *included* in the time of Pepa’s hunger. This means that Pepa’s hunger is an ongoing situation at the reference time. As a result, while the reference time (of arrival) is necessarily in the past of utterance time, fixed by tense, and at least some of the hunger time must also be in the past, there is no requirement that the entire time of Pepa’s hunger is prior to the utterance time. This captures the acceptability of (2.15).

Pronominal tense

In Prior’s (1967) tense logic, a tense is treated as an existential quantifier over times, introducing a reference time which is then related to the utterance/evaluation time of a sentence. In a contemporary framework, this assumes that tense applies to a function from times to propositions (a predicate of times). On this view, we might define past and present operators as follows:

$$(2.16) \quad \text{a. } \llbracket \text{PST} \rrbracket := \lambda w \lambda t_i \lambda P_{i,st}. \exists t' [t \prec_i t' \wedge P(w)(t')]$$

¹The division of labour I adopt here is reasonably described as the standard approach, but it is not the only possible account of tense and aspect in temporal interpretation. Alternative analyses are proposed by Krifka (1998) and de Swart (1998).

$$\text{b. } \llbracket \text{PRES} \rrbracket := \lambda w \lambda t_i \lambda P_{i,st}. \exists t' [t' = t \wedge P(w)(t')]$$

Here, we let i be the type of times (ultimately, temporal intervals), and t a variable representing an element of type i , with \prec_i a precedence relation on times. We will define these elements more carefully shortly. Like world arguments, time arguments are taken to be supplied by utterance contexts: I use the variable t^* to represent the *now* of an utterance.

The approach in (2.16) leads to a number of well-known problems, stemming from the fact that the property of times, P , has no access to any temporal information other than the reference time. This causes problems in the evaluation of sentences like (2.17), where the intuitive interpretation involves comparing a set of individuals who are teachers at t^* to a set of individuals who are students at some past time $t \prec_i t^*$.

(2.17) Some time ago, all my teachers were students. (Cresswell, 1990)

A similar problem arises from ‘sequence of tense’ contexts like (2.18), where the sentence supports two interpretations which differ in their temporal properties. One interpretation has Mary’s pregnancy prior to the time of John’s hearing about it; the other locates the two events simultaneously.

(2.18) John heard that Mary was pregnant.

The approach in (2.16) only predicts the first reading.

Though there are solutions to these problems within the quantificational framework above (see Ogihara, 1995), a more recent approach treats tenses as pronouns. This approach stems from Partee (1973), who observes that tenses and pronouns share certain types of uses, including deictic and anaphoric reference, and points out the existence of contexts in which both tenses and pronouns can be bound.

(2.19) I didn’t turn off the stove.

Partee provides (2.19) as one illustration of the shortcomings of the quantificational analysis in (2.16), as neither of the interpretations made available by a past tense defined as (2.16a) are appropriate. If the negation in (2.19) scopes over the tense, we are forced to interpret

(2.19) as indicating that the speaker has never, at any past time, turned off the stove. On the other hand, if the negation scopes below tense, then (2.19) will be true just as long as there is some past time at which the speaker did not turn off the stove. The correct interpretation of (2.19) involves the speaker making reference to some contextually-salient past time (during which she did not turn off the stove): Partee concludes that this involves a deictic use of tense, which should therefore be treated analogously to pronominal variables.

Following Partee, more recent treatments of tense adopt a referential approach. On this view, time variables are represented in the syntax of an utterance, and are assigned values in the same way as pronouns. Tense operators are semantically empty, but introduce presuppositions – treated as definedness conditions – about the relationship between the time variable and the speech time (Heim, 1994; Kratzer, 1998).

- (2.20) a. $\llbracket \text{PST} \rrbracket$ is defined iff $t \prec_i t^*$. If defined, $\llbracket \text{PST} \rrbracket := t$
 b. $\llbracket \text{PRES} \rrbracket$ is defined iff $t = t^*$. If defined, $\llbracket \text{PRES} \rrbracket := t$

For current purposes, nothing much rides on the choice between (2.16) and (2.20). I will adopt the referential view here. Borrowing a notational convention from Hacquard (2006), the presuppositional content of a tense operator will be indicated in a semantic representation in curly brackets (e.g., $\{t \prec_i t^*\}$).

The category of aspect

The term *aspect* in fact refers to two different, but intertwined concepts, both of which deal with the internal temporal makeup of situations. Here, we are concerned with what is known as **grammatical**, or **viewpoint aspect**. Grammatical aspect is overtly marked in many languages, including French, Hindi, and Greek, and, broadly, provides information relevant for the perspective we have on a particular situation. **Lexical aspect** refers to the inherent temporal or durational properties of a situation. These properties, also called **aspectual class** or **aktionsart** properties, are not overtly coded in morphological or syntactic representation. I focus here on grammatical aspect, which is evidently implicated in the actuality inference phenomenon, and postpone a discussion of lexical aspect until Chapter 6.

In the system we have built up, the output of grammatical aspect will be the input to tense. Tense takes as its input a predicate of times, so this is necessarily the output type of aspectual operators. What should the input to aspect be? We have said that grammatical aspect gives us a durational perspective on a situation or an event, but the interpretation system so far established does not include any objects of this type.

Our first step, then, is to introduce a new type of object into our system: events. I use ϵ to indicate the type of events. Davidson (1967) argues that moving to an event-based semantics allows us to capture entailment patterns such as the following:

- (2.21) a. Jones buttered the toast with a knife.
b. Jones buttered the toast.

Intuitively, (2.21a) entails the proposition in (2.21b). This is easily captured if we assume that the verb takes an event argument in addition to its nominal arguments, since the event description in (2.22a) straightforwardly entails the event description in (2.22b) (ignoring tense for the moment).

- (2.22) a. Jones buttered the toast with a knife.
 $\equiv \exists e[\text{butter}(e) \wedge \text{AGENT}(e)(J) \wedge \text{THEME}(e)(\text{toast}_1) \wedge \text{INSTR}(e)(\text{knife})]$
b. Jones buttered the toast.
 $\equiv \exists e[\text{butter}(e) \wedge \text{AGENT}(e)(J) \wedge \text{THEME}(e)(\text{toast}_1)]$

There are a number of ways to implement an event-based semantics; I refer to Kratzer (1996) for one option. For current purposes, it will be enough to represent verbs as having an open event argument. On this view, verbal projections return predicates of events, which are passed as inputs to grammatical aspect. The representations in (2.22) indicate the thematic roles of various arguments to the main verb: there are differing views on the right way to indicate these relationships. I do not take a position on this issue. For the most part, I will indicate events by simply adding an event argument to the verbal predicate (plus its arguments): thus the event of Jones buttering the toast in (2.22b) would be represented as $\text{butter}(J)(\text{toast}_1)(e)$. However, there are a few places where the thematic role of an argument

is important to the discussion, and in these cases I will indicate it as an independent conjunct, as shown in (2.22).

In a Davidsonian (or Neo-Davidsonian; Parsons 1990, Kratzer 1996, among others) semantics, grammatical aspect is then a function from predicates of events to predicates of times. It relates the reference time provided by tense to the situation time (the time at which the event description holds). Unlike the temporal relationships introduced by tense, this is not an ordering or precedence relationship, but instead an *inclusion* or containment relationship (Klein, 1994).

The chief distinction made at the level of grammatical aspect is between perfective and imperfective aspect. Imperfective aspect corresponds to an ‘internal’ perspective, as in (2.14): locating reference time within situation time results in an interpretation of the main event as ongoing with respect to the reference time. The perfective aspect is associated with the inverse relationship, providing an ‘external’ perspective on events by containing situation time within reference time. These relationships are captured in the lexical entries below, due to Kratzer (1998):

- (2.23) a. $\llbracket \text{PFV} \rrbracket := \lambda w \lambda t_i \lambda P_{et}. \exists e [\tau(e) \subseteq t \wedge P(w)(e)]$
 b. $\llbracket \text{IMPF} \rrbracket := \lambda w \lambda t_i \lambda P_{et}. \exists e [\tau(e) \supseteq t \wedge P(w)(e)]$

The function τ , defined by Krifka (1998), when applied to an event e , returns the **temporal trace** of that event, or the interval of time which corresponds to the runtime of the event.

The perfective aspect is often associated with an episodic view of events, in which they are presented as completed units. This follows from the direction of the inclusion relation in (2.23a): if the reference time from which an event is viewed contains the entire runtime of this event, then we necessarily see the event both externally and as completed. On the other hand, if the reference time is contained in the runtime of the event, as in (2.23b), we view the event as ‘ongoing’ at reference time, or even as potentially incomplete. We saw one example of this in (2.14): since the time of my arrival at home (reference time) was located within the time of Pepa’s hunger (situation time), the interpretation of (2.14) not only presented the hunger as ongoing at reference time, but was also compatible with an interpretation on

which the runtime of the hunger event continued up to and potentially beyond utterance time. There are a number of different interpretations for imperfective morphology, including the ‘habitual’ perspective discussed informally in Chapter 1; other interpretations include a generic reading, and, in some languages, a progressive interpretation.² I will address these interpretations in more detail as they come up in the course of the main discussion.

Modifications to the formal system

To deal with tense and aspect in our formal interpretation system, we need to introduce times and events, as well as certain relations between objects of these types.

Following Condoravdi (2010), I let \mathcal{T} represent a set of non-empty temporal intervals. These intervals are the basic ‘time’ objects in our system; \mathcal{T} is partially ordered by the subset relation. We let i be the type of times, as before.

Definition 2.6 (Temporal domain). *The domain D_i of times is a tuple $\langle \mathcal{T}, <_i \rangle$, with \mathcal{T} the set of non-empty temporal intervals, and $<_i$ a (partial) precedence relation on \mathcal{T} . We define $<_i$ as follows:*

- i. *Let $\mathcal{T}_p \subseteq \mathcal{T}$ be the set of **temporal points**, singleton elements of \mathcal{T} . We take \mathcal{T}_p to be linearly ordered by a precedence relation $<:$ this order is a primitive notion in the domain of times.*
- ii. *$<$ induces a partial order $<_i$ on \mathcal{T} :*

$$\frac{\forall t, t' \in \mathcal{T}, t <_i t' \text{ iff } \forall t_p, t'_p \in \mathcal{T}_p : t_p \subseteq t \text{ and } t'_p \subseteq t', \text{ we have } t_p < t'_p}{}$$

²One possible reading of the French *imparfait* is as a progressive: (ib) corresponds to the English past progressive in (ia).

- (i) a. At ten o'clock this morning, Marja was swimming.
- b. *À dix heures ce matin, Marja nageait.*
 ‘At ten o'clock this morning, Marja swam-IMPF.’

The Greek imperfective also has a progressive interpretation (see, e.g. Bary, 2009). Hindi, by contrast, only allows a habitual interpretation for the imperfective aspect, using separate and dedicated morphology to convey progressives.

I take \mathcal{E} to represent the set of events, with ϵ the type of events. Following Link (1983) and Krifka (1998), I adopt a part-whole structure for the domain of events.³

Definition 2.7 (Event domain). *The domain of events D_ϵ is a tuple $\langle \mathcal{E}, \oplus \rangle$ with \mathcal{E} the set of events and $\oplus : \mathcal{E} \times \mathcal{E} \rightarrow \mathcal{E}$ such that $\forall e, e', e'' \in \mathcal{E}$, we have:*

- i. $e \oplus e' = e' \oplus e$ \oplus is commutative
- ii. $e \oplus e = e$ \oplus is idempotent
- iii. $e \oplus (e' \oplus e'') = (e \oplus e') \oplus e''$ \oplus is associative
- iv. $\neg \exists e$ such that $\forall e', e \oplus e' = e'$ no empty events

We can then define a subevent relation, \sqsubseteq in terms of \oplus :

Definition 2.8 (Subevent relation). *Let $D_\epsilon = \langle \mathcal{E}, \oplus \rangle$ be the domain of events. Then we define an inclusion relation \sqsubseteq and an overlap relation \sqcap on events such that $\forall e, e' \in \mathcal{E}$:*

- i. $e \sqsubseteq e'$ iff $e \oplus e' = e'$
- ii. $e \sqsubset e'$ iff $e \sqsubseteq e'$ and $e \neq e'$
- iii. $e \sqcap e'$ iff $\exists e'' \in \mathcal{E}$ such that $e'' \sqsubseteq e \wedge e'' \sqsubseteq e'$

Then \sqsubseteq is a partial order on \mathcal{E} .

Finally, events and times are related to one another via the **temporal trace** function $\tau : \mathcal{E} \rightarrow \mathcal{T}$, such that for any event $e \in \mathcal{E}$, $\tau(e)$ returns a temporal interval corresponding to the runtime of e .

I conclude this section with sample derivations for the same sentence radical under both perfective and imperfective marking, to illustrate that the semantics developed here produces the contrast we expect:

(2.24) a. *Marja a nagé.*

‘Marja swam-PFV.’

³Formally, this type of structure is a *join semi-lattice* with no bottom element.

- i. $(2.24a) \equiv \text{PST}(\text{PFV}(\text{Marja swim}))(w^*)$
 - ii. $\begin{aligned} \llbracket (2.24a) \rrbracket^{w^*} &:= \llbracket \text{PST}(\text{PFV}(\lambda w \lambda e. \text{swim}(M)(w)(e))) \rrbracket^{w^*} \\ &= \llbracket \text{PST}(\lambda w \lambda t. \exists e : \tau(e) \subseteq t \wedge \text{swim}(M)(w)(e)) \rrbracket (w^*) \\ &= \lambda w. \exists e [\tau(e) \subseteq t \{t <_i t^*\} \wedge \text{swim}(M)(w)(e)](w^*) \\ &= \exists e [\tau(e) \subseteq t \{t <_i t^*\} \wedge \text{swim}(M)(w^*)(e)] \end{aligned}$
 - iii. *There is a past interval t such that t contains the runtime of an event which is an event of Marja swimming in the actual world.*
- b. *Marja nageait.*
- ‘Marja swam-IMPF.’
- i. $(2.24b) \equiv \text{PST}(\text{IMPF}(\text{Marja swim}))(w^*)$
 - ii. $\begin{aligned} \llbracket (2.24b) \rrbracket^{w^*} &:= \llbracket \text{PST}(\text{IMPF}(\lambda w \lambda e. \text{swim}(M)(w)(e))) \rrbracket^{w^*} \\ &= \llbracket \text{PST}(\lambda w \lambda t. \exists e : \tau(e) \supseteq t \wedge \text{swim}(M)(w)(e)) \rrbracket (w^*) \\ &= \lambda w. \exists e [\tau(e) \supseteq t \{t <_i t^*\} \wedge \text{swim}(M)(w)(e)](w^*) \\ &= \exists e [\tau(e) \supseteq t \{t <_i t^*\} \wedge \text{swim}(M)(w^*)(e)] \end{aligned}$
 - iii. *There is a past interval t such that t is contained in the runtime of an event which is an event of Marja swimming in the actual world.*

The truth conditions derived for (2.24a) and (2.24b) therefore differ with respect to the relationship between the past reference time and the runtime of the event of Marja swimming, as desired. In (2.24a), we require that the reference time contain a completed swimming event, giving us the desired ‘external’ perspective. In (2.24b), on the other hand, the reference time instead gives us a perspective from the inside of the swimming event, resulting in a potentially incomplete or ongoing interpretation of this event.

2.2 Modality and aspect in actuality entailments

2.2.1 A first attempt

Now that we have a means for manipulating aspect and modality within a formal interpretation system, we can check what happens when the perfective is combined with an ability

modal. This is the context in which we find actuality entailments, as shown in (1.9b), repeated from Chapter 1. As it turns out, however, the most straightforward way to compose modality and aspect on the analyses provided in the previous section will not derive the desired result.

(1.9b) *Marja a pu traverser le lac Nokomis à la nage, #mais elle ne l'a pas traversé.*

‘Marja could-PFV swim across Lake Nokomis, #but she did not cross it.’

In the linguistics literature, ability modals are most commonly taken to represent a subtype of circumstantial modality, the “modality of rational agents” (Kratzer, 1991, p.646). Where a circumstantial claim like (2.8b) is concerned with the possibilities opened up by certain real-world facts about conditions in San Francisco, an ability modal will instead deal with the possibilities opened up by the physical and/or mental properties of an agent.

(2.8b) The climate and soil in San Francisco are such that dahlias can grow here.

~ *In view of the conditions in San Francisco, it is possible for dahlias to grow here.*

(1.10) Marja can swim across Lake Nokomis.

~ *In view of her physical properties, it is possible for Marja to swim across Lake Nokomis.*

This classification appears to capture the intuitive paraphrase for (1.10) given in Chapter 1, and for the time being, we take abilitative modality to be evaluated with respect to a circumstantial modal base and an empty ordering source.

At least in those languages which mark aspect overtly, it is usually taken to appear below tense in syntactic structure, and to apply to the output of a verbal projection. In the cases we are interested in, the ‘verbal’ projection contains a modal auxiliary. This gives us the following structure for (2.25a):

(2.25) a. *Marja a pu traverser le lac Nokomis à la nage.*

‘Marja could-PFV swim across Lake Nokomis.’

b. (2.25a) \equiv PST(PFV(CAN_{ability}(Marja swim across Lake Nokomis)))

modal claim in (2.25a) is not licensed in such a context.

Setting aside the core semantic treatments of both modality and aspect, I made two assumptions that produced this result. First, I chose to treat ability modals as ‘pure’ circumstantial modals, assigning them existential force, and evaluating them with respect to a circumstantial modal base and an empty ordering source. Secondly, I adopted a particular (fairly standard) compositional structure for (2.25a), on which the perfective aspect applies to the output of the modal projection (or, more generally, to the output of the top verbal projection). In the remainder of this section, I explore one way, proposed by Hacquard (2006), for revising the second assumption.

2.2.2 A scope-based approach: Hacquard (2006)

Hacquard’s (2006; 2009) analysis of actuality entailments remains the most prominent account of the phenomenon. Broadly, Hacquard derives actuality entailments as an epiphenomenon of a particular scopal interaction in the composition of aspect and (abilitative) modality. Her account preserves most of the features of the standard semantics for aspect and modality, but involves a more complex compositional process.

The analysis centers on a distinction between two broad groupings of modals.⁴ Modals in the *epistemic* class, which deals with necessity and possibility as projected from a particular informational state, do not generate actuality entailments. Example (1.11) is repeated from Chapter 1:

(1.11) *Jean a (bien) pu partir, mais il est aussi possible qu’il soit resté.*

‘Jean (well) could-PFV leave, but it is also possible that he stayed.’

This class can be contrasted with so-called *root* modals, which include the ability modals we are interested in. Hacquard includes in the root group other ‘subject’-oriented modalities, including goal-oriented (or teleological) modalities, and a class of *ought-to-do* deontics

⁴The epistemic versus root modal distinction has a long history in the linguistic literature. Since the account I ultimately propose for actuality entailments does not rely on it, I do not discuss these classifications with any details, but instead refer to Kratzer (2012[1981]); Hacquard (2006), and other references noted in this section for additional details of the syntactic and semantic arguments supporting an epistemic-root split.

(Feldman, 1986), which express what the sentential subject is obligated or permitted to do.⁵ Crucially, she argues that actuality entailments are not the special provenance of ability modals, but in fact arise from any and all root modalities, when they are marked with perfective aspect. Examples (2.28) and (2.29) are from Hacquard: (2.28) provides an example of a goal-oriented modal under perfective and imperfective marking, and (2.29) gives an *ought-to-do* deontic (which, as Hacquard herself notes, might simply be assimilated to the goal-oriented cases, by taking the relevant goals to be those of Lydia’s father).

(2.28) Actuality entailment contrasts for goal-oriented root modals:

- a. *Jane pouvait prendre le train pour aller à Londres, mais elle a pris l’avion.*
 ‘Jane could-IMPF take the train to go to London, but she took the plane.’
- b. *Jane a pu prendre le train pour aller à Londres, #mais elle a pris l’avion.*
 ‘Jane could-PFV take the train to go to London, #but she took the plane.’

(2.29) Actuality entailment contrasts for (goal-oriented) deontic modals:

- a. *Lydia pouvait aller chez sa tante (selon les ordres de son père), mais n’y est pas allée.*
 ‘Lydia could-IMPF go to her aunt’s place (according to her father’s orders), but she did not go there.’
- b. *Lydia a pu aller chez sa tante (selon les ordres de son père), #mais n’y est pas allée.*
 ‘Lydia could-PFV go to her aunt’s place (according to her father’s orders), #but she did not go there.’

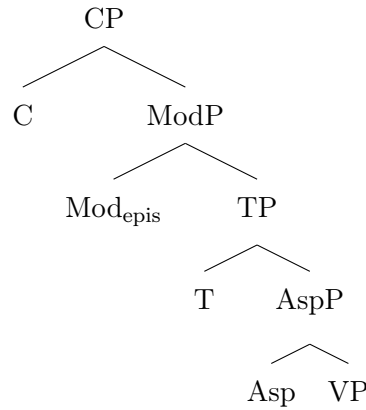
Drawing on arguments from Brennan (1993), Cinque (1999), and Butler (2003), Hacquard takes the epistemic-root distinction to correspond to a difference in the height at which modals are merged in syntactic structure. For her, epistemics are merged above tense

⁵Hacquard classifies a second group, the *ought-to-be* deontics, with epistemic modals, on the grounds that both types are speaker-oriented, rather than subject-oriented. Epistemic modals deal with possibility and necessity on the basis of the speaker’s beliefs, while *ought-to-be* deontics express permissions or requirements for the addressee, as placed by the speaker. I refer to Feldman (1986) and Hacquard (2006) for additional details of this classification, as it is ultimately tangential to my investigation.

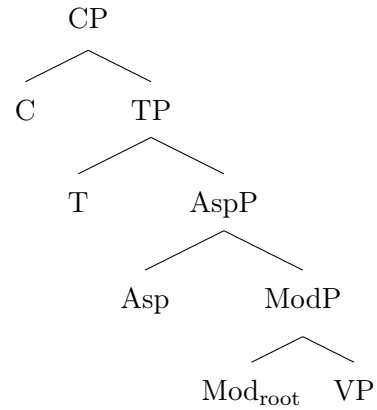
(accounting, on Hacquard’s view, for their lack of subject-orientation), while root modals are merged directly above the verbal projection.⁶ Roughly, then, the structure of an epistemic modal claim is as in (2.30a), while the structure of a root modal is as given in (2.30b).

(2.30) Merge height of epistemic versus root modals (per Hacquard, 2006)

a. Epistemic modals:



b. Root modals:



The contrast in actuality entailment behaviour between (1.9b), (2.28b), and (2.29b), on the one hand, and (1.11), on the other, will follow from this structural difference. It is worth highlighting that this contrast Hacquard is after here is not the one with which we introduced actuality entailments (between perfectly- and imperfectly-marked modals), but instead the contrast in entailment patterns that arises between different modal flavours.

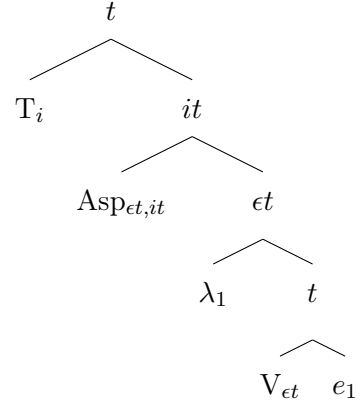
By itself, the structure in (2.30b) is not enough to derive the entailment behaviour we are after. We saw the result of a straightforward composition with this form in Section 2.2.1: applying the perfective aspect as-is to the output of a circumstantial possibility modal does not predict an actuality entailment. Thus, in order for the structural difference to derive the contrast she is after, Hacquard needs additionally to make some changes to the compositional interaction. She does this by introducing two key modifications in the analysis of aspect.

First, Hacquard treats aspect as base-generated inside the verbal projection, in essence providing an event as an argument of the main verb. This does not affect the position at

⁶I will usually indicate a verbal projection with VP, but this should be interpreted as shorthand, and does not reflect any theoretical commitments.

which aspect is interpreted, which remains as shown in (2.30b), but since this interpretation position now requires aspect to raise from its base position, the revised analysis means that aspectual marking leaves behind a bound event variable in the verb phrase.

(2.31) Aspect after raising out of the verbal projection:



The second modification Hacquard makes is to treat aspect as taking a world argument in its restriction as well as in its scope. This is motivated by the analogy between individual quantifiers and a view of aspect as quantifiers over events. In the context of individual quantifiers, Percus (2000) argues that the world arguments in the restriction and scope can, under certain circumstances, be tied to different binders. If we include a world argument in the restriction of aspect, the same sort of thing can happen: the world arguments in the restriction and scope of aspect can be bound independently. According to Hacquard, this is precisely what happens in the derivation of an actuality entailment.

These two modifications result in the following lexical entry for the perfective aspect:

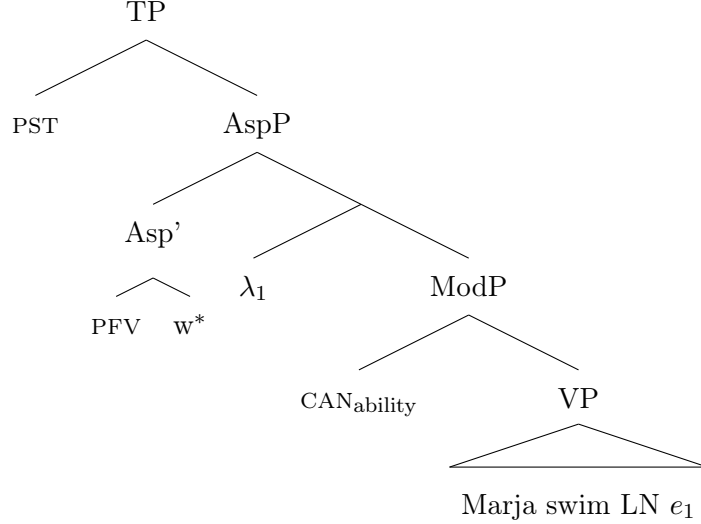
$$(2.32) \quad \llbracket \text{PFV}^H \rrbracket := \lambda w \lambda t \lambda P_{et}. \exists e [e \text{ in } w \wedge \tau(e) \subseteq t \wedge P(e)]$$

Since aspect is interpreted above the modal in a root modal structure, its world argument will not be bound by the modal, but instead by something higher in the structure, which, in the cases we are interested in, will be the actual world. Thus, the world argument of aspect will give us an event which is located in the actual world. Moreover, since aspect binds the event variable in the verb phrase, the ‘matrix’ event will be tied to the prejacent event. (2.33) gives the truth conditions for (2.25a) under Hacquard’s analysis.

(2.33) *Marja a pu traverser le lac Nokomis à la nage.* ≡ (2.25a)

‘Marja could-PFV swim across Lake Nokomis.’

a.



- b. $\llbracket (2.25a) \rrbracket^{w^*} = \llbracket \text{PST}(\text{PFV}_1(\text{CAN}_{\text{ability}}(\text{Marja swim across Lake Nokomis } e_1))) \rrbracket^{w^*}$
 $= \llbracket \text{PST}(\text{PFV}_1(\text{CAN}_{\text{ability}}(\lambda w.\text{swim-LN}(e_1)(w) \wedge \text{AGENT}(M)(e_1)))) \rrbracket^{w^*}$
 $= \llbracket \text{PST}(\text{PFV}_1(\lambda w.\exists w' \in \text{Opt}_\emptyset(\text{CIRC}(w))[\text{swim-LN}(e_1)(w') \wedge \text{AGENT}(M)(e_1)])) \rrbracket^{w^*}$
 $= \llbracket \text{PST} \rrbracket^{w^*} (\lambda w \lambda t. \exists e[e \text{ in } w \wedge \tau(e) \subseteq t \wedge$
 $\quad \exists w' \in \text{Opt}_\emptyset(\text{CIRC}(w))[\text{swim-LN}(e)(w') \wedge \text{AGENT}(M)(e)])$
 $= \exists e[e \text{ in } w^* \wedge \tau(e) \subseteq t\{t \prec_i t^*\} \wedge$
 $\quad \exists w \in \text{Opt}_\emptyset(\text{CIRC}(w^*))[\text{swim-LN}(e)(w) \wedge \text{AGENT}(M)(e)]]$
- c. *There is an event in the actual world located in a past interval, and there is a world compatible with Marja's properties in the actual world where that event is an event of Marja swimming across Lake Nokomis.*

On Hacquard's analysis, then, we have a link between an event in the world of evaluation and an event meeting the prejacent's description in the accessible worlds. This contrasts with the truth conditions we achieved in (2.27), where no real-world event was identified. However, (2.33c) still falls short of deriving the actuality entailment: as stated, the prejacent event description is not directly connected to the real-world event. To complete the story, Hacquard suggests that the interpretation of modal claims are subject to a general principle

which ‘transfers’ event descriptions across worlds.

(2.34) **Preservation of Event Description (PED).** (Hacquard, 2006, p.57)

For all worlds w_1, w_2 , if e_1 occurs in w_1 and in w_2 , and e_1 is a P -event in w_1 , then *ceteris paribus*, e_1 is a P -event in w_2 as well.⁷

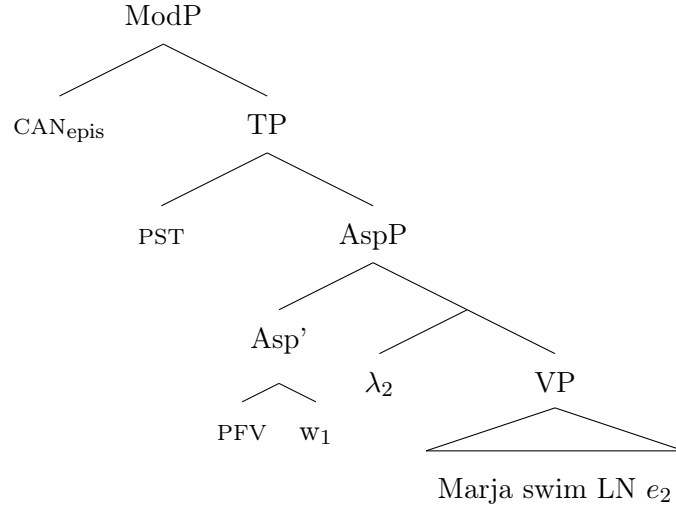
With the PED principle in place, it follows that the real-world event in (2.33c), by virtue of having a counterpart event which is an event in which Marja crosses Lake Nokomis, will also be an event in which Marja crosses Lake Nokomis. Thus, from an abilitative claim, we get a real-world event meeting the description of the prejacent: an actuality entailment.

We can contrast this result with an epistemic under perfective marking. In (2.35), the modal operator is interpreted above tense and aspect, and thus binds the world argument of aspect. As a result, we get an interpretation that looks more like (2.27) than (2.33c); no real-world event is ever established.

(2.35) *Marja a pu_{epis} traverser le lac Nokomis à la nage.*

‘Marja could_{epis}-PFV swim across Lake Nokomis.’

a.



⁷Hacquard calls this principle a ‘pragmatic’ one, noting that there are cases – e.g. counterfactual conditionals – where it obviously fails. The idea is that it operates as a default, and abrogating it requires morphological indication from the speaker, such as the use of *conditionnel* for counterfactuals in French. The status of such a principle is unclear: it seems to suggest that there ought to be a way for speakers to actively cancel actuality entailments.

- b. $\llbracket (2.35) \rrbracket^{w^*} = \llbracket \text{CAN}_{\text{epis},1}(\text{PST}(\text{PFV}_2(\text{Marja swim across Lake Nokomis } e_2)w_1)) \rrbracket^{w^*}$
 $= \exists w \in \text{Opt}_{\emptyset}(\text{EPIS}(w^*))[\exists e[e \text{ in } w \wedge \tau(e) \subseteq t\{t \prec_i t^*\} \wedge$
 $\text{swim-LN}(e)(w) \wedge \text{AGENT}(M)(e)]]$
- c. *There is a world compatible with what is known in the actual world such that this world contains an event, located within a past interval, which is an event in which Marja swims across Lake Nokomis.*

Thus, comparing (2.33) to (2.35), we see that Hacquard’s proposal derives the actuality entailment contrast between a root modal and an epistemic modal.

A particularly striking feature of Hacquard’s account is that the actuality entailment is not in any way driven by the lexical semantics of the perfective aspect, but instead by certain assumptions about the configuration of elements in the derivation. The inclusion relation which represents the fundamental contrast between perfective and imperfective aspects as indicated in (2.23) simply does not play a role in the entailment. At first glance, this appears to be a problem, since transferring Hacquard’s assumptions to the imperfective aspect will also predict an actuality entailment for imperfectively-marked root modals.

$$(2.36) \quad \llbracket \text{IMPF}^H \rrbracket := \lambda w \lambda t \lambda P_{et}. \exists e[e \text{ in } w \wedge \tau(e) \supseteq t \wedge P(e)] \quad (\text{Hacquard, 2006, p.53})$$

$$(2.37) \quad \text{Marja pouvait traverser le lac Nokomis à la nage.}$$

‘Marja could-IMPF swim across Lake Nokomis.’

- a. $\llbracket (2.37) \rrbracket^{w^*} = \exists e[e \text{ in } w^* \wedge \tau(e) \supseteq t\{t \prec_i t^*\} \wedge$
 $\exists w \in \text{Opt}_{\emptyset}(\text{CIRC}(w^*))[\text{swim-LN}(e)(w) \wedge \text{AGENT}(M)(e)]]$
- b. *There is an event in the actual world which is ongoing at some past interval, and there is a world compatible with Marja’s properties in the actual world where that event is an event of Marja swimming across Lake Nokomis.*

The only difference between these truth conditions and those of (2.25a) is the perspective we have on the real-world event in question. The perfective gives us a completed swimming event, while the imperfective gives us an ongoing swimming event (from the perspective of the past reference time), but this ongoing event is nevertheless a real one. This contradicts

the empirical evidence, which shows that ability modals under imperfective marking are compatible with an interpretation on which no partial or complete preadjacent event occurs.

- (2.38) *Marja pouvait traverser le lac Nokomis à la nage, mais elle ne nageait jamais dans ce lac.*

‘Marja could-IMPF swim across Lake Nokomis, but she never swam-IMPF in that lake.’

Hacquard’s explanation for the non-entailing behaviour of examples like (2.37) is tied to the interpretation of imperfective aspectual marking, as opposed to the semantic contribution of the perfective. Her proposal is based on one from Bhatt (1999), who argues that non-entailing imperfectively marked ability modals are exclusively associated with habitual or generic readings. This argument is based on Hindi data, which does not allow a progressive interpretation for imperfective aspect. The idea is that non-entailing claims involve a generic operator GEN: Hacquard proposes that the combination of GEN and the imperfective aspect is simply spelled out with imperfective marking. The crucial feature of generic claims, in this argument, is that they do not in all cases require verifying instances (English examples from Carlson, 1995):

- (2.39) a. Sally handles the mail from Antarctica.
 b. *Sally s’occupe du courrier venant de l’Antarctique.*
 ‘Sally handles.PRES the mail from Antarctica.’
 c. *Sally s’occupait du courrier venant de l’Antarctique.*
 ‘Sally handled.IMPF the mail from Antarctica.’

- (2.40) a. This machine crushes oranges.
 b. *Cette machine écrase les oranges.*
 ‘This machine crush.PRES the oranges.’
 c. *Cette machine écrasait les oranges.*
 ‘This machine crushed.IMPF the oranges.’

These examples seem to describe what ‘normally’ occurs under certain conditions – for instance, in the event that mail arrives from Antarctica. This is attributed to the presence of a generic operator, GEN. Roughly speaking, GEN quantifies over ‘normal’ or ‘stereotypical’ worlds, where what qualifies as normal is determined on the basis of context.⁸ Crucially, the real world (or the world of evaluation) need not count as normal according to these criteria, and thus is not necessarily included in GEN’s domain of quantification. For Hacquard, the introduction of GEN has a similar effect to the presence of an (epistemic) modal above aspect. By introducing a higher layer of quantification, we eliminate the requirement that there is some event in the actual world which has a counterpart matching the (root) modal’s prejacent.

(2.41) shows how this works.⁹ In (2.41), the argument p is a contextually-relevant proposition which ‘picks up’ any further contextual restrictions or preconditions imposed by the lexical content of GEN’s other arguments (Schubert and Pelletier, 1989).

$$(2.41) \quad \llbracket \text{GEN} \rrbracket := \lambda w \lambda p \lambda q. \forall w' [w' \in \text{NORM}(w) \wedge p(w')], q(w')$$

$$(2.42) \quad \text{Marja pouvait traverser le lac Nokomis à la nage.} \quad \equiv (2.37)$$

‘Marja could-IMPF swim across Lake Nokomis.’

$$\begin{aligned} \text{a. } \llbracket (2.42) \rrbracket^{w^*} &= \llbracket \text{GEN}(\text{PST}(\text{IMPF}(\text{CAN}_{\text{ab}}(\text{Marja swim across Lake Nokomis}))) \rrbracket^{w^*} \\ &= \llbracket \text{GEN}(\text{PST}(\lambda w \lambda t \exists e. [e \text{ in } w \wedge \tau(e) \supseteq t \wedge \\ &\quad \exists w \in \text{Opt}_\emptyset(\cap \text{CIRC}(w^*)) [\text{swim-LN}(e)(w) \wedge \text{AGENT}(M)(e)]]) \rrbracket^{w^*} \\ &= \llbracket \text{GEN} \rrbracket^{w^*} (\lambda w. \exists e [e \text{ in } w \wedge \tau(e) \supseteq t \{t \prec_i t^*\} \wedge \\ &\quad \exists w \in \text{Opt}_\emptyset(\cap \text{CIRC}(w^*)) [\text{swim-LN}(e)(w) \wedge \text{AGENT}(M)(e)]]) \\ &= \forall w \in \text{NORM}(w^*) [\exists e [e \text{ in } w \wedge \tau(e) \supseteq t \{t \prec_i t^*\} \wedge \\ &\quad \exists w \in \text{Opt}_\emptyset(\cap \text{CIRC}(w^*)) [\text{swim-LN}(e)(w) \wedge \text{AGENT}(M)(e)]]) \end{aligned}$$

⁸This is the basic idea behind a generic operator. There are a number of proposals for handling its contribution more precisely, but examining these is beyond the scope of the current investigation. I refer to Zobel (2012), in particular Chapter 3, for a careful discussion of both past accounts and the issues involved in cashing out a semantics for GEN.

⁹The derivation in (2.42) is a much-simplified version of the actual proposal in Hacquard (2006), based on a lexical entry for GEN from Hacquard (2005, p.92). Following von Stechow (1997), Hacquard (2006) actually treats GEN as an operator which can quantify over either ‘normal’ events or ‘normal’ individuals, rather than over ‘normal’ worlds. For the purposes of showing how GEN affects actuality entailments, the simpler treatment – which takes GEN to be a modal operator – is sufficient.

- b. *All of the worlds w which are normal from the perspective of the actual world contain an event which contains a salient past interval such that there is a world compatible with Marja's properties in w in which that event is an event of Marja swimming across Lake Nokomis.*

Thus, unlike the representation in (2.36), but similarly to (2.35), nothing forces the existence of a real world event, under any description, and no actuality entailment arises.

2.2.3 Some complications

We have seen that Hacquard's analysis successfully derives the entailment contrast between root and epistemic modals, on the one hand, and between perfectly- and imperfectly-marked root modals, on the other. This success rests on four assumptions:

- (i) Epistemic and root modals are merged at different positions, with epistemics above aspect and root modals below
- (ii) Aspect has a world argument in its restriction, and is base-generated as an argument of the verb
- (iii) Preservation of event descriptions across worlds (PED)
- (iv) Non-entailing instances of imperfectly-marked root modals are necessarily interpreted as generics (as opposed to habituais or progressives)

Setting aside (ii), I argue that (i), (iii) and (iv) all have undesirable consequences.¹⁰

¹⁰One potential issue for the structural components of Hacquard's analysis comes from Greek. Hacquard's account requires that modal constructions form a single clause containing both modal and prejacent, and "thus [involve] a single tense and aspect layer" (2006; p.310). This assumption is crucial, for instance, in Hacquard's (2008) account of the difference between Italian *volere* ('want') and its French counterpart *vouloir*: the Italian predicate, which she argues forms a single clause with its complement, gives rise to actuality entailments in the perfective. French *vouloir* constructions, which do not generate actuality entailments, are argued to involve a second layer of aspect on the complement alone. For Hacquard, this results in a description involving two independent events; a 'wanting' event in the real world, and an event of the complement's realization in the desire-worlds of the sentential subject.

Greek modal constructions, however, involve a biclausal structure in which both the modal and its complement have their own aspectual marking. Given Hacquard's system, this should result in an interpretation where actuality is possible, but not forced, since the world carried by modal aspect and the aspect on its

Contrasts in modal force under event identification

First, let us consider the consequences of the PED principle. Hacquard derives actuality entailments on root modals directly from their height with respect to aspect. As a result, her analysis predicts that *all* root modals, regardless of flavour and in particular regardless of quantificational force, will also generate actuality entailments. The necessity claim in (2.43) bears out this prediction (see Hacquard, 2006, for additional supporting data).

(2.43) *Jane a dû prendre le train pour aller à Londres, #mais elle a pris l'avion.*

‘Jane must-PST.PFV take the train to go to London, #but she took the plane.’

(2.28b) *Jane a pu prendre le train pour aller à Londres, #mais elle a pris l'avion.*

‘Jane could-PFV take the train to go to London, #but she took the plane.’

Despite the entailment that (2.43) shares with (2.28b), the universal and existential claims preserve a contrast in meaning. Intuitively, (2.28b) will be felicitous in contexts where, in addition to the train that Jane actually took, she had other transportation options for getting to London (e.g., the plane). (2.43) is obviously not felicitous in such a context. The modal force requires that any circumstantially-accessible worlds in which Jane got to London are ones in which she took the train; thus, there were no alternative options.

The problem is this: adopting PED will eliminate this meaning difference. The idea behind PED is to force a uniform description for counterpart events across worlds; this is how the actual event in an example like (2.25a) is forced to be an event which matches the description in the modal’s prejacent. Applied across all counterpart events in (2.28b), however, this means that all counterpart events of the modalized taking-the-train-to-London event must also be taking-the-train-to-London events. That is, PED forces all of the worlds in which there is a going-to-London event to be worlds in which this is a taking-the-train-to-London event. But this is precisely what we get from a universal modal. PED, essentially, rules out the possibility that Jane had alternative possible routes for going to London, and thus, we should not expect any perceived meaning difference between (2.43) and (2.28b).

complement need not be the same. It may be the case that some additional principle can be invoked to resolve this, but as it stands, the structural account cannot predict actuality entailments on Greek modals (or, indeed, for any other language which uses a biclausal structure for modal claims).

This result shows that, at least as stated, the PED principle is too strong an assumption.¹¹ Without this principle, however, Hacquard’s analysis leaves us with an actual event which has a counterpart meeting the description in the modal’s prejacent, but stops short of deriving the actuality entailment. I do not see any clear way to bridge the gap that remains.

Predictions from genericity

A second problem follows from the use of a generic operator to eliminate what we might call an ‘underlying’ actuality entailment for imperfectively-marked root modals. This explanation centered on the observation that generic claims do not always require verifying instances. Consequently, a similar argument should apply to any imperfectively-marked claim where the predicate of events under aspect has an actualization requirement. The case that is of particular interest here involves **implicative verbs**, which are characterized by complement entailment. (1.12) is repeated here from Chapter 1.

(1.12) Marja managed to swim across Lake Nokomis, #but she did not cross the lake.

Crucially, aspectual marking does not affect the entailment pattern of an implicative verb. (2.44) illustrates this for the French implicative *réussir* (‘manage’, ‘succeed’):

(2.44) a. *Jean réussissait à s’enfuir, #mais il ne s’est pas enfui.*

‘Jean managed-IMPF to escape, #but he did not escape.’

b. *Jean a réussi à s’enfuir, #mais il ne s’est pas enfui.*

‘Jean managed-PFV to escape, #but he did not escape.’

As far as I can tell, Hacquard’s account predicts that (2.44a) need not entail that Jean escaped, contrary to the empirical data. Specifically, the imperfectively-marked implicative should have an available interpretation – involving GEN – on which its complement is not realized in the actual world.

We do not need a full semantic treatment of *réussir* to see why this should be the case. *Réussir*, as its characterizing feature, links a *managing* (or *succeeding*) event which

¹¹Indeed, Hacquard (2009) acknowledges that the event identification principle seems difficult to maintain in the face of counterfactual interpretations for modals.

takes place in the world of evaluation to a complement-realizing event which is also in the world of evaluation. For now, we can remain agnostic as to whether these should be treated as the same event or not. The consequence of introducing a generic operator, on Hacquard's analysis, is that the *manage*-claim is evaluated in 'normal' worlds, but not necessarily evaluated in the actual world. Thus, if one interpretation of the imperfective marker is as a generic, we expect imperfectively-marked *réussir* to have a reading on which no complement event need occur in the actual world. No such reading exists.

By itself, this is not necessarily an insurmountable problem. One way out would be to propose an analysis for *manage* which – for some reason – renders it incompatible with GEN. At the moment, however, it appears as though such a restriction would necessarily be stipulated, rather than derived.

Perfective ability modals without actuality entailments

One final problem has to do with the tightness of the root-actuality entailment connection. Hacquard suggests that this can be used to distinguish clearly between 'real' modals (*pouvoir*) and periphrastic modal constructions such as *avoir la capacité* ('have the ability') and *avoir la possibilité* ('have the possibility'). Since these do not entail even under perfective, they should not be given the Kratzerian modal semantics assigned to *pouvoir* – which, of course, raises the question of how they ought to be analyzed, particularly with respect to their apparent modality. Mari and Martin (2007, 2009) and Homer (2011) observe, however, that there are root uses of *pouvoir* with the perfective that also fail to entail, which should not be possible on Hacquard's analysis.

(2.45) *Olga a soudain pu soulever un frigo, mais elle ne l'a pas fait.*

'Olga could-PFV suddenly lift a fridge, but she did not do it.'

Hacquard (to appear) suggests that this and similar examples represent present perfect uses of the French *passé composé*, as opposed to the past perfective uses we have so far focused on. This is not an altogether satisfying answer, since the actuality entailments for perfective examples are produced in the combination of her structural assumptions about aspectual

marking and the application of the PED principle: in the absence of an additional layer of modality, such as a generic operator, there is no obvious reason why the mechanisms that generate an actuality entailment for perfective ability modals should not do the same with (2.45). Moreover, while (2.45) plausibly generates the inference that Olga’s ability to lift a fridge persists at speech time, lending some credence to the present perfect analysis, the same cannot be said of an example like (2.46), which – according to Mari and Martin – similarly fails to generate an actuality entailment.

- (2.46) *Notre nouveau robot a même pu repasser les chemises à un stade bien précis de son développement. Mais on a supprimé cette fonction (qui n’a jamais été testée) pour des raisons de rentabilité.*

‘Our new robot could-PFV even iron shirts at a particular stage of its development. But we suppressed this function (which was never tested) for reasons of profitability.’

I will not address these and similar data points until Chapter 6. For the moment, however, I note that both examples involve the overt manipulation of durational information. In (2.45), this manipulation is due to the adverbial *soudain* (‘suddenly’). In (2.46), the duration of the alleged ability stage is limited by the phrase *à un stade bien précis de son développement* (‘at a particular stage of its development’). This seems suggestive, particularly in light of the English *be able* examples with which we began: as we saw in Chapter 1, the preference for an ability or an actuality reading in (1.4) is influenced by temporal or durational considerations.

- (1.4) Marja was able to swim across Lake Nokomis.
- a. In her twenties, Marja was able to swim across Lake Nokomis.
 - b. Yesterday morning, Marja was able to swim across Lake Nokomis.

Ultimately, then, an account which makes good on the contribution of perfective aspect to temporal interpretation would seem to be a more promising approach.

Taken together, I believe these three objections present a strong argument for pursuing an account of actuality entailments that is more directly tied to the lexical semantics of the key players – modality and aspect – rather than to structural considerations in the compositional process. The obvious place to begin is with the ability modal.

2.3 A closer look at ability modals

In revising the assumption that ability modals are simply a subtype of circumstantial possibility modals, I am pursuing the idea that actuality entailments are, at least in part, a consequence of logical or semantic properties that distinguish ability modals from the non-entailing modal flavours. This brings us, rather directly, to the question of what it is to have an ability, the first of the three core questions posed in Section 1.3 of the introduction.

Alongside the linguistic literature on the connection between ability and actuality, the nature of ability has driven an extensive philosophical literature. The philosophical study of ability centers on two issues: the logic of ability, and the connections between ability, agency (or agentivity), and action. This is a natural place to begin my investigation of the semantic meaning of ability ascriptions. I do not attempt to provide a comprehensive overview of theories of ability here. The discussion instead focuses on two points of divergence between ability modals and regular circumstantial possibility operators.

Epistemic and circumstantial modals belong to a class of *alethic* modalities, which validate certain logical inference patterns. One such property is illustrated by (2.47):

(2.47) *Context:* While visiting a park in San Francisco, I see a clump of dahlias growing along the side of the path.

- a. Dahlias can grow in San Francisco [in view of the climate and geological conditions].

(2.47a) is felicitous in the context provided: my real-world observation of dahlias successfully growing in San Francisco is sufficient evidence for a circumstantial possibility claim.

The inference from actuality to circumstantial possibility follows on the semantics assigned to circumstantial possibility modals. In particular, a circumstantial possibility modal requires for its truth, that the prejacent – in this case, *Dahlias grow in San Francisco* – is validated by at least one world which preserves the relevant circumstances of the actual world. As we saw in Section 2.1.2, the domain of quantification ($\cap \text{CIRC}(w)$) for a circumstantial modal necessarily includes the world of evaluation. Thus, the fact that dahlias actually grow in San Francisco is sufficient for the truth of (2.47a), on a pure circumstantial reading. This inference pattern is captured by Axiom 2.9.

Axiom 2.9. *For any proposition p , and alethic possibility operator \Diamond , we have:*

$$p \rightarrow \Diamond p$$

Ability modals do not appear to validate Axiom 2.9. We saw evidence of this in the first example from Chapter 1, based on uncertainty about how (1.1a) is truthfully answered.

- (1.1) *Context:* Yesterday, for the first time, you ran into Tara at the golf course. You saw her miss a few shots, and then line up the ball from the tee and make a hole in one. Later, you mention seeing Tara to a mutual friend, who asks:
- a. Can Tara make a hole in one?

This example was based on (2.48), due to Maier (2018b, p.412):

- (2.48) *Context:* Suppose Tara is a beginning golfer. She misses most of her shots. On this occasion, however, she strikes the ball from the tee and it happens to go into the hole, so on this occasion she makes a hole in one.
- a. ?Tara can make a hole in one.

Axiom 2.9 would predict the acceptability of (7.17a). In the context in (2.48), however, it is at least difficult to decide on the truth of (7.17a). The inclination to declare (7.17a) to be false is, at least in part, due to the information we have regarding Tara’s golfing experience. The problem here mirrors the problem that was posed by Thalberg’s erratic marksman, Brown: Tara did make a hole in one, but she does not do so with any regularity,

and therefore we hesitate to attribute to her an ability to make a hole in one. In this case, in order to comfortably declare that Tara *can* (or even *is able to*) make a hole in one, it seems clear that we require evidence of reliability, or some pattern of regularity in Tara's golfing success. This the conclusion drawn by Kenny, who argues that "...abilities are inherently general; there are no genuine abilities which are abilities to do things only on one particular occasion" (1976; p.224).

The apparent need for regularity is surprising in the face of examples like (1.6) and (2.38), which demonstrate the acceptability of ability claims in contexts precluding even a single instantiation of the modal prejacent.

(1.6) In her twenties, Marja was able to swim across Lake Nokomis, but she always chose to do laps of Lake Harriet instead.

(2.38) *Marja pouvait traverser le lac Nokomis à la nage, mais elle n'a jamais nagé dans ce lac.*

'Marja could-IMPF swim across Lake Nokomis, but she never swam in that lake.'

If empirical uncertainty over the appropriate answer to (1.1a) is due to a lack of sufficient evidence, then we certainly should not expect the ability assertions in (1.6) and (2.38) to be acceptable. How are we to make sense of these data? The only possible explanation is that, while regular instantiation provides sufficient proof, the apparent 'reliability' requirement of ability claims cannot be reduced to a regularity requirement. The semantics of ability seem to be stronger than the semantics of pure possibility (in that they have stricter requirements for their truth), but it is not clear where or how this additional strength should enter the semantic picture.

Examining abilitative *can* with respect to a second axiom of alethic modalities will help us to make some headway on this issue. Consider: the logical disjunction $p \vee q$ is true just in case one of the two propositions p and q is true. If we modalize the disjunction, taking the possibility claim $\Diamond(p \vee q)$, we simply shift the truth conditions for $p \vee q$, requiring that at least one world in the domain of quantification is a world where either p is true or q is true. But, if such a world exists, then it follows that there is either some accessible world

where p is true or some accessible world where q is true. Thus, starting from $\Diamond(p \vee q)$, we can ‘distribute’ the possibility operator:

Axiom 2.10 (Distributivity). *For any two propositions p and q , and alethic possibility operator \Diamond , we have:*

$$\Diamond(p \vee q) \rightarrow \Diamond p \vee \Diamond q$$

The distributivity axiom does not hold for ability modals. Kenny (1976) demonstrates this with a simple example, on which (2.49) is based.

(2.49) Suppose we have a randomly shuffled deck of cards, with equal distributions of black and red cards. Karl is about to pick a card from this deck, colours unseen.

a. Karl can pick a red or a black card.

\sim Karl is able to pick a red or a black card./Karl has the ability to pick a red or a black card.

b. #Karl can pick a red card or Karl can pick a black card

(2.49a) is clearly true. The distributed ability claim in (2.49b) is clearly false. What differentiates the two?

Since all of the cards in the deck are either red or black, Karl’s chosen card is guaranteed to be one of these two colours. Put another way, Karl has a foolproof strategy for realizing (2.49a)’s prejacent, *Karl picks a red card or Karl picks a black card* – all he needs to do is go ahead and choose a card. He does not, however, have a similar strategy for bringing about either that he draws a red card or that he draws a black card. Indeed, unless he is somehow able to distinguish the cards without seeing their colours, there is no plausible strategy for ensuring that the card is red or for ensuring that the card is black. The absence of such a strategy is what makes (2.49b) false. Axiom 2.10, then, does not hold.

Extrapolating from this gives us a way of cashing out the reliability requirement without reducing it to regularity. Abilitative uses of *can* embed a guarantee, by establishing the existence of a ‘foolproof’ (reliable) strategy for the agent to bring about the prejacent. This proposal also makes sense of our reluctance to grant (7.17a): Tara’s past golfing record is

a strong indicator that she is not yet in full control of her shots, and thus that she cannot have a foolproof way of bringing it about that she makes a hole in one.

This rough proposal for ability ascriptions is captured neatly in a suggestion from Brown:

“The idea is the following: when I say that I can bring it about that A is true, I can be understood to mean that there is an action open to me, the execution of which would assure that A would be true.” Brown (1988, p.4)

Brown’s proposal belongs to a class of *hypothetical* theories of ability. The most prominent type of hypothetical theory is the *conditional analysis* of ability: versions of a proposal like (2.50) are offered by Moore (1912) (interrogated at length in Austin’s 1961 essay on “Ifs and cans”), Cross (1986), Thomason (2005), and others.¹²

(2.50) **The conditional analysis of ability**

S can_{ability} A := S would A if S tried to A (modified from Maier, 2018a)

There is a well-known objection to the conditional analysis, which challenges its sufficiency as a theory of ability. Lehrer (1968) offers an example in which an individual’s (evident) physical capacities are counteracted by his psychological predispositions:

(2.51) *Context*: “I am offered a bowl of candy and in the bowl are small round red sugar balls. I do not choose to take one [...] because I have a pathological aversion to such candy.” (Lehrer, 1968, p.32)

a. #I can_{ability} take a piece of the candy.

It is immediately clear that (2.51) does not license the ability claim in (2.51a): if the speaker’s mental state precludes an attempt to take the candy, then he cannot (is not able to) take the candy. On a conditional analysis, however, we expect (2.51a) to be felicitous. It might well be the case that there are no circumstances under which the speaker tries to take the candy, but since no physical limitations stand in the way, it is also true that were he, somehow, to

¹²Proponents of a conditional analysis of ability may include Hume (1748), who suggests something like (2.50) as a qualification for voluntary action.

try, we would be in a world in which the aversion is not relevant, and he would (presumably) succeed (see also Chisholm, 1964).¹³

Brown’s proposal gets us around this problem. While the action that is open for the agent, on his view, can be understood as constituting one notion of what it means to *try* to do something (see also Sharvit, 2003), the requirement that it be *open* specifies that it is in some way immediately available to the agent; in other words, that it is a ‘live’ possibility. Consequently, a scenario in which there is an action that assures *A*, but which is unavailable to the agent, possibly due to some predisposition, will, *ipso facto*, preclude a claim that the agent can (abilitatively) do *A*. Other proposals which fix a similar ‘live’ possibility requirement include those of Belnap (1991), based on Belnap and Perloff’s (1988) *stit* theory of agentive action, and, more recently, the *act conditional* analysis of Mandelkern et al. (2017), and Maier’s (2018b) ‘hybrid’ account. Mandelkern et al. refer to their notion of ability as representing a **hypothetical guarantee**, and I adopt this term to cover theories like Brown’s, excluding conditional analyses of the sort in (2.50).

Against Kenny (1976), who takes the failure of Axioms 2.9 and 2.10 to demonstrate that ability cannot be analyzed as a real modality, Brown demonstrates that the hypothetical guarantee structure can be cashed out reasonably in a possible-worlds framework. Ability modals fail to validate Axiom 2.9 because a single accessible world which realizes the prejacent is, intuitively, too weak for an ability claim: it offers only hypotheticality, but no guarantee. It is clear that trying to analyze ability modals as necessity operators is a non-starter: in this case we would have the guarantee, but no hypotheticality. What we need is something in between pure possibility and pure necessity: this is offered by requiring the complement of an ability modal to hold not in a single accessible world, but across a set of worlds.

“We can take different clusters of worlds to correspond to different logically possible actions [...] and take *relevant* clusters to correspond to choices of actions of which I am actually *capable*. Then a given cluster will be the set of all

¹³Other objections to the conditional analysis – including arguments against taking the conditional to be a necessary condition for ability – are discussed by Wolf (1990), Mandelkern et al. (2017), and Maier (2018a).

worlds in which I take a certain possible action. Or [...] I can take each cluster to be, or to correspond to, the proposition that I take a certain possible action.”

Brown (1988, p.5)

In essence, we achieve the desired result by embedding a necessity operator under a possibility operator. The available actions or choices are projected as ‘live’ circumstantial possibilities from the evaluation world, and the alternatives against which the embedded necessity is evaluated are projected from this point, rather than the evaluation world itself. A recent proposal by Louie (2014)¹⁴ implements this in the following way. She adopts an ontology in which actions (α) are included as a basic type, but omits events; a refinement of this might treat actions as a particular subtype of events. The operation R instantiates actions with respect to an individual, world, and time.

(2.52) **Action instantiation.** (Louie, 2014, p.14)

$R(a_\alpha, x_e, w_s, t_i) :=$ The action a is instantiated by x in w at t (where t is the runtime of the event instantiating a)

Abilitative *can* then has the denotation in (2.53).

(2.53) $\llbracket \text{can}_{\text{ability}}^L \rrbracket := \lambda P \lambda x \lambda t \lambda w. \exists a [\forall w' [R(a, x, w', t) \wedge w' \in \text{Opt}_\emptyset(\cap \text{CIRC}(w))] \rightarrow P(x, w', t)]$

\sim *There is an action a , available to x in w at t , such that all of the worlds with instantiations of that action by x at t and which are compatible with x ’s circumstances in w are P -worlds.* (Proposal; Louie, 2014, p.15)

Although Louie’s outer layer of quantification involves actions (events), rather than possible worlds, a proposal like (2.53) shows that the hypothetical guarantee class of accounts are connected to the Kratzer semantics, in that they preserve the possibility meaning associated with *can* on its other construals. Instead of applying the possibility operator to the modal prejacent directly, as in epistemic, deontic, or pure circumstantial cases, however, we

¹⁴Louie’s treatment of ability modals is motivated by her investigation of actuality entailment patterns in Blackfoot (Algonquian).

have to introduce a proposition which is not visible in the surface structure: the proposition that an agent S takes some intermediary action H . The possibility of the ability complement then holds *in virtue of* the possibility of S doing H .

If we wish to fully integrate a hypothetical guarantee analysis with the standard modal semantics, there is evidently a fair amount of work yet to do. A central concern, at this point, is what the *in virtue of* relationship really represents. The aim here is to capture the intuitions which led us to a hypothetical guarantee structure for ability in the first place: that S can (is able) to A is true just in case S has a (reliable) strategy for *bringing* $A(S)$ *about*. What type of necessity captures this? For Louie, the embedded necessity modal is taken to be circumstantial. (2.53) falls short of enforcing a link between the intermediary action $H(S)$ and the modal complement $A(S)$ which is reasonably paraphrased by ‘bringing about’, since it simply requires a conjunction of $H(S)$ and $A(S)$ in relevant worlds, but does not tie their occurrences together in any way. I leave the question of how a ‘bringing about’ relationship is to be understood and implemented open here: the answer will be developed over the course of the investigation in Chapters 3 through 5.

A final note: in focusing in on the meaning and logic associated with ability modals, I have set aside an important component of the actuality entailment phenomenon. We saw, in Section 2.2.2, that Hacquard’s analysis was based on the observation – supported with data from goal-oriented and ‘ought-to-do’ deontic modals – that actuality entailments arise from all modals, and not just ability modals. More recently, Mari (2016) has suggested that the correct generalization associates actuality entailments with all teleological (goal-oriented) modals, a class which she takes to include ability modals. I postpone further discussion of the broader class of actualizing modals to Chapter 7, when a more precise notion of the ‘bringing about’ relationship involved in ability claims will give us a clearer view of how abilitative modality might relate to the means-goal structure of teleological modals.

2.4 Summary and outlook

This chapter set out the analytical background against which the main account pursued in the dissertation will be developed. First, I provided an overview of the standard approaches to modality and aspect, and presented a formal illustration of the problem posed by actuality entailment on these accounts. The most straightforward approach to the semantic composition of modality and aspect analyzes ability as a type of ‘pure’ circumstantial possibility, and simply imposes the event-bounding (or *including*) semantics of perfective aspect on top of this possibility. We saw that this approach does not predict actuality inferences, motivating the revision of at least one of the lexical or compositional components of the derivation.

First, we reviewed a prominent proposal from Hacquard (2006). She revises the compositional details of the aspect-modality combination, while maintaining the lexical semantic core of the standard treatments for both categories. Unfortunately, it turns out that some of the key assumptions Hacquard takes on make predictions – about the modal force associated with entailing modal claims, and the availability of non-entailing readings for verbs like *manage* – which are not empirically upheld. Notably, Hacquard’s success in deriving actuality entailments does not hinge on the semantic contribution of the perfective aspect, but instead on its height (or scope) with respect to ability modals. As a result, there is no obvious way for her to accommodate examples (2.45)-(2.46) (from Mari and Martin 2007, 2009 and Homer 2011), in which overt manipulation of durational or temporal properties seems to eliminate actuality entailments. Taken together, the objections raised in Section 2.2.3 lend weight to the idea that the source of actuality entailments should be sought at least in part in the lexical contribution of ability and aspect, rather than solely in the structural configuration.

Section 2.3 represents the first step in a lexically-focused investigation of actuality inferences. I reviewed two well-known arguments from the philosophical literature on ability which strongly suggest that ability modals should be treated separately from pure circumstantial possibility operators. In trying to make sense of our intuitions about when ability

claims are licensed or precluded, we arrived at a pre-theoretical description of ability as establishing the existence of a foolproof strategy by means of which an agent can bring about a certain event (the modal complement). Finally, we saw that this structure aligns with existing proposals that analyze ability attributions as **hypothetical guarantees**, and outlined one way in which this complex structure might be cashed out in a possible-worlds framework.

Where does this leave us with respect to the three core questions set out in Chapter 1? We are still at a preliminary stage in the investigation, but it is clear on consideration that we have made progress on some specific points. For ease of reference, I repeat the questions below, in abbreviated form.

(I) **What is the semantic content of an ability ascription?**

What do expressions of ability necessarily encode, in view of which they are compatible with both actualized and potentially unrealized ability interpretations?

(II) **What is the connection between ability, actuality, and possibility?**

What, semantically speaking, accounts for the cross-linguistic use of possibility modals to ascribe abilities? How is the ability meaning associated with possibility, and how can this connection be maintained in the context of actualized interpretations?

(III) **What is the role of aspect in actuality and ability interpretations?**

What does aspect contribute to an ability meaning in order to ‘erase’ its modality?

Why does this occur only with perfective aspect, and not with imperfective marking?

Section 2.3 provides a partial answer to Question I, by proposing that to have an ability to *A* is to have as a ‘live’ possibility a means of bringing it about that *A* occurs. This hypothetical-guarantee structure captures the pure ability interpretations for *be able* and ability modals, cross-linguistically, by capturing the ‘reliability’ requirement associated with ability in a means that is consistent with the potential for the ability to go unrealized. The nature of the ‘bringing about’ relation that constitutes the guarantee component, however, remains an open question. In addition, the proposal so far only makes sense of one of the

possible readings for ability ascriptions: we have yet to explore whether or not a hypothetical guarantee structure is compatible with actualized interpretations, let alone whether or not it can play an explanatory role in the derivation of actuality inferences.

We have also made some progress on Question II. Viewed as a ‘layered’ type of modality, which embeds a necessity modal under circumstantial possibility, treating ability as a hypothetical guarantee offers a possible means of reconciling a differential treatment of ability with the standard semantics associated with other construals of the possibility modal.

There is something rather puzzling here, however. I motivated the hypothetical guarantee analysis in part on the basis of Kenny’s (1976) observation that, unlike alethic modalities, ability modals fail to validate Axiom 2.9 ($p \rightarrow \Diamond p$). This inference pattern, however, is in some ways what actuality entailments are about. This is what Thalberg’s shooting range scenario illustrates: in a context which provides an isolated performance of the complement action, a pure-ability attribution is not licensed, but an actualized interpretation of *was able* is felicitous.

(1.2) *Context*: “Before he hit [...] three bull’s-eyes, [Brown] fired 600 rounds, without coming close to the bull’s-eye, and his subsequent tries were equally wild.”

- a. #Brown had the ability to hit the bull’s-eye three times in a row.
- b. Brown was able to hit the bull’s-eye three times in a row.

In other words, the actualized interpretation of an ability ascription seems to erase precisely those features of abilitative modality which distinguish it from pure circumstantial modality in the first place. Insofar as the goal of distinguishing ability modals was to uncover semantic features that *explain* actualized interpretations, we seem to be going in circles.

Of course, we have yet to consider the last feature of actualized interpretations: they arise only under episodic readings, or in the presence of perfective aspect. The split in logical behavior between pure ability interpretations and actualized interpretations for ability ascriptions, then, should be linked to the perfective, and in particular to its semantic contribution to temporal interpretation. Finding complete answers to Questions I and II, then, ultimately rests on finding an explanation for Question III.

The discussion of ability modals in this chapter has focused on the pure ability side of Thalberg’s ‘ambiguity’. As the preceding discussion shows, many of the issues that remain open are focused on the other side, and in particular on how the actualized interpretations of ability ascriptions can be reconciled with (unrealized) possibility and pure ability. Thus, the next step in investigating the phenomenon of actuality inferences is to look more closely at actuality inferences themselves. In order to understand how these inferences come about, we need to understand the semantic structure that underlies them: for instance, whether perfectly-marked ability modals establish the realization of their complements directly, as part of asserted content (that is, whether actualized ability ascriptions simply mean ‘did’, as per Thalberg), or actualization instead follows as a semantic or logical consequence of what is directly established.

Looking for clues as to how this question should be answered leads us back to Bhatt (1999). In his original description of actuality inferences, Bhatt observes a striking similarity between the interpretation of actualized ability predicates and the interpretation of the implicative verb *manage*. Ultimately, he suggests that actuality entailments are entirely parallel to the complement entailments associated with implicative verbs.

(1.12) Marja managed to swim across Lake Nokomis, #but she did not cross the lake.

As we saw in Section 2.2.2, implicative entailments in aspect-marking languages do not show a sensitivity to aspect. Thus, if Bhatt’s comparison reflects a real semantic continuity between ability modals and *manage*, implicative verbs give us a window on the structure and content of actualized ability claims which allow us to abstract away from the complications introduced by aspectual variation. Chapter 3, therefore, is concerned with an investigation of implicative verbs, with the overall aim of establishing the underlying semantic components that produce complement entailments in the case of verbs like *manage*.

Chapter 3

Causal dependence in implicative inferences

In his original description of the actuality inference phenomenon, Bhatt (1999) contrasts the ‘had the ability’ reading of generic *was able* claims like (3.1a) with what he calls the ‘managed to’ reading that follows naturally in episodic contexts like (3.1b).

- (3.1) a. *Generic, no actuality implication, generically interpreted subject:*

In those days, a fireman was able to eat five apples in an hour.

- b. *Episodic, actuality implication, existentially interpreted subject:*

Yesterday, at the apple eating contest, a fireman was able to eat five apples.

(Bhatt, 1999, p.2)

This stands in opposition to Thalberg’s (1972) informal description of actualized interpretations as simply meaning ‘did’. In drawing a parallel with *manage*, Bhatt is making the claim that actualized interpretations of ability ascriptions do not just contribute the ‘did’ of complement realization, but also carry any additional inferential material associated with the interpretation of (past-tense) *manage*.

The immediate parallel between *managed to* and episodic ability ascriptions is, of course, in the realization of their respective complements. *Manage* belongs to a class of **implicative**

verbs, which are characterized by a pattern of complement entailment (Karttunen, 1971). (3.2) illustrates this behaviour.

- (3.2) Juno managed to open the door, #but she didn't open it.

As Bhatt points out, *managed to* and actualized ability have more than complement inferences in common. He observes that, like *manage*, ability modals “do not just mean that an event related to the embedded predicate took place”, but add to this the impression or presumption of effort. This presumption can be identified in the contrast between Bhatt's examples (3.3a) and (3.3b). (3.3a) is marked, but the perceived infelicity disappears with the addition of context that supplies evidence of “some kind of sustained (non-minimal) effort” (1999, p.5).

- (3.3) a. #/?A woman in Watertown **was able** to win 3 million dollars in the lottery yesterday.
 b. After buying lottery tickets regularly for several years, a woman in Watertown **was** finally **able** to win 3 million dollars in the lottery yesterday.

We find precisely the same contrast if we replace *was able* with *managed*:

- (3.4) a. #/?A woman in Watertown **managed** to win 3 million dollars in the lottery yesterday.¹
 b. After buying lottery tickets regularly for several years, a woman in Watertown finally **managed** to win 3 million dollars in the lottery yesterday.

¹Bhatt marks this example as ruled out semantically; along with (3.3a), it seems to me to be highly marked, but not entirely unacceptable. To foreshadow the discussion in Section 3.2, general unlikelihood (in this case, the unlikelihood of winning a lottery) seem to be a potential licensing condition for *manage*. The reason for lingering oddness, despite the unlikelihood of winning a lottery, is, I suspect, due to the indefinite nature of the subject in these examples: in the case of any specific individual, winning a lottery is unlikely, but in the big picture, some person is likely to win. In support of this explanation, we can compare (3.3a) and (3.4a) with (ia) and (ib):

- (i) a. I was able to win 3 million dollars in the lottery yesterday.
 b. I managed to win 3 million dollars in the lottery yesterday.

By replacing the indefinite subject with the first person pronoun, we make the unlikelihood of a specific individual's lottery win salient, eliminating the infelicity perceived in the original examples.

Thus, in addition to actuality inferences, episodic ability ascriptions and *manage* appear to share a specific precondition of use: that realizing the embedded proposition required effort from the sentential subject.

We can add this precondition to our understanding of actualized ability claims. Although the examples in (3.3) involve English *be able*, and not an ability modal, comparing *pouvoir* and the French implicative *réussir* (‘manage,’ ‘succeed’) suggests that Bhatt’s inferential parallels hold in the cross-linguistic context.²

(3.5) *Juno a pu ouvrir la porte.*

‘Juno could-PFV open the door.’

a. *Entails*: Juno opened the door.

b. *Presumes*: Opening the door required effort (for Juno).

(3.6) *Juno a réussi à ouvrir la porte.*

‘Juno managed-PFV to open the door.’

a. *Entails*: Juno opened the door.

b. *Presumes*: Opening the door required effort (for Juno).

This gives us a new angle of attack. If actuality inferences can, at an analytical level, be treated as instances of implicative behaviour, or **implicativity**, an investigation of *manage* is simultaneously an investigation of the meaning and implications associated with actualized ability ascriptions. At the end of Chapter 2, I suggested that, in order to understand what an actuality inference really is, we need to understand precisely how it is derived, and whether it belongs directly to asserted content or follows in a process of semantic reasoning. The analysis of *manage* is an attractive route to take in trying to answer this question. This is because, in the implicative context, the source of complement entailments must reside in lexical semantics, rather than in the details of a compositional interaction between ability and aspect to which we do not have direct access.

²Bhatt’s cross-linguistic evidence comes from Greek and Hindi; the judgements of similarity between (3.5) and (3.6) are due to my French informants.

Crucially, implicative entailments are not sensitive to aspect. This is shown for French *réussir* in (2.44), repeated from Chapter 2. In (3.7), we see that the entailments of *manage* are likewise unaffected by the choice of a generic or an episodic context.

- (2.44) a. *Jean réussissait à s'enfuir, #mais il ne s'est pas enfui.*

‘Jean managed-IMPF to escape, #but he did not escape.’

- b. *Jean a réussi à s'enfuir, #mais il ne s'est pas enfui.*

‘Jean managed-PFV to escape, #but he did not escape.’

- (3.7) a. *Generic:*

In those days, a fireman managed to eat five apples in an hour, #but no fireman ate five apples in an hour.

- b. *Episodic:*

Yesterday, at the apple eating contest, a fireman managed to eat five apples, #but he did not eat five apples.

It follows from this indifference to aspect that the semantic features responsible for complement entailments are encoded directly by *manage/réussir*, and not introduced compositionally. Thus, an account of *manage* offers a means of establishing the semantic underpinnings of actuality inferences while filtering out any complications introduced by aspect. If actuality inferences are genuine instances of ‘implicativity,’ then an analysis which identifies the essential lexical semantic components that derive implicative behaviour will simultaneously identify those components of meaning which must appear in the joint contribution of aspect and ability in examples like (3.1b) and (3.5). In turn, having these components in hand paves the way for a close examination of the independent contribution of both ability and aspect in the derivation of actuality inferences.

With this goal in mind, this chapter focuses on the meaning and interpretation of *manage*, and develops a novel account of the implicative verb class. On my analysis, implicative entailments (and any associated implications) are derived from relations of **causal dependence** embedded in the lexical semantic representations of implicative verbs. The introduction of a causal component is inspired by Baglini and Francez’s (2016) recent treatment of

manage, but the account I develop represents a significant revision and expansion of that work. My proposals are motivated by data from Finnish as well as English, and, in addition to identifying the key components of implicativity, extend a causal account from the specific case of *manage* alone to the full range of implicative verbs.

In the course of this chapter, I introduce a formal system for representing causal relationships. Following Baglini and Francez, I adopt the **causal dynamics** framework of Schulz (2007, 2011), which in turn is based on the structural equation models of Pearl (2000). Since my focus in this chapter is on the work done by causal dependence relations in explicating the interpretation of implicative verbs, I illustrate my claims within the dynamics framework, and set aside for the moment the formal system of representation introduced in Chapter 2. Once I have established the key features of implicativity – and their causal underpinnings – I return in Chapter 4 to the standard interpretation system. Ultimately, in Chapter 5, I discuss one route towards integrating the two systems.

3.1 Managing, specifically and gener(ic)ally

The most prominent existing account of *manage* is due to Karttunen and Peters (1979). On their analysis, all that an implicative asserts is the truth of its complement. The impression of effort associated with *manage* is analyzed as a precondition of use, contributing to the not-at-issue dimension of meaning.

(3.8) **The ‘direct assertion’ account:** (Proposal; Karttunen and Peters, 1979).

For an agent S and a one-place predicate A , the claim that S *managed to* A :

- i. *Asserts*: S did A ($A(S) = 1$)
- ii. *Presupposes*: Doing A was effortful for S

A presuppositional diagnosis of the effort inference is supported by (3.9), which shows that the inference projects through negation in the matrix clause of a *manage* claim:³

³Karttunen and Peters (1979) actually propose that the not-at-issue content of implicative *manage* is an instance of *conventional implicature*. Since this material survives the ‘family of sentences’ tests, I am

(3.9) Juno did not **manage** to open the door.

Licenses: Opening the door was effortful for Juno.

It is immediately obvious that Proposal 3.8 derives both the complement entailment and the presumption of effort associated with *manage*. Before diving into a close examination of implicative verbs, then, I present some additional motivation – from the perspective of our investigation into actuality inferences – for rejecting the ‘standard’ Karttunen and Peters account.

This motivation comes, in a somewhat roundabout fashion, from Bhatt’s explanation of the ability-*manage* connection. He accounts for the similarities between actualized ability and *managed to* in a very direct manner, proposing simply that these similarities follow from semantic equivalence at the lexical level. For Bhatt, *be able* and ability modals, represented uniformly as ABLE, are themselves implicative verbs, and in particular share the underlying semantics of *manage*. Since *manage* always entails its complement proposition, this proposal hard-codes complement entailment into the semantics of ABLE.

(3.10) **ABLE as an implicative:** (Proposal; Bhatt, 1999)

For some agent S and a one-place predicate A , the claim that S ABLE A :

- i. *Asserts:* S did A ($A(S) = 1$)
- ii. *Presupposes:* Doing A was effortful for S

We can check that, as in the case of *manage*, the effort inference projects through negation of an ABLE claim:

(3.11) Juno **was** not **able** to open the door.

Licenses: Opening the door was effortful for Juno.

Proposal 3.10 achieves three desired results. First, it explains the close comparison between *manage* and actualized ability ascriptions. Second, in so doing, it derives the inclined to classify it as presuppositional. A more thorough investigation of this issue is left for future work. I will refer to implicative ‘presuppositions’ throughout, but this can be taken to stand in for ‘not-at-issue inferences’ without consequences for the main analysis.

actuality entailments of perfectly-marked ability modals (instances of ABLE, for Bhatt). This follows directly from the asserted content in (3.10)-i, distinguishing Bhatt’s proposal from subsequent accounts of actuality inferences, such as Hacquard’s (2006), which aim instead to derive actuality in the composition of ability and aspect.

- (1.7) a. **Boresa** na sikoso afto to trapezi, #ala den to sikosa.
 can.PST.PFV NA lift.NON-PST-PFV.1S this the table #but NEG it lift.IMPF
 ‘I was able to lift this table, #but I didn’t lift it.’ Greek
- b. Yusuf havaii-jahaaz uṛaa **sak-aa**, #lekin us-ne havaii-jahaaz nahĩ
 Yusuf air-ship fly can-PFV.MASC #but he-ERG air-ship NEG
 uṛaa-yii.
 fly-PFV.FEM.
 ‘Yusuf was able to fly the airplane, #but he didn’t fly the airplane.’ Hindi

- (1.9b) *Marja a **pu** traverser le lac Nokomis à la nage, #mais elle ne l’a pas traversé.*
 ‘Marja could-PFV swim across Lake Nokomis, #but she did not cross it.’

French

Second, by assigning the effort inference to presuppositional content, Proposal 3.10 predicts the aforementioned felicity contrast between (3.3a) and (3.3b):

- (3.3) a. #/?A woman in Watertown **was able** to win 3 million dollars in the lottery yesterday.
- b. After buying lottery tickets regularly for several years, a woman in Watertown **was** finally **able** to win 3 million dollars in the lottery yesterday.

In spite of these positive consequences, however, there are reasons to doubt that the semantics in Proposal 3.10 can be maintained.

As an analysis of ability modals like *boro*, *saknaa*, and *pouvoir* (examples 1.7a, 1.7b, and 1.9b, respectively), Bhatt’s proposal diverges from the possible worlds semantics. If we assume – with good reason – that the premise semantics represents the right account of possibility modals on their non-abilitative construals, then adopting Proposal 3.10 forces us to accept that abilitative and non-abilitative uses of possibility modals do not involve the

same lexical item. This is, indeed, the position that Bhatt takes, insofar as he claims that ABLE is at base an implicative verb, and not an (ability) modal at all.

While this ambiguity is distinct from the ‘did’/‘had the ability’ ambiguity, the objection raised in Chapter 1 to Thalberg’s ambiguity is equally valid here.⁴ In particular, the lexical split between ABLE and the possibility modal, like the ‘did’/‘had the ability’ split, would require that the same ambiguity, involving a particular class of item, appears systematically across a wide range of languages. This remains less plausible than the type of account we are after, on which the cross-linguistic pattern of ability and actuality interpretations for possibility modals reflect (to some degree) a shared semantic core.

One possible way out of this conclusion – attempting to accommodate Proposal 3.10 in terms of the premise semantics for possibility – turns out to be a dead end. Since the possibility meaning (modal force) is fixed by the lexical entry for *can* and its counterparts, both the actuality entailment and the presumption of effort will need to be captured in terms of modal flavour – that is, by the choice of the conversational backgrounds relative to which possibility is evaluated. I do not see a way to do this. We can force an actuality entailment by requiring that ability claims invoke a totally realistic modal base: this guarantees that the domain of quantification for possibility includes only the evaluation world, which must then be the one in which the modal complement holds. There is no obvious reason that the interpretation of ability claims should be restricted in this way. Moreover, it does not seem possible to account for the effort presupposition in terms of conversational backgrounds.

Even if we set aside the question of ambiguity, Bhatt’s proposal raises an obvious question: how do we account for non-implicative ‘pure ability’ interpretations of ABLE predicates? As we have seen, imperfectly-marked ability modals do not give rise to actuality entailments.

⁴Following Thalberg’s suggestion leads to the conclusion that the abilitative construals of possibility modals are in themselves ambiguous ([...] ‘was able’ sometimes means ‘had the ability’, and sometimes means ‘did.’ 1972; p.121), but does not necessarily divorce the pure ability cases from non-abilitative uses of the possibility modal. Bhatt’s ambiguity does not split the abilitative meaning of possibility modals into two, but divorces ability modals from a unified group containing epistemic possibility modals, deontic possibility modals, and so on. On Bhatt’s view, both actualized and pure ability interpretations can be derived from the *manage* semantics.

(3.12) *Jean pouvait s'enfuir, mais il ne s'est pas enfui.*

‘Jean could-IMPF escape, but he didn’t escape.’

We have already seen a version of Bhatt’s explanation, in the previous chapter’s discussion of Hacquard (2006). Specifically, Bhatt argues that non-entailing readings for *able* are generic readings.⁵ On this view, the imperfective marker introduces a covert generic operator, which ‘lifts’ the hard-coded actuality entailment by quantifying over a set of normal worlds, to which the actual world need not belong.

The basic problem with this explanation is that, once the lexical semantics of ABLE has been identified with the lexical semantics of *manage/réussir*, then we expect compositional processes to affect both predicates in the same way. If covert GEN produces non-entailing readings for ABLE, then it should do the same for *manage*. Thus, Bhatt’s proposal predicts the availability of non-entailing interpretations for implicatives, and in particular for *réussir*, under imperfective marking. But – as already established – no such interpretations exist.

(2.44a) *Jean réussissait à s'enfuir, #mais il ne s'est pas enfui.*

‘Jean managed-IMPF to escape, #but he did not escape.’

⁵Bhatt justifies the localization of non-actualized interpretations to generic readings on the basis of Hindi data. Imperfectively-marked *saknaa*, like imperfectively-marked *pouvoir*, fails to entail the realization of its complement.

(1.8b) Yusuf havaii-jahaaz uṛaa **sak-taa** thaa, lekin vo havaii-jahaaz nahī
 Yusuf air-ship fly can-IMPF.MASC be.PST.MASC, but 3SG air-ship NEG
 uṛaa-taa thaa.
 fly-PFV.MASC be.PST.MASC.

‘Yusuf was able to fly airplanes, but he didn’t fly airplanes.’

In Hindi, the imperfective marking is only compatible with a generic or habitual reading, and not with a progressive interpretation (which is possible for the imperfective in Greek, French, and a number of other languages). For Bhatt, this indicates that the generic imperfective is implicated in the absence of actuality entailments.

It turns out that the dedicated progressive marker in Hindi is altogether incompatible with an ability modal.

- (i) *Yusuf havaii-jahaaz uṛaa **sak** rah-aa thaa.
 Yusuf air-ship fly can PROG-MASC be.PST.MASC.
Intended: ‘Yusuf was being able to fly airplanes.’

If we assume that (i) is reflective of the situation in other languages – that is, that progressive interpretations cannot be generated for ability modals in any language – then we conclude, as Bhatt does, that the generic/habitual imperfective must be solely responsible for the absence of an actuality entailment.

We have the same problem for *manage*, as compared to *be able*: despite the shared effort and complement inferences, the overall inferential patterns of these two predicates are not as well-matched as Proposal 3.10 predicts. Episodic contexts like (3.13a) favour the actualized interpretation for *was able*. However, (3.13b) shows that, with the right contextual support, the realization of the ability-complement is felicitously denied, and so cannot be classified as an entailment.

- (3.13) a. This morning, Popeye was able to lift a fridge.

\leadsto *Popeye lifted a fridge this morning.*

- b. Due to a sudden increase in strength from eating spinach this morning, Popeye was able to lift a fridge, but he used his strength to hurl rocks instead.

\nrightarrow *Popeye lifted a fridge this morning.*

On Bhatt's analysis, we might explain the inferential contrast in (3.13) by arguing that (3.13b) incorporates a covert generic, where (3.13a) does not. Again, however, since the semantic contribution of *be able* is taken to be precisely that of *manage*, we should expect to replicate the contrast with *manage*. (3.14) shows that we cannot.

- (3.14) a. This morning, Popeye managed to lift a fridge.

\vdash *Popeye lifted a fridge this morning.*

- b. Due to a sudden increase in strength from eating spinach this morning, Popeye managed to lift a fridge, #but he used his strength to hurl rocks instead.

The contrast between *be able* and ability modals, on the one hand, and implicatives like *manage* and *réussir*, on the other, constitutes strong evidence against an account which equates the lexical semantics of the predicate ABLE with the standard Karttunen and Peters account of *manage*. Indeed, the data in (3.12)-(3.14) argue against any account of actuality inferences on which the ability-attributing predicates which license them are taken to be underlyingly implicative.

This leaves us in a tricky position. It appears that Proposal 3.10 is not tenable, but the comparison Bhatt observes between actualized ability ascriptions and *managed to* claims

remains striking, all the more so because it encompasses both entailed and not-at-issue content. Any account of actuality inferences will need to provide an explanation of this parallel.

In pursuing an account of implicative verbs, I take the view that the similarities noted by Bhatt are not just a matter of coincidence, but reflect a real point of contact between actuality entailments and implicative entailments. On this view, the problems with Bhatt's account ultimately pose a challenge to Karttunen and Peters's semantics for *manage* (Proposal 3.8), for the following reason.

If *manage* simply asserts the realization of its complement, then there is no way to 'break down' an implicative entailment into its component properties: no such component properties exist, and there is no way in which they might be distributed across ability and aspect in a compositional derivation. Thus, if the direct-assertion account is the correct analysis of *manage*, the only way for us to analyze actuality entailments as instances of implicative behaviour is the route taken by Bhatt. Since this route is untenable, there is only one other possibility: the complement entailment properties of implicative verbs are not hard-coded, but instead follow as a logical consequence of the meaning that an implicative actually encodes. This gives us a top-level answer to the question of how actuality inferences are drawn in the process of interpretation. The remainder of this chapter is devoted to establishing the lexical semantics that induces the particular calculation in which we are interested.

3.2 Assertion and presupposition in implicative meaning

Cross-linguistically, implicative verbs can be identified by their inferential profile. As shown in (3.15)-(3.16), *manage*, *dare*, and their Finnish counterparts (*onnistua* and *uskaltaa*, respectively) all generate entailments to the truth of their complements.

(3.15) English implicative entailments:

- | | |
|---|---|
| a. Morgan managed to solve the riddle. | \vdash <i>Morgan solved the riddle.</i> |
| b. Ana dared to enter the cave. | \vdash <i>Ana entered the cave.</i> |

(3.16) Finnish implicative entailments:

- a. Jean **onnistu-i** kuitenkin pakenema-an.
 Jean succeed-PST.3SG however flee-INF.ILL
 ‘Jean managed to flee.’ ⊢ *Jean fled.*
- b. Juno **uskals-i** avat-a ove-n.
 Juno dare-PST.3SG open-INF door-GEN/ACC
 ‘Juno dared to open the door.’ ⊢ *Juno opened the door.*

As Karttunen (1971) points out, these verbs can be distinguished from *factives*, which also license inferences about the truth of their complements, by their behaviour under negation. Factive verbs like *know* and *regret* presuppose the truth of their complements, and thus factive complement inferences project unchanged through matrix negation.

(3.17) Factive complement inferences:

- a. Sarah knew that Juno opened the door. → *Juno opened the door.*
- b. Sarah did not know that Juno opened the door. → *Juno opened the door.*

By contrast, negating an implicative verb reverses the polarity of the complement inference as well:

(3.18) English implicatives under negation:

- a. Morgan did not **manage** to solve the riddle.
⊢ *Morgan did not solve the riddle.*
- b. Ana did not **dare** to enter the cave. ⊢ *Ana did not enter the cave.*

(3.19) Finnish implicatives under negation:

- a. Jean e-i **onnistu-nut** kuitenkaan pakenema-an.
 Jean NEG-3SG succeed-SG.PP however flee-INF.ILL
 ‘Jean did not manage to flee.’ ⊢ *Jean did not flee.*
- b. Juno e-i **uskalta-nut** avat-a ove-a.
 Juno NEG-3SG dare-SG.PP open-INF door-PART.
 ‘Juno did not dare to open the door.’ ⊢ *Juno did not open the door.*

The two-way entailment pattern established by (3.15)-(3.16) and (3.18)-(3.19) sets up an interesting puzzle. Let I represent an arbitrary implicative verb, S its subject, and A its complement. Then, indicating the full proposition represented by the implicative complement as $A(S)$, we have the following relationships:

$$(i) \ I(S, A) \vdash A(S)$$

$$(ii) \ \neg I(S, A) \vdash \neg A(S)$$

In logical terms, entailment (ii) is the converse of entailment (i). Taken together, then, (i)-(ii) suggest that an implicative assertion and its complement are mutually entailing. This should give us the equivalence relation in (iii).

$$(iii) \ I(S, A) \equiv A(S)$$

While entailments (i) and (ii) hold for *manage*, *dare* and their Finnish counterparts, (iii) does not. An implicative assertion is simply not interchangeable with the assertion of its complement proposition. The challenge for an analysis of implicatives, then, is to capture (i) and (ii) in a compositional manner, while avoiding the “intuitively unacceptable conclusion” in (iii) – that an implicative assertion is indistinguishable from the assertion of its complement (Karttunen, 1971, p.343).

3.2.1 Prerequisites and obstacles in implicative verbs

Karttunen’s suggestion, which has been widely adopted, is that equivalence between an implicative assertion and its complement is blocked by presuppositional content associated with the implicative verb. The idea is that verbs like *manage* and *dare* place certain requirements or preconditions on a context of utterance. ‘Bare’ assertions of the implicative complements do not impose the same restrictions, meaning that these assertions of these propositions will often be felicitous in contexts which preclude the use of a full implicative statement. As a result, the use of an implicative verb is expected to have certain discourse effects, and in particular will license inferences about the utterance context that do not follow from the assertion of the complement alone.

This approach to the implicative puzzle appears promising. We have already seen evidence that *manage* imposes restrictions on its context of utterance, in particular presupposing that the realization of its complement required effort on the part of the sentential subject. This is reiterated in (3.20).

- (3.20) Morgan **managed** to solve the riddle.
- a. *Entails*: Morgan solved the riddle.
 - b. *Presupposes*: It required effort for Morgan to solve the riddle.

Similar sorts of ‘requirement’ inferences arise alongside the characteristic entailments of other English and Finnish implicatives.⁶

- (3.21) English:
- a. γ Tempting fate, I **dared** to open an umbrella indoors.
 \vdash *I opened an umbrella indoors.*
 - b. γ [...] Mr. Sinha **condescended** to meet the tainted persons.
 \vdash *Mr. Sinha met the tainted persons.*

- (3.22) Finnish:
- a. Hän e-i **viitsi-nyt** vastast-a.
he.NOM NEG-3SG bother-PP.SG answer-INF
‘He didn’t **bother** to answer.’ \vdash *He didn’t answer.*
 - b. Marja e-i **iljen-nyt** katso-a.
Marja NEG-3SG bring.self-PP.SG look-INF
‘Marja couldn’t bring herself to look.’ \vdash *Marja didn’t look.*

Dare in (3.21a) (as well as its Finnish counterpart *uskaltaa*; examples 3.16b and 3.19b), suggests that boldness or courage was required to realize the implicative complement; in (3.22a), *viitsia* (‘bother’) suggests that interest or engagement – an absence of apathy – was required from the subject. The use of *condescend* in (3.21b) suggests that meeting with ‘the tainted persons’ required Mr. Sinha to suppress or overcome some inherent disdain. Finally,

⁶Following a convention introduced in Horn (2010), I use the diacritic γ to indicate that a sentence was found on the internet. Sources for all naturally-occurring examples can be found in the appendix.

iljetä (roughly, ‘bring-self’) indicates that Marja had to overcome some internal shame or aversion in order to look.⁷ Each of these implications projects through negation, as indicated for *dare* and *condescend* below:

(3.23) I did not **dare** to open an umbrella indoors.

- a. *Entails*: I did not open an umbrella indoors.
- b. *Licenses*: Opening an umbrella indoors required courage.

(3.24) Mr. Sinha did not **condescend** to meet with the tainted persons.

- a. *Entails*: Mr. Sinha did not meet with the tainted persons.
- b. *Licenses*: Mr. Sinha had to suppress disdain in order to meet with the tainted persons.

These implicative presuppositions are united by a common thread: in each case, they invoke some condition that plays a role in determining whether or not the sentential subject can realize the complement proposition. The precise content of this condition varies from verb to verb, but in each case establishes a *prerequisite*. In general, then, implicatives seem to presuppose the existence of some kind of difficulty or potential ‘obstacle’ for the realization of the implicative complement (see also Karttunen, 2014). As the range of meaning in (3.21)–(3.22) demonstrates, implicatives can vary widely in terms of what they lexicalize about the nature of an obstacle. Compared to implicatives like *dare*, *condescend*, *viitsia* (‘bother’), and so on, *manage* (along with its Finnish counterpart *onnistua*; examples 3.16a and 3.19a) evidently represents something of a general case – the effort presupposition suggested by Karttunen and Peters can be interpreted as indicative of the presence of a potential obstacle, without providing any specification as to its nature.

Based on the evidence we have seen so far, I take the following to be the central facts about implicative verbs:

⁷According to L. Karttunen (p.c.), *iljetä* is a difficult verb to translate accurately. The sense of aversion or the baked-in notion that the implicative complement is something that one would need to ‘bring oneself’ to do is imported from the speaker’s perspective, and does not necessarily reflect the attitude of the subject towards the complement event.

- (A) An assertion $I(S, A)$ conditions $A(S)$ on S 's overcoming some potential obstacle. (This will ultimately block entailment from $A(S)$ to $I(S, A)$.)
- (B) Given both (i) $I(S, A) \vdash A(S)$ and (ii) $\neg I(S, A) \vdash \neg A(S)$, surmounting the obstacle must be both sufficient and necessary for $A(S)$ in context.
- (C) An assertion of $I(S, A)$ non-defeasibly conveys $A(S)$; its negation, $\neg I(S, A)$, conveys $\neg A(S)$

In developing an account of implicative verbs, the task is to determine what division of labour between at-issue and not-at-issue content will capture the above facts.

3.2.2 The ‘direct assertion’ account

As we have seen, Karttunen and Peters (1979) aim to capture Fact (C) by making the at-issue content of an implicative utterance $I(S, A)$ equivalent to that of its (reconstructed) complement, $A(S)$. This move takes its justification from Karttunen’s observation that “all that takes place when John *manages to do* something is that he does it [...] *managing to do* is inseparable in time and space from *doing*; it is the same event” (1971; pp.349–350),⁸ I repeat the proposal here.

(3.8) **The ‘direct assertion’ account:** (Proposal; Karttunen and Peters, 1979).

For an agent S and a one-place predicate A , the claim that S *managed to* A :

- i. *Asserts*: S did A ($A(S) = 1$)
- ii. *Presupposes*: Doing A was effortful for S

On Proposal 3.8, the not-at-issue content of *manage* is taken to be the presumption that the *manage*-complement required effort. We have already seen evidence supporting this

⁸It is not difficult to see why this might suggest that *manage*(S, A) and its complement are assertorically equivalent, but it is not at all clear that Karttunen himself takes this view in the 1971 paper. He goes on to say that an “affirmative assertion [of an implicative] states, according to the speaker’s supposition, that a sufficient condition for the truth of the complement is fulfilled,” and that a “negative assertion claims that a necessary condition for the truth of the complement is not fulfilled [...]” (p.352), which indicates instead that he takes the truth or falsity of $A(S)$ to follow as a conclusion on the basis of the main implicative statement, rather than being literally contained within it. This view aligns well with the account I develop here.

proposal, including that the effort inference projects through matrix negation. Karttunen and Peters additionally test the not-at-issue status of an effort requirement by embedding a *manage* claim under the presupposition ‘hole’ *discover* (Karttunen, 1973). In (3.25), the embedding verb applies to the complement entailment, but does not transfer to the presumption of effort: someone uttering (3.25) is committed to (3.25a), but not to (3.25b). The proposed presupposition of effort instead survives intact, *sans* any modification.

(3.25) I just discovered that Solomon **managed** to build the temple.

- a. *Entails*: I just discovered that Solomon built the temple.
- b. *Does not license*: I just discovered that building the temple required effort for Solomon.
- c. *Licenses*: Building the temple required effort for Solomon.

A problem for direct assertion

In Section 3.1, I suggested that the close comparison between *manage* and actualized ability observed by Bhatt gives us a reason to question the ‘direct assertion’ component of Karttunen and Peters’s proposal. Another problem created by the proposed assertion in Proposal 3.8-i has to do with the interaction between an implicative verb and adverbial modifiers. Karttunen (1971) shows that temporal modifiers attached to the main implicative claim seem to be ‘inherited’ by the complement proposition.

(3.26) Yesterday, Morgan **managed** to solve the problem.

⊢ *Yesterday, Morgan solved the problem.*

The same thing happens with locative modifiers:

(3.27) At the door, Juri finally **managed** to apologize.

⊢ *At the door, Juri finally apologized.*

The facts in (3.26) and (3.27) are consistent with the hypothesis that *manage* simply asserts its complement proposition, since we expect the temporal and locative adverbials in these examples to modify asserted content.

The problem arises when we consider a specific type of modifier: clauses introduced by *because*. Karttunen points out that modifying an implicative claim with a *because*-clause does not produce the same results as modifying the claim with a temporal or locative adverbial. Instead, there is a contrast in the way that *because*-clauses are interpreted when they attach to an implicative statement versus directly to the complement proposition.

- (3.28) a. Juno **managed** to open the door because it was unlocked.
 b. Juno opened the door because it was unlocked.

In (3.28a), the *because*-clause is most naturally interpreted as explanatory, in the sense that it indicates how or why Juno was able to open the door. Linking this to the notion of implicative obstacles, the *because*-clause seems to indicate how it came about that the potential obstacle (presumably the door's potential to be locked) was circumvented. In (3.28b), on the other hand, the same clause appears instead to provide information about Juno's motivation for opening the door – suggesting, for instance, that her action was guided by a tendency towards idle curiosity. While the explanatory reading may be (very marginally) available in (3.28b), the motivational interpretation is ruled out in (3.28a).

This is unexpected on a direct assertion account. If *manage* and its complement make identical at-issue contributions, then we expect the full implicative claim and the complement claim to behave the same way under any operation that modifies asserted content. The simplest explanation for the contrast in (3.28) is that either the implicative or its complement contributes something to at-issue content that the other does not.

Malleable presuppositions

The other half of Karttunen and Peters's proposal – the presupposition of effort – also turns out to be problematic. The effort inference readily arises from an example like (3.29), and moreover behaves in the expected manner for not-at-issue content. However, it is not the only inference that has this sort of relationship with *manage* claims. For instance, Givón (1973) suggests that *manage* presupposes that its subject tried, or made an “active attempt” to bring about the complement proposition. A similar, but slightly weaker, inference is that

the subject of a *manage* claim intended to bring about the complement. Both of these seem to be reasonable proposals:

- (3.29) a. Solomon **managed** to build the temple.
- i. *Licenses*: Solomon tried to build the temple.
 - ii. *Licenses*: Solomon intended to build the temple.
- b. Solomon did not **manage** to build the temple.
- i. *Licenses*: Solomon tried to build the temple.
 - ii. *Licenses*: Solomon intended to build the temple.

To make matters worse, Coleman (1975) observes that there are perfectly good uses of *manage* which fail to background either effort or intention:

- (3.30) a. Harry **managed** to insult Ursula without even trying.
- b. Harry's dog **managed** to wake him up every time he fell asleep on the couch.
- c. My neighbors **managed** to schedule their one wild party of the year on the night before my German exam.

(3.30a) explicitly denies that Harry made an attempt to insult Ursula – and, accordingly, suggests that it did not take effort for him to do so. (3.30b) is perfectly compatible with an interpretation on which the dog does not have the intention of waking Harry up, and in (3.30c), it need not be the case that the neighbors intended to cause me problems, nor that it took any particular effort from them to schedule their party on the night they chose.

To explain what is going on in (3.30), Coleman suggests that, in each case, the “vanishing” effort or intention presuppositions are supplanted by something weaker – specifically, the inference that realizing the complement was *a priori* unlikely. Her idea is that the presuppositional contribution of *manage* varies in a systematic manner between the three options spelled out in (3.31): intention, effort/difficulty, and unlikely.

- (3.31) Solomon **managed** to build the temple.
- a. Solomon intended to build the temple.

- b. Building the temple required effort for Solomon.
- c. It was unlikely that Solomon would build the temple.

On Coleman’s view, the variation is governed by a strength ordering among (3.31a)-(3.31c), with intention representing the strongest possible presupposition, followed by effort, and last by unlikelyhood. In any given context, the strongest tenable presupposition is expected to hold, subsuming the weaker ones. For an example like (3.30a), where intention is denied, we next check for effort or difficulty.⁹ If the context also fails to support the presumption of effort, then it must support unlikelyhood. On this account, *manage* is predicted to be infelicitous in case – and only in case – unlikelyhood (the weakest possible presupposition) fails.

This proposal seems to work for the examples we have so far seen, but recent work by Baglini and Francez (2016) shows that a strength-based hierarchy cannot explain the mal-leability of *manage*’s not-at-issue content in the general case. It is crucial for Coleman’s proposal that the validity of a stronger presupposition necessitates the validity weaker ones. Against this requirement, Baglini and Francez provide a range of naturally-occurring examples which illustrate the acceptability of *manage* in contexts where any one of the intention, effort, or unlikelyhood conditions is supported, but the others are precluded.¹⁰ The examples in (3.32) illustrate this point: in each case, one or more of the proposed presuppositions is ruled out, but the other(s) are left intact.

- (3.32) a. \neg Without intending to, Ms. Streisand actually managed to synthesize the problem of diversity mania.

\neg intention, \neg difficulty, \sim unlikelyhood

⁹While the majority of her discussion is focused on *manage*, Coleman also argues that implicatives like *happen* and *fail* also invoke strength-ordered presuppositional content. This type of presupposition, on her view, is to be seen, along with complement entailment, as a feature of the implicative class.

¹⁰Examples (i)-(ii) are from Baglini and Francez (2016): (i) explicitly denies difficulty, but nevertheless presumes effort, and (ii) denies any unexpectedness, but again leaves effort or intention untouched.

- (i) Clad in civilian clothes and having passports, they easily **managed** to get back over the Volga.
- (ii) Now it’s becoming obvious that Fork will **manage** to kill someone important.

- b. γ By 1998, four years after a federal ban on assault weapons took effect, gun manufacturers had easily managed to bypass the laws by making small alterations to their weapons.

\leadsto intention, $\not\leadsto$ difficulty, $? \leadsto$ unlikely

- c. γ The social democrats (Socialdemokratiet) managed to strengthen their position as Denmark's strongest political force as expected during local elections.

\leadsto intention, $? \leadsto$ difficulty, $\not\leadsto$ unlikely

Ultimately, then, while it seems clear that *manage* places some restrictions or preconditions on its utterance context, it is not at all clear what unites these restrictions from case to case, if indeed they can be captured and described in a unified manner. At the very least, however, it is clear that the presupposition of effort set out on the direct assertion account of *manage* will not be equal to the task.

3.2.3 An alternative approach

The discussion in Section 3.2.2 suggests that we will need to look beyond Karttunen and Peters's proposal to fully capture the implications of *manage*. Baglini and Francez's (2016) recent proposal offers a different way of dividing up the asserted and presuppositional content of an implicative.

Baglini and Francez argue that the apparently capricious behaviour of *manage*'s presuppositions indicates that the not-at-issue content of *manage* must be relatively abstract, in essence 'distilling' the intention, effort, and unlikely conditions down to some content that they have in common. Moreover, since examples like the ones in (3.30) and (3.32) show that context affects the way in which *manage*'s presuppositional content is interpreted, the more abstract presupposition must, in some way, be subject to input from the discourse context.

Baglini and Francez also discuss the *because*-clause contrast illustrated in (3.28). They arrive at the same conclusion as we did above: the *because* contrast shows that the at-issue content of a *manage* statement differs non-trivially from the content of its complement.

This means that the complement entailments which characterize implicative verbs cannot arise directly as asserted content, but instead must follow in some process of reasoning from the meaning of a *manage* claim. In other words, where the direct assertion account simply stipulates Fact (C), the account developed by Baglini and Francez will instead need to derive this fact.

The central insight behind Baglini and Francez’s proposal is that the relationship between an implicative and its complement is one of **causal dependence**. The idea, roughly, is this: if the realization of an implicative complement is derived as a causal consequence of the main assertion, we have a way of differentiating the at-issue content of the implicative and complement propositions, as desired, while maintaining a straightforward explanation for the characteristic entailment patterns. On this approach, the not-at-issue contribution of *manage* will simply be to background the existence of the relevant causal relationship; since different contexts will supply different ways of fleshing out the basic relationship, we expect the precise content of *manage*’s ‘presupposition’ to vary from one case to another. Baglini and Francez’s proposal is given below:

(3.33) **The catalyst account:** (Proposal; Baglini and Francez, 2016)

For an agent S and one-place predicate A , the claim that S *managed to* A :

- i. *Presupposes:* The familiarity (salience and truth) of a **catalyst**, or *causally necessary but causally insufficient situation*, for the truth of $A(S)$
- ii. *Asserts:* The catalyst **actually caused** $A(S)$

The asserted relation of *actual cause* will, presumably, derive the desired complement entailments. Even better, the notion of a causally necessary but causally insufficient catalyst seems, at least at first glance, to capture the idea that implicatives invoke the existence of some sort of obstacle for the realization of their complements. In particular, each of the implicative verbs discussed in Section 3.2.1 indicates that there is particular requirement for overcoming this obstacle. This notion of a prerequisite is realized in Proposal 3.33 as the causal necessity of the catalyst for the implicative complement. Roughly speaking, then, it

seems as if an implicative like *dare* or *viitsia* ('bother') will impose specific features on a backgrounded catalyst; *manage* represents a more general case.

The real weight of Proposal 3.33 lies in the precise formulations of the three causal dependence relations: causal necessity, causal sufficiency, and actual cause. In order to check that our intuitions about the catalyst account are borne out, and to investigate any further consequences of this analysis, we will first need to see how these relations are cashed out. Baglini and Francez formalize their proposal in terms of the **causal dynamics** framework of Schulz (2007, 2011), which I now discuss.

3.3 Modeling causal dependencies

In this section, I take a step back from the main plot of the chapter, and introduce in some detail the causal framework in which we will formalize the specific dependency relations in which we are interested. Schulz's causal dynamics belongs to the class of *interventionist* or *structural equation* causal models, and is largely based on the model developed by Pearl (2000). Structural equation models are not the only available option for representing causal networks, nor the only type of model which can support a pluralist approach to causation as it is encoded in semantics and grammatical structure.¹¹ As far as I am aware, nothing hinges on the use of a particular framework for representing causal information, and my choice to work with Schulz's dynamics is motivated primarily by a desire for continuity with existing research. In this dissertation, my aim is simply to establish that the types of relationships that can be formally articulated in a causal model are explanatory and predictive with respect to the lexical semantics of implicative verbs (and ultimately, of ability predicates). I leave it for future research to compare and contrast the consequences of particular modeling choices.¹²

¹¹In this context, a pluralist approach is one which argues that language draws on a set of basic and contrasting causal relations – such as causal necessity and causal sufficiency – rather than a single concept of causal dependence, as in the work of Dowty (1979). The *force dynamics* approach to causation, introduced by Talmy (1988), and developed by Phillip Wolff and colleagues (Wolff and Song, 2003; Wolff, 2007; Wolff et al., 2010a,b), is one prominent example of a pluralist approach to causation.

¹²For some experimental work in this area, see Wolff and Song (2003); Sloman et al. (2009) and Livengood and Rose (2016).

3.3.1 Preliminary remarks

The notions of causal necessity and causal sufficiency we define in the causal framework are not reducible to the more familiar alethic relations of logical necessity and sufficiency, nor identifiable with metaphysical variants of these relations. Specifically, causal necessity will not be equated with counterfactual necessity (*à la* Lewis 1973), and causal sufficiency will not be equated with *metaphysical* settledness (truth in all possible courses of events). The challenges associated with defining causation in terms of counterfactual dependence are well known from the philosophical literature (see Menzies 2017, Paul and Hall 2013, Sosa and Tooley 1993, and references therein). These include the problems posed by a range of so-called ‘pre-emption’ scenarios, in which counterfactual dependence fails to hold between two facts or events C and E , but C is nevertheless judged to be a cause (or even *the* cause) of E .¹³ In a similar vein, a causal sufficiency relation defined in terms of metaphysical settledness would be much too strong. Intuitively, if an event C was causally sufficient for another event E , we can think of C as the occurrence which *guaranteed* that E would occur, given the actual way in which other events in the world unfolded. This is a strictly weaker notion than metaphysical settledness, in that we only need to make reference to a particular subset of all of the possible courses of events.

In defining causal necessity and causal sufficiency, then, a first task is to characterize the set of courses of events that are taken into account in interpreting causal claims. Intuitively, these are the courses of events in which the world proceeds ‘as expected,’ based on what is known at evaluation time, both about the state of the world (i.e. what facts are established), and what is known about the (typical) causal consequences of this state. In

¹³One variant of a frequently-discussed pre-emption scenario is as follows:

- (i) Billy and Suzy throw rocks at a bottle. Suzy throws slightly before Billy, so her rock gets there first and shatters the bottle. If Suzy’s throw had not hit the bottle, Billy’s throw would have shattered it, so the bottle would have shattered regardless of Suzy’s action. However, Suzy’s throw is felt to be the cause of the bottle’s shattering, while Billy’s throw is not.

I will not have anything further to say about pre-emption, but various authors, including Hall (2004), Paul and Hall (2013), Copley and Wolff (2014) examine how causal modeling approaches can deal with the problems such scenarios raise for theories of causation which attempt to work solely with counterfactual necessity in the standard logical sense.

order to evaluate causal statements, then, we will need three things: a context or set of facts about the evaluation world, a means of representing or encoding knowledge about causal relationships in the world, and a mechanism for applying the latter to the former to work out the predictable (causal) consequences.

Such a representation of causal information, both generalized and situation-specific, is what I mean in referring to a **causal model**. I take such a model to have as its basic components propositions (which represent events, anchored to specific times and worlds), and causal links: it is a network of (one-way) links between propositions, in which a link represents the information that the proposition at which it originates is causally relevant for the proposition it points to. For current purposes, a causal link is an atomic concept, which is not further decomposable. In drawing on a causal model to define elements of lexical semantic representation, I take this type of network to be part of a language user's knowledge about the world. In the type of system outlined here, the causal relations encoded by specific lexical items are neither themselves unanalyzable, nor defined in terms of logical relationships, but instead pick out certain structural configurations over a network of (un-analyzable) causal-relevance links. In other words, causal necessity and causal sufficiency (and other potential causal dependence relations) are simply concise labels for structural configurations in a complex causal network.

3.3.2 Dynamics for causal entailment

Consider the following example, due to Lifschitz (1990):

(3.34) **The circuit example.**

- a. Suppose there is a circuit with two switches and one lightbulb, such that the light comes on just in case both switches are in the same position (either both up or both down).
- b. At the moment, both switches are up.

(3.34) contains two kinds of information. (3.34a) sets out the 'rules' of the system – that is, a set of cause-and-effect relations that are known to obtain between relevant facts. (3.34b)

describes a particular context in which the causal laws in (3.34a) may come into effect, by settling or fixing certain of the relevant facts.

Crucially, the situation described in (3.34b) does not fix all of the facts of the circuit system: it tells us the position of the switches, but does not inform us about the state of the light (perhaps the switches are in one room, where we can observe them, but the bulb is in another, and is out of view). A *situation* in this sense is a part or a partial description of a world:¹⁴ in a possible-worlds setting, it corresponds to a set of one or more worlds. Based on the set of relevant facts in (3.34), the situation in (3.34b) picks out two possible worlds: one in which (3.34b) holds and the light (when we go to check on it) turns out to be on, and another in which (3.34b) holds, but the light turns out to be off.

Intuitively, of course, only one of these two worlds is a reasonable possibility. This follows from what we know about causation in the circuit system: if the information provided in (3.34a) is correct and complete, we expect that the light will be on. A world in which (3.34b) holds but the light is off violates the causal laws as we know them: since this is an abnormal outcome, it typically will not figure into our reasoning about causal consequences. More generally, once we have established a set of causal laws, we expect that events in the (actual) world will unfold in accordance with these laws. Causal laws, thus allow us to work out what the expected or *normal causal developments* of a particular situation will be. This is an extremely natural – and extremely familiar – way to reason about the world.

Of course, we might well walk into the other room to check on the state of the light, and find, contrary to expectation, that it is off. This might be explained by any number of eventualities which are not accounted for in (3.34): for instance, the circuit may have shorted, or the bulb may have burned out. The fact that contingencies like these are not included in (3.34) reflects the assumption that they are unexpected or unusual events, which have not been taken into account in the context that is taken to be relevant with respect to (3.34b).

Reasoning about normal causal developments, then, is a form of closed-world reasoning

¹⁴This view of situations appears in a variety of treatments of situation semantics, including Barwise and Perry (1981) and Kratzer (1989, et seq).

(Reiter, 1978). The implicit assumption in the Lifschitz example and other similar scenarios is that what you see is what you get: the facts represented or made salient by a discourse context comprise all of the relevant ones, and what happens in the course of normal causal developments (and in the actual world, which we assume to be causally normal) will depend only on this information. Put another way, the normality assumption is equivalent to the assumption that our model of causality is complete and contains all of the relevant information. Causal inference is thus inherently defeasible, but in a particular, self-correcting way. If we find that the actual world violates a causal law, we do not usually throw up our hands and conclude that the causal laws have broken down. Instead, we infer that some relevant information is missing from our model, and may then go on to revise the set of relevant facts and/or laws to take account of new information.¹⁵ For example, if we discover that the light in (3.34) is off, and work out that this is due to the presence of a master switch that we were previously unaware of, we will update our model of the situation: any subsequent communication or reasoning about the circuit system will include this update.

The formal system

The causal **dynamics** is a framework for representing causal information of the sort provided in (3.34), and in which causal consequences (or normal causal developments) can be formally computed. Within this framework, Schulz defines a central notion of **causal entailment**, which I use in turn to define notions of **causal necessity** and **causal sufficiency**. This is similar to the way in which logical necessity and sufficiency are built from the standard notion of logical entailment or consequence.

A dynamics encodes what we know about causal structure and causal relationships with respect to a (closed) system, or a finite set of salient propositions P . As we have seen, this type of representation can be manipulated and updated as time (or a discourse) progresses.

¹⁵Certain formal systems for representing causal knowledge build this defeasibility into the model, for instance, by means of a generalized ‘abnormality’ predicate \mathbf{AB} (see, e.g., Hobbs, 2005). In such a system, if what we know is that events A and B (typically) jointly bring about event C , we can capture this by taking the conjunction of A, B , and $\neg\mathbf{AB}$ to be causally sufficient for C . If we find, looking at the world, that A and B occurred, but C did not, we will conclude that $\neg\mathbf{AB}$ is false and from there go on to reason about what abnormality may have arisen.

Thus, it can be thought of as a contextual parameter which keeps track of and responds to what is known, assumed, backgrounded, or overtly communicated about causal relationships. For example, discovering that the second switch in the Lifschitz circuit has become disconnected from the bulb will push us to revise our causal laws; similarly, if someone tells us that they have installed a master switch which overrides the two we know about, we will add at least one new proposition to the set P . Going forward, I treat a dynamics as a parameter which can be augmented, queried, and modified by (both at-issue and not-at-issue) discourse contributions, in the same way as other features of the context or the common ground (see also Baglini and Francez, 2016; Lauer and Nadathur, 2018, 2019).

We start from a (finite) set of proposition P and define a language:

Definition 3.1 (Language). *Given a set of proposition letters P , let the **language** \mathcal{L}_P be the closure of P under the logical connectives negation \neg , conjunction \wedge , and disjunction \vee .*

Given a finite set of propositions P , Schulz defines a **dynamics** for \mathcal{L}_P :

Definition 3.2 (Dynamics). *A **dynamics** for \mathcal{L}_P is a tuple $\mathcal{D} = \langle B, F \rangle$ where:*

- (a) $B \subseteq P$ is the set of background variables.
 - (b) F is a function that maps elements X of $I = P - B$ to tuples $\langle Z_X, f_X \rangle$, where
 - i. Z_X is an n -tuple of elements of P
 - ii. $f_X : \{0, 1\}^n \rightarrow \{0, 1\}$ is a two-valued truth function from n -tuples on $\{0, 1\}$ to $\{0, 1\}$
- F is rooted in B .

Background (or *exogenous*; Pearl 2000) variables represent propositions which are taken to be causally independent of any and all other propositions in P . The complement set I of *inner* or *endogenous* variables thus contains those propositions which depend causally on one another, and on the background variables. Definition (3.2) indicates that dependent variables are associated in \mathcal{D} with a function that identifies their set of immediate causal ancestors (Z_X), as well as the nature of the direct dependencies. The requirement that this function F be *rooted* in B prevents cyclicity in causal dependencies, by ensuring that a ‘backwards walk’ through the causal ancestors of any variable always ends in B .

Definition 3.3 (Rootedness). *Let $B \subseteq P$ be a set of proposition letters, and F a function mapping elements of $I = P - B$ to tuples $\langle Z_X, f_X \rangle$ as above. Let R_F be the relation that holds between the letters X, Y if $Y \in Z_X$. Let R_F^T be the transitive closure of R_F . F is **rooted** in B if $\langle P, R_F^T \rangle$ is a poset and B is the set of its minimal elements.*

For truth and falsity, Schulz works with the strong three-way Kleene logic, in which propositions are valued from $\{u, 0, 1\}$. The truth table for this logic is given in Table 3.1. A 0 or 1 (false or true) valuation of a proposition will be referred to as a **determination**, while a variable assigned the value of u is **undetermined**. The set of truth values is assigned a partial order $u \leq 0, u \leq 1$, to indicate that undetermined variables can evolve or grow into propositions that are either true or false. Based on this system, we define **worlds** and **situations** as suggested by the informal presentation above.

X	Y	$\neg X$	$X \vee Y$	$X \wedge Y$
0	0	1	0	0
0	1	1	1	0
0	u	1	u	0
1	0	0	1	0
1	1	0	1	1
1	u	0	1	u
u	0	u	u	0
u	1	u	1	u
u	u	u	u	u

Table 3.1: Strong three-valued logic

Definition 3.4 (Worlds and situations). *For a language \mathcal{L}_P over P :*

- (a) A **world** for \mathcal{L}_P is any function $w : P \rightarrow \{0, 1\}$
- (b) A **situation** for \mathcal{L}_P is any function $w : P \rightarrow \{u, 0, 1\}$

Thus, a situation is a three-way valuation of P , which may leave certain relevant propositions undetermined. Given a situation s , and the causal laws as represented in a dynamics \mathcal{D} for \mathcal{L}_P , we would like to check whether the settled facts of s have any causal consequences

(in other words, we would like a method for calculating the normal causal developments of s).

To do this, Schulz defines an operator $\mathcal{T}_{\mathcal{D}}$ which ‘runs’ the dynamics for one step.

Definition 3.5 (Causal update). *Let \mathcal{D} be a dynamics, with s a situation. We define the situation $\mathcal{T}_{\mathcal{D}}(s)$ by:*

- (a) if $X \in B$, then $\mathcal{T}_{\mathcal{D}}(s)(X) = s(X)$
- (b) if $X \in I$, with $Z_X = \{X_1, \dots, X_n\}$, then
 - i. if $s(X) = u$ and $f_X(s(X_1), \dots, s(X_n))$ is defined,

$$\mathcal{T}_{\mathcal{D}}(s)(X) = f_X(s(X_1), \dots, s(X_n))$$
 - ii. if $s(X) \neq u$ or $f_X(s(X_1), \dots, s(X_n))$ is undefined, $\mathcal{T}_{\mathcal{D}}(s)(X) = s(X)$.

Since P is finite, a finite number of iterations of $\mathcal{T}_{\mathcal{D}}$ will necessarily exhaust the set of consequences of a given starting situation s , producing a *fixed point* (see Schulz 2011 for the proof of this claim). This result allows Schulz to define causal entailment as follows:

Definition 3.6 (Causal entailment). *Let \mathcal{D} be a dynamics. A situation s **causally entails** a proposition ϕ iff ϕ is true at the least fixed point s^* of $\mathcal{T}_{\mathcal{D}}$ relative to s :*

$$s \models_{\mathcal{D}} \phi \text{ iff } s^*(\phi) = 1$$

In other words, a situation s (which can, equivalently, be thought of as a set of literals from \mathcal{L}_P such that for any $X \in P$, at most one of X or $\neg X$ is in s) causally entails a proposition ϕ if and only if the maximal normal causal development of s determines (assigns a 0-1 value to) ϕ .

Causal necessity and causal sufficiency

We are interested in the way in which – given a context of utterance or background situation – one fact or event is causally involved in bringing about another. In reality, causes do not act alone. Any claim that one event C brought about another event E will be evaluated with respect to a set of established facts: what we do when we evaluate causative claims is

consider whether adding the causing event to the set of background facts has a particular sort of consequence for the occurrence (or non-occurrence) of the relevant effect event E .¹⁶ Thus, our first goal is to define relations of causal necessity and sufficiency that hold between two facts *relative* to a background situation.

Definition 3.7 (Facts in a dynamics). *Given a dynamics \mathcal{D} for \mathcal{L}_P , a **fact** is a determination for a variable $X \in P$; that is, an assignment $X = x$ where $x \in \{0, 1\}$. We write facts as $\langle X, x \rangle$.*

Definition 3.8 (Augmenting a situation with a fact). *Given a situation s and a fact $\langle X, x \rangle$, the situation $s[X \mapsto x]$ is given by the situation s' which reassigns the value of X to x , but is otherwise identical to s .*

As I define it here, augmenting a situation with a fact overrides an existing determination of the relevant variable in s . For the most part we will be concerned with cases where s does not already contain a determination of the variable in question.

Definition 3.9 (Domain of a situation). *For any situation s , the **domain** of s is given by*

$$\text{dom}(s) = \{X \in P \mid s(X) \neq u\}$$

Finally, I define consistency relative to the causal structure:

Definition 3.10 (Causal consistency). *In a dynamics \mathcal{D} over \mathcal{L}_P , a situation s is **causally consistent** if, for inner variables $X \in P - B$ such that $X \in \text{dom}(s)$, we have:*

$$s[X \mapsto u] \not\models_{\mathcal{D}} \begin{cases} \neg X & \text{if } s(X) = 1 \\ X & \text{if } s(X) = 0 \end{cases}$$

¹⁶Essentially, to check whether C brought about E in some way, we first want to add the information that C occurred to the stock of background facts, and then compare the consequences of this to the consequences of the background facts alone. Conceptually, this is similar to the type of reasoning we perform in evaluating conditional statements according to the *Ramsey test* (Ramsey, 1931): given a statement of the form *If p , then q* , we first ‘add’ p to the established facts, and then check the status of q .

In other words, a situation is internally causally consistent if there is no inner variable whose determination ‘breaks the rules’ of \mathcal{D} with respect to the other determined variables.

With this notions in hand, we can define the causal necessity and sufficiency of one fact for another relative to a situation. Causal sufficiency of a fact $\langle X, x \rangle$ for another fact $\langle Y, y \rangle$ reduces to causal entailment. Given a set of facts s , we want the causal necessity of $\langle X, x \rangle$ for $\langle Y, y \rangle$ to capture the idea that the only causally consistent paths going from s to $\langle Y, y \rangle$ involve (first) validating $\langle X, x \rangle$.

Definition 3.11 (Causal necessity and sufficiency of facts). *Let \mathcal{D} be a dynamics for \mathcal{L}_P . Let s be a situation and let $\langle X, x \rangle, \langle Y, y \rangle$ be facts such that $s \not\models_{\mathcal{D}} (X = x), s \not\models_{\mathcal{D}} (Y = y)$. Then:*

- (a) $\langle X, x \rangle$ is **causally sufficient** for $\langle Y, y \rangle$ relative to s ($\langle X, x \rangle \blacktriangleright_s \langle Y, y \rangle$) iff
 $s[X \mapsto x] \models_{\mathcal{D}} (Y = y)$:
- (b) $\langle X, x \rangle$ is **causally necessary** for $\langle Y, y \rangle$ relative to s ($\langle X, x \rangle \blacktriangleleft_s \langle Y, y \rangle$) iff:
 - i. there is a consistent supersituation s' of $s[X \mapsto x]$ such that $Y \notin \text{dom}(s')$ and $s' \models_{\mathcal{D}} (Y = y)$
 - ii. there is no consistent supersituation s' of s such that $Y \notin \text{dom}(s')$ and $s' \models_{\mathcal{D}} (Y = y)$ but $s' \not\models_{\mathcal{D}} (X = x)$

The similarity between Definition 3.11 and a counterfactual notion of necessity is evident; crucially, however, the necessity of one fact for another relative to a situation does not require that the negation of $\langle Y, y \rangle$ is (causally) entailed in case $\langle X, x \rangle$ is false or undetermined.

These definitions capture intuitive ideas about how necessity and sufficiency should work. Causal necessity ‘opens up’ the possibility of a particular outcome $\langle Y, y \rangle$, which can be thought of in the context of a dynamics as ‘opening up’ a causal pathway or pathways that may lead to $\langle Y, y \rangle$ without breaking any of the causal laws. However, causal necessity does not by itself ensure the realization of $\langle Y, y \rangle$, since it does not ensure the realization of a complete pathway to $\langle Y, y \rangle$. Causal sufficiency, on the other hand, guarantees the completion of a pathway to the effect in question, thus guaranteeing the effect as well.

It is important to note that Definition 3.11 restricts the evaluation of causal necessity

and sufficiency relative to a situation to background situations which are not by themselves sufficient for either the causing fact or the effect. This is essential for reasonable definitions of these notions. In the case of causal sufficiency, if we allow the causing fact to be causally entailed by the background situation, we must also allow the effect to be entailed (since adding the causing fact is sufficient for the effect). If we allow both facts to be entailed by the background situation, then any fact in a cause-entailing background situation will be sufficient for the effect, even if it is not a causal ancestor of the effect. If we allow only the effect to be entailed by the background situation, then any fact not entailed by the background situation will be sufficient for the effect, again regardless of its causal connections. In the case of causal necessity, the insufficiency of the background situation follows from the definition. If we allow the background situation to entail the cause, then in a real sense a causal pathway to $\langle Y, y \rangle$ was already open, and the cause was not by itself necessary.

I return to the circuit example (3.34) to illustrate how Definitions 3.11a-b work in practice. Figure 3.1 provides a graphical representation of the relevant dynamics.¹⁷ The three nodes S_1, S_2 , and L represent the three relevant propositions for the circuit system: S_1 encodes whether the first switch is up ($S_1 = 1$) or down ($S_1 = 0$), S_2 encodes whether the second switch is up or down, and L encodes whether the light is on ($L = 1$) or off ($L = 0$). The arrows represent causal links between propositions, with the direction of the arrow indicating the direction of causal influence: thus S_1 and S_2 are causal ancestors of L , but L is not a causal influencer of either of the other propositions. The truth table accompanying the graph specifies the causal laws as stated in (3.34a), by defining f_L : it tells us what the value of L is expected to be for any combination of valuations for S_1 and S_2 . Note that we might also express f_L in terms of a logical equation, in this case $L := (S_1 \wedge S_2) \vee (\neg S_1 \wedge \neg S_2)$. In Figure 3.1 and other graphical representations, I indicate background variables with a double enclosing circle.

In place of (3.34b), let us consider a new background situation which fixes the position of the first switch as up, but leaves the state of the second switch and the light undetermined:

¹⁷As noted, the fact that the function F is rooted in B , as in Definition 3.3, prevents cyclicity in the causal dependencies. Consequently, the network of causal links over a set of propositions will always be represented by a *directed acyclic graph*.

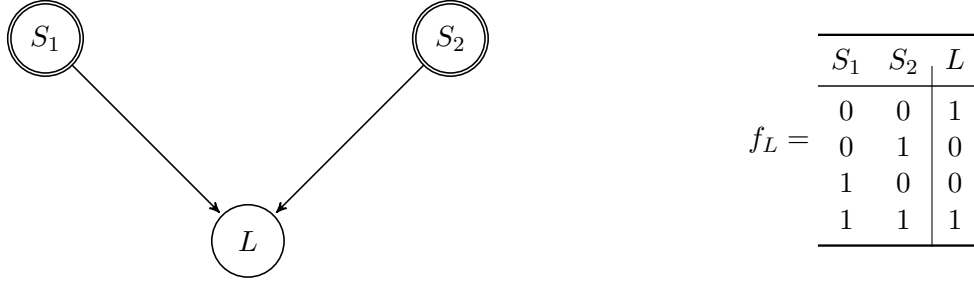


Figure 3.1: Graphical representation of the circuit example

$s = \{\langle S_1, 1 \rangle, \langle S_2, u \rangle, \langle L, u \rangle\}$. Relative to s , the fact $\langle S_2, 1 \rangle$ is both causally necessary and causally sufficient for $\langle L, 1 \rangle$ – that is, setting the second switch to the up position is both causally necessary and causally sufficient for the light to be on:

(3.35) Given the background situation $s = \{\langle S_1, 1 \rangle, \langle S_2, u \rangle, \langle L, u \rangle\}$:

a. *Claim:* $\langle S_2, 1 \rangle \blacktriangleright_s \langle L, 1 \rangle$.

We show this by showing that $s[S_2 \mapsto 1] \models_{\mathcal{D}} (L = 1)$

1. $s[S_2 \mapsto 1] = \{\langle S_1, 1 \rangle, \langle S_2, 1 \rangle, \langle L, u \rangle\}$
2. $s_1 = \mathcal{T}_{\mathcal{D}}(s[S_2 \mapsto 1]) = \{\langle S_1, 1 \rangle, \langle S_2, 1 \rangle, \langle L, 1 \rangle\}$
3. s_1 determines all of the relevant propositions, so s_1 is the least fixed point of s with respect to $\mathcal{T}_{\mathcal{D}}$; $s_1 \models_{\mathcal{D}} (L = 1)$.

Thus, $s[S_2 \mapsto 1] \models_{\mathcal{D}} (L = 1)$, and we have $\langle S_2, 1 \rangle \blacktriangleright_s \langle L, 1 \rangle$.

b. *Claim:* $\langle S_2, 1 \rangle \blacktriangleleft_s \langle L, 1 \rangle$.

1. Since $\langle S_2, 1 \rangle \blacktriangleright_s \langle L, 1 \rangle$, condition (i) is met.
2. For condition ii, we have two alternative situations to consider:

(a) $s' = \{\langle S_1, 1 \rangle, \langle S_2, u \rangle, \langle L, u \rangle\}$

$\mathcal{T}_{\mathcal{D}}(s') = s'$, so s' is its own fixed point, and $s' \not\models_{\mathcal{D}} (L = 1)$.

(b) $s' = \{\langle S_1, 1 \rangle, \langle S_2, 0 \rangle, \langle L, u \rangle\}$

In this case, $\mathcal{T}_{\mathcal{D}}(s') = \{\langle S_1, 1 \rangle, \langle S_2, 0 \rangle, \langle L, 0 \rangle\}$. This new situation

determines all available variables, so is its own fixed point, and
 $\mathcal{T}_{\mathcal{D}}(s') \not\models_{\mathcal{D}} (L = 1)$.

Thus, condition ii is satisfied

Both conditions for causal necessity are met, so $\langle S_2, 1 \rangle \blacktriangleleft_s \langle L, 1 \rangle$.

In light of Baglini and Francez's catalyst proposal, we are interested in two additional relations: causal necessity and causal sufficiency between situations and facts. Causal sufficiency is again straightforwardly defined on the basis of causal entailment, but causal necessity turns out to be somewhat less intuitive, since it requires considering the consequences of revising the valuations of (causally-relevant) facts from the established context.

Definition 3.12 (Causal ancestors). *Let \mathcal{D} be a dynamics for \mathcal{L}_P . Given a variable $X \in P - B$, the set A_X of **causal ancestors** of X is given by $A_X = \{Y \in P \mid R_F^T(X, Y)\}$.*

Definition 3.13 (Causal necessity and sufficiency of situations). *Let \mathcal{D} be a dynamics over P . Let s be a situation and let $\langle X, x \rangle$ be a fact.*

- (a) *s is **causally sufficient** for $\langle X, x \rangle$ ($s \blacktriangleright \langle X, x \rangle$) iff $s \models_{\mathcal{D}} (X = x)$.*
- (b) *s is **causally necessary** for $\langle X = x \rangle$ ($s \blacktriangleleft \langle X, x \rangle$) iff, for any situation s' with:*
 - i. $\text{dom}(s) \cap A_X \subseteq \text{dom}(s') \cap A_X$ and
 - ii. $\exists Y \in \text{dom}(s) \cap A_X$ with $s(Y) \neq s'(Y)$ and
 - iii. $s'(X) \neq x$*we have $s' \not\models_{\mathcal{D}} (X = x)$.*

A note on causal necessity

My focus in this chapter is on the idea that relations of causal necessity and causal sufficiency are of relevance to – and referenced by – the lexical semantics of natural language expressions, and in particular the lexical semantics of implicative verbs. Accordingly, I set aside a serious treatment of a number of issues associated with the semantics (and metaphysics) of *cause* (or CAUSE) and causal necessity; however, a few points regarding the modeling choices relevant for Definition 3.13 are nevertheless in order.

Although the definition of causal necessity for situations may not seem intuitive at first, it follows naturally from the process of formalizing common-sense intuitions about the meaning of necessity over the type of causal structures we deal with here.

Definition 3.14 (Realizability). *Given a dynamics D with $X \in P - B$, a fact $\langle X, x \rangle$ is **causally realizable** if there is at least one situation s such that s is internally consistent, $\text{dom}(s) \neq \{X\}$, and $s \models_D (X = x)$. We call such a situation s a **causal route** to $\langle X, x \rangle$.*

Note that if $\langle X, x \rangle$ is not causally realizable, then D must be defined so that there is no 0-1 assignment \vec{z} to Z_X such that $f_X(\vec{z}) = x$. In other words, f_X is the constant function at either 0 or 1. If $X = x$ is false regardless of the determinations of its causal ancestors, then it does not in any real sense depend on them. I will treat any dynamics permitting such an arrangement to be degenerate, and assume that, in any permissible dynamics, all inner variables are causally realizable.

Given a causally realizable fact $\langle X, x \rangle$ associated with an inner variable X , causal necessity should (intuitively) pick out facts that *must* hold in order for $\langle X, x \rangle$ to be realized. This follows by analogy with analytic necessity. Any causal route to $\langle X, x \rangle$ must ‘go through’ these facts. Since, by construction of a dynamics, we can freely vary the values of variables on which X does not depend (those in $P - A_X$), the facts under consideration are restricted to determinations of variables from A_X . In other words, the relevant facts are those determinations of variables in A_X which are causally entailed by the situation m_X , defined as the intersection of all causal routes m to $\langle X, x \rangle$. (Here, I define the intersection s of two situations s_1 and s_2 as the situation which contains all of the determinations that appear in both s_1 and s_2 , and which assigns u to all other variables in P .)

Since the values of variables in $P - A_X$ do not affect the value of X , we are presented with a modeling choice. No determination outside of A_X will be entailed by *all* causal routes to $\langle X, x \rangle$ (that is, by m_X). One possibility would be to treat all situations which determine variables in $P - A_X$ as unnecessary for $\langle X, x \rangle$. This restriction, while in some respects reasonable, would mean that we cannot talk about necessity in any situation in which facts irrelevant to the effect under discussion are part of the background or common ground. In

practice however, we often describe such situations as necessary for some subsequent event, on the basis of the facts they contain which are relevant. This suggests that we would like a definition for necessity that extends beyond situations determined only on A_X . Concretely, I follow Baglini and Francez (2016) here in assuming that the presence of ‘irrelevant’ facts in a situation does not count towards the assessment of causal necessity.

These constraints lead to Definition 3.13. Let s be a situation which contains a fact $\langle Y, y \rangle$ with $Y \in A_X$ such that $m_X \not\models_{\mathcal{D}} \langle Y, y \rangle$. Then there is some causal route m to $\langle X, x \rangle$ such that $m \models_{\mathcal{D}} \neg \langle Y, y \rangle$. But, by Definition 3.14 (of causal routes), the existence of m guarantees the existence of another route, m' , with $\neg \langle Y, y \rangle \in m'$. We can, therefore, ‘flip’ some set of determinations in s and arrive at a new situation s' (with $\text{dom}(s) \cap A_X \subseteq \text{dom}(s') \cap A_X$) such that $s' = m'$; by definition, $s' = m' \models_{\mathcal{D}} (X = x)$. Conversely, if s only contains determinations of A_X that are entailed by m_X , then every causal route to $\langle X, x \rangle$ entails these determinations, and there is no situation s' with $s' \models_{\mathcal{D}} (X = x)$ which entails (or contains) the negation of one of these determinations.

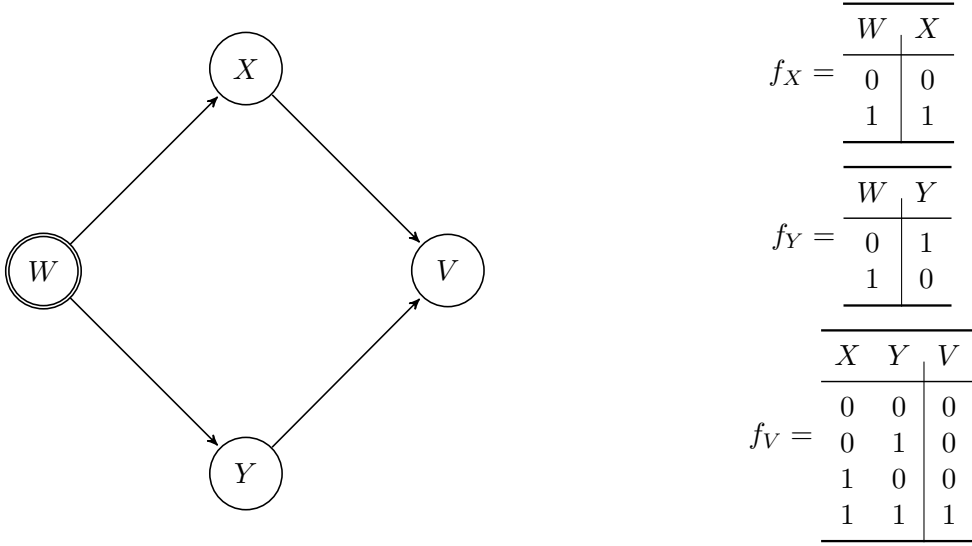
This definition has several positive consequences:

Fact 3.15. *If a situation s is such that $s \models_{\mathcal{D}} \neg(X = x)$, s is not necessary for $\langle X, x \rangle$.*

Proof. Suppose $x = 1$. If $s \models_{\mathcal{D}} \neg(X = 0)$, then s entails (pointwise) a vector \vec{z} of values for the variables in Z_X such that $f_X(\vec{z}) = 0$. Since $\langle X, 1 \rangle$ is causally realizable, there is at least one vector \vec{z}_1 such that $f_Z(\vec{z}_1) = 1$, with $\vec{z}_1 \neq \vec{z}$. If s determines all of the variables in Z_X , then let $s' = s[Z_X \mapsto \vec{z}_1]$; $s' \models_{\mathcal{D}} (X = 1)$, and s is not necessary for $\langle X = 1 \rangle$. If s does not determine all of Z_X , then $\exists Y \in A_X$ such that s determines Y ; let $\langle Y, y \rangle$ represent this determination. Then define the alternative situation $s' = s[Y \mapsto \neg y][Z_X \mapsto \vec{z}_1]$: $\text{dom}(s') \cap A_X \supseteq \text{dom}(s) \cap A_X$ and $s' \models_{\mathcal{D}} (X = 1)$. The proof for the case where $x = 0$ follows by symmetry. \square

In a special set of cases, where $\langle X, x \rangle$ is causally but not consistently realizable, the predictions made by Definition 3.13 accord with intuition. A toy example illustrates:

(3.36) Consider a dynamics \mathcal{D} as in Figure 3.2. Any internally consistent valuation of P has $V = 0$, since $V = X \wedge Y$, but $X = W$ and $Y = \neg W$. By Definition 3.13, the

Figure 3.2: A toy dynamics where X is not consistently realizable

following three situations are necessary for $\langle V, 1 \rangle$:

$$s_{X,u} = \{\langle W, u \rangle, \langle X, 1 \rangle, \langle Y, u \rangle, \langle V, u \rangle\}$$

$$s_{X,0} = \{\langle W, 0 \rangle, \langle X, 1 \rangle, \langle Y, u \rangle, \langle V, u \rangle\}$$

$$s_{XY} = \{\langle W, u \rangle, \langle X, 1 \rangle, \langle Y, 1 \rangle, \langle V, u \rangle\}$$

The situation $s_{X,1} = \{\langle W, 1 \rangle, \langle X, 1 \rangle, \langle Y, u \rangle, \langle V, u \rangle\}$ is not necessary for $\langle V, 1 \rangle$.

- a. $\text{dom}(s_{X,u}) = \{X\}$, and $s_{X,u}(X) = 1$ so the only allowable alternative s' must have $s'(X) = 0$. But $V = X \wedge Y$, so no s' with $s'(X) = 0$ is such that $s' \models_{\mathcal{D}} (V = 1)$.
- b. $\text{dom}(s_{X,0}) = \{X, W\}$. The allowable alternatives s' either have $s'(X) = 0$ or $s'(W) = 1$. If $s'(X) = 0$, $s' \not\models_{\mathcal{D}} (V = 1)$ as above. If $s'(W) = 1$, then $s' \models_{\mathcal{D}} (Y = 0)$, and since $V = X \wedge Y$, $s' \not\models_{\mathcal{D}} (V = 1)$.
- c. $\text{dom}(s_{XY}) = \{X, Y\}$. The allowable alternatives s' either have $s'(X) = 0$ or $s'(Y) = 0$; by the above reasoning, neither type of situation can entail $V = 1$.
- d. $\text{dom}(s_{X,1}) = \{X, W\}$. The situation $s_{X,0}$ is an allowable alternative to $s_{X,1}$,

and $s_{X,0} \models_{\mathcal{D}} (Y = 1)$. Since $s_{X,0}(X) = 1$, then $s_{X,0} \models_{\mathcal{D}} (V = 1)$. The non-necessity of $s_{X,1}$ for $\langle V, 1 \rangle$ follows directly from the fact that $s_{X,1} \models_{\mathcal{D}} (V = 0)$; this means that we can change a variable determination in $s_{X,1}$ and reach a situation which contains a causal route to $\langle V, 1 \rangle$.

Definition 3.13 differs in a small but important way from the version of causal necessity for situations in Baglini and Francez (2016). Translated into the notation used here, they propose the following:

Definition 3.16 (Causal necessity of situations, Baglini and Francez 2016). *A situation s is **causally necessary** for a fact $\langle X, x \rangle$ about an inner variable $X \in P - B$, iff, for any alternative situation s' such that:*

- i. $\text{dom}(s) \cap A_X = \text{dom}(s') \cap A_X$ and*
- ii. $\exists Y \in \text{dom}(s) \cap A_X$ with $s(Y) \neq s'(Y)$ and*
- iii. $s'(X) \neq x$*

we have $s' \not\models_{\mathcal{D}} (X = x)$.

The crucial difference between this definition and the one I offer in Definition 3.13 is in the first clause. Baglini and Francez require only that we consider alternative situations which determine precisely the same set of causal ancestors (for the effect $\langle X, x \rangle$) as s does. Definition 3.13 also permits alternative situations s' which determine new (additional) causal ancestors of X , as long as these also change a relevant determination in s . This change is motivated by examples such as the following:

- (3.37) Consider a simple dynamics with three variables. Let $B = \{W, X\}$, and let $Y \in I$ with $Z_Y = B$ and $f_Y = W \vee X$. Intuitively, $\langle W, 1 \rangle$ and $\langle X, 1 \rangle$ are individually sufficient for $\langle Y, 1 \rangle$, and neither $\langle W, 1 \rangle$ nor $\langle X, 1 \rangle$ is necessary.

Given this dynamics, two conclusions follow from Definition 3.16:

- (3.38) a. The situation $s_{WX} = \{\langle W, 1 \rangle, \langle X, 0 \rangle, \langle Y, u \rangle\}$ is not necessary for $\langle Y, 1 \rangle$, as desired.

The relevant alternative situations are the ones which ‘flip’ the value of W , X , or both. Consider, for instance, $s' = s_{WX}[X \mapsto 1]$. Then $s' \models_{\mathcal{D}} (Y = 1)$.

- b. The situation $s_W = \{\langle W, 1 \rangle, \langle X, u \rangle, \langle Y, u \rangle\}$ is necessary for $\langle Z, 1 \rangle$, counter to intuition.

The situation s determines only one variable, so there is only one alternative situation to consider: $s' = s_W[W \mapsto 0]$. But s' is its own least fixed point; in the absence of a determination for X , the dynamics does not allow us to determine Y , so we have $s' \not\models_{\mathcal{D}} (Y = 1)$, as required by 3.16.

In other words, it follows from Definition 3.16 that an intuitively unnecessary situation can become necessary simply in the absence of a determination for a crucial variable in an alternative pathway to the effect under consideration. This unfortunate contrast is neutralized in the updated definition, which imposes a less strict clause (a) requirement on alternative situations: $\text{dom}(s) \cap A_X \subseteq \text{dom}(s') \cap A_X$.

(3.39) By Definition 3.13, neither s_W nor s_{WX} is necessary for Y :

The situation $s' = \{\langle W, 0 \rangle, \langle X, 1 \rangle, \langle Y, u \rangle\}$ is an allowable alternative to either s_W or s_{WX} . $\text{dom}(s_W) \cap A_Y \subset \text{dom}(s') \cap A_Y$, $\text{dom}(s_{WX}) \cap A_Y = \text{dom}(s') \cap A_Y$, and s' flips the value of X from its previous determination in either case. Since $s'(W) = 1$, $s' \models_{\mathcal{D}} (Y = 1)$.

The fact that neither s_W nor s_{WX} is necessary for $\langle Y, 1 \rangle$ is the formal realization of our intuition that $\langle W, 1 \rangle$ is not necessary for $\langle Y, 1 \rangle$ in the given dynamics. (The fact that $\langle X, 1 \rangle$ is unnecessary follows from symmetric reasoning.)

3.4 A closer look at the catalyst proposal

Baglini and Francez’s (2016) proposal is restated below:

(3.33) **The catalyst account:** (Proposal; Baglini and Francez, 2016)

For an agent S and one-place predicate A , the claim that S *managed to* A :

- i. *Presupposes*: The familiarity (salience and truth) of a **catalyst**, or *causally necessary but causally insufficient situation*, for the truth of $A(S)$
- ii. *Asserts*: The catalyst **actually caused** $A(S)$

We now have the appropriate definitions of causal necessity and causal sufficiency (Definition 3.13), but Proposal 3.33 invokes one more dependence relation. Baglini and Francez define *actual cause* as follows (see also Pearl 1998, Halpern and Pearl 2005 and subsequent work):

Definition 3.17 (Actual cause). *Given a dynamics D and a world w , a situation s **actually causes** a proposition $X \in P - B$ if $s(X) = u$, $w(X) = 1$, and w is consistent with the least fixed point of \mathcal{T}_D on s .* (Baglini and Francez, 2016, p.554)

With this definition in hand, we check that Proposal 3.33 derives the desired results.

Based on the catalyst presupposition, assertions of $manage(S, A)$ or $\neg manage(S, A)$ are only felicitous when the context establishes the truth of a causally necessary but insufficient situation, call it C , for $A(S)$; as anticipated by Karttunen (1971), the presuppositional content of $manage$ will block an entailment from $A(S)$ to the implicative assertion.

The at-issue question for $manage(S, A)$ is whether or not the relationship of actual cause holds between C and $A(S)$. A positive assertion, $manage(S, A)$ answers in the affirmative. Thus, since the catalyst situation holds in any context where $manage$ is felicitous, the definition of actual causes ensures that $A(S) = 1$ in the world of evaluation. This gives us the desired entailment from $manage$ to its complement. Conversely, a negative assertion, $\neg manage(A, S)$, denies that C actually caused $A(S)$. Again, since C is presupposed to hold, we conclude that $A(S) = 0$ in the world of evaluation, and this gives us the entailment from $\neg manage(A, S)$ to $\neg A(S)$.

Consequences of the catalyst presupposition

Recall the central facts about implicative verbs:

- (A) An assertion $I(S, A)$ conditions $A(S)$ on S 's overcoming some potential obstacle. (This will ultimately block entailment from $A(S)$ to $I(S, A)$.)

- (B) Given both (i) $I(S, A) \vdash A(S)$ and (ii) $\neg I(S, A) \vdash \neg A(S)$, surmounting the obstacle must be both sufficient and necessary for $A(S)$ in context.
- (C) An assertion of $I(S, A)$ non-defeasibly conveys $A(S)$; its negation, $\neg I(S, A)$, conveys $\neg A(S)$

The positive and negative complement entailments capture Fact (C). The presupposition of a contextually familiar causal catalyst also appears to capture Facts (A)-(B). Since C is causally insufficient for $A(S)$, the problem of achieving sufficiency (in context) can be construed as Karttunen's potential obstacle, and since C is necessary for $A(S)$, the conditioning relationship ultimately involves both necessity and sufficiency. Crucially, Baglini and Francez argue that defining the presupposed content of *manage* purely in terms of causal dependencies in a dynamics allows them to account for the context-sensitivity noted by Coleman and to handle the cases where her hierarchy breaks down, while simultaneously preserving Karttunen's intuitions about the relationship between *managing* and *doing*. Broadly speaking, the context-dependence of a dynamics allows the precise composition of the catalyst C to variously invoke notions of effort, difficulty, or unlikelihood, as supported by the discourse context. (3.40) illustrates.

(3.40) Maya **managed** to sit through an opera.

Suppose we know the following: Maya has a strong aversion to opera (AVR). Her best friend, however, really enjoys it, and has bought them tickets to go. Maya never says no to her friend, so she'll go if she is asked; suppose she has been asked. In this scenario, the following variables might form a familiar catalyst: the purchase of the tickets (TKT), and the request (ASK) from the friend. These variables form a causally necessary situation for Maya to attend the opera (ATT), but they are insufficient to ensure that she sits through it (STT): this depends on other factors such as the length of the opera (LEN), and whether or not she has a drink beforehand (ALC). A graphical representation for this example is given in Figure 3.3. To preserve readability, I omit the specification of the associated structural equations.

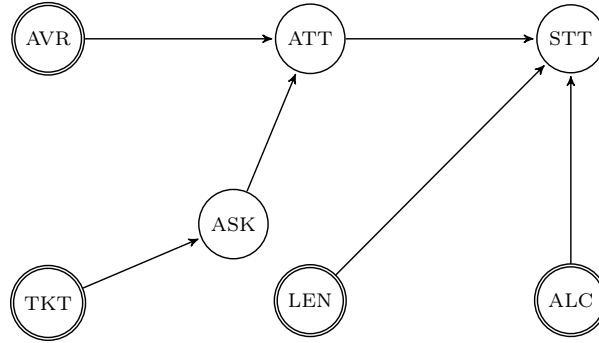


Figure 3.3: A dynamics for the opera example

From the truth of the catalyst ($\text{TKT} \wedge \text{ASK} = 1$), we can infer directly that Maya will make the attempt. In this scenario, we get the inference that sitting through the opera will be difficult for Maya, given her dislike of opera, represented by the background variable AVR. This inference is not affected by the truth or falsity of the full implicative assertion. We might also arrive at an inference of unlikelihood – it was unlikely that Maya would go, given her aversion.

If the dynamics is constructed differently, we will get a slightly different set of inferences. For instance, suppose Maya knows nothing about opera, so she neither likes nor dislikes it (AVR is undetermined, but might evolve to be true or false at a later time). It might still be unlikely, then, that she would go on her own, but we know that she'll try it out if her friend asks her to go. The presupposition of trying or effort is thus preserved, but we lose the inference that sitting through an opera is necessarily difficult for Maya. In this altered scenario, it seems felicitous to utter (3.41):

(3.41) Maya easily **managed** to sit through an opera.

In this way, the previously mysterious malleable nature of *manage*'s presuppositions is explained by the context-dependent way in which the dynamics sorts the complement proposition's causal ancestors into those which belong to the familiar catalyst C , and those which do not.

Turning to asserted content, Proposal 3.33 is distinguished from the standard account by the claim that the at-issue content of $\text{manage}(A, S)$ is not simply the entailed proposition

$A(S)$. According to Baglini and Francez, this provides an explanation of the facts about *because*-clauses. Since the at-issue content of the implicative statement deals with a causal chain for $A(S)$, it follows that the *because*-clause in (3.28a) addresses how or why $A(S)$ was *actually caused*, rather than the how or why of $A(S)$ itself, as in (3.28b).

- (3.28) a. Juno **managed** to open the door because it was unlocked.
 b. Juno opened the door because it was unlocked.

If this is correct, (3.28a) implies both that a discourse-familiar catalyst *actually caused* Juno to open the door, and that the relation of actual cause came about as a result of the door's being unlocked. For simplicity, assume that the catalyst in this context is just the attempt to open the door (e.g., turning the knob and pushing). Making this attempt is certainly a necessary condition for Juno to open the door, but it could be insufficient for any one of several reasons – the door might be particularly heavy, or have boxes piled against it, or it might simply be locked. The positive *manage* assertion (3.28a) conveys that the attempt to open the door was effective in context, and we conclude that the potential obstacle was avoided. Moreover, if the *because*-clause modifies the assertion of actual cause as suggested, it must convey that the contextual sufficiency of the attempt followed from the door's being unlocked – that is, that the contextually-relevant potential obstacle was the state of the lock. The fact that it was unlocked was, therefore, the decisive factor permitting the relation of actual cause to go through. As a result of this, (3.28a) conveys that no other relevant causal factors were open or in question with regards to opening the door. Since *manage* presupposes the truth of the catalyst regardless of matrix polarity, it seems that the door not being locked (when it might well have been) is in fact the proximate cause of $A(S)$, not Juno's attempt to open the door. Thus, following this reasoning to its natural conclusion, it turns out that the question of whether or not the door was successfully opened does not hinge (in context) on the catalyst, but rather on a catalyst-independent causal factor: the state of the lock.

This reveals something important about Baglini and Francez's proposal. The preceding discussion illustrates that the way in which the catalyst presupposition is formulated in

Proposal 3.33 winds up mandating the existence of a catalyst-independent causal ancestor (or set thereof) for $A(S)$ which, in the context of utterance, constitutes the decisive factor for the realization of the implicative complement. Since the catalyst itself is insufficient for $A(S)$, the relation of actual cause will only hold if all catalyst-external causal ancestors for $A(S)$ are set in a way conducive to $A(S)$. In a negative *manage* statement, we must assume that these variables were set in a way that prevents $A(S)$: the background situation causally entails $\neg A(S)$, regardless of the catalyst. In other words, an important consequence of Proposal 3.33 is that, in any context where an assertion of *manage* or its negation is made felicitous by the truth of a catalyst C , there must be some factor (a variable or situation) which is causally independent of C , and is simultaneously both necessary and sufficient for $A(S)$ with respect to the utterance context. This factor is, then, the proximate cause of $A(S)$.

It seems, therefore, that as anticipated in Section 3.2.3, the catalyst presupposition does indeed relate to the notion of a potential obstacle for the implicative complement. It does so in a rather roundabout way, however. The catalyst itself cannot represent the obstacle. Rather, it is the *insufficiency* of the catalyst that represents the obstacle – but this, as we have seen, translates into the observation that the resolution of some catalyst-external factor fully determines the truth of $A(S)$ in context. Ultimately, then, it is this factor which represents an implicative’s backgrounded prerequisite, and the possibility that it will be resolved negatively which represents a potential obstacle for the realization of the implicative complement.

3.5 Beyond *manage*

3.5.1 Catalyst-external causes

As noted, *manage* is semantically bleached compared to the majority of implicatives. In particular, where the verbs in (3.21)-(3.22) clearly indicate the nature of the prerequisite/potential obstacle for their complements, *manage* does not. As a result of this, the catalyst presupposition in Baglini and Francez’s proposal causes problems when we try to

extend their account to more specific predicates.

- (3.42) a. He **dared** to kill the cat. \vdash *He killed the cat.*
 b. He didn't **dare** to kill the cat. \vdash *He didn't kill the cat.*
- (3.43) a. Hän **henno-i** tappa-a kissa-n.
 he.NOM have.heart-PST.3SG kill-INF cat-GEN/ACC
 'He had the heart to kill the cat.' \vdash *He killed the cat.*
- b. Hän e-i **henno-nut** tappa-a kissa-a.
 he.NOM NEG-3SG have.heart-SG.PP kill-INF cat-PART
 'He didn't have the heart to kill the cat.' \vdash *He didn't kill the cat.*

Dare and *hennoa* ('have the heart') highlight a particular causal prerequisite as the determining factor for their complements. In (3.42), the presence or absence of courage decides the cat's fate, while in (3.43) it is the presence or absence of 'heart' (something like emotional forbearance, perhaps). From these examples, we see that it is the factor that is lexically specified by an implicative whose potential absence represents the potential obstacle in an implicative utterance. In contexts which license (3.42) or (3.43), the unresolved state of a courage or 'heart' variable, respectively, can be compared to the status of the lock in (3.28a).

The catalyst presupposition cannot account for this. We expect the presuppositional component of an implicative verb to highlight the features of the context which make the implicative felicitous; the 'named' elements in (3.42)-(3.43) do just this. In order to extend Proposal 3.33 to the full implicative class, then, we would like the catalyst to subsume courage and 'heart', respectively. But doing this produces the wrong inferences! The catalyst, on Baglini and Francez's view, holds regardless of matrix polarity, but the named factor does not. In (3.42)-(3.43), the required courage or 'heart' is present *only* in positive matrix contexts; the negative assertion conveys their absence. Moreover, it is this absence that prevents the actualization of the implicative complement $A(S)$. The same is true for *bother* and *maltaa* ('have the patience'): (3.44a)-(3.44b) suggest that the deciding factor was apathy, or lack thereof, and (3.45a)-(3.45b) that it was patience.

- (3.44) a. Juri **bothered** to respond to my email. \vdash *Juri responded to my email.*
 b. Juri didn't **bother** to respond to my email.
 \vdash *Juri didn't respond to my email.*
- (3.45) a. Hän **maltto-i** odotta-a
 he.NOM have.patience-PST.3SG wait-INF
 'He had the patience to wait.' \vdash *He waited.*
- b. Hän e-i **maltta-nut** odotta-a
 he.NOM NEG-3SG have.patience-SG.PP wait-INF
 'He did not have the patience to wait.' \vdash *He didn't wait.*

In general, then, implicative verbs highlight the fact that a specific, determinative causal factor for $A(S)$ is in question or open in the discourse context. That is, implicative presuppositions focus our attention directly on the potential obstacle, rather than on an insufficient catalyst situation.

Coleman's problem now comes back to the forefront. If implicatives describe the obstacle for their complements, we still need to account for the 'vanishing' presuppositions of *manage*. I suggest that *manage* represents a special case. Like other implicatives, *manage* highlights the existence of a potential obstacle (i.e. a contextually determinative factor which is in question) for its complement, but it deviates from lexically-specific verbs in failing to specify what this factor constitutes. Finnish *onnistua* ('manage', 'succeed') is similar. In either case, matrix polarity determines whether the obstacle was overcome. The lack of specificity in *manage* and *onnistua* allow the discourse context to supply information about the nature of the obstacle, leading variously to presumptions of effort, difficulty, unlikelihood, etc.

This view preserves the key gains of Proposal 3.33. Since the relationship between a potential obstacle and an implicative complement is causal in nature, we retain Baglini and Francez's explanation for Coleman's variable presuppositions. Similarly, we retain the causal account of the facts about *because*-clause modification. Instead of adopting the catalyst presupposition, I show that the existence of a catalyst actually follows from a more direct characterization of the implicative obstacle. Ultimately, this will allow a causal-dependence account to extend to implicatives other than *manage*. In a situation that licenses the use of

an implicative verb, it need not be the case that either the composition of a catalyst or the nature of a potential obstacle is established; the choice of one implicative verb over another will be governed by what, if anything, is known. *Manage* and its counterpart *onnistua* come into the picture as nonspecific choices, to be used when a speaker is either uncertain or does not wish to communicate anything about the nature of the obstacle for the actualization of the implicative complement.

3.5.2 One-way implicatives

Further complications for Proposal 3.33 arise when we consider predicates that entail only in one direction, such as Finnish *pystya* ('be able').¹⁸ These **one-way** implicatives share the overall inferential pattern of their two-way cousins. However, while the inferences generated under negative matrix polarity remain entailments, as shown in (3.46b), the complement inference under positive matrix polarity is at best a defeasible implicature.

- (3.46) a. Hän **pysty-i** tappelema-an.
 he.NOM able-PST.3SG fight-INF
 'He was able to fight.' $\nvdash (\leadsto) \textit{He fought.}$
- b. Hän e-i **pysty-nyt** tappelema-an.
 he.NOM NEG-3SG able-SG.PP fight-INF
 'He was not able to fight.' $\vdash \textit{He did not fight.}$

Neither the direct assertion account nor Baglini and Francez's proposal can account for the behaviour of one-way implicatives. The direct assertion account, as named, requires that a positive implicative claim asserts its complement directly; there is no way to make this inference defeasible. On the catalyst account, the asserted relation of actual cause ensures the positive entailment, which we do not want.

In order to avoid this entailment, we will need to make the at-issue content of *pystya* ('be able') weaker than actual cause. If we look more closely at how this relation is defined, then it becomes clear that – since the truth of the catalyst is backgrounded – the only at-issue

¹⁸The translation of this verb is rather suggestive, given the broad goals of this investigation. In fact, Karttunen (1971) includes English *be able* in the class of one-way implicatives. This is discussed at the end of the chapter.

content added by the matrix verb on Proposal 3.33 is that the implicative complement $A(S)$ also holds. If we take this away to capture the one-way implicative pattern, we are forced to include that a one-way implicative contributes nothing to asserted content. This would be rather startling. Moreover, since this means that negating a one-way implicative also does not introduce at-issue content, we lose both the negative complement entailment, which we want to preserve, and any means of distinguishing between the meaning of a positive and negative one-way claim. This obviously will not do.

Attempting to modify the presuppositional content of Proposal 3.33 instead does not help. Catalysts are already insufficient, so our only option is to change the presumption of necessity. It turns out that eliminating the requirement of causal necessity between a catalyst and the implicative complement has no effect on complement entailments. The negative entailment, $\neg I(A, S) \vdash \neg A(S)$, still follows from the definition of actual cause. The only way to satisfy the negation of the actual cause relationship between the familiar catalyst and the implicative complement is for $A(S)$ to be false, since the catalyst is presupposed to hold. The unwanted positive entailment follows for the opposite reason: actual cause requires that $A(S)$ is true in the presence of the catalyst.

One obvious way around the problem would be to argue that one-way predicates like *pystya* ('be able') do not belong to the implicative class at all; that is, that there is no such thing as a one-way implicative. The empirical evidence does not support this conclusion. There are a number of complement-taking predicates in Finnish which both share the one-way inferential pattern in (3.46), and seem to specify prerequisites/potential obstacles in the same way as lexically-specific two-way implicatives.

- [illegible]

- (3.48) a. Hän **mahtu-i** kulke-ma-an ove-sta.
 he.NOM fit-PST.3SG go-INF-ILL door-ELA
 ‘He was small enough to go through the door.’
 \leadsto *He went through the door.*
- b. Hän e-i **mahtu-nut** kulke-ma-an ove-sta.
 he.NOM NEG-3SG fit-PP.SG go-INF-ILL door-ELA
 ‘He was not small enough to go through the door.’
 \vdash *He did not go through the door.*

This suggests a unity between one- and two-way implicatives, which a full account of implicative semantics ought to capture. While Baglini and Francez’s proposal makes great strides over the direct assertion account, we have seen here that it leaves something to be desired in its treatment of other two-way implicatives, and that it cannot account for the behaviour of one-way verbs like *jaksaa* (‘have the strength’), in (3.47) and *mahtua* (‘fit’, ‘be small enough’), in (3.48), at all.

3.6 Causal necessity and causal sufficiency in implicativity

What we are after is an account of implicative behaviour – *implicativity* – that preserves the causal component introduced by Baglini and Francez (2016), but which focuses on the potential obstacle (i.e. the in-question, contextually-decisive prerequisite) instead of on a contextually-established catalyst. This account should derive Facts (A)-(C), restated below, with the caveat that one-way implicatives do not exhibit the positive entailment $I(S, A) \vdash A(S)$. We have seen, in Section 3.5.2, that one-way implicatives parallel two-way implicatives in making the actualization of the complement contingent on the resolution of a specific prerequisite. This suggests that the at-issue contribution of one-way implicatives is the same as the at-issue contribution of two-way predicates. Consequently, the difference between one- and two-way implicatives must follow from a (minimal) difference in their not-at-issue contributions.

- (A) An assertion $I(S, A)$ conditions $A(S)$ on S 's overcoming some potential obstacle. (This will ultimately block entailment from $A(S)$ to $I(S, A)$.)
- (B) Given both (i) $I(S, A) \vdash A(S)$ and (ii) $\neg I(S, A) \vdash \neg A(S)$, surmounting the obstacle must be both sufficient and necessary for $A(S)$ in context.
- (C) An assertion of $I(S, A)$ non-defeasibly conveys $A(S)$; its negation, $\neg I(S, A)$, conveys $\neg A(S)$

As it turns out, the basic structure of the account we want was anticipated by Karttunen (1971) in his original paper on implicatives. In the wake of the direct assertion account (Karttunen and Peters 1979, which perhaps supplanted Karttunen's earlier ideas), the following passage has not received much attention:

“In the following, let us ignore the individual differences among implicative verbs and try to state precisely in what respect they are all alike. Let v stand for any implicative verb and S for the sentence that manifests itself as the infinitival complement of that verb in the surface structure. I assume that, in the representation of the main clause, $v(S)$ constitutes the central part of the proposition to which negation, modals, and time and locative references are attached. Leaving out these other details, the semantic analysis of the whole sentence can be represented by the following schema:”

Presupposition: $v(S)$ is a necessary and sufficient condition for S

Proposition: $v(S)$

Karttunen (1971, p.352)

While this schema is underspecified from our current perspective, it is easy enough to see that it captures Facts (A)-(C).

To flesh out the lexical details of Karttunen's schema, we need to answer the following question: what exactly is the “central part of the proposition”? In other words, what (if anything) does an implicative specify about the nature of the necessary and sufficient condition it presupposes, and whose truth it asserts? We have already seen what the answer

must be. The central part of an implicative proposition, and the necessary and sufficient condition for the implicative complement is just that unresolved prerequisite, whose status is resolved by the implicative assertion.

We can at this point add something further to Karttunen’s schema: the connection between the central part of the proposition and the implicative complement involves *causal* necessity and sufficiency, in particular. We have already seen that introducing a causal component allows us to account for certain aspects of the interpretation of *manage* and other implicatives which resisted explanation on the direct assertion account. To cement the importance of causal dependence with respect to Karttunen’s schema, consider (3.49).

- (3.49) *Context:* In the United States, being (at least) 21 years of age is a necessary and sufficient condition for the legal consumption of alcoholic beverages. Amira has been eager to try a glass of wine for a long time, but has refrained because she is too law-abiding. She turned 21 yesterday.
- a. ??Yesterday, Amira managed to drink a glass of wine.

This example backgrounds a salient necessary and sufficient condition for the implicative complement. Rather than a causal condition, however, the context in (3.49) involves legal (deontic) necessity and sufficiency. As the judgement in (3.49a) shows, the deontic condition does not on its own license the use of *manage*. In order to make sense of the implicative claim, we wind up making inferences about non-legal conditions that might hold in context: for instance, we might wonder if it was particularly logistically difficult for Amira to procure wine, or that some physical condition or perhaps distaste made it difficult for her to drink the entire glass. In other words, despite the salience of a deontically necessary and sufficient condition for the implicative complement, the use of *manage* encourages us to speculate about possible necessary and sufficient conditions which are *causally* involved in Amira’s wine-drinking – that is, conditions which, unlike legal regulations, concretely precipitate or preclude the complement event.

3.6.1 The proposal

Putting all of the pieces together, we arrive at the following precisification of the implicative semantic template:

(3.50) **The prerequisite account of implicatives.** (Proposal)

For a two-way implicative verb I , an agent S , a one-place predicate A , and a background situation c , the proposition $I(S, A)$:

- i. *Presupposes*: The existence of a predicate H such that $H(S)$ is *causally necessary* for $A(S)$ in the utterance context. $H(S) \blacktriangleleft_c A(S)$
- ii. *Asserts*: $H(S)$
- iii. *Presupposes*: $H(S)$ is the only unmet causally necessary condition for $A(S)$ in context (so $H(S)$ is *causally sufficient* for $A(S)$ relative to c) $H(S) \blacktriangleright_c A(S)$

On the prerequisite account, the presupposed condition $H(S)$ is, crucially, unresolved in the discourse context (this can be contrasted with Baglini and Francez’s established catalyst). As a result, the presuppositional content of an implicative, per Proposal 3.50, highlights that, given what the speaker knows about the causal ancestors of $A(S)$, $H(S)$ is not only causally necessary for $A(S)$ with respect to the background situation, but is also undetermined by this situation. It is worth noting that the intuition that $H(S)$ remains unresolved at utterance time is not explicitly encoded in the presuppositional content in Proposal 3.50. I suggest instead that this inference arises as an implicature from the use of an implicative construction $I(S, A)$ instead of a salient simpler alternative, the bare complement $A(S)$. In other words, the inference that $H(S)$ is unresolved comes about as a sort of ‘justification’ for the implicative construction. This is, in a sense, the source of the ‘obstacle’ impression. We generally conceive of actions and events in the world as embedded in causal chains. Using an implicative, especially a lexically-specific implicative, draws attention to a particular piece of this chain. It is hard to recover a reason for doing this if the relevant piece is already resolved in the discourse context – consequently, we infer

that it is not.¹⁹

presupposed information, as a causal consequence of what is actually asserted.

Given Proposal 3.50, we can straightforwardly encode the additional contribution of lexically-specific implicatives as constraints on possible candidates for the predicate H . For example, where *jaksaa* (‘have the strength’) establishes that H involves the use of strength, *dare/viitsiä* instead names courage or perhaps temerity. Implicatives vary not only in the types of condition they encode, but also in their degree of specificity: a verb like *mahtua* (‘fit’, ‘be small enough’) is extremely specific about H , but *pystya* (‘be able’) is much less precise, and *manage/onnistua* essentially convey only what is given in Proposal 3.50.

An illustration: the modified Dreyfus scenario

Let us consider a fictionalized version of the Dreyfus scenario, adapted from Baglini and Francez (2016). Suppose the following conditions hold:

- (3.51) If Dreyfus intends (INT) to spy for the Germans (SPY), then:
- a. he will collect secrets about the French (SEC) SEC = INT
 - b. if he has the nerve (NRV) as well as the intent to spy, he will send a radio message to make contact with the Germans MSG = INT \wedge NRV
 - c. if it happens that a German is listening on the correct frequency (LST), and the message is not garbled (BRK), Dreyfus will establish a private communications line (COM) COM = MSG \wedge LST \wedge \neg BRK
 - d. he will use the line to pass information to the Germans, thus spying for them SPY = SEC \wedge COM

The structure of the causal dynamics described in (3.51) is represented graphically in Figure 3.4. The background variables in this example are INT (whether or not Dreyfus has the intention to spy), NRV (whether or not Dreyfus has the nerve to spy), LST (whether or not a German is listening), and BRK (whether or not the message is garbled).

Suppose we are in a context which establishes that Dreyfus intends to spy, and has in fact already collected secret information. Then the relevant background situation s has INT

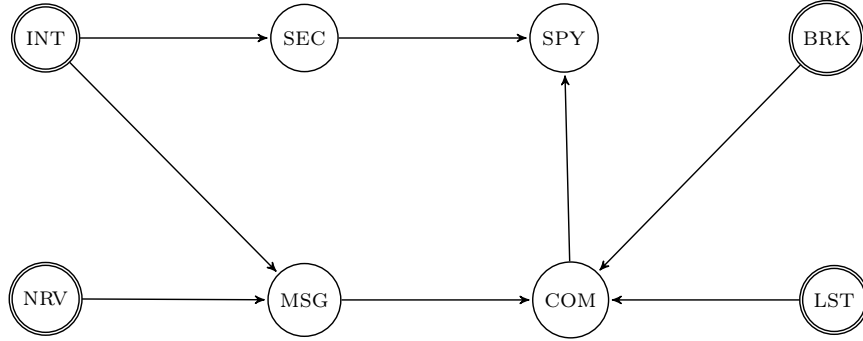


Figure 3.4: A dynamics for the Dreyfus example

$= \text{SEC} = 1$. In this context, we have the following intuitive judgements about the felicity of (3.52a)-(3.52d).

- (3.52) a. Dreyfus dared to send a message to the Germans.
 b. Dreyfus did not dare to send a message to the Germans.
 c. ?/#Dreyfus dared to make contact with the Germans.
 d. ?/#Dreyfus dared to spy for the Germans.

Proposal 3.50 correctly predicts the judgements in (3.52a) and (3.52b). In context, by virtue of being the only undetermined condition for MSG, NRV is both necessary and sufficient for the truth of MSG. The polarity of the *dare* claim then sets the value of NRV, allowing us to conclude whether or not MSG was realized.

On the other hand, while *dare* in (3.52c) also resolves NRV, Proposal 3.50 predicts that it will not be acceptable in this case. This is because two relevant conditions for COM are unresolved in the discourse context: we do not know the values of either BRK or LST. In other words, NRV in this case is necessary, but not sufficient for the implicative complement, and *dare* cannot be felicitously used. The story is more or less the same for (3.52d). NRV is again causally necessary but not causally sufficient for the implicative complement SPY, because its causal ancestors BRK, LST and COM are all undetermined in the discourse context.

We can also use the fictitious Dreyfus dynamics to illustrate how *manage* works as a non-specific or semantically-bleached implicative. Intuitively, all of (3.53a)-(3.53d) are felicitous.

- (3.53) a. Dreyfus managed to send a message to the Germans. $\rightarrow \text{NRV} = 1$
 b. Dreyfus did not manage to send a message to the Germans. $\rightarrow \text{NRV} = 0$
 c. Dreyfus managed to make contact with the Germans.
 $\rightarrow \text{NRV} = \text{MSG} = \text{LST} = 1, \text{BRK} = 0$
 d. Dreyfus managed to spy for the Germans.
 $\rightarrow \text{NRV} = \text{MSG} = \text{LST} = \text{COM} = 1, \text{BRK} = 0$

What accounts for the contrast between (3.52c)-(3.52d) and (3.53c)-(3.53d)? The current account predicts that, while *dare* requires that the only unresolved causal ancestor for its complement is connected in some way with Dreyfus's courage, *manage* – due to its lack of lexical specificity – simply requires that the set of unresolved causal ancestors for its complement can represent a causally necessary and sufficient condition. This view is supported by the fact that each statement in (3.53) licenses a particular set of inferences about the values of various relevant propositions in the Dreyfus situation. Should any of these conditions turn out not to be true, *manage* will no longer be appropriate (and might also be false).

For completeness, we consider finally a scenario nearer to the truth of the Dreyfus affair. Suppose Dreyfus is innocent, and in particular has no intention to spy for the Germans, though he is known for his unmatched courage in all situations. In this context, with a background situation that fixes $\text{INT} = 0$ and $\text{NRV} = 1$, each of (3.52a)-(3.52d) is infelicitous, since NRV is not sufficient in context for any of MSG , COM , or SPY . Notably, each of (3.53a)-(3.53b) also becomes infelicitous in the absence of Dreyfus's intent to spy, because if the background fixes that $\text{INT} = 0$ there is no condition or set of conditions which can possibly represent a sufficient situation for MSG , COM , or SPY .

3.6.2 More evidence for the prerequisite account

Proposal 3.50 meets the desiderata of Facts (A)-(C), and captures the differences between one- and two-way implicatives while assigning them identical at-issue content. I next present some empirical evidence that supports this proposal over the catalyst account from Baglini and Francez.

For a one-way implicative I , the prerequisite account makes two claims. First, a positive assertion $I(S, A)$ states that $H(S)$ obtains. Second, the truth of $H(S)$ is not enough to derive the actualization of $A(S)$. (3.54) illustrates this. In this case, it is not contradictory to follow the positive implicative claim with the negation of its complement, and we see that there is no positive entailment from $I(S, A)$ to $A(S)$. Nevertheless, (3.54) conveys that the requisite strength was available.

- (3.54) Hän **jakso-i** tappelema-an, mutta päätt-i sitä
 he.NOM have.strength-PST.3SG fight-INF, but decide-PST.3SG he.PART
 vastaan.
 against.ILL
 ‘He had the strength to fight, but he decided not to.’

Baglini and Francez do not make predictions about this case, since the catalyst proposal simply does not cover one-way implicatives.

Since both prerequisite and catalyst proposals derive the dual entailment pattern of two-way implicatives, the most promising ground for adjudication between the two accounts is represented by the not-at-issue content. Proposal 3.50 in particular predicts infelicity from two-way implicative utterances in contexts where causal factors for $A(S)$ independent of the named attribute are known to be in question (thus invalidating the sufficiency presupposition). This does not follow from Baglini and Francez’s proposal, since the catalyst situation is not taken to be causally sufficient for $A(S)$.

On Proposal 3.50, then, we expect infelicity to result from using a two-way implicative in contexts where the dynamics is explicitly constructed so that, in addition to $H(S)$, $A(S)$ has other unresolved causal ancestors. This prediction is supported by the following examples, using *bother* and the two-way Finnish implicatives *ehtiä* (‘have the time’) and *kehdata* (‘be unashamed’).

- (3.55) *Context.* Bill is apathetic about parties. He’s known to be a networker, though, and will often convince himself to show up if he thinks there will be someone there who would be useful to make a connection with. Mary planned a party for some friends and neighbors, and invited the newly-elected members of city council. She

invited Bill last week and he said he would think about whether he wanted to meet the councillors. When she told him the date of the party, however, he said he might be away on a business trip and so he wasn't sure if he'd be able to attend in any case. They didn't get a chance to talk again before the party, so she never found out what he decided or if he had to go out of town. In the end, he didn't show up, and Mary says:

- a. ?“Bill didn't bother to come to my party.”

The context in (3.55) explicitly introduces a consideration unrelated to apathy which might prevent Bill from attending the party, and which is unresolved in context. Being in town is clearly a necessary condition for his attendance. There is some variation in judgement with respect to the felicity of (3.55a) in this context; however, where it was felt to be acceptable, my informants interpreted Mary's comment as a 'meta'-comment on Bill's general attitude, or his failure to properly RSVP, rather than as an accurate description of the situation at hand. In general, however, since the reasons for Bill's absence remained unknown, Mary's use of *bother* was felt to be marked. This markedness is even more obvious with the addition of a *because*-clause which attempts to pin down the connection between *bother* and the specific target of Bill's (potential) apathy:

- (3.56) Mary: #“Bill didn't bother to come to my party because he decided the councillors weren't worth his time.”

Judgements are sharper for *ehitiä* ('have the time') and *kehdata* ('be unashamed') in similarly-constructed contexts:

- (3.57) *Context:* A hunter in the forest had lost count of the number of times he had fired his gun and was not sure if he had used all the bullets or not. He decided to check after eating something, and put the gun down to get some food from his bag. While he had both hands in the bag, he caught sight of a bear coming towards him.

- a. #Hän **eht-i** ampu-a karhu-n.
 he.NOM have.time-PST.3SG shoot-INF bear-GEN/ACC
 'He had enough time to shoot the bear.' ⊢ *He shot the bear.*

The context in (3.57) explicitly suspends a necessary and time-independent condition for shooting the bear – namely, whether or not the hunter had any bullets remaining. This results in the infelicity of (3.57a): one informant explained this by saying she could not use *ehitiä* (‘have the time’) because “if he didn’t have any bullets, he could not have shot the bear.” She identified the same problem for a negative *ehitiä* assertion in the same context, even if the intention of the speaker was to convey that the bear was not shot.

My informants also judged the use of *kehdata* (roughly, ‘act without shame’) to be inappropriate in the context provided in (3.58). As in (3.57), the context establishes an unresolved condition which might have independently prevented the actualization of the implicative complement: namely, the consultant might not have had the version of the survey which included the offending questions.

- (3.58) *Context:* Two versions of a survey were prepared for a policy consultant to take door to door. One version had unusually detailed questions about sexual preferences which were not included on the other. The policy consultant was only given one version, but we are not sure which one. We are wondering whether he asked the personal questions.

- a. #Hän **kehtas-i** kysy-ä niin henkilökohtais-i-a asio-i-ta.
 he.NOM unashamed-PST.3SG ask-INF such personal-PL-PART thing-PL-PART
 ‘He acted without shame in asking something so personal.’

⊢ *He asked the personal questions.*

The judgements reported for (3.55)-(3.58) support the predictions of the prerequisite account. In both cases, two-way verbs are infelicitous when a causally necessary condition independent of the condition specified by the implicative is explicitly left unresolved in the discourse context. This contrasts with contexts where other factors are not made salient. In a neutral context – for instance, one where the background contains only the information that the hunter in (3.58) was reaching for food and not holding his gun when he spotted the bear – (3.58a) will not only be felicitous, but will also allow us to infer that the only potential obstruction to the complement’s realization was time. Given the positive resolution of the time condition, we infer that the hunter shot the bear. Taken together with the evidence

from (3.55)-(3.58), this suggests that an account of implicatives which includes a causal sufficiency precondition is on the right track.

3.6.3 Additional remarks

Circumscription, presupposition, and implicature

In Proposal 3.50, the difference between one- and two-way predicates is captured by the difference between a single presupposition of causal necessity and a dual presupposition, which adds causal sufficiency to causal necessity. The condition $H(S)$ invoked by a one-way verb is only taken to be necessary for the realization of the implicative complement, whereas the condition invoked by a two-way implicative is taken to be sufficient as well.

The second presupposition in Proposal 3.50, (3.50-iii), is formulated in a particular way: causal sufficiency is established by closing off the possibility that any necessary conditions other than $H(S)$ are left unresolved or open in context. This is a ‘what you see is what you get’ presupposition – or, to be more precise, a presupposition that ‘what you see is all there is’ (WYSIATI; Kahneman 2011). Essentially, we take it for granted that the causally necessary condition that has been brought to our attention (highlighted by the implicative verb, via the causal necessity presupposition) represents the only relevant condition on which the determination of the implicative complement hinges.

This kind of reasoning – from the highlighting of a single condition to conclusion that alternative conditions of the same type are not contextually relevant – is a very natural sort of pragmatic reasoning. I want to suggest that it is precisely the WYSIATI inference, drawn at the pragmatic level in the case of one-way implicatives, which accounts for the observed tendency for positive assertions of one-way verbs to defeasibly implicate their complements. These implicatures are spelled out for *jaksaa* (‘have the strength’) and *mahtua* (‘be small enough’) in (3.47)-(3.48).

- (3.47) a. Hän **jakso-i** noust-a.
 he.NOM have.strength-PST.3SG rise.INF
 ‘He had the strength to rise.’ \rightsquigarrow *He rose.*

- (3.48) a. Hän **mahtu-i** kulke-ma-an ove-sta.
 he.NOM fit-PST.3SG go-INF-ILL door-ELA
 ‘He was small enough to go through the door.’
 \leadsto *He went through the door.*

Bolstering this hypothesis, Karttunen (2012) draws a parallel between these implicatures and the well-known pragmatic phenomenon of **conditional perfection** (Geis and Zwicky, 1971). In cases of conditional perfection, a statement of the form *if P, (then) Q* is interpreted biconditionally, as *Q if and only if P*. (3.59) is an example of conditional perfection.

- (3.59) You will get an A on the test if you study Chapter 5 carefully.
 a. *Implicates*: You will not get an A on the test if you do not study Chapter 5 carefully.
 b. *‘Perfected’ interpretation*: You will get an A on the test if and only if you study Chapter 5 carefully.

The two phenomena – conditional perfection and the complement implicatures of verbs like *jaksaa* (‘have the strength’) and *mahtua* (‘be small enough’) – both involve WYSIATI inferences. In each case, the listener infers from the highlighting of a single condition (P or $H(S)$) that it is in fact the *only* contextually-relevant condition for the relevant conclusion (Q or $A(S)$). In cases of conditional perfection, we infer necessity (3.59a, above) from asserted sufficiency. For implicative implicatures, we infer causal sufficiency from presupposed causal necessity. Since the necessity-sufficiency direction is reversed in the implicative case, we might call these implicatures instances of **antiperfection**. Perfection and antiperfection are not fundamentally different, however: both implicatures are licensed by the speaker’s mention of a single condition.

We may even go one step farther in classifying implicative ‘antiperfection’ inferences by comparing them to the implicatures of causative verbs. In Lauer and Nadathur (2018, 2019), we analyze periphrastic causatives like *cause* and *make* in terms of causal dependency relations, focusing on the claim that *make* (as in “Gurung made the children dance”) asserts that the bringing-about relationship between a cause and its effect is one of causal sufficiency.

Empirically, however, there are many uses of *make* that seem to license inferences about (causal) necessity:

(3.60) *Context:* the speaker is on trial for participating in the blocking of a coal train in Spokane, Washington. The action was undertaken in an effort to protest and/or curtail global warming.

a. \neg Climate change made me do it.

\leadsto *I would not have done it, were it not for climate change.*

Lauer and Nadathur explain this phenomenon as one of **causal perfection**, an inference about the structure of a causal dynamics. Causal perfection proceeds from the stated availability of a single (sufficient) causal pathway for the realization of a particular effect, to the conclusion that no other causal pathway to this effect are consistently realizable in context. This makes the *make*-cause (climate change, in example 3.60) a necessary as well as a sufficient condition. The analogy with conditional perfection, in (3.59), is immediate.

Since implicative ‘antiperfection’ also involves reasoning about the structure of a causal dynamics, we can describe the complement implicatures in (3.47)-(3.48) as instances of **causal antiperfection**. Causal antiperfection might also be expected to arise in the interpretation of necessity causatives (if such causatives exist; some treatments of English *cause* suggest that it predicates only necessity, but there is no consensus on the meaning of this verb). It remains to be seen whether the fourth permutation – *conditional antiperfection* – arises as a natural-language inference pattern.

The WYSIATI reasoning involved in (anti)perfection is also known as *circumscription*:

“Circumscription is a rule of conjecture that can be used by a person or program for ‘jumping to certain conclusions’. Namely, *the objects that can be shown to have a certain property P by reasoning from certain facts A are all the objects that satisfy P.*”

McCarthy (1980, p.27, emphasis in original)

In the semantic/pragmatic literature, McCarthy’s circumscription is formalized as the (pragmatic) operation of *exhaustive interpretation*, first introduced by Groenendijk and Stokhof

(1984), and further developed by van Rooij and Schulz (2004); Schulz and van Rooij (2006). The idea is that one-way implicative implicatures – instances of causal antiperfection – arise through circumscription/exhaustive interpretation, as long as the utterance context does not preclude the results of the operation.²⁰

We have seen that two-way implicatives are infelicitous when a condition independent of $H(S)$ is explicitly left unresolved. Moreover, they are accommodated when no other factors are mentioned. From use of a two-way implicative, listeners will infer a background in which all causal conditions for $A(S)$ other than $H(S)$ are met. This inference is distinguished from antiperfection implicatures, by not being at issue (and thus not defeasible) in the discourse context. Formulating the causal sufficiency presupposition of Proposal 3.50 as a circumscriptive one thus establishes a natural continuity between one- and two-way predicates.

On this view, two-way implicatives can be seen to have lexicalized antiperfection inferences, resulting in two-way entailments. One-way implicatives do not lexicalize antiperfection, but it easily arises in the pragmatic dimension, in case no alternative causal conditions for the implicative complement are made salient. If alternative conditions are in fact salient, one-way verbs simply fail to implicate complement actualization. This lexicalization hypothesis remains speculative, but may find some support in Flint’s (1980) taxonomy of Finnish verbs of possibility and sufficiency. Flint ranks implicatives with similar lexical content by the strength with which they invite the conclusion that their complements hold. On this view, the distinction between presupposed and implicated causal sufficiency is gradient rather than sharp (see also White, 2015, 2016). The degree of fluidity involved, which verbs are subject to it, and the potential relevance of any frequency or usage effects are left as matters for future investigation.

²⁰Franke (2009) and Nadathur (2013) offer accounts of conditional perfection in terms of pragmatic exhaustive interpretation. These accounts are to be distinguished from *exhaustification* accounts of conditional perfection, which rely on the ‘grammatical’ operation *exh* (Fox, 2007; Chierchia et al., 2012). Herburger (2015) offers an analysis in the latter style.

Polarity-reversing implicatives

One more group of predicates deserves attention: polarity-reversing implicatives like *fail* and *laiminlyödä* (‘neglect’). As examples (3.61) and (3.62), show, positive assertions of two-way polarity reversing implicatives entail the negation of their complements; negative assertions entail complement actualization.

- (3.61) a. Juri **failed** to open the door. \vdash *Juri did not open the door.*
 b. Juri did not **fail** to open the door. \vdash *Juri opened the door.*
- (3.62) a. Hän **laiminlö-i** korjat-a virhee-n.
 he.NOM neglect-PST.3SG repair-INF error-GEN/ACC
 ‘He neglected to correct the error.’ \vdash *He did not correct the error.*
- b. Hän e-i **laiminlyö-nyt** korjat-a virhe-ttä.
 he.NOM NEG-3SG neglect-PP.SG repair-INF error-PART
 ‘He did not neglect to repair the error.’ \vdash *He corrected the error.*

There are two fairly easy ways in which we might extend Proposal 3.50 to polarity-reversing implicatives. Either option involves a minor change to the presuppositional content associated with polarity-preserving implicatives. The first possibility would be to background the highlighted condition $H(S)$ as causally necessary in context for $\neg A(S)$; this derives the negative entailments in (3.61b) and (3.62b) immediately, and the positive entailments in (3.61a) and (3.62a) secondarily as a result of circumscribing $H(S)$ as the only causally necessary condition in question. Alternatively, we might instead background the failure of $H(S)$ as causally necessary for $A(S)$. If we choose this route, we get the positive entailments directly, and the negative entailments as a result of the second, circumscriptive presupposition. From the two-way data in (3.61) and (3.62) alone, it is not clear which route is to be preferred.

One-way polarity-reversing implicatives resolve the matter. *Hesitate* and its Finnish equivalent *epäröidä* preserve entailment under a negative matrix assertion, but, like polarity-preserving one-way implicatives, do not entail in the positive case.

- (3.63) a. Amira **hesitated** to drink a beer. \nVdash *Amira drank a beer.*
 b. Amira did not **hesitate** to drink a beer. \vdash *Amira drank a beer.*
- (3.64) a. Juno **epärö-i** otta-a osa-a kilpailu-un
 Juno hesitate-PST.3SG take-INF part-PART race-ILL
 ‘Juno hesitated to take part in the race.’
 \nVdash *Juno did not take part in the race.*
- b. Juno e-i **epäröi-nyt** otta-a osa-a kilpailu-un
 Juno NEG-3SG hesitate-PP.SG take-INF part-PART race-ILL
 ‘Juno did not hesitate to take part in the race.’
 \vdash *Juno took part in the race.*

Since the positive entailments (from $H(S)$ to the negation of the implicative complement) are the ones that disappear in the one-way case, it seems as if the negative entailments should be taken as more basic. In particular, this favours an analysis on which the pre-supposition shared by one- and two-way polarity-reversing implicatives takes a condition $H(S)$ to be causally necessary for the failure of the implicative complement. Then, as in the polarity-preserving cases, two-way polarity-reversers can be seen to have lexicalized the circumscriptive reasoning that leads to a causal sufficiency relationship, while one-way polarity-reversers have not.

A final observation: where one-way polarity-preserving implicatives are strongly associated with antiperfection implicatures, as discussed above, the tendency towards these inferences is for some reason much weaker in the polarity-reversing case. More surprising still is the apparent potential for positive assertions of one-way polarity-reversing verbs to generate implicatures which follow a factive pattern (that is, do not change with matrix polarity), as well as implicatures in the implicative pattern. Whether an implicative or factive-type inference is drawn (if either is) depends heavily on context.

- (3.65) Juri **hesitated** to ask for help.
- a. *Implicative implicature*: Juri didn’t ask for help (because of her hesitance).
 b. *Factive implicature*: Juri asked for help (after some time had passed).

- (3.66) Leo **ujostel-i** näyttä-ä kuva-{a/n} minu-lle.
 Leo shy-PST.3SG show-INF picture-{PART/GEN} me-ILL
 ‘Leo was shy to show me the picture.’²¹

- a. *Implicative implicature*: Leo did not show me the picture (due to shyness).
- b. *Factive implicature*: Leo showed me the picture (with reluctance).

The availability of both types of inferences shown in (3.65)-(3.66) opens up questions about the semantic relationship between implicative and factive verbs. If one-way polarity-reversing verbs like *hesitate* can, in fact, trend towards the factive pattern, this may shed some light on recent results described in Karttunen (2014) (see also Tonhauser et al. 2015), which indicate a certain fluidity in the use of implicative- or factive-type inferencing for phrasal constructions like *be lucky to* (which have traditionally been treated as factive). I leave an investigation of these connections for future work.

3.7 Conclusions and outlook for actuality inferences

Motivated by Bhatt’s (1999) observations linking actualized interpretations of ability ascriptions with the interpretation of *managed to* claims, this chapter focused on an analysis of implicative verbs, ultimately proposing a new account of implicative lexical semantics. Where Bhatt’s original account of actuality inferences aims to derive the semantic parallels from an underlying equivalence in the lexical representations of *manage* and a predicate ABLE (representing both ability modals and *be able*), I argued that the parallels actually arise at an analytical level. In other words, the lexical semantic properties that derive the complement entailments of *manage* (and other two-way implicative verbs) are the same properties that derive actuality entailments, but in the latter case arise in the composition of ability and (perfective) aspect.

To pursue this idea, we first needed to know how implicative entailments are themselves derived, and to establish what semantic features constitute the property of *implicativity*.

²¹In Finnish, case marking within the embedded proposition seems to correlate with which implicature is preferred. In (3.66), partitive marking on *kuva* (‘picture’), seems to privilege a factive inference, while the genitive/accusative marker privileges an implicative inference.

The account of implicative verbs developed in this chapter allows us to identify three key components in the production of the characteristic two-way entailment pattern. First, as anticipated by Karttunen (1971), implicatives presuppose the existence of a necessary and sufficient condition for the realization of their complements. Some verbs, such as *dare* and *bother*, place constraints on the nature of the condition, while others do not – notably, *manage*, its Finnish counterpart *onnistua*, and by extension the French implicative *réussir* (‘manage’, ‘succeed’). Secondly, building on an insight from Baglini and Francez (2016), I argued that the relations of necessity and sufficiency involved in implicative semantics are causal in nature. Necessity and sufficiency of any sort are modal notions, insofar as they deal with relations of consistency and consequence in inferential systems – as we saw in Section 3.3, for instance, causal necessity and causal sufficiency involve reasoning about normal causal developments, or different ways in which a course of events might unfold in the world. Thus, the second condition for implicative behaviour amounts to the requirement that the modality involved is causal in flavour. Finally, against Karttunen and Peters (1979), I proposed that implicatives do not trivially assert their complement propositions, but instead establish whether or not the causal condition was met as their at-issue contribution. Thus, as originally suggested by Karttunen, an implicative statement has as its ‘central’ proposition the claim that a necessary and sufficient condition was satisfied. The implicative entailments follow as causal consequences in the joint contribution of presupposed and asserted content.

Table 3.2 summarizes these findings; as before, S is the individual argument to an implicative, $A(S)$ the complement proposition, and $H(S)$ stands for the causal condition. I let c be the background situation provided by the utterance context. If actuality entailments are, as hypothesized, derived in the implicative pattern, then each of the components in Table 3.2 must appear in the combination of ability and aspect. The next task, then, is to locate them.

As a starting point, let us take another look at the inferences associated with *be able*. Under positive matrix polarity, the situation is familiar: past-tense uses of *was able* may implicate their complements, but they do not entail them. We have not yet considered what happens under negative matrix polarity, however. As (3.67b) shows, negative *was*

construction	semantic component			inference	
	<i>mod. flavour</i>	<i>presuppose</i>	<i>assert</i>	<i>pos</i>	<i>neg</i>
implicative	causal, circumstantial	$H(S) \blacktriangleleft_c A(S)$ $H(S) \blacktriangleright_c A(S)$	$H(S)$	$\vdash A(S)$	$\vdash \neg A(S)$

Table 3.2: The semantic components of polarity-preserving two-way implicativity

able statements entail the negation of their complements. *Be able*, then, has the inferential profile of a one-way polarity-preserving implicative.

- (3.67) a. Eman was able to go to the party ... \leadsto *Eman came to the party.*
 \checkmark ... but she decided to stay at home.
- b. Eman was not able to go to the party ... \vdash *Eman did not go to the party.*
 $\#$... but she went in the end.

On the basis of this inference pattern, Karttunen (1971, 2012) classifies *be able* as a one-way implicative.²² Adopting this idea now leads to the analysis in (3.68).

- (3.68) ***Be able* as a one-way implicative.** (Proposal, to be revised)

For an agent S , and a one-place predicate A , the claim that S is able to A :

- i. *Presupposes:* The existence of a predicate H such that $H(S)$ is causally necessary for $A(S)$ in the utterance context. $H(S) \blacktriangleleft_c A(S)$
- ii. *Asserts:* $H(S)$

²²Karttunen (p.c.) also classifies Finnish *pystyä* ('be able'), which we saw in Section 3.5.2 as a one-way implicative; Flint (1980) describes this verb as one of "possibility," and places it in a taxonomy which includes both modal verbs and one- and two-way implicatives.

- (3.46) a. Hän **pysty-i** tappel_{ema}-an.
he.NOM able-PST.3SG fight-INF
'He was able to fight.' $\nVdash (\leadsto)$ *He fought.*
- b. Hän e-i **pysty-nyt** tappel_{ema}-an.
he.NOM NEG-3SG able-SG.PP fight-INF
'He was not able to fight.' \vdash *He did not fight.*

This seems promising. While we maintain the spirit of Bhatt’s proposal, we improve on his predictions by treating *be able* as a one-way implicative rather than equating it with the two-way implicative *manage*. The similarities between *be able* and *manage* follow from their shared implicative structure, but the key contrast – that *be able* does not entail its complement under positive matrix polarity, while *manage* does – now follows from the difference between one- and two-way implicatives: namely, that two-way implicatives presuppose both the causal necessity and the causal sufficiency of some condition for their complements, one-way verbs presuppose only causal necessity.

If we pursue this line of analysis further, by taking on Bhatt’s idea that *be able* and ability modals like *pouvoir* and *saknaa* are all realizations of a single predicate, ABLE, we also predict the observed contrast between *pouvoir* (‘can’, ‘be able’) and *réussir* (‘manage’, ‘succeed’) under imperfective marking. The imperfective ability claim in (3.69a) is compatible with Jean’s never having escaped; the implicative claim in (3.69b) is not.

- (3.69) a. *Jean **pouvait** s’enfuir, mais il ne s’est jamais enfui.*
 ‘Jean could-PFV escape, but he never escaped.’
 b. *Jean **réussissait** à s’enfuir, #mais il ne s’est jamais enfui.*
 ‘Jean managed-IMPF to escape, #but he never escaped.’

We run into trouble at this point, however. Bhatt’s account assigned ABLE an underlyingly complement-entailing semantics, thus requiring an additional explanation for the acceptability of (3.69a). If ABLE has the semantics in (3.68), we have what amounts to the opposite problem. We predict the acceptability of (3.69a), but we still have not explained what produces the actuality entailment when the ability modal appears with perfective marking.

- (3.70) *Jean a pu s’enfuir, #mais il ne s’est jamais enfui.*
 ‘Jean could-PFV escape, but he never escaped.’

To go from the one-way implicative meaning to the complement-entailing interpretation

in (3.70), we need to add the one component from Table 3.2 which (3.68) omits: the presupposition of causal sufficiency. But the only difference between (3.69a) and (3.70) is the aspectual contrast. Thus, if we are to make an implicative account of ABLE work, it seems as if we need the perfective to somehow introduce causal sufficiency. Given what we know about the semantics of perfective aspect (see Section 2.1.3), it is difficult to see how this might come about.

Nevertheless, there is reason to believe that the implicative approach to ABLE is on the right track. To see why, we take a step back out and consider the overall aims of the investigation. One of the goals established by the framing questions in Chapter 1 was to develop a semantic treatment of *be able* and ability modals – ABLE, following Bhatt – which connects the three meanings of (pure) ability, actuality, and possibility.

It is fairly straightforward to locate a possibility meaning in (3.68): under positive matrix polarity, the assertion that a causally necessary condition $H(S)$ for $A(S)$ was met leaves the truth of $A(S)$ open, and thus making the truth of $A(S)$ a possible (but not guaranteed) causal development. Although the one-way implicative analysis does not yet allows us to explain actuality entailments, it does supply a straightforward account of the weaker actuality implicatures associated with *be able*. As we saw in Sections 3.5.2 and 3.6.3, positive assertions of one-way implicatives are predicted to license defeasible ‘antiperfection’ inferences to the realization of their complements.

What we are missing is a connection to the pure ability reading associated with both *be able* and ability modals. In Section 2.3 of Chapter 2, we saw that these readings demanded some notion of ‘regularity’ or ‘reliability’: in particular, we saw that pure ability interpretations of ability modals are not licensed by a single witness for the modal complement. I proposed to capture the reliability requirement by representing abilitative predicates as hypothetical guarantees. In Chapter 2, we left the precise content of the ‘guarantee’ component as an open question. Following the discussion of causal dependence relations in Section 3.3, we are now in a position to formalize this component in terms of causal sufficiency, making $H'(S)$ in (3.71) the event that ensures or makes $A(S)$ inevitable, given the actual (normal) course of events in the world.

(3.71) *Can/be able as a hypothetical guarantee.* (Proposal, to be revised)

For an agent S and a one-place predicate A , the claim that S *can/is able to* A is true just in case S has an available action, H' , such that $H'(S)$ is causally sufficient for (guarantees) $A(S)$.

There is an intriguing structural similarity between the analysis of ABLE as a one-way implicative and the hypothetical guarantee proposal in (3.71). Both proposals make relevant an intermediary or intervening event which is causally involved in the realization of $A(S)$, and in which S is participant. These intervening conditions, however, cannot be quite the same. In (3.71), $H'(S)$ is causally sufficient for $A(S)$. A possibility meaning for $A(S)$ is preserved insofar as the realization of $H'(S)$ is not asserted, but only its availability (to S). On the implicative view in (3.68), however, the intervening condition $H(S)$ is causally necessary for $A(S)$. In this case, the realization of $H(S)$ *is* asserted. Moreover, it is the absence of a causal sufficiency relationship that preserves the possibility meaning for $A(S)$ in this case, and which crucially distinguishes ABLE from *manage/réussir* in examples like (3.69).

What emerges from this discussion is that the way forward on each of the two problems faced by the implicative analysis of ABLE, as it is stated in (3.68), seems to involve a causal sufficiency component. Causal sufficiency is needed, on the one hand, to move from positive assertions of ABLE which license only actuality implicatures to assertions which produce the full actuality entailment. On the other hand, it is needed – as per the hypothetical guarantee proposal – to capture the reliability or regularity requirement of pure ability readings. In other words, causal sufficiency – in some way that we have not yet explained – unifies the divergent actuality and ability meanings at the heart of the actuality inference puzzle! This finding is a compelling reason to continue the current line of investigation.

What we would like, to help us complete the picture, is some way of reconciling the two proposals (3.68) and (3.71), while preserving the positive features of both analyses. In particular, we would like this merged proposal to encode the causal sufficiency component required to capture the notion of reliability, but somehow leave it ‘inactive’ except in the

overt presence of perfective aspect. In order to see how this might work, we need some way to probe more deeply into the structure of ABLE, and in particular, into the nature and structure of the causal condition which figures in both the one-way implicative analysis and the hypothetical guarantee structure. It does not seem possible to do this directly with either ability predicates or implicative verbs.

It turns out, however, that there is a class of predicates which will allow us to look at the structure of ability and implicativity at a finer level of granularity. *Enough* and *too* predicates, like the ones marked in bold in (3.72), belong to a class of ‘optional’ or ‘defeasible’ implicatives:

- (3.72) a. γ [John Boehner] **was smart enough** to leave once he saw the direction his party was going.
- b. γ When I played soccer as a chubby little ten-year-old, I **was too slow** to score any goals, so my dad (who was the coach) had me play defense.

Enough and *too* predicates are related to implicative verbs insofar as they “must sometimes be understood in an implicative, sometimes in a non-implicative sense” (Karttunen, 1971, p.354). As we will see in the next chapter, some of this variability is governed by aspect; the implicative behaviour of certain *enough/too* predicates shows the same sensitivity to aspect as the implicative inferences of ability modals. In addition, and crucially for our current purposes, these predicates are unlike either lexical implicatives or abilitative predicates in that they have an internal compositional structure. *Enough* and *too* are complex, produced in the composition of either *enough* or *too* with a gradable adjective. This complexity represents a point of access to their internal structure which will allow us to get ‘under the hood’ of their implicative behaviour in a way that is impossible with simple implicative and abilitative predicates. The next chapter therefore takes up the investigation of implicativity in *enough* and *too* constructions.

Chapter 4

Variable implicativity in *enough* and *too* constructions

In Chapter 3, I proposed an analysis of implicative verbs which derives their characteristic entailments from relations of causal necessity and causal sufficiency embedded in their lexical representations. Examples (4.1) and (4.2) restate the entailment patterns of two-way implicatives:

(4.1) Polarity-preserving implicatives:

- a. Morgan managed to solve the riddle. \vdash *Morgan solved the riddle.*
- b. Morgan did not manage to solve the riddle. \vdash *Morgan did not solve the riddle.*

(4.2) Polarity-reversing implicatives:

- a. Morgan failed to solve the riddle. \vdash *Morgan did not solve the riddle.*
- b. Morgan did not fail to solve the riddle. \vdash *Morgan solved the riddle.*

The examination of implicative verbs was motivated by the semantic parallels between the interpretation of *managed to* claims and actualized interpretations for abilitative predicates, first noted by Bhatt (1999). While I concluded that an account which treats actuality inferences as instances of implicative behaviour is on the right track, I also showed that we do not yet have a way to adapt the implicative semantic structure to the full range of

interpretations for ability modals and *be able* (jointly represented as ABLE). Treating ABLE as a (polarity-preserving) one-way implicative allows us to explain some of its empirical behaviour, but predicts only actuality implicatures from positive ABLE claims.

(3.68) ***Be able as a one-way implicative.*** (Proposal, to be revised)

For an agent S , and a one-place predicate A , the claim that S is able to A :

- i. *Presupposes:* The existence of a predicate H such that $H(S)$ is causally necessary for $A(S)$ in the utterance context. $H(S) \blacktriangleleft_c A(S)$
- ii. *Asserts:* $H(S)$

(3.67) Positive and negative *be able* claims:

- a. Eman was able to go to the party ... \leadsto *Eman came to the party.*
 \checkmark ... but she decided to stay at home.
- b. Eman was not able to go to the party ... \vdash *Eman did not go to the party.*
 $\#$... but she went in the end.

Crucially, the one-way implicative analysis does not give us a way to account for the inference ‘strengthening’ that turns ability modals’ implicatures into actuality entailments under overt perfective marking:

(4.3) French *pouvoir* under imperfective and perfective marking:

- a. *Eman pouvait aller à la fête, mais elle n’y est pas allée.*
‘Eman could-IMPF go to the party, but she did not go.’
- b. *Eman a pu aller à la fête, #mais elle n’y est pas allée.*
‘Eman could-PFV go to the party, #but she did not go.’

On the account of implicatives proposed in Chapter 3, one semantic feature differentiates between polarity-preserving one-way implicatives, which have the inferential profile in (3.67), and two-way polarity-preserving implicatives like *manage*. One-way implicatives presuppose only the causal necessity of some condition ($H(S)$) for the realization of their complements; two-way implicatives presuppose that this condition is causally sufficient as well.

(3.50) **The prerequisite account of implicatives.** (Proposal)

For a two-way implicative verb I , an agent S , a one-place predicate A , and a background situation c , the proposition $I(S, A)$:

- i. *Presupposes*: The existence of a predicate H such that $H(S)$ is causally necessary for $A(S)$ in the utterance context. $H(S) \blacktriangleleft_c A(S)$
- ii. *Asserts*: $H(S)$
- iii. *Presupposes*: $H(S)$ is the only unmet causally necessary condition for $A(S)$ in context (so $H(S)$ is *causally sufficient* for $A(S)$ relative to c)
 $H(S) \blacktriangleright_c A(S)$

Thus, if we wish to pursue an implicative account of actuality inferences, the difference between (4.3a) and (4.3b) must come down to the absence or presence of causal sufficiency. This is perplexing, since it suggests that the perfective aspect somehow introduces this component of meaning. At the same time, however, the discussion at the end of Chapter 3 indicated an independent need to associate an account of ABLE (*be able*, ability modals) with causal sufficiency, in order to capture not just the possibility and actuality interpretations, but pure ability meanings as well. A causal sufficiency component evidently cannot be ‘on the surface’ of an implicative semantics for ABLE, since this would predict actuality entailments in all contexts; yet it must be active in perfectly-marked uses of ability modals, where actuality entailments are in evidence.

In this chapter, I begin an examination of a set of variably-implicative predicates which will allow us to unpack the content of abilitative and implicative predicates and take a closer look at their internal structure. As noted by Karttunen (1971), phrasal *enough* and *too* predicates, marked in bold in (3.72), in many cases seem to license inferences about the truth of their complements, but – unlike ‘true’ (lexical) implicatives – exhibit optionality, defeasibility, and sensitivity to viewpoint aspect in their implicative behaviour.

- (3.72) a. γ [John Bochner] **was smart enough** to leave once he saw the direction his party was going.

- b. γ When I played soccer as a chubby little ten-year-old, I **was too slow** to score any goals, so my dad (who was the coach) had me play defense.

Enough and *too* constructions have an implicative flavour, apparently indicating some relationship between a specific property described by the matrix clause and the realization of the eventuality described by their infinitival complements. They also bear an intuitive similarity to abilitative predicates, in that the properties they involve can (often) be described as involving specific sorts of ability – the capacity or ability to behave cleverly, as in (3.72a), or (a lack of) the ability to run with speed, as in (3.72b). The meanings of these predicates arise in the composition of a gradable adjective (e.g., *smart*, *slow*) with a comparative *enough* or *too* operator, and thus their decompositional analysis gives us a view of the internal structure of both abilitative and implicative predicates, and allows us to investigate how varying the components of an *enough* or *too* construction affects their overall inferential profile. Ultimately, the granularity of analysis that *enough* and *too* predicates permit will prove essential to developing an understanding of the underlying structure of ability modals, and in particular how this interacts with aspect and contributes to the aspectually-driven alternation in actuality inferences.

The next three chapters develop a step-by-step treatment of the semantics and implicative behaviour of *enough* and *too* constructions like (3.72a)-(3.72b), culminating in an account of their interactions with viewpoint aspect. This chapter focuses on the empirical picture: specifically, on establishing the full range of complement inference patterns associated with *enough* and *too* constructions, with the goal of linking these patterns systematically to particular features or components of the *enough/too* predicates, as well as to the components of implicativity as established in the previous chapter. While some of the parameters of *enough/too* variation have previously been identified, the full range of variation has yet to be explored and systematically described.

I first present an overview of *enough* and *too* constructions, describing at a coarse level the optionality, defeasibility, and aspect-sensitivity of their implicative inferences. To dig more deeply into these patterns, I begin with the parameters of variation noted in two

existing treatments of *enough/too* constructions: first, the role played by modal flavour, noted by Meier (2003), who proposes an underlyingly non-implicative treatment, and then the role of viewpoint aspect described by Hacquard (2005), who instead treats *enough/too* predicates as ‘at-base’ implicative. I show that while both authors illuminate key features of *enough/too* constructions, neither of their accounts can explain or predict the full range of data. In establishing some important caveats to both Meier’s and Hacquard’s generalizations, I draw on some under-appreciated observations from Marques (2012). To this, I add new observations about the nature and underlying characteristics of those specific *enough/too* predicates which participate in implicative behaviour. The data presented in this chapter draw primarily from English and French; Marques’s data are from Portuguese.

The final section of this chapter organizes the observations, with the aim of isolating and characterizing just those *enough/too* constructions that (a) show a default tendency towards generating implicative inferences (in English), and (b) participate in the aspectually-governed actuality entailment pattern of ability modals. I link these patterns to the features of implicativity as established in Chapter 3. The empirical picture developed here sets the stage for Chapter 5’s proposal for the semantics of *enough* and *too* constructions and the analysis of aspectual interactions which is presented in Chapter 6.

4.1 Preliminaries

4.1.1 An overview of *enough* and *too* implicativity

Karttunen includes *enough* and *too* predicates in a list of predicates “that must sometimes be understood in an implicative, sometimes in a non-implicative sense” (1971; p.354). He points out that, while (4.4a) strongly suggests the truth of its complement, (4.4b) – despite employing the same matrix predicate – does not, instead reading as a simple attribution of (a high degree of) cleverness. The examples in (4.4) are slightly modified from Karttunen’s (1971; p.355).

- (4.4) a. Juri **was clever enough** to leave early. \leadsto *Juri left early.*

- b. Juri **was clever enough** to be a rocket scientist.

\nrightarrow *Juri was a rocket scientist.*

Where complement inferences arise, they seem to appear in the two-way implicative pattern. Thus, the past-tense use of *be fast enough* in (4.5a) strongly suggests that Juno won the race, while its negation in (4.5b) suggests the opposite. The *too* constructions in (4.6) pattern with polarity-reversing implicatives (see *fail* in example 4.2), implicating complement falsity in (4.6a) and complement realization under negation in (4.6b).

- (4.5) a. Juno **was fast enough** to win the race. \leadsto *Juno won the race.*
 b. Juno **was not fast enough** to win the race. \leadsto *Juno did not win the race.*
 (4.6) a. Juno **was too slow** to win the race. \leadsto *Juno did not win the race.*
 b. Juno **was not too slow** to win the race. \leadsto *Juno won the race.*

These inferences are all defeasible, as demonstrated by (4.7)-(4.8).

- (4.7) a. Juno **was fast enough** to win the race, but she was not allowed to participate.
 b. Juno **was not fast enough** to win the race, but the lead runner unexpectedly tripped on the final lap, making Juno the winner.
 (4.8) a. Juno **was too slow** to win the race, but the lead runner unexpectedly tripped on the final lap, making Juno the winner.
 b. Juno **was not too slow** to win the race, but she chose not to participate.

The ‘default’ nature of the inferences in (4.5)-(4.6) argue in favour of a semantic analysis of *enough* and *too* constructions which is connected in some real way to the analysis of implicative entailments, as Karttunen’s classification suggests. However, the defeasibility of both positive and negative inferences complicates the picture. Following the discussion of one-way implicatives in Sections 3.5.2 and 3.6.3 of Chapter 3, we might expect defeasibility from the inferences in (4.5a) and (4.6b) in case having some particular speed represents a necessary (but not sufficient) condition for winning the race. By extension, we might similarly expect defeasible inferences from (4.5b) and (4.6a) if we analyze *be fast enough* and *be*

too slow as a type of implicative construction which backgrounds only sufficient conditions for their complements, and not necessary ones.¹ The pattern of defeasibility in complement inferences, however, goes in both directions: lifting both the necessity and sufficiency pre-suppositions in Proposal 3.50 would effectively eliminate the connection between the matrix predicate and the achievement of the complement clause. It is intuitively obvious that this is not the right analysis.

To make matters worse, Hacquard (2005) observes that *enough* and *too* constructions like (4.5) and (4.6) show the same aspectually-driven alternation as ability modals. In French, ‘defeasibly’ implicative *enough/too* predicates become fully implicative under perfective marking, generating complement entailments in the implicative pattern. This is illustrated by (4.9) (examples Hacquard’s; pp.80–81), which shows that the realization or failure of the complement cannot be cancelled without producing contradiction.

- (4.9) a. *Jean a été assez rapide pour s’enfuir, #mais il ne s’est pas enfui.*

‘Jean was-PFV fast enough to escape, #but he did not escape.’

- b. *Jean n’a pas été assez rapide pour s’enfuir, #mais il s’est enfui.*

‘Jean was-PFV not fast enough to escape, #but he escaped.’

- (4.10) a. *Jean a été trop lent pour s’enfuir, #mais il s’est enfui.*

‘Jean was-PFV too slow to escape, #but he escaped.’

- b. *Jean n’a pas été trop lent pour s’enfuir, #mais il ne s’est pas enfui.*

‘Jean was-PFV not too slow to escape, #but he did not escape.’

This pattern leads Hacquard to propose an analysis on which *enough* and *too* constructions

¹This analysis would postulate the existence of a second type of one-way implicative, which generates entailments under positive polarity by means of a sufficiency condition, but, lacking a necessity condition, does not entail under matrix negation. As far as I can tell, this type of implicative is not attested in either English or Finnish. Karttunen (2012) lists some verbs with this implication pattern, including polarity-preserving *make* and *force*, and polarity-reversing *prevent (from)* and *keep (from)*. As he notes, these verbs are usually classified as **causatives**. On most analyses, causative verbs are taken to establish a causal relationship between two actions or events as part of their at-issue content, distinguishing them from implicatives on the current analysis. Some further evidence for this typological distinction comes from Finnish: verbs which only entail their complements (or the negation of their complements, in the case of polarity-reversers) under positive matrix polarity, appear in a dedicated causative construction, and do not pattern with implicatives, grammatically speaking (L. Karttunen, p.c.). I leave further investigation of these distinctions for future research.

share the (complement-entailing) semantics of two-way implicative verbs. While her account, discussed in Section 4.2.2, predicts the judgements in (4.9)-(4.10), it leaves the contrast between English implicative entailments and the defeasible *enough/too* pattern in (4.5)-(4.6) unexplained. Moreover, since Hacquard's analysis directly codes both necessity and sufficiency into the meanings of *enough* and *too*, the 'optionality' of implicative inferences (cf. example 4.4b) also presents a complication for her.

As expected on the actuality entailment pattern, she also observes that the entailments in (4.9)-(4.10) disappear when the matrix *enough/too* predicates are marked with imperfective instead of perfective aspect.²

(4.11) *Jean **était assez rapide** pour s'enfuir, mais il ne s'est pas enfui.*

'Jean was-IMPF fast enough to escape, but he did not escape.'

(4.12) *Jean **était trop lent** pour s'enfuir, mais il s'est enfui.*

'Jean was-IMPF too slow to escape, but he escaped.'

The alternation between (4.9)-(4.10) and (4.11)-(4.12) is also a problem for a fully-implicative account of *enough/too* constructions because – as we have now seen several times – implicative entailments are not affected by aspectual marking. Example (2.44), repeated again from Chapter 2, illustrates:

(2.44) a. *Jean **réussissait** à s'enfuir, #mais il ne s'est pas enfui.*

'Jean managed-IMPF to escape, #but he did not escape.'

b. *Jean **a réussi** à s'enfuir, #mais il ne s'est pas enfui.*

'Jean managed-PFV to escape, #but he did not escape.'

Taken together, these data show that we do not yet have available a proper treatment of *enough/too* predicates. We would first of all like to account for the similarity between

²In the *too* case in (4.12), my informants preferred a cancellation which included an explanation of the non-implicative interpretation, for instance indicating that some unexpected or unusual circumstances obtained at the escape time:

(i) *Jean était trop lent pour s'enfuir, mais le gardien s'était endormi alors il a réussi à s'enfuir.*

'Jean was-IMPF too slow to escape, but the guard was asleep, and so Jean managed-PFV to escape.'

I discuss this further in Section 4.3.2.

enough/too constructions and true (lexical) implicatives in just those cases where it arises, deriving the entailments in (4.9)-(4.10) in a manner that unifies them with the entailments of implicative verbs. At the same time, however, the analysis assigned to *enough/too* constructions should also allow us to explicate and predict both the optionality and defeasibility of *enough/too* complement inferences. These goals are further tempered by the original problem posed by actuality entailments: what work is done by aspectual marking, and how does it interact with the compositional semantics of *enough* and *too* predicates to produce contrasts in the sentence-level inferences associated with these predicates?

4.1.2 Desiderata and complications

The investigation of implicatives in Chapter 3 was motivated first of all by Bhatt's (1999) observation that perfectly-marked, entailing ability modals are closely paraphrased by implicative statements with *manage*. On the assumption that actuality entailments are, at some semantic level, instances of implicativity or implicative behaviour, this led to the following question: what semantic properties constitute *implicativity*? Based on Proposal 3.50, we identified three key components:

- (i) the existence of a condition that is both necessary and sufficient for the (implicative) complement
- (ii) a causal interpretation of the necessity and sufficiency relations
- (iii) an assertion that resolves the truth status of the necessary and sufficient condition

The summary table from the end of Chapter 3 is repeated here as Table 4.1. S represents the individual argument to the verb, $A(S)$ its full (reconstructed) complement, and $H(S)$ indicates the causal or 'hinge' condition (in which S is involved). As before, the subscript on the necessity and sufficiency operators indicates that these relations are evaluated relative to a background situation c .

In the case of simple (non-phrasal) implicatives, all of the features in Table 4.1 must be encoded in the lexical semantics of the implicative itself. I propose that, in the case of a

construction	semantic component			inference	
	<i>mod. flavour</i>	<i>presuppose</i>	<i>assert</i>	<i>pos</i>	<i>neg</i>
implicative	causal, circumstantial	$H(S) \blacktriangleleft_c A(S)$ $H(S) \blacktriangleright_c A(S)$	$H(S)$	$\vdash A(S)$	$\vdash \neg A(S)$

Table 4.1: The semantic components of polarity-preserving two-way implicativity

complex predicate like *be fast enough*, this need not be the case. Indeed, given the variability of implicative behaviour in *enough/too* constructions, we should not expect to find all of the relevant features of implicativity encoded in one lexical item. Instead, if *enough/too* complement inferences are truly implicative in nature, these properties will arise in the composition of the gradable adjective, the *enough* or *too* operator, and an infinitival complement, as well as in the interaction of these components with the perfective aspect. Crucially, we expect each of the component elements in an *enough/too* predicate to make an independent and potentially variable contribution to the construction's overall semantic profile. For instance, where the polarity-preserving or reversing behaviour of a lexical implicative is part of its lexical encoding, the polarity features of *enough/too* constructions are evidently localized in the choice of a comparative operator. *Enough* constructions are conducive to complement inferences that preserve the polarity of the matrix clause, and *too* constructions to inferences that reverse it. Intuitively, this contrast is associated with the types of measurement or comparison imposed by *enough* and *too*: sufficiency and excess, respectively (see also Fortuin's 2013 cross-linguistic typology).

(4.5a) Juno **was fast enough** to win the race. \leadsto *Juno won the race.*

(4.6a) Juno **was too slow** to win the race. \leadsto *Juno did not win the race.*

The necessarily compositional nature of implicative behaviour in *enough/too* constructions is further complicated by the strength difference between *enough/too* inferences and the entailments of true implicatives. As we saw above, English *enough/too* inferences license only defeasible implicatures to the realization of their complements. It is not immediately

clear what components of implicative semantics, on the one hand, and of the semantic combination of a gradable adjective and comparative, on the other, we can recruit to account for this defeasibility. For instance, we saw in Chapter 3 that omitting the necessity presupposition predicts a one-way inference pattern. Finnish *jaksaa* ('have the strength'; example 3.47) presumably presupposes that the matrix condition is necessary but not sufficient for its complement, while English *hesitate* (example 4.13), as a polarity-reversing one-way implicative, backgrounds the necessity of the matrix condition for the negation of its complement.

- (3.47) a. Hän **jakso-i** noust-a.
he.NOM have.strength-PST.3SG rise-INF
'He had the strength to rise.'
 \leadsto *He rose.*
- b. Hän e-i **jaksa-nut** noust-a.
he.NOM NEG-3SG have.strength-PP.SG rise-INF
'He did not have strength to rise.'
 \vdash *He did not rise.*
- (4.13) a. The mole **hesitated** to walk into the Wild Wood.
 \nmid *The mole didn't walk into the Wild Wood.*
- b. The mole didn't **hesitate** to walk into the Wild Wood.
 \vdash *The mole walked into the Wild Wood.*

Comparing a polarity-preserving *enough/too* predicate like *be fast enough* to the implicative *dare*, for instance, suggests that one difference between the two predicate types might be the absence of a sufficiency presupposition in the *enough* construction. In (4.14), denying the sufficiency of daring/courage for the realization of the complement (by an overt indication that some other necessary condition was unmet in the utterance context) produces infelicity. In (4.15), on the other hand, the (default) implicature that Juno won the race is simply precluded by the mention of an unsatisfied alternate condition, without any associated infelicity: this suggests that a relationship of sufficiency between the property specified in the matrix clause and the realization of the *enough* complement is not hard-coded in the meaning of *be fast enough to A*.

(4.14) Pandora **dared** to open the box, ??but she didn't have the key to unlock it.³

(4.15) Juno **was fast enough** to win the race, but she was injured and could not run (that day).

Given this contrast, we might plausibly suppose that *enough/too* constructions, unlike true implicatives, fail to background a sufficiency relationship. If this is the case, however, we are hard-pressed to explain the apparent re-emergence of such a relationship – apparently as a background condition – under perfective marking. As shown in (4.16a), following an observation from Hacquard (2005), perfectly-marked *enough/too* constructions become infelicitous, patterning with (4.14) rather than (4.15), when the sufficiency of (some degree of) the matrix adjective for the complement proposition is brought into question. Under imperfective marking in (4.16b), however, the English pattern is restored.

(4.16) a. *Juno a été assez rapide pour gagner la course, #mais elle était blessée et ne pouvait pas courir (ce jour-là).*

‘Juno was-PFV fast enough to win the race, #but she was injured and could not run (that day).’

b. *Juno était assez rapide pour gagner la course, mais elle était blessée et ne pouvait pas courir (ce jour-là).*

‘Juno was-IMPF fast enough to win the race, but she was injured and could not run (that day).’

In accounting for the distribution of *enough* and *too* implicativity, we will have to account for the contrast between (4.15) and (4.16b), on the one hand, and, on the other, (4.16a). It is not at all clear, at this stage, how we might establish a connection between the semantics of the perfective aspect and the presence of a now-you-see-it-now-you-don't sufficiency presupposition. The same problem, in the context of ability modals, was discussed at the end of Chapter 3.

³This infelicity can ostensibly be mitigated by emphatic focus on *dare*. This plausibly introduces metalinguistic considerations (or metalinguistic negation), and I set aside data points of this type for the purposes of the current investigation. As noted in Chapter 1, the bold typeface in (4.14) simply marks the implicative verb, and does not indicate emphasis.

Defeasibility in the negative *enough* implications is also puzzling. If we try to attribute the pattern in (4.7b) to the absence of a necessity presupposition in the meaning of *be fast enough to X*, we can account for the English and French imperfective cases, but will fail to explain the infelicity of the same example under perfective marking in the matrix clause.

(4.7b) Juno **was** not **fast enough** to win the race, but the lead runner tripped on the final lap, and so Juno won after all.

(4.17) *Juno n'a été pas assez rapide pour gagner la course, #mais la coureuse en tête a trébuché dans la dernière manche, et donc, Juno a gagné (après tout).*

‘Juno was-PFV not fast enough to win the race, #but the lead runner tripped on the final lap, and so, Juno won (after all).’

More puzzling still, it goes against basic intuitions about the interpretation of *enough* and *too* constructions to suggest that the matrix property and the complement proposition are not linked by a relationship of necessity. This can be seen, even in English, by the markedness of an overt denial of such a relationship:

(4.18) a. Juno **was fast enough** to win the race, #but speed is not necessary for winning a race.

b. Juno **was** not **fast enough** to win the race, #but speed is not necessary for winning a race.

Moreover, if the defeasibility of English *enough/too* inferences indicates that neither necessity nor sufficiency is part of the (not-at-issue) meaning of these constructions, then it is not at all clear what connection is established between the matrix property and the *enough/too* complement.

The literature on *enough* and *too* constructions (including Nelson 1980, Bierwisch 1987, Meier 2003, Hacquard 2005, Schwarzschild 2008, and others), while differing in details, for the most part agrees on a basic analysis of these constructions as degree comparatives with a modal component.⁴ On this view, a sentence like (4.5) compares the real degree to which the

⁴One notable exception to this consensus comes from Zhang (2018), who argues that not all uses of *enough* and *too* involve modal relationships.

sentential subject has the matrix property, to a ‘modal’ degree provided by the complement proposition. In particular, this comparison degree is that degree d of the matrix adjective which (in some way) makes it possible for the sentential complement to be realized. Thus, (4.5) and (4.6) can be paraphrased as follows:⁵

(4.19) Juno **is fast enough** to win the race.

~ *Juno’s actual speed is at least d , where d is the speed which makes it possible (for her) to win the race.*

(4.20) Juno **is too slow** to win the race.

~ *Juno’s actual speed is less than d , where d is the speed which makes it possible (for her) to win the race.*

While these paraphrases clearly indicate some similarity between *enough/too* constructions and implicatives – insofar as they convey a modal relationship between some property or condition and the complement proposition, and assert that this condition was met – they also underline the necessity/sufficiency puzzle described above, and thus the difficulty faced in assigning an implicative-style analysis to *enough/too* constructions. As noted, the necessity relationship captured by defining d as the degree of speed that makes it possible for Juno to win the race would lead us to expect non-defeasible implicative inferences from negative *enough* and positive *too* constructions. But, as we have seen, the inferences in both of these cases are defeasible – except under perfective marking.

The rough view that emerges is this: while both implicative and *enough/too* constructions background a modal relationship between the matrix property and the complement, this modal relationship is, in some sense to be made precise, more semantically accessible or malleable for *enough/too* constructions than it is for implicatives. We observe that, while both constructions convey information about the status of a matrix-specified condition, the assertion of a lexical implicative – that the condition was met – leads to direct conclusions

⁵These paraphrases are loosely based on Nelson (1980); as we look more closely at the compositional semantics of *enough* and *too* constructions, we will refine them.

about the truth-value of the complement, while *enough/too* assertions – attributing a certain degree of the matrix adjective to the sentential subject – in some cases allow only a modalized conclusion about the complement.

If implicative inferences in *enough* and *too* constructions can be unified with the entailments of lexical implicatives, then we expect to find implicativity just in case all three of the features described in Table 4.1 come together in composition. I will show that the majority of *enough* and *too* constructions satisfy some of these requirements, but it is only under very specific circumstances that all three conditions are met. In order to understand how and why they come together – in the composition of complex *enough* and *too* predicates, and in the way these predicates interact with aspectual marking – we first need to establish the full range of inferential behaviour associated with *enough* and *too* constructions.

4.2 Two approaches to *enough* and *too* constructions

4.2.1 Covert modality and modal flavour: Meier (2003)

The most prominent treatment of *enough/too* constructions is due to Meier (2003). She focuses on English data, offering a semantic analysis on which *enough/too* constructions are essentially non-implicative. On her account, the ‘optionality’ of *enough/too* implicativity is attributed to variation in the flavour of a modal relationship between the matrix predicate and the *enough/too* complement.⁶ The compositional details of Meier’s proposal are rather complicated. As I will ultimately pursue an alternative structural analysis for *enough/too* constructions, I only present an overview of Meier’s proposal here.

Meier treats *enough/too* constructions as degree comparatives, distinguished from standard comparatives (like *more*, *less*, *-er*) by the inclusion of a modal element. On her account, modality is localized in the *enough/too* complement. *Enough* and *too* are treated as simple comparative operators, with one special feature: they require an infinitival complement

⁶The fact that *enough/too* constructions can vary in modal flavour – and the observation that this affects their interpretation with respect to the truth of the *enough/too* complement – was also noted much earlier by Nelson (1980), but has not otherwise been remarked upon. Meier (2003) provides the first comprehensive proposal for the compositional semantics of *enough/too* constructions, as well as the first attempt to derive the observed implicative behaviour from variation in modal flavour.

which is necessarily modal.

Meier's argument for locating modality in the complement is based on the strong intuitive similarity between examples like (4.21a), where no modal appears at surface structure, and its overly modalized counterpart (4.21b).

- (4.21) a. Bertha is old enough to drive.
 b. Bertha is old enough to be allowed to drive.

Assuming the semantic equivalence of (4.21a) and (4.21b), Meier's *enough/too* constructions have the structure represented in (4.22). The modal operator indicated in (4.22) is required – by *enough* and *too* – to appear as part of the infinitival complement, but on her view is potentially (and often) covert.

(4.22) **Meier's hypothesis** (2003; p.71):

$$X \text{ is } \left\{ \begin{array}{l} \text{adj. } \textit{enough} \\ \textit{too} \text{ adj.} \end{array} \right\} p := X \text{ is } \left\{ \begin{array}{l} \text{adj. } \textit{enough} \\ \textit{too} \text{ adj.} \end{array} \right\} \text{MODAL } p$$

A standard comparative operator like *-er* is analyzed as taking two open degree predicates, and comparing them on the basis of the range of values which makes each predicate true (Cresswell, 1976; Bierwisch, 1987; von Stechow, 1984; Kennedy, 2001). Thus, if a gradable adjective like *tall* is taken to relate an individual to an interval of degrees (assigning true if d less than or equal to the individual's maximum height), the comparative *-er* simply needs to check if one predicate is satisfied by a greater range of values than the other.⁷

(4.23) $\llbracket \text{tall} \rrbracket = \lambda w \lambda d \lambda x. \text{HEIGHT}(x)(w) \geq d,$

where HEIGHT is a measure function associated with *old*, assigning to every individual a unique (maximal) degree of age in a given world w .

(4.24) $\llbracket \text{-er} \rrbracket := \lambda w \lambda P_{dt} \lambda Q_{dt}. \forall d [P(d) = 1 \rightarrow Q(d) = 1] \wedge \exists d [Q(d) = 1 \wedge P(d) = 0]$

(Kennedy, 2001)

⁷Evaluating comparatives in this way thus requires us to add to our semantic ontology a set of numerical degrees, which will be represented as having type d . See also Section 5.1.2 of Chapter 5.

To cash out (4.22), since *enough* and *too* select for a modalized complement, rather than a second degree predicate, Meier must build into their semantics not only a comparative operation, but also a way for them to recover a second degree predicate from this complement clause. She proposes that the second degree predicate is supplied by a ‘hidden’ conditional, formed by taking the matrix clause as antecedent, and the infinitival complement as consequent. (4.25a-i)-(4.25b-i) give the ‘hidden’ conditionals associated with (4.25a)-(4.25b), respectively, and (4.25a-ii)-(4.25b-ii) provide paraphrases indicating how the conditional features in the truth conditions Meier is after.

- (4.25) a. Bertha is old enough to drive a car.
- i. *Hidden conditional*: If Bertha is *d*-old, she is allowed to drive a car.
 - ii. *Paraphrase*: Bertha’s age in the real world is at least as great as the (minimum) age *d* such that, if Bertha is *d*-old, she is allowed to drive a car.
- b. Bertha is too young to drive a car.
- i. *Hidden conditional*: If Bertha is *d*-old, she is allowed to drive a car.
 - ii. *Paraphrase*: Bertha’s age in the real world is less than the (minimum) age *d* such that, if Bertha is *d*-old, she is allowed to drive a car.

The idea that certain constructions embed a covert modal has precedent in the analysis of regular conditionals: the standard Lewis-Kratzer semantics assumes that an apparently ‘bare’ conditional like (4.26) contains a modal quantifier, which is restricted by the conditional antecedent (see Kratzer, 1986, 2012).

- (4.26) If my hen has laid eggs today, then the Cologne cathedral will collapse tomorrow morning. (Kratzer, 1986)
- ≡ [MUST: my hen has laid eggs today] [the Cologne cathedral will collapse tomorrow morning]

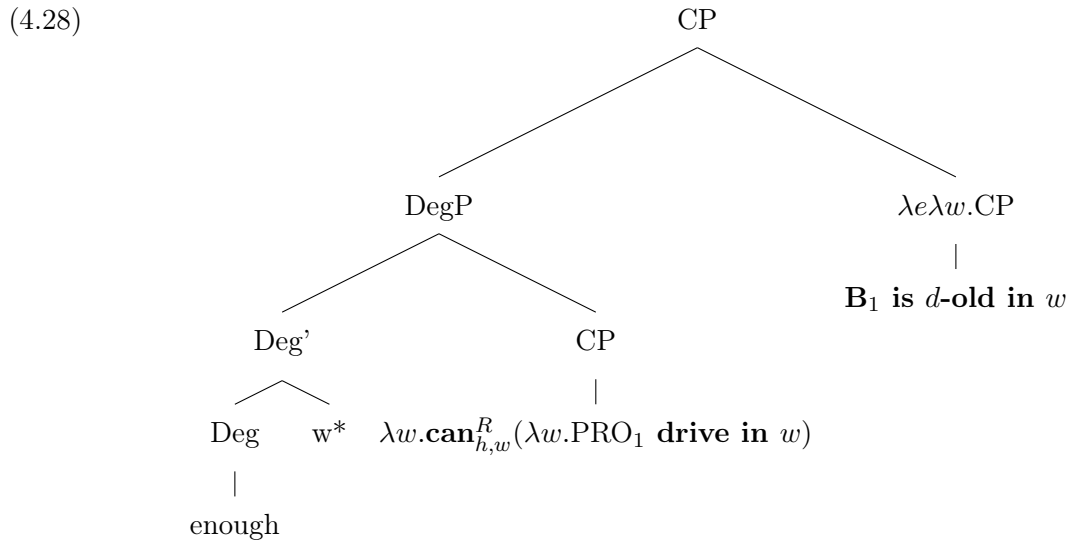
The key difference between a covert modal in a conditional like (4.26) and the covert modal postulated by Meier for an *enough/too* hidden conditional is that, while (4.26) defaults to a universal quantifier, the default in *enough/too* cases is instead to existential force. This is

illustrated by the evident non-equivalence of (4.21a) and (4.27): (4.21a) is easily interpreted to indicate that Bertha's age is at least 16 (assuming it is uttered in the United States), while (4.27) is pragmatically anomalous, insofar as it suggests a state of affairs in which there is an age after which one is legally required to drive.

(4.27) Bertha is old enough to be required to drive a car. \neq (4.21a)

To capture the parallel with conditionals in a compositional manner, Meier treats the complement of an *enough/too* construction as an 'open' conditional, which requires a proposition for its antecedent. This slot is filled by the open degree predicate in the matrix clause, thereby producing a second (conditional) degree predicate to feed to the comparative operation. Consequently, the matrix clause appears in two places in the composition: Meier's lexical entries for *enough* and *too* achieve this by supplying (a copy of) the matrix clause to the open conditional complement.

Meier assumes a structure on which *enough/too* and their complements form a constituent that raises above the matrix clause, in parallel with standard treatments of *-er* (see Cresswell, 1976; Bierwisch, 1987; von Stechow, 1984; Kennedy, 2001).



Enough and *too* are treated as two-place operators over the matrix and complement clauses: *enough* performs an equative operation (similar to *as ADJ as*), while *too* is a true comparative

like *-er*. I provide Meier’s lexical entries in (4.29):⁸

- (4.29) a. $\llbracket \text{enough} \rrbracket := \lambda w \lambda Q \lambda P. \text{MAX}(\lambda d. P(d)(w)) \geq \text{MIN}(\lambda d'. P(d'))$
 b. $\llbracket \text{too} \rrbracket := \lambda w \lambda Q \lambda P. \text{MAX}(\lambda d. P(d)(w)) > \text{MAX}(\lambda d'. P(d'))$

Putting everything together, we get the interpretations in (4.30) for (4.21a) and its negation.⁹ The positive *too* case produces an equivalent interpretation to (4.30b), while the negative case is equivalent to (4.30a). I refer to Meier (2003) for the precise details. The superscript on the modal indicates Meier’s (somewhat idiosyncratic) relational use of *can*, on which it requires an antecedent proposition to restrict its domain of quantification. Meier (2003) collapses the two conversational backgrounds of the Kratzer (1981) semantics to a single parameter, represented here by *h*. I represent the set of worlds picked out by *h* with ACC_h in the the derivations below.

- (4.30) a. Bertha is old enough to drive \equiv (4.21a)
 i. $\equiv \llbracket \text{enough} \rrbracket(w^*)(\lambda w. \lambda P. \text{CAN}^R(w)(h)(\text{PRO}_1 \text{ drive in } w)(P))$
 $(\lambda w \lambda d. \text{B}_1 \text{ is } d\text{-old in } w)$

⁸I have glossed over a number of the details of Meier (2003)’s account here, including the fact that she takes as her starting point the extent semantics for gradable adjectives proposed in von Stechow (1984), rather than the more standard degree approach (Cresswell, 1976). Extents are represented by particular types of intervals on a scale: for example, a positive extent (of height) is represented by an interval of the form $[0, n]$, where n is a positive real number. Just as the degree semantics associates an individual with a range of degrees up to and including their (maximum) height, the extent semantics associates an individual with a set of extents with the same character. The MAX and MIN operators in (4.29) thus pick out extents (intervals), rather than individual degrees, and, as a consequence of how the ordering on positive and negative extent is defined, the direction of the underlying comparison operation can remain constant, despite the fact that the intuitive paraphrase assigned to *enough* composed with a positive polar adjective requires a different distribution of maximums and minimums than does the paraphrase assigned to *enough* with a negative polar adjective.

- (i) a. Bertha is old enough to drive.
 \sim *The maximum degree of age that Bertha has in the actual world is at least as great as the minimal degree d of age such that, if Bertha is at least d -old in the actual world, she can drive (in view of the law).*
 b. Bertha is young enough to buy a half-price ticket.
 \sim *The maximum degree of age that Bertha has in the actual world is at least as small as the maximum degree d of age such that, if Bertha is d -old in the actual world, she can buy a half-price ticket (in view of the ticket regulations).*

⁹I omit a derivation of the *too* cases here, because the details rely on von Stechow’s extent semantics (von Stechow, 1984), which I do not introduce.

- ii. $\equiv \text{MAX}(\lambda d. B_1 \text{ is } d\text{-old in } w^*) \geq \text{MIN}(\lambda d. \exists w \in \text{ACC}_h(w^*) :$
 $(B_1 \text{ is } d\text{-old in } w)(B_1 \text{ drives in } w))$
- iii. *The maximum age d such that Bertha is d -old in the actual world is at least as great as the minimum age d' such that, in some accessible world where Bertha is d' -old, Bertha drives.*
- b. Bertha is not old enough to drive.
 - i. $\equiv \neg[\llbracket \text{enough} \rrbracket(w^*)(\lambda w. \lambda P. \text{CAN}^R(w)(h)(\text{PRO}_1 \text{ drive in } w)(P))$
 $(\lambda w \lambda d. B_1 \text{ is } d\text{-old in } w)]$
 - ii. $\equiv \neg \text{MAX}(\lambda d. B_1 \text{ is } d\text{-old in } w^*) \geq \text{MIN}(\lambda d. \exists w \in \text{ACC}_h(w^*) :$
 $(B_1 \text{ is } d\text{-old in } w)(B_1 \text{ drives in } w))$
 $\equiv \text{MAX}(\lambda d. B_1 \text{ is } d\text{-old in } w^*) < \text{MIN}(\lambda d. \exists w \in \text{ACC}_h(w^*) :$
 $(B_1 \text{ is } d\text{-old in } w)(B_1 \text{ drives in } w))$
 - iii. *The maximum age d such that Bertha is d -old in the actual world is less than the minimum age d' such that, in some accessible world where Bertha is d' -old, Bertha drives.*

These interpretations capture the paraphrases proposed by Meier in (4.25). Moreover, it is clear that, unless the accessibility relation contains only the actual world, this semantics will not produce implicative entailments. In fact, we only expect implicative inferences in the past tense (discussed in Section 4.3.5), but since layering the past tense over the preceding examples simply locates the time of Bertha being d -old in the past, this should not systematically affect the composition of the accessibility relation.

Given this analysis, Meier ties the implicative behaviour of *enough/too* constructions to features of the utterance/interpretation context which affect the selection of a modal accessibility relation. Specifically, she points out that the optionality of implicative behaviour is correlated with the type of modality that an *enough/too* construction invokes.

- (4.4) a. Juri was clever enough to leave early. \rightsquigarrow *Juri left early.*

- b. Juri was clever enough to be a rocket scientist.

$\not\models$ *Juri was a rocket scientist.*

Where (4.4a) invites us to consider alternative possibilities in which the basic circumstances of the actual world are fixed, (4.4b) instead appeals to ‘ideals’ (in view of which very clever people ‘ought’ to be scientists). Since there is no reason why the real world should be included in a set of worlds that conforms to these ideals, there is no reason to expect an implicative inference from (4.4b). On the other hand, she suggests that (4.4a) not only appeals to a realistic modal base, in which circumstances of the actual world are held constant, but in fact involves a *totally realistic* modal base. As previously discussed, this reduces the domain of quantification for a modal to a singleton set containing the actual world; this is represented in (4.31) as CIRC_{TR} . Interpreted with respect to a totally realistic modal base, possibility and necessity collapse. In order for the hidden condition in (4.31a) to provide a comparison degree, the set of degrees corresponding to the conditional *If Juri is d-clever, she can leave early* must be nonempty: this requires that there is some accessible world (where Juri has a measurable intelligence) in which Juri leaves early. Since there is only one accessible world, the world in which she leaves early can only be the actual world.

- (4.31) a. Juri was clever enough to leave early.
 b. $\llbracket \text{enough} \rrbracket(w^*)(\lambda w. \lambda P. \text{CAN}^R(w)(h)(\text{PRO}_1 \text{ leave-early in } w)(P))$
 $(\lambda w \lambda d. J_1 \text{ is } d\text{-clever in } w)$
 c. $\text{MAX}(\lambda d. J \text{ is } d\text{-clever in } w^*) >$
 $\text{MAX}(\lambda d. \exists w \in \text{CIRC}_{\text{TR}}(w^*) : (J \text{ is } d\text{-clever in } w)(J \text{ leave-early in } w))$
 d. *The maximum degree d to which Juri is clever in the actual world is at least as great as the minimum degree d' such that, in some accessible world where she is d' clever, she leaves early.*

Meier’s analysis has two immediate positive consequences with respect to the implicative behaviour of *enough/too* constructions. First, since context determines the type of modality which is relevant for the interpretation of a particular *enough/too* construction, she has a

natural explanation for the defeasibility of implicative inferences when they do arise. On her account, cancelling an inference involves (overtly) indicating that the set of alternatives considered should include more than just the actual world. Secondly, by making the modal flavour wholly responsible for the presence or absence of implicative inferences, she explains why inferences do not arise with examples like (4.30a) and (4.30b): both examples invoke the legal connection between age and driving, and thus appeal to a deontic modality. This allows us to narrow the paraphrases provided above: for (4.30a) and (4.30b), we compare the age that Bertha has in the actual world to her age in those worlds where certain relevant circumstances of the world are fixed by the modal base, and in which she drives while violating the fewest laws. Since we typically do not assume that the real world is one in which laws (about driving or other matters) are necessarily followed, nor that the real world is one in which we necessarily act on our legal rights, there is no reason to conclude that Bertha either drove (example 4.30a) or did not drive (example 4.30b) in the real world, only that it is either legal or illegal (in view of her age) for her to do so.

Issues with Meier's account

Although Meier's link between modal flavour and optionality in implicative inferences is intuitively correct, her implementation creates several problems. Setting aside its compositional complexity, and focusing just on implicative behaviour, the first problem is that the proposal that implicative inferences arise just in case the context indicates a totally realistic accessibility relation seems to require more from context than it actually needs to provide. Specifically, this does not explain why implicative readings for examples like (4.4a) and (4.5a), below, seem to be invited even in the absence of a discourse context.

(4.5a) Juno was fast enough to win the race. \leadsto *Juno won the race.*

One way around this objection might be to say that there is some 'default' or stereotypical context for these cases, though this would require further explanation. A more serious problem arises, however, when we consider how this might work for positive *too* and negative *enough* constructions.

It turns out that a totally realistic modal base cannot derive the complement inferences licensed by (4.6a) or (4.5b), repeated below:

(4.6a) Juno was too slow to win the race. \leadsto *Juno did not win the race.*

(4.5b) Juno was not fast enough to win the race. \leadsto *Juno did not win the race.*

Suppose that (4.5b) is interpreted, as Meier suggests, with respect to a totally realistic modal base. As in the positive case, this narrows the set of possible worlds under consideration to just one: the actual world. In order for the conditional *If Juno is d-fast, she can win the race* to supply a comparison degree, it must return a non-empty set of degrees. So, as before, the actual world must be one in which Juno wins the race. But this is precisely the opposite of the inference we aim to derive.

The role played by aspect (observed by Hacquard 2005 subsequently to Meier 2003) also presents a complication for the totally-realistic explanation of *enough/too* implicative behaviour. Recall the semantics of the perfective operator as given in Chapter 2:

$$(2.23a) \quad \llbracket \text{PFV} \rrbracket := \lambda w \lambda t \lambda P. \exists e [\tau(e) \subseteq t \wedge P(w)(e)]$$

Glossing over the details of adapting Meier's analysis to the event-based framework, this would give us roughly the interpretation below for (4.32a), which is the perfectly-marked French version of (4.5a).

(4.32) a. *Juno a été assez rapide pour gagner la course.*

‘Juno was-PFV fast enough to win the race.’

$$\begin{aligned} \text{b. } &\equiv \llbracket \text{PST} \rrbracket (\llbracket \text{PFV} \rrbracket (\llbracket \text{enough} \rrbracket (w^*) (\lambda w. \lambda P. \text{can}^R(w)(h)(\text{PRO}_1 \text{ win-race in } w)(P)) \\ &\quad (\lambda w \lambda e \lambda d. \text{SPEED}(J_1)(d)(e)(w)))) \\ &\equiv \exists e [\tau(e) \subseteq t \{t \prec_i t^*\} \wedge [(\text{SPEED}(J) \geq d)(e)(w^*) \wedge d = \min\{d' | \exists w \in \text{ACC}_h(w^*) : \\ &\quad \exists e' [(\text{SPEED}(J)) \geq d'](e')(w) \wedge \text{win-race}(J)(e')(w)]]] \end{aligned}$$

c. *At some time interval t prior to utterance time, there is a real-world eventuality of Juno's (maximal) speed being at least d such that the run-time of this eventuality is contained in t , and where d is defined as the minimum speed such that*

there is some accessible world where Juno is d-fast and Juno wins the specified race.

On the surface, this limits the period of time during which the speed that makes race-winning possible is attributed to Juno, perhaps suggesting that she no longer has this speed. It does not in any obvious way force us to constrain the set of worlds which we consider in deriving the comparison degree *d*. Specifically, while (4.32a) might be evaluated with respect to a totally realistic accessibility relation, there is no reason why this should not, as in Meier's explanation for the English version, remain a defeasible assumption. As we have seen, however, (4.32a) is incompatible with a denial that Juno actually won the race.

(4.33) *Juno a été assez rapide pour gagner la course, #mais elle n'a pas gagné.*

‘Juno was-PFV fast enough to win the race, #but she did not win.’

In the search for a unified explanation of the English and French data, then, we need to link implicative behaviour to something other than (or perhaps in addition to) the modal flavour of the relationship between matrix predicate and *enough/too* complement.

On a related note, it is worth observing that the effect of aspectual marking in French also gives us a way of testing the basic assumption of Meier's analysis: that is, the claim that the modality of an *enough/too* construction is necessarily located in the complement. If (4.34a) and (4.34b) are semantically equivalent, then any entailments or logical consequences of one sentence should also follow from the other. This is plausible when we consider the defeasible implicative inferences associated with the English examples, but makes a clear prediction about what will happen under perfective marking in French: if (4.35a) entails that Juno won the race, then a semantically equivalent (4.35b) should do so as well.

(4.34) a. Juno was fast enough to win the race. \leadsto *Juno won the race.*

b. Juno was fast enough to be able to win the race. \leadsto *Juno won the race.*

(4.35) a. *Juno a été assez rapide pour gagner la course.*

‘Juno was-PFV fast enough to win the race.’ \vdash *Juno won the race.*

b. *Juno a été assez rapide pour pouvoir gagner la course.*

‘Juno was-PFV fast enough to can-INF win-INF the race.’

⊭ *Juno won the race.*

This prediction does not seem to be upheld. While my informants expressed a general tendency to interpret (4.35b) as indicating that Juno did in fact win the race, they were able – with some thought – to accept a continuation canceling this inference in the case of (4.35b), but not in the case of (4.35a). While the judgements in this case remain tentative, this contrast is suggestive of an underlying semantic difference between *enough/too* constructions with ‘covertly’ vs overtly modal complements. As far as implicative interpretations are concerned, it seems as if the interaction between modality and aspect that contributes to an actuality/implicative entailment does not apply ‘at a distance’ (that is, does not extend to a modal embedded in the infinitival complement). Consequently, the contrast in (4.35) should lead us to question the basic structure (4.22) of Meier’s *enough/too* constructions, and to look instead for a semantic treatment on which the built-in modality of *enough/too* constructions is located not in their complements, but instead in the matrix predicate, as it is for implicative verbs.

One final issue with the architecture proposed by Meier (2003) has to do with the very specific requirements her proposal imposes on the arguments of *enough* and *too*. Motivated to some extent by existing analyses of *-er* and other comparatives, Meier’s semantics for *enough* and *too* requires a complement clause. Moreover, the complement clause must represent an ‘open’ conditional if it is to produce a degree comparative with the intuitively correct meaning. These assumptions are challenged, however, by the apparent acceptability of ‘truncated’ *enough/too* constructions like (4.36)-(4.37).

(4.36) γThe baby’s mother carried him home and took care of him. And when he was old enough, she took him to the king’s daughter, who adopted him.

(4.37) γ“Pesireron’s punch was powerful, but he was too slow,” Park said later in a nationally televised interview in Chonju, about 125 miles south of Seoul.

It is intuitively clear in both examples that the *enough/too* predicates are evaluated with

respect to some standard which is not made explicit; Meier’s analysis might be rescued by treating these as cases of ellipsis. However, I want to suggest that an ultimately more parsimonious explanation would be one in which the infinitival complement is not grammatically required to appear – that is, one in which (at least some) features of the standard of comparison can be recovered in a purely pragmatic sense. Ultimately, the availability of ‘truncated’ *enough/too* structures represents another argument for locating the modality of *enough/too* constructions in the matrix predicate, rather than relegating it to the complement clause: if *enough/too* comparisons always involve degree comparisons with a modal component, it is reasonable to assume that the source of the modal component lies in the obligatory elements of the construction.

4.2.2 The implicative treatment: Hacquard (2005)

Hacquard (2005) proposes just such an account, locating modality in the semantics of *enough* and *too*. While Meier takes *enough/too* constructions to be basically non-implicative and aims to explain implicative behaviour on a wholly context-dependent basis, Hacquard flips the narrative. For her, *enough/too* constructions are semantically (‘at base’) implicative, with the lexical entries she proposes for *enough* and *too* enforcing an implicative-type necessary and sufficient condition. On this view, it is the defeasibility of certain implicative inferences that needs to be explained, rather than the presence of implicative entailments in certain cases.

Hacquard’s central observation, and the motivation for her proposal, was already presented in Section 4.1. Under perfective marking, a French *enough/too* construction like (4.9a) or (4.10a) licenses non-defeasible implicative entailments; these inferences become cancellable under the imperfective aspect, as shown in (4.11) and (4.12).

(4.9a) *Jean a été assez rapide pour s’enfuir, #mais il ne s’est pas enfui.*

‘Jean was-PFV fast enough to escape, #but he did not escape.’

(4.10a) *Jean a été trop lent pour s’enfuir, #mais il s’est enfui.*

‘Jean was-PFV too slow to escape, #but he escaped.’

(4.11) *Jean **était assez rapide** pour s'enfuir, mais il ne s'est pas enfui.*

‘Jean was-IMPF fast enough to escape, but he did not escape.’

(4.12) *Jean **était trop lent** pour s'enfuir, mais il s'est enfui.*

‘Jean was-IMPF too slow to escape, but he escaped.’

These patterns argue against a fully pragmatic account of *enough/too* implicativity, since the role played by aspect indicates that the inference patterns are (in some way) “grammatically encoded” (Hacquard, 2005, p.80).

Hacquard draws a direct parallel between *enough/too* implicative inferences and actuality entailments, leading her to pursue an analysis inspired by Bhatt’s (1999) proposal for ABLE (see Section 3.1). On her proposal, *enough/too* constructions share the semantic structure of implicative statements. Notably, her approach to implicative semantics follows Karttunen’s original schema, rather than Karttunen and Peters’s (1979) ‘direct assertion’ account (Section 3.2.2). On Karttunen’s (1971) view, the ‘central part’ $v(S)$ of an implicative assertion with verb v is presupposed to be both necessary and sufficient for the realization of the implicative complement S .

(4.38) **Karttunen’s implicative schema.** (Karttunen, 1971, p.352)

a. *Presupposition:* $v(S)$ is a necessary and sufficient condition for S

b. *Proposition:* $v(S)$

Schema 4.38 shares the structure of the prerequisite account proposed in Chapter 3 (Proposal 3.50), but does not specify anything about the modal flavour of the necessity/sufficiency condition.

Like Meier, Hacquard takes the basic meaning of *enough* and *too* constructions to be a degree comparison. She proposes that the relevant necessary and sufficient condition equates possession of a particular degree of the matrix adjective with the realization of the *enough/too* complement. Modality, on this account, will again be associated with the type of necessary and sufficiency invoked by the juxtaposition of the matrix adjective and the infinitival complement.

(4.39) *Jean a été assez rapide pour s'enfuir.*

‘Jean was-PFV quick enough to escape.’

- a. *Presupposes:* There is a degree d of quickness which is necessary and sufficient for Jean to escape.
- b. *Asserts:* Jean had the necessary/sufficient degree d of quickness.

Neither necessity nor sufficiency, independently of the other presupposition, will produce the entailments we are after. Assuming a necessity-only analysis, we get the non-actualization entailment from negative *enough* constructions, but nothing enforces the positive entailment:

(4.40) *Presuppose:* There is a degree d of quickness which is necessary for Jean to escape

a. *Jean a été assez rapide pour s'enfuir.*

‘Jean was-PFV quick enough to escape.’

- i. \sim *Jean's quickness is at least as great as the quickness necessary for him to escape.*
- ii. \nvdash Jean escaped.

b. *Jean n'a pas été assez rapide pour s'enfuir.*

‘Jean was-PFV not quick enough to escape.’

- i. \sim *Jean's quickness is less than the quickness necessary for him to escape.*
- ii. \vdash Jean did not escape (since he did not satisfy a necessary condition for escaping).

The inverse problem arises if we associate *enough/too* constructions with a sufficiency-only presupposition:

(4.41) *Presuppose:* There is a degree d of quickness which is sufficient for (ensures) Jean's escape.

a. *Jean a été assez rapide pour s'enfuir.*

‘Jean was-PFV quick enough to escape.’

- i. \sim *Jean's quickness is at least as great as the quickness which ensures his escape.*
- ii. \vdash Jean escaped (since his quickness guaranteed it).
- b. *Jean n'a pas été assez rapide pour s'enfuir.*
'Jean was-PFV not quick enough to escape.'
 - i. \sim *Jean's quickness is less than the quickness which ensures his escape.*
 - ii. \nvdash Jean did not escape (it might still have been possible, though not ensured).

Consequently, Hacquard argues that the implicative interpretation of *enough/too* constructions like (4.9a) and (4.10a) must reflect the relevance of a condition that is both necessary and sufficient for the realization of the *enough/too* complement. This leads her to the following formulation of *enough* and *too* presuppositions: recall that *enough* predicates correspond to polarity-preserving implicatives, while *too* predicates correspond to polarity-reversing implicatives.¹⁰

- (4.42) a. X is ADJ *enough* to Q (in w)
Presupposes: $\iota d : \forall w' \in \text{ACC}(w) [X \text{ is } d\text{-ADJ in } w' \leftrightarrow Q(X)(w')]$
- b. X is *too* ADJ to Q (in w)
Presupposes: $\iota d : \forall w' \in \text{ACC}(w) [X \text{ is } d\text{-ADJ in } w' \leftrightarrow \neg Q(X)(w')]$

The necessary and sufficient condition of *enough/too* constructions is thus supplied by either *enough* or *too*, while the matrix adjective does the work of specifying the nature of the condition (in contrast to lexical implicatives, which encode both pieces of information). Hacquard's lexical entries for *enough* and *too* are in (4.43). As in Meier's analysis, the comparative operators take the other components of the sentence as arguments; here, they represent three-place operators over a predicate of degrees, a (closed) propositional complement, and an individual.

¹⁰The presence of the ι operator, which introduces a unique necessary/sufficient degree in (4.42a)-(4.42b) is attributed to a "definite description of degrees" contained in the *too* and *enough* operators (Hacquard, 2005, p.85).

$$\begin{aligned}
(4.43) \quad \text{a. } \llbracket \text{enough} \rrbracket &:= \lambda w \lambda P_{dest} \lambda Q_{st} \lambda x. P(\iota d : \forall w' \in \text{ACC}(w) \\
&\quad [Q(w') \leftrightarrow P(d)(x)(w')])(x)(w) \\
\text{b. } \llbracket \text{too} \rrbracket &:= \lambda w \lambda P_{dest} \lambda Q_{st} \lambda x. P(\iota d : \forall w' \in \text{ACC}(w) \\
&\quad [\neg Q(w') \leftrightarrow P(d)(x)(w')])(x)(w)
\end{aligned}$$

Recall, from Section 4.2.1, that a positive polar adjective like *fast*, in (4.44a), will return true of an individual and a degree just in case the individual has at least that degree in the world of evaluation. A negative polar adjective inverts the relationship, as shown in (4.44b) (cf. Heim, 2001).

$$\begin{aligned}
(4.44) \quad \text{a. } \llbracket \text{fast} \rrbracket &:= \lambda w \lambda d \lambda x. \text{SPEED}(x)(w) \geq d \\
\text{b. } \llbracket \text{slow} \rrbracket &:= \lambda w \lambda d \lambda x. \neg(\text{SPEED}(x)(w) \geq d) \quad (\equiv \lambda w \lambda d \lambda x. \text{SPEED}(x)(w) < d)
\end{aligned}$$

Necessity and sufficiency are encoded in the equivalence relationships in (4.43), indicated by \leftrightarrow . As a polarity-reversing operator (in the implicative sense), *too* equates a particular degree of the matrix adjective with the non-actualization of the implicative complement (see also Section 3.6.3).¹¹ Thus, Hacquard's entries for *enough* and *too* involve a comparison between the unique degree of the matrix adjective identified in the presuppositions in (4.42) and the optimal (maximal or minimal, depending on adjective polarity) degree associated with the sentential subject in the world of evaluation.

Setting aside the effects of tense and aspect for the moment, we get the desired interpretations for the sentence radicals in (4.45)-(4.46). The interpretations for (4.45a) and (4.46b) are equivalent to one another, as are the interpretations for (4.45b) and (4.46a).

(4.45) Derivations for *enough* sentence radicals (Hacquard, 2005):

- a. Jean be fast enough to escape
 - i. $\equiv \llbracket \text{enough} \rrbracket(w^*)(\lambda w \lambda d \lambda x. x \text{ is } d\text{-fast in } w)(\lambda w \lambda x. x \text{ escape in } w)(J)$
 - ii. $\text{SPEED}(J)(w^*) \geq (\iota d : \forall w \in \text{ACC}(w^*)[\text{escape}(J)(w) \leftrightarrow \text{SPEED}(J)(w) \geq d])$

¹¹Combined with the semantics for gradable adjectives in (4.44), the semantics in (4.43b) for *too* will produce the same presupposition as a *enough* construction, provided that *too* is given the opposite polar adjective. This enforces an intuitively correct duality relationship between *enough* and *too* constructions.

- iii. *Jean has (at least) the speed d in the actual world such that, in all worlds w accessible from the actual world, having at least speed d in w is equivalent to (i.e., necessary and sufficient for) escaping in w*

b. Jean not be fast enough to escape

$$\text{i. } \equiv \neg \llbracket \text{enough} \rrbracket(w^*)(\lambda w \lambda d \lambda x. x \text{ is } d\text{-fast in } w)(\lambda w \lambda x. x \text{ escape in } w)(J)$$

$$\begin{aligned} \text{ii. } & \neg [\text{SPEED}(J)(w^*) \geq (\iota d : \forall w \in \text{ACC}(w^*) \\ & \quad [\text{escape}(J)(w) \leftrightarrow (\text{SPEED}(J)(w) \geq d])]) \\ & \equiv \text{SPEED}(J)(w^*) < (\iota d : \forall w \in \text{ACC}(w^*) \\ & \quad [\text{escape}(J)(w) \leftrightarrow \text{SPEED}(J)(w) \geq d])] \end{aligned}$$

- iii. *Jean's speed in the actual world is less than the speed d such that, in all worlds w accessible from the actual world, having at least speed d in w is equivalent to (i.e., necessary and sufficient for) escaping in w*

(4.46) Derivations for *too* sentence radicals (Hacquard, 2005):

a. Jean be too slow to escape.

$$\text{i. } \equiv \llbracket \text{too} \rrbracket(w^*)(\lambda w \lambda d \lambda x. x \text{ is } d\text{-slow in } w)(\lambda w \lambda x. x \text{ escape in } w)(J)$$

$$\begin{aligned} \text{ii. } & \neg [\text{SPEED}(J)(w^*) \geq (\iota d : \forall w \in \text{ACC}(w^*) \\ & \quad [\neg \text{escape}(J)(w) \leftrightarrow \neg (\text{SPEED}(J)(w) \geq d])]) \\ & \equiv \text{SPEED}(J)(w^*) < (\iota d : \forall w \in \text{ACC}(w^*) \\ & \quad [\text{escape}(J)(w) \leftrightarrow \text{SPEED}(J)(w) \geq d])] \end{aligned}$$

- iii. *Jean's speed in the actual world is less than the speed d such that, in all worlds w accessible from the actual world, having at least speed d in w is equivalent to (i.e., necessary and sufficient for) escaping in w*

b. Jean not be too slow to escape.

$$\text{i. } \equiv \neg \llbracket \text{too} \rrbracket(w^*)(\lambda w \lambda d \lambda x. x \text{ is } d\text{-slow in } w)(\lambda w \lambda x. x \text{ escape in } w)(J)$$

$$\begin{aligned} \text{ii. } & \neg [\neg [\text{SPEED}(J)(w^*) \geq (\iota d : \forall w \in \text{ACC}(w^*) \\ & \quad [\neg \text{escape}(J)(w) \leftrightarrow \neg (\text{SPEED}(J)(w) \geq d])])] \end{aligned}$$

$$\begin{aligned} &\equiv \text{SPEED}(J)(w^*) \geq (\iota d : \forall w \in \text{ACC}(w^*) \\ &\quad [\text{escape}(J)(w) \leftrightarrow \text{SPEED}(J)(w) \geq d]) \end{aligned}$$

- iii. *Jean has (at least) the speed d in the actual world such that, in all worlds w accessible from the actual world, having at least speed d in w is equivalent to (i.e., necessary and sufficient for) escaping in w*

As in Meier's account, the accessibility relation (ACC , as defined by the joint contribution of a modal base and ordering source) does important work here. Hacquard argues that examples like (4.9a) and (4.10a) appeal to circumstantial modality. This makes ACC in this case a reflexive relation, meaning that the actual world will be included in the set of alternatives under consideration. Thus, if all accessible worlds are such that having a particular degree d of speed is equivalent to (i.e., necessary and sufficient for) escaping, the actual world will also have this property. Since, by assertion, Jean either has or does not have this necessary and sufficient speed in the actual world, the positive or negative entailment follows immediately from the combination of presupposition and assertion. This parallels the derivation of lexical implicative entailments in Chapter 3.

We maintain non-entailment for deontic *enough* and *too* constructions, as desired. Here, I represent the set of worlds that results from combining a circumstantial modal base and deontic ordering source by DEON . In the terms presented in Section 2.1.2 of Chapter 2, $\text{DEON}(w) = \text{Opt}_{\text{DEON}(w)}(\cap \text{CIRC}(w))$, for any world w .

- (4.47) a. Bertha be old enough to drive

- i. $\equiv \llbracket \text{enough} \rrbracket(w^*)(\lambda w \lambda d \lambda x. x \text{ is } d\text{-old in } w)(\lambda w \lambda x. x \text{ drive in } w)(B)$
- ii. $\text{AGE}(B)(w^*) \geq (\iota d : \forall w \in \text{DEON}(w^*) [\text{drive}(B)(w) \leftrightarrow \text{AGE}(B)(w) \geq d])$
- iii. *Bertha has (at least) the age d in the actual world such that, in all worlds w where the driving laws are the same as ours, and are not violated, having age d is necessary and sufficient for driving in w .*

- b. Bertha not be old enough to drive

- i. $\equiv \neg \llbracket \text{enough} \rrbracket(w^*)(\lambda w \lambda d \lambda x. x \text{ is } d\text{-old in } w)(\lambda w \lambda x. x \text{ drive in } w)(B)$

- ii. $\neg[\text{AGE}(B)(w^*) \geq (\iota d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \leftrightarrow (\text{AGE}(B)(w) \geq d])])]$
 $\equiv \text{AGE}(B)(w^*) < (\iota d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \leftrightarrow \text{AGE}(B)(w) \geq d])]$
- iii. *Bertha's age in the actual world is less than the age d such that, in all worlds w where the driving laws are the same as ours, and are not violated, having age d is necessary and sufficient for driving in w .*

The deontic accessibility relation, as defined, gives us a set of worlds where the relevant laws are the same as ours and in which the fewest laws are violated; the presupposition is held to be valid in those worlds. This will not in general be a reflexive relation, since there is no reason to assume that the real world is one in which laws are not broken. The addition of tense and aspectual marking will not change this. Consequently, we do not get implicative entailments from (4.47a) or (4.47b), despite the necessity/sufficiency semantics contributed by *enough*.

Hacquard thus preserves (and derives) Meier's key observation, to the effect that modal flavour matters in the production of implicative inferences. The current account improves on Meier (2003) insofar as the necessity/sufficiency semantics for *enough* and *too* additionally derives the entailment pattern as it arises under perfective marking.

Complications for the fully-implicative approach

Hacquard's analysis immediately raises two questions. First, we would like the encoding of a single necessary and sufficient condition to be justified by more than its success in deriving the perfective entailments. Second, if *enough* and *too* constructions are 'at base' complement entailing (assuming circumstantial modality), we need to find a way of explaining the defeasibility of complement inferences in the English and imperfective versions of (4.45)-(4.46). While Hacquard does to a certain extent address both questions, problems remain. I discuss these next.

1. The sufficiency requirement

To make sense of a joint necessity/sufficiency presupposition, Hacquard observes that attempting to deny the necessity of an *enough/too* matrix condition for the complement results in obvious infelicity: we saw this for English in (4.18). The same effect occurs in French, as Hacquard shows by comparing examples (4.48a)-(4.48b) (2005, p.87).

(4.48) a. *Marie n'a pas été assez belle pour être élue Miss France. #Son talent a aussi joué.*

‘Marie was-PFV not pretty enough to be crowned Miss France. #Her talent also counted.’

b. *Sa beauté n'a pas suffi à ce qu'elle soit élue Miss France. Son talent a aussi joué.*

‘Her beauty did not suffice-PFV that she be crowned Miss France. Her talent also counted.’

Hacquard argues that the contrast between (4.48a) and (4.48b) demonstrates that *enough* cannot just mean something like *suffice* or *be sufficient for*. If the condition introduced was not assumed to be a necessary one, then denying that the condition is satisfied should be compatible with a continuation indicating that Marie was, in fact, crowned Miss France (on the basis of her prettiness as well as other factors). This is acceptable when *enough* is replaced by *suffire* (‘suffice’), demonstrating that something in the meaning of *be pretty enough* (*être assez belle*) contrasts with the condition introduced by *suffire*.

Hacquard also provides an argument for the inclusion of a sufficiency presupposition, acknowledging that it is not *a priori* obvious that there should, in an example like (4.45a), be some speed that is sufficient (on its own) for escaping. Specifically, she points out that a sufficiency presupposition means that the condition introduced by the *enough/too* matrix clause should be the *only* unmet condition relevant for complement actualization (again, in parallel with what we saw for implicative verbs). Thus, in contexts where the resolution of an additional condition is explicitly left open, she predicts infelicity. (4.49) is Hacquard’s example (2005; p.88)

- (4.49) *Context:* I am having a conversation with my cousin in Los Angeles about the glamorous life of Hollywood's jet-set. She tells me about a very exclusive party on the hills and in the course of the conversation, she establishes that in order to get invited, one has to be both rich and famous. Her friend Pierre jumps into the conversation and says:

- a. Nick a été assez riche pour se faire inviter.

'Nick was-PFV rich enough to be invited.'

Hacquard argues that the predictions of a sufficiency presupposition are borne out by this example, insofar as, in the context established in (4.49), (4.49a) is naturally interpreted as indicating that Pierre takes it for granted that Nick is famous (i.e., that he meets the other relevant condition for being invited).

This argument seems to me to be less stable than the argument she makes for a necessity presupposition. While my informants agree that (4.49a) invites the inference suggested by Hacquard – that Nick is famous – it is not obvious that this is due to presupposition accommodation, rather than the circumscriptive reasoning that arises with one-way implicatives like Finnish *jaksaa* ‘have the strength’: (3.47) is repeated here from Chapter 3.

- (3.47) a. Hän **jakso-i** noust-a.
he.NOM have.strength-PST.3SG rise-INF
‘He had the strength to rise.’
 $\leadsto He\ rose.$
 b. Hän e-i **jaksa-nut** noust-a.
he.NOM NEG-3SG have.strength-PP.SG rise-INF
‘He did not have strength to rise.’
 $\vdash He\ did\ not\ rise.$

In the previous chapter, I argued that a one-way implicative like *jaksaa* only presupposes the necessity of (a certain degree of) strength for the sentential subject to rise: the inference in the positive case, (3.47a), arises from pragmatic ‘antiperfection’ reasoning to the effect that ‘what you see is all there is’ – that is, that the condition mentioned is the *only* condition in question in context. Similarly, since the context in (4.49) establishes that being famous is the other relevant condition for being invited, a discourse contribution which only references

the richness condition could easily be interpreted as (pragmatically) conveying that the fame condition was not in question (i.e., that it was satisfied).

On the other hand, there seem to be cases where backgrounding a second unmet but necessary condition for the realization of the *enough/too* complement does produce the infelicity that we might expect in case of presupposition failure. (4.50) is an example of this sort.

- (4.50) *Context:* Juno is competing in today's race, which is about to take place. Just before the race begins, an announcement is made that the age qualifications have changed from what was stated on the entry form she filled out in the morning – specifically, that the minimum age for participating has changed. Juno was already right on the cusp of not qualifying due to her age, so after this announcement we are not sure if she meets the qualifications any longer. The gun goes off before we have a chance to figure out anything further. I can see that Juno is clearly the fastest runner, and crosses the finish line first. You did not see the race, because you were looking for an official to find out about the new qualifications, but you have not been successful in this. I report the result to you by saying:

a. ?*Juno a été assez rapide pour gagner la course.*

‘?Juno was-PFV fast enough to win the race.’

My informants judge (4.50a) to be inappropriate in the context provided, unless the complement clause is pragmatically reinterpreted to mean something like “to finish the race first,” rather than “to win the race” in a sense that includes being awarded the prize. This is similar to the judgements reported for examples (3.57)-(3.58) in Section 3.6.2 of Chapter 3; those examples showed that a two-way implicative was judged to be inappropriate in contexts which explicitly left open some other condition for the realization of the implicative complement. The problem in (4.50) seems to be of the same nature, thus suggesting that the *enough* construction in (4.50a) is only felicitous in a context where the condition it invokes is sufficient as well as necessary for its complement. This is what Hacquard's example (4.49) is intended to show.

The difference between (4.49a) and (4.50a) is rather mysterious, and the plot thickens when we observe that, in a case where the matrix clause and complement are deontically related, no sufficiency requirement seems to arise, regardless of aspectual marking.

- (4.51) a. *Bertha a été assez grande pour conduire, mais sa vue n'était pas assez bonne pour obtenir un permis.*
 'Bertha was-PFV old enough to drive, but her eyesight was-IMPF not good enough to get a license.'
- b. *Bertha était assez grande pour conduire, mais sa vue n'était pas assez bonne pour obtenir un permis.*
 'Bertha was-IMPF old enough to drive, but her eyesight was-IMPF not good enough to get a license.'

The chief difference in interpretation between the two examples in (4.51) seems to be this: the perfective version in (4.51a) conveys that Bertha has just reached the legal driving age, while the imperfective version (4.51b) simply conveys that Bertha's age is at least the legal driving age. We will see why this difference arises in Chapter 6. On Hacquard's semantics, however, while neither example need entail that Bertha actually drove (in view of her age), the explicit indication that some other legal condition for driving is not met should still cause infelicity, in view of a presupposition that the *enough*-condition names something that is sufficient as well as necessary for the (legal) realization of the complement.

In fact, the interpretation of deontic *enough/too* constructions is a more general problem for the sufficiency condition. As noted above, Hacquard's 'at-base' implicative proposal for *enough/too* constructions preserves Meier's (2003) crucial observation about the effect of modal flavour on implicative inferences, insofar as the implicative account appeals to the reflexive property of circumstantial accessibility relations in deriving complement entailments (under perfective marking). Deontically-flavoured *enough/too* constructions do not seem either to entail or to implicate their complements (at least in the absence of specific world knowledge). At least at first glance, Hacquard's proposal seems to derive this result.

(4.52) *Amira a été assez grande pour boire de l'alcool.*

‘Amira was-PFV old enough to drink alcohol.’

(*Interpretation:* Amira became old enough to drink alcohol.)

a. (4.52) \equiv PST(PFV(Amira be old enough to drink alcohol))

b. $\llbracket (4.52) \rrbracket^{w^*} = \llbracket \text{PST}(\text{PFV}(\lambda w.\text{enough}(w)(\lambda w'\lambda d\lambda x.\text{AGE}(x)(w') \geq d)$
 $(\lambda w'\lambda x.\text{drink-alc}(x)(w'))(A)) \rrbracket^{w^*}$
 $= \exists e[\tau(e) \subseteq t\{t \prec_i t^*\} \wedge \text{AGE}(A)(e)(w^*) \geq$
 $(\iota d : \forall w \in \text{DEON}(w^*)[\text{drink-alc}(A)(w) \leftrightarrow (\text{AGE}(A)(w) \geq d)])]$

c. *There is a temporal interval in the past of utterance time such that this interval includes the timespan of an eventuality of Amira being (becoming) at least the age d such that being at least d -old is necessary and sufficient for drinking alcohol in all worlds where the drinking laws are the same as in the actual world, and are not violated.*

Since the real world need not be one in which the drinking laws are upheld, we concluded that Hacquard’s proposal derives the correct (non-entailing) result for deontic cases like (4.52). However, if we now look more closely at the truth conditions for this example, we find that the necessity and sufficiency (implicative) semantics in fact imposes an unexpected and problematic constraint on interpretation.

Consider how the presupposition introduced by the implicative semantics is realized for the sentence radical in a case like (4.52)

(4.53) Amira be old enough to drink.

Presupposes: $\iota d.\forall w \in \text{DEON}(w^*)[\text{drink}(A)(w) \leftrightarrow \text{AGE}(A)(w) \geq d]$

Assuming again that $\text{DEON}(w)$ represents the set of worlds determined by the combination of a circumstantial modal base and a deontic ordering source consisting of the drinking laws, this presupposition requires that all of the ideal worlds (i.e., those in which none of the drinking laws are violated) have the following characteristic: there is a particular age such that reaching that age is both necessary *and sufficient* for drinking. In other words,

worlds where the laws are not violated must be worlds in which Amira drinks alcohol.

I can see two ways of satisfying this surprising requirement. In the first case, the context might supply the information that Amira has been eager to try drinking alcohol, but her law-abiding nature is the only thing holding her back. In this case, our modal base might fix facts about Amira's circumstances and/or dispositions (her intention to drink, her access to alcohol, her inclination to obey the law, etc), with the effect of establishing that the legal issue is the only condition in question for Amira's drinking. In the absence of such a context, the presupposition in (4.53) will only be satisfied in case there is a law requiring that one drink after reaching a certain age, thus making reaching this age deontically sufficient for drinking. In any ordinary utterance context, we can rule out the existence of such a law. But then, the only way in which an example like (4.52) should be felicitous is the context in which Amira's dispositions and circumstances are such that reaching the legal age guarantees that she drinks – in other words, (4.52) should only be felicitous in case Amira drinks in the actual world. This prediction is, as we know, not borne out:

(4.54) *Amira a été assez grande pour boire d'alcool, mais elle ne l'a jamais bu.*

‘Amira was-PFV old enough to drink alcohol, but she never drank it.’

It seems, therefore, that sufficiency imposes too strong a requirement on the semantic interpretation of deontic *enough/too* constructions.

I will leave the contrasts between (4.50), on the one hand, and (4.49), (4.51), and (4.52) on the other, as a puzzle for the time being, simply noting that, while Hacquard's suggestion that *enough/too* constructions presuppose a necessary and sufficient condition for their complements does seem to be upheld in contexts like (4.50), there are good reasons to question whether a sufficiency condition is built into the meaning of *enough* and *too* across the board.

2. Deriving the non-implicative interpretations

The next question for the implicative account is how to derive the non-implicative interpretation for imperfectly-marked examples like (4.11)-(4.12), as well as the defeasibility of implicative inferences for English examples like (4.5a)-(4.6a). Bhatt's (1999) account of

ABLE as a two-way implicative led to a parallel question; Hacquard adopts his explanation for non-entailment here.

To review the proposal, Bhatt suggests that non-implicative interpretations are due to a generic use of the imperfective, as opposed to a progressive interpretation.¹² As we saw in Section 2.2.2 of Chapter 2, generic statements do not always require ‘verifying instances.’ The truth of (2.39a) does not depend on whether or not mail has actually arrived from Antarctica (or ever will), but only on what is reasonably expected to happen if it does.

(2.39a) Sally handles the mail from Antarctica. (example from Carlson, 1995)

Hacquard, like Bhatt, assumes that the imperfective aspect can introduce a generic operator, which quantifies over the relevant normal worlds. In her lexical entry for GEN, repeated from Chapter 2, Hacquard takes P to represent a proposition that restricts the set of normal worlds in the domain of quantification to just those that are ‘relevant’ under the circumstances.

$$(2.41) \quad \llbracket \text{GEN} \rrbracket := \lambda w \lambda p \lambda q. \forall w' [w' \in \text{NORM}(w) \wedge p(w')], q(w')$$

Following arguments from Schubert and Pelletier (1989), Hacquard argues that, in the case of generic *enough* or *too* constructions, it is the presupposition of a necessary and sufficient condition which is assigned to P . Assuming that the imperfective morphology in (4.55) is the surface realization of the combination of past tense with GEN, we get the following interpretation for (4.55): the generic operator effectively “forces one to only consider worlds that strictly depend on the adjective” (Hacquard, 2005, p.94).

¹²In fact, it is not obvious that explaining the non-implicative reading of habitual/generic cases is sufficient for French *enough/too* constructions, since these appear to be compatible with progressive interpretations. To illustrate, this point, some of the natural ways in which my informants offered ‘cancellations’ for implicative inferences under imperfective marking involved interrupting an ongoing event, appealing to a progressive interpretation of the *enough/too* claim:

- (i) *Juno n'était pas assez rapide pour gagner la course, mais la coureuse en tête a trébuché dans la dernière manche, et donc, Juno a gagné (après tout).*
 ‘Juno was-IMPF not fast enough to win the race, but the lead runner tripped on the final lap, and so, Juno won (after all).’
Interpretation: Juno was not running at the necessary speed to win the race ...

It is not possible to make a comparison with Hindi examples in the *enough/too* case, because Hindi lacks a dedicated marker for either excess or sufficiency (see also Fortuin, 2013).

(4.55) *Jean était assez rapide pour s'enfuir.*

‘Jean was-IMPF fast enough to escape.’

a. IMPF(Jean be fast enough to escape)

≡ PST(GEN(w^*)(Jean be fast enough to escape))

b. PST($\forall w[w \in \text{NORM}(w^*) \wedge (\iota d : \text{SPEED}(J)(w) \geq d \leftrightarrow \text{escape}(J)(w))]$)

($\text{SPEED}(J)(w^*) \geq d$)

c. *There is a time in the past of utterance time such that, for all of the normal worlds in which there is a degree d of speed that is both necessary and sufficient for Jean to escape, Jean had at least that speed.*

Thus, if the real world happens to be a normal world in which there is a necessary and sufficient speed for Jean to escape, (4.55) will entail that Jean had that speed, and the fact that he escaped will follow as in the perfective case. However, there is no reason why the actual world should satisfy the *enough/too* presupposition (let alone count as a normal world), and consequently there is no general entailment under imperfective marking. Hacquard does not explicitly deal with the English cases, but the generic explanation can be extended to treat the defeasibility of implicative inferences from (circumstantial) *enough/too* constructions in English if we assume that aspectual marking in the English past tense is covert, rendering it ambiguous on the surface between an episodic (perfective) and a habitual or generic (imperfective) reading.

(4.56) Jean was fast enough to escape.

a. *Episodic*: PST(PFV(Jean be fast enough to escape)) \vdash *Jean escaped.*

b. *Habitual/generic*: PST(GEN(Jean be fast enough to escape)) \nvdash *Jean escaped.*

In adopting Bhatt’s account for the absence of actuality entailments under imperfective marking, Hacquard also inherits its drawbacks. In particular, since she assigns *enough/too* constructions an implicative semantics, she cannot account for the fact that lexical implicatives entail their complements regardless of aspectual marking (or the lack thereof).

If we take a closer look at the facts about lexical implicatives, it does seem to be the case that a generic or habitual interpretation of *manage/réussir* enables us to deny that the implicative complement was realized in some small number of specific instances:

- (4.57) a. Morgan *(generally) managed to solve riddles, but on this occasion, the riddle was too difficult for her.
- b. *Morgan réussissait à résoudre les énigmes, mais cette énigme-là était trop difficile pour elle.*
 ‘Morgan managed-IMPF to solve riddles, but this riddle was too difficult for her.’

The argument from GEN, however, is intended to explain why imperfectively-marked *enough/too* constructions require no verifying instances at all:

- (4.58) a. Morgan was clever enough to solve riddles, but she never solved any.
- b. *Morgan était assez intelligente pour résoudre les énigmes, mais elle ne résolvait jamais d’énigmes.*
 ‘Morgan was-IMPF clever enough to solve riddles, but she never solved any.’

This is not a possible interpretation for generic *manage* or imperfective *réussir*, as (4.59) shows: the implicatives only seem to be licensed if the real world supplies verifying instances in which their complements are realized. Moreover, they appear to require that the majority of relevant situations are verifying cases.

- (4.59) a. Morgan (usually) managed to solve riddles, #but she never solved any.
- b. *Morgan réussissait à résoudre les énigmes, #mais elle ne résolvait jamais d’énigmes.*
 ‘Morgan managed-IMPF to solve riddles, #but she never solved a riddle.’
- (4.60) a. Morgan (usually) managed to solve riddles, #but most of the time she did not solve them.

- b. *Morgan réussissait à résoudre les énigmes, #mais d'habitude, elle n'en résolvait jamais.*

‘Morgan managed-IMPF to solve riddles, #but usually she did not solve them.’

Hacquard cannot explain this contrast. On her account, we would expect the necessity and sufficiency presuppositions of an implicative verb to also be pushed into the restriction of GEN, thus producing an interpretation where all normal worlds which are such that there is a (causally) necessary and (causally) sufficient condition for the realization of the complement are also worlds where this condition is realized. As in the *enough* case above, there should be no reason why the real world must belong to the set of normal worlds characterized in this manner, and thus we would expect complement entailments to be lifted in (4.59)-(4.60), as they are in (4.55) and (4.58). Consequently, while there does seem to be something intuitively correct about the appeal to a generic or habitual interpretation for the imperfective, a complete explanation of the non-implicative behaviour of French imperfective *enough/too* constructions, and the defeasibility of implicative inferences in their English counterparts will need to go beyond the Bhatt-Hacquard proposal.

4.2.3 Further caveats: Marques (2012)

So far, we have seen two clear dimensions along which the implicative inferences of *enough* and *too* constructions can vary. From Meier (2003), we have that, unlike lexical implicatives, *enough/too* constructions can vary in modal flavour, and do not give rise to implicative inferences in deontic (or ‘idealistic’) contexts. Hacquard (2005) refines this by suggesting that implicative inferences arise just in case the relevant modal accessibility relation is reflexive (as in the case of circumstantial *enough/too* constructions). This refinement, as far as we have seen, relies on Hacquard’s fully-implicative semantics for *enough* and *too*, on which they presuppose that the condition described in the matrix clause is both necessary and sufficient for the realization of the complement. I have provided some reasons to question this analysis, which I return to later.

Hacquard’s observations added another crucial condition for *enough/too* variability: aspectual marking. Specifically, those *enough/too* constructions which produce ‘default’ implicative inferences in English (and only those constructions) generate full implicative entailments in the perfective aspect in French. This follows, for Hacquard, from the joint necessity/sufficiency presupposition. We have seen reasons to believe that sufficiency is too strong to impose across the board, insofar as it makes odd predictions for deontic *enough/too* constructions (see, e.g., (4.51) and (4.52)).

Drawing on data from Portuguese which, like French, shows actuality entailments from perfectly-marked ability modals,¹³ Marques (2012) presents some additional caveats to Hacquard’s aspectual generalization. While examples like (4.61) carry the complement entailment Hacquard predicts, Marques notes that *enough* and *too* can also combine with verbs like *study* or predicates like *have time*, which appear to attribute a particular ‘resource’ to their subjects. In (4.62)-(4.63) the implicative inference remains defeasible, perfective marking notwithstanding.

- (4.61) A Ana foi suficientemente corajosa para entrar na gruta, #mas não
 the Ana was.PFV enough brave to enter in.the cave, #but NEG
 a deixaram entrar.
 her allow enter.INF
 ‘Ana was brave enough to enter the cave, #but she wasn’t allowed to enter.’
- (4.62) A Ana estudou o suficiente para ter uma boa nota no exame, mas
 the Ana studied.PFV the enough to have a good score at.the exam, but
 teve uma nota péssima.
 had a score bad.
 ‘Ana studied enough to get a high score on the exam, but she got a bad score.’
- (4.63) A Maria teve tempo suficiente para acabar o artigo, mas não o acabou.
 the Maria had.PFV time enough to finish the paper, but not it finished.
 ‘Maria had enough time to finish the paper, but she didn’t finish it.’

¹³Alxatib (2016) also demonstrates actuality entailments in Brazilian Portuguese. This is mediated by a surprising property, shared with Spanish (Borgonovo and Cummins, 2007; Vallejo, 2017), Albanian, Basque, and Galician (Hacquard, 2009): under perfective aspect, ability modals in these languages must either be interpreted as having an actuality entailment or as strictly counterfactual. The ‘intermediate’ possibility (epistemic uncertainty) is ruled out. Laca (2018) offers an account of the distribution of available readings in French and Spanish.

Examples like (4.62)-(4.63) will not be my primary focus. However, the deniability of the complement propositions in these cases is a serious problem for any analysis which bakes implicativity directly into the meaning of *enough* and *too*. On Hacquard's proposal, the necessity/sufficiency presupposition should apply to (4.62)-(4.63) as well as to (4.61), producing complement entailments in the absence of imperfective/generic marking. The absence of these entailments is further evidence in support of the points made at the end of Section 4.2.2: at-base implicativity imposes too strong a condition on the semantics of *enough* and *too*. Marques arrives at a related conclusion: he argues that, while the perfective aspect is evidently a necessary condition for complement entailments to arise from *enough/too* constructions, it is not a sufficient condition, because it is not fully predictive of the distribution of these entailments (thus precluding an at-base implicative semantics for *enough* and *too* as comparative operators).

Marques points out two additional features that seem crucial for *enough/too* complement entailments, both of which will feature in the account ultimately developed here. Focusing on examples like (4.62), he suggests that true (i.e., complement-entailing) implicative interpretations require not only the perfective aspect, but also a temporal overlap between the time of the matrix clause and the time of the complement event/eventuality.¹⁴ To illustrate this requirement, note that (4.61) involves such an overlap, while (4.62) does not. From our perspective, which seeks to link *enough/too* complement inferences with the components of true implicativity, this is in some ways a predictable requirement: lexical implicative constructions appear to share temporal specification across the matrix and complement clauses. Karttunen (1971) points out that implicative complements cannot contain time adverbials which conflict with the tense of the matrix clause, and (indirectly) suggests that lexical implicatives force temporal overlap between their matrix and complement clauses in arguing that “*managing to do* is inseparable in time and space from *doing*; it is the same event” (1971; pp.349–350). More recently, Wurmbrand (2014) classifies implicatives with a set of

¹⁴In a similar vein, Hacquard (2006, pp.201–203) observes that implicative inferences in phrasal constructions (*buy enough wood, have the courage*) seem to depend on our ability to interpret the matrix and complement as parts of a single event.

verbs (including ‘aspectual’ verbs like *try* and *begin*) that take ‘tenseless simultaneous infinitives’. She proposes that implicative complements are underlyingly tenseless, and thus get their temporal specification from the matrix clause; this claim is supported with evidence showing that the matrix and complement clauses share a temporal specification.

In addition to the temporal constraint, Marques points out that certain adjectives seem more tightly keyed to an implicative reading than others. These include properties like *courage*, *cowardice* and *intelligence*. In the presence of perfective marking and temporal overlap, implicative inferences with these predicates seem to be uncancellable.

- (4.61) A Ana foi suficientemente corajosa para entrar na gruta, #mas não
 the Ana was.PFV enough brave to enter in.the cave, #but NEG
 a deixaram entrar.
 her allow enter.INF
 ‘Ana was brave enough to enter the cave, #but she wasn’t allowed to enter.’
- (4.64) Ele foi demasiado covarde para saltar, #mas saltou.
 he was.PFV too coward to jump, #but jumped.
 ‘He was too afraid/cowardly to jump, #but he jumped.’
- (4.65) A Ana foi suficientemente inteligente para resolver a equação, #mas
 the Ana was.PFV enough intelligent to solve the equation, #but
 não a resolveu.
 NEG it solved.
 ‘Ana was intelligent enough to solve the equation, #but she didn’t solve it.’

Marques suggests that the uncancellable inferences here arise on the basis of ‘evaluative’ modality (Rescher, 1968). He relates the inference to the idea that the amount of courage, cowardice, or intelligence required for an undertaking varies on the basis of the undertaking itself; thus, he suggests that the only way of ‘measuring’ whether or not the sentential subject has the relevant degree is in whether or not they achieve the *enough/too* complement.

I want to propose a different explanation for the data in (4.61) and (4.64)-(4.65). In particular, if we consider the way in which the attributed properties in these examples are connected to complement realization, we can see that they must characterize some action or decision taken by the sentential subject en route to achieving the complement. On this view, these cases are not about ‘measurement’ or evaluative modality: the crucial feature is

that they involve adjectives which necessarily characterize actions, and are thus interpreted as characterizing actions which are performed by the subject as part of the complement-realization process.

Marques inadvertently illustrates an additional point with his data. A number of his unexpectedly non-implicative examples involve property attributions with the auxiliary *have* (Portuguese *ter*, *teve* in example 4.63) instead of *be* (*ser*, *foi* in examples 4.61, 4.64, 4.65). We are focused, here, on French and English examples using *be* (*was*; *être/était/a été* in French). There seems to be something fundamentally different about the *have* cases as opposed to the *be* cases (see also comments in the conclusion to Hacquard 2006). Significantly, the contrast between *have the speed/intelligence* in (4.66a) and *be fast enough* in (4.66b) parallels the observed contrast in ability attributions between *have the ability* in (4.67a) and *be able/can* in (4.67b): (4.66a) and (4.67a) do not produce implicative entailments in the perfective, while (4.66b) and (4.67b) do.

- (4.66) a. *Juno a eu de vitesse pour gagner la course, ma elle n'a pas gagné.*
 ‘Juno had-PFV the speed to win the race, but she did not win.’
 b. *Juno a été assez rapide pour gagner la course, #mais elle n'a pas gagné.*
 ‘Juno was-PFV fast enough to win the race, #but she did not win.’
- (4.67) a. *Olga a eu la capacité pour soulever cette table, mais elle ne l'a pas fait.*
 ‘Olga had-PFV the ability to lift this table, but she did not do it.’
 b. *Olga a pu soulever cette table, #mais elle ne l'a pas fait.*
 ‘Olga could-PFV lift this table, #but she did not do it.’

The interpretation of *have* cases under the perfective aspect generally delimits the temporal duration of some latent ability – for instance, we interpret (4.66a) to mean that Juno was at one point capable of the speed required to win the race, but no longer has this capacity. This seems like a natural consequence of the ‘bounding’ semantics of the perfective aspect, which, as we have seen, indicates that the runtime of an eventuality in its scope is fully contained in the reference time.

The *be* cases, however, do not get this ‘bounded’ interpretation, but instead produce actuality entailments. This suggests that the key contribution of the perfective aspect with respect to the actuality entailment phenomenon cannot be the contribution it makes to semantic interpretation by bounding the duration of an event (as has been suggested by Mari and Martin 2007, 2009, for instance). The systematic differences between the interpretations of *have* and *be* predicates under perfective marking instead suggests that there is some interaction between the perfective aspect and certain decompositional features of the property or ability attribution which it modifies. We will explore this idea further in Chapter 6.

4.3 The inferential patterns of *enough* and *too* constructions

In this section, I collect and organize the various observations made in this chapter, and set out systematically how they correlate with the availability of implicative inferences in *enough/too* constructions. In some cases – for instance, with respect to modal flavour – I will not have much to add to the preceding discussion, whereas in others I aim to characterize the variation more precisely. For each dimension of variation, I attempt to provide some new examples, drawing on naturally-occurring data where possible.

4.3.1 Modal flavour

The basic point to be made about modal flavour remains more or less unchanged from Meier (2003): the modal flavour of the relationship between an *enough/too* predicate and the complement proposition affects the availability of implicative inferences. This dimension of variation represents a key way in which *enough* and *too* constructions diverge from lexical implicatives, which, as we saw in Chapter 3, necessarily involve a circumstantial – and specifically, a causal – relationship between the matrix condition and the complement proposition. To emphasize this point, recall example (3.49), from Chapter 3, which showed that the contextual salience of a deontically necessary and sufficient condition for the implicative complement is not enough to license the use of an implicative like *manage*.

- (3.49) *Context:* In the United States, being (at least) 21 years of age is a necessary and sufficient condition for the legal consumption of alcoholic beverages. Amira has been eager to try a glass of wine for a long time, but has refrained because she is too law-abiding. She turned 21 yesterday.

a. ??Yesterday, Amira managed to drink a glass of wine.

Enough and *too* constructions, on the other hand, can occur with a wider range of modal flavours:

- (4.68) Naturally-occurring deontic cases:

- a. γ My daughter was tall enough to ride 7DMT but was too scared.
- b. γ Kavanaugh was old enough to know better.
- c. γ Though he was too young to vote, Foster looked forward to the 1848 presidential election, where he hoped to “advance a boy’s opinion” in favor of the new antislavery Free Soil Party.

- (4.69) Naturally-occurring circumstantial cases:

- a. γ But in Sochi, Hamlin was fast enough to win bronze, the first time ever an American luger reached an Olympic podium.
- b. γ A dangerous header off of the free kick bounced to the left of goalkeeper Peter Swinkels but he was nimble enough to scoop it up before the ball crossed the goal line.
- c. γ Air traffic control chiefs withdrew a job offer from a talented graduate because he was too tall to fit his legs under the control room desks.

This dimension of variation accounts for Karttunen’s (1971) original observation about the ‘optionality’ of *enough/too* implicativity. In particular, the effect of modal flavour explains why (4.4a) and (4.4b) contrast with respect to implicativity, despite involving the same matrix predicate.

- (4.4) a. Juri was clever enough to leave early. \leadsto *Juri left early.*

- b. Juri was clever enough to be a rocket scientist.¹⁵

\nrightarrow *Juri was a rocket scientist.*

In order to explain why (4.4a) defaults to an implicative interpretation, but (4.4b) does not, we do not need to postulate any ambiguity in the basic semantics of *be clever enough*, but can appeal instead to the fact that (4.4b) invokes an idealistic modality (in view of what is ‘right’), while (4.4a) is circumstantial in nature. Our intuitive understanding of the modality involved in an *enough/too* construction is due essentially to world knowledge about the ways in which being clever is typically connected to various types of achievements.

World knowledge can in some cases cause deontic constructions to generate inferences which seem implicative in nature. Consider, for example, (4.70a) or (4.70b).

- (4.70) a. \neg When I was in JC, I was too light to donate blood.

\leadsto *I did not donate blood.*

- b. \neg The last time we visited, two years ago, [my son] was not tall enough to ride the ... Spider-Man virtual reality 3D ride.

\leadsto *My son did not ride the Spider-Man ride.*

In both of these cases, it is very natural to infer that the *enough/too* complement was not realized. This contrasts with the deontic examples in (4.68a) and (4.68b), where we do not draw implicative-type inferences. The crucial difference for the examples in (4.70) is that both contexts – blood donation and amusement park rides – involve situations where we standardly assume the presence of an authority figure who enforces any relevant regulations, thus precluding any violation of the rules. Inferences of this sort do not translate into entailments under perfective aspect, and are to be distinguished from the fundamentally implicative inferences in which we are interested. We expect implicativity to arise in the joint contribution of the semantic components established in Chapter 3 (see Table 4.1), instead of as a result of purely external/world knowledge factors.

¹⁵Note that, if we assume for instance that Juri was a child at the reference time of (4.4b), this example also involves a temporal separation between matrix and complement (that is, under normal assumptions about the time of life at which one may be or become a rocket scientist).

By contrast, we have seen that the only English *enough/too* constructions which invite default (context-free) implicative inferences, and whose French counterparts show implicative entailments under perfective marking, crucially involve circumstantial modality. The naturally-occurring examples in (4.69) bolster this point, as they are used in contexts where the complement is taken to be true.

In addition to deontically- and circumstantially-flavoured *enough* and *too* constructions, Nelson (1980) points to the existence of examples involving epistemic modality:

- (4.71) a. Lee is mean enough to be the mugger.
 b. Lee is too kind-hearted to be the mugger.

Epistemic readings seem to be supported, in certain cases, by use of the perfect *have* in the complement:

- (4.72) a. ?I mean, I'm sure that I was tired enough to have imagined Santa, but there is no way I could've dreamed away all of those Wiffle balls and Game Boys.
 b. ?When he died in 1984, the Glasgow Herald argued that he was too nice to have got involved in the grubby business of managing an international team.
 c. ?Rather than being concerned about the song or movie, it seems reasonable to have some sensitivity regarding the possible implications of this quote, especially for those women who were too nice to have been harmed, but were.

None of the examples in (4.71)-(4.72) invite implicative inferences, although they may invite inferences about what the speaker believes with respect to the *enough/too* complements. Putting this type of construction in the perfective aspect is marginal at best. To the extent that the results are acceptable, they do not generate implicative entailments. If, as suggested by Hacquard (2005), implicative inferences are tied to reflexivity in the modal accessibility relation, this result is as expected.

- (4.73) a. ?*Lee a été trop gentil pour être/pour avoir été l'agresseur.*
 'Lee was-PFV too nice to be/to have been the attacker.'

⊭ *Lee was not the attacker.*

b. ?*Lee a été assez insensible pour être/pour avoir été l'agresseur.*

‘Lee was-PFV hard-hearted enough to be/to have been the attacker.’

⊭ *Lee was the attacker.*

I conclude, then, that one of the necessary conditions which must be met in order for an *enough/too* construction to license (genuinely) implicative inferences is a circumstantial relationship between the property or condition identified in the matrix clause and the realization of the *enough/too* complement. This is not by itself sufficient for implicative behaviour, however: we will see below how it intersects with other requirements.

4.3.2 Aspectual marking

As observed by Hacquard (2005), aspectual marking has an effect on the implicative behaviour of *enough/too* constructions. This effect is in part what makes *enough/too* constructions fruitful ground for investigation in pursuing an account of actuality entailments. As previously noted, the effect of aspectual marking respects the modal flavour generalization above: we do not get implicative entailments from deontic or epistemic *enough/too* constructions, regardless of the matrix aspect.

(4.54) *Amira a été assez grande pour boire d l'alcool, mais elle ne l'a jamais bu.*

‘Amira was-PFV old enough to drink alcohol, but she never drank it.’

(4.73a) ?*Lee a été trop gentil pour être l'assaillant.*

‘Lee was-PFV too nice to be the attacker.’

⊭ *Lee was not the attacker.*

In those cases which do invite implicative inferences in English, the aspectual marking of their French counterparts appears to govern the strength or defeasibility of an implicative inference, rather than its optionality (in the sense of Karttunen):

(4.5a) Juno was fast enough to win the race.

↷ *Juno won the race.*

(4.33) *Juno a été assez rapide pour gagner la course, #mais elle n'a pas gagné.*

‘Juno was-PFV fast enough to win the race, #but she did not win.’

(4.74) *Juno était assez rapide pour gagner la course, mais elle n'a pas gagné.*

‘Juno was-IMPF fast enough to win the race, but she did not win’

We have seen some reason to question Hacquard’s analysis of these facts, and in particular the inclusion of a sufficiency presupposition. I return to a formal treatment of this issue in the next chapter. However, a few additional observations are in order. Crucially, Hacquard points out that imperfective *enough/too* constructions do not generate complement entailments. We may note, however, that there is something of an asymmetry in the ‘defeasibility’ of complement inferences in the positive *enough* (and negative *too*) cases, where a sufficiency presupposition *à la* Hacquard would be expected to directly generate a positive inference, and the negative *enough* (positive *too*) cases, where it is instead necessity that is crucial. Cancelling the sufficiency-based inferences is fairly straightforward: when asked to do so, my informants provided examples like (4.7a) or (4.75), which indicate that some alternative necessary condition for complement realization (race-winning) was left unmet.

(4.7a) Juno was fast enough to win the race, but she was not allowed to participate.

(4.75) *Juno était assez rapide pour gagner la course, mais elle n'avait pas le droit de participer.*

‘Juno was-IMPF fast enough to win the race, but she was not allowed to participate.’

By contrast, attempts to cancel the necessity inference are better supported with *actually* or *in general* in the main clause – this seems almost obligatory in English. Typically, these cancellations involve an overt indication that something unexpected or unusual happened in the case at hand.

(4.76) a. Juno was not ??(really/actually) fast enough to win the race, but her competitors were ill that day and ran unusually slowly.

b. *Juno n'était (généralement) pas assez rapide pour gagner, mais ses concurrents étaient malades cette journée-là et ils ont couru lentement.*

‘Juno was-IMPF not (ordinarily) fast enough to win, but her competitors were ill that day and ran slowly.’

This indicates two things. First, it reinforces the point made in Section 4.2.2, to the effect that the necessity relationship between matrix and complement is more tightly encoded in the semantics of *enough/too* constructions than the proposed sufficiency condition. Secondly, this supports the Bhatt/Hacquard idea that imperfective marking invokes a habitual or generic interpretation.

To the extent that French and English permit progressive uses of *enough* and *too* constructions, however, something similar seems to be taking place with such uses: the entailment or inference is cancelled by an ‘interruption’ or unexpected event.

- (4.7b) ?Juno was not fast enough to win the race, but the lead runner tripped on the final lap, making Juno the winner.

Intended (marginal): Juno was not running fast enough to win, but something changed during the race.

- (4.77) *Juno n'était pas assez rapide pour gagner la course, mais la coureuse en tête a trébuché dans la dernière manche, et donc, Juno a gagné (après tout).*

‘Juno was-IMPF not fast enough to win the race, but the lead runner tripped on the final lap, and so, Juno won (after all).’

Interpretation: Juno was not running fast enough to win, but ...

These examples are reminiscent of the **imperfective paradox** (Dowty, 1979; Landman, 1992; Portner, 1998). In ‘paradoxical’ examples, the expected culmination point of some event (typically an accomplishment predicate) is not reached, due to some unexpected interruption:

- (4.78) a. Mary built a house. \vdash *A house was built/completed.*
 b. Mary was building a house. \nvdash *A house was built/completed.*

Somewhat unexpectedly, under a progressive interpretation of the imperfective, attempts to cancel the positive (sufficiency-based) inference also seem to require a ‘unexpected interruption’, rather than a simple indication that some other condition was unmet.

- (4.79) *Juno était assez rapide pour gagner la course, mais elle est tombée près de la ligne d'arrivée et n'a pas gagné.*

‘Juno was-IMPF fast enough to win the race, but she fell near the finish line, and did not win.’

Interpretation: Juno was running fast enough to win the race, but ...

This suggests that there is, after all, a sufficiency relationship associated with at least some circumstantial *enough/too* constructions. Recalling the discussion at the end of Chapter 3, the puzzle is a familiar one. Sufficiency does not appear to figure in *enough/too* constructions unless they both involve circumstantial modality and are in the perfective. Our task remains the same as before: to explain the now-you-see-it-now-you-don't nature of the sufficiency relationship, and to understand how this is connected to the semantic contribution made by aspectual marking.

4.3.3 Adjective type

The observation that adjective type matters for implicative behaviour builds on Marques's (2012) points about 'evaluative' adjectives, but I now propose a more precise characterization of the variation in this respect. We have seen that circumstantial *enough/too* constructions are the only (modal) type which give rise to implicative inferences. As it turns out, however, not all circumstantial constructions participate in the two-way implicative pattern. I want to suggest that this difference is predictable based on the type of adjective involved in a circumstantial *enough/too* construction: those that participate (subsuming Marques's examples) have a specific **dynamic** character, while those that do not participate are essentially **static** (unchanging) properties. This distinction, like the modal flavour dimension, leads to a tighter connection between implicative inferences in *enough/too* constructions and the entailments of lexical implicatives.

To illustrate the static/dynamic distinction as it affects *enough/too* implicative inferences, consider the contrast between examples (4.80) and (4.5):

(4.80) Static:

- a. Nima was tall enough to reach the top shelf. \nrightarrow *Nima reached the top shelf.*
- b. Nima was not tall enough to reach the top shelf.
 \leadsto *Nima did not reach the top shelf.*

(4.5) Dynamic:

- a. Juno was fast enough to win the race. \leadsto *Juno won the race.*
- b. Juno was not fast enough to win the race. \leadsto *Juno did not win the race.*

Where *be fast enough* in (4.5) shows a two-way default implicature pattern, *be tall enough* only seems to license an implicative inference in the negative direction. The negative inference is quite strong, and may in fact be uncancellable: I discuss this below.

The difference between a static property like *tall*, on the one hand, and a dynamic property like *fast*, on the other, crosscuts the established distinction between stage-level and individual-level predicates (Carlson, 1977; Chierchia, 1995; Kratzer, 1995). The suggestion I want to make here was foreshadowed in Section 4.2.3: the relevant difference between *tall* and *fast* has to do with the manner in which the property attributed to the sentential subject is involved in the realization of the complement proposition. While *being tall* is essential for reaching high-up objects, and thus represents an enabling condition of some sort, it is not *actively* involved in the process of realizing the *enough/too* complement. More specifically, no part of the shelf-reaching process can be characterized in terms of *tallness*. *Being fast*, on the other hand, is actively implicated in the process of realizing the complement in (4.5). In particular, speed characterizes actions or events that are normally essential to the realization of race-winning (for instance, in a running race, one must run *fast* as part of the process of winning). The same is true of *being clever* in (3.72a), or in the Portuguese example (4.65): in both cases, the matrix adjective characterizes some action (thinking, or making a decision) which is procedurally involved in realizing the *enough/too* complement. In other words, what links examples like (4.5a) to examples like (3.72a) and (4.65) with respect to implicativity is the essentially *actionable* nature of the matrix adjective: the properties of *fastness* (speed) and *cleverness* or intelligence are manifest in the sentential subjects only

insofar as they characterize an action taken by the subject.

- (4.5a) Juno was fast enough to win the race. \leadsto *Juno won the race.*
- (3.72a) γ [John Boehner] was smart enough to leave once he saw the direction his party was going. \leadsto *Boehner left.*
- (4.65) A Ana foi suficientemente inteligente para resolver a equação, #mas the Ana was.PFV enough intelligent to solve the equation, #but não a resolveu. NEG it solved.
 ‘Ana was intelligent enough to solve the equation, #but she didn’t solve it.’

Tall, by contrast, does not have this actionable character. It describes a fundamentally static, unchanging property of an individual, modifying or describing the individual directly, rather than attributing a (latent) property which characterizes actions that the individual might take. This characterization is supported by the fact that *be tall* cannot really be used with the progressive, while *be clever*, for instance, can:

- (4.81) a. *Nima is being tall today./*Nima was being tall when he reached the shelf.
 b. Morgan is being clever today./Morgan was being clever when she solved the riddle.

The implicative difference associated with the static/dynamic split carries over to the aspectual contrast in French. To the extent that *be tall* is acceptable in the perfective aspect, no entailment arises in the positive (non-implicating) case.

- (4.82) *Nima a été assez grand pour atteindre l’étagère du haut.*
 ‘Nima was-PFV tall enough to reach the topmost shelf.’
 \nVdash *Nima reached the top shelf.*

Interpretation: Nima became tall enough to reach the topmost shelf.

What about the negative case? In both English and French, the negative inference is extremely difficult to cancel. We can get around it to some degree, again, by invoking unusual or atypical circumstances, but there is an important way in which this differs from the ‘unexpected’ cancellations for examples with dynamic matrix adjectives.

(4.83) (?)Nima was not tall enough to reach the top shelf, but by standing on a ladder and straining, he managed to get to it.

(4.84) ?*Nima n'était pas assez grand pour atteindre l'étagère du haut, mais avec un tabouret et en se tenant sur ses orteilles, il a réussi à l'atteindre.*

‘Nima was-IMPF not tall enough to reach the top shelf, but by using a stepstool and standing on his toes, he managed to reach it.’

In order to make sense of (4.83), we implicitly think of the complement *to reach the top shelf* as conveying an event in which Nima reaches the top shelf *by himself*; this contrasts with the event in which he does reach the top shelf, where the basic circumstances have changed. A similar sense arises with the attempt to cancel a static (negative) inference in the imperfective, as in (4.85): my informants suggest that *fitting* and *going in* are not really the same thing.

(4.85) *Ma main était trop grande pour tenir dans ce gant, j'ai dû mettre toutes mes forces pour l'y faire rentrer.*

‘My hand was too big to fit in this glove, I had to use all my strength to get it to go in.’

These examples are for the most part unacceptable in the perfective aspect, barring a ‘fantasy’ context, in which one’s height, hand size, or the size of a glove is freely variable.

The static/dynamic adjective distinction respects the two previous dimensions of variation. The aspectual facts are described above. To see that the adjective type does not override modal flavour, I refer again to the contrast between (4.4a) and (4.4b), or between (4.86a) and (4.86b):

- | | | | |
|--------|----|---|------------------------------|
| (4.4) | a. | Juri was clever enough to leave early. | circumstantial, \leadsto |
| | b. | Juri was clever enough to be a rocket scientist | ‘idealistic’, \nrightarrow |
| (4.86) | a. | Juno was fast enough to qualify for the Boston marathon. | circumstantial, \leadsto |
| | b. | Juno was fast enough to register for the Boston marathon. | deontic, \nrightarrow |

In (4.86), qualifying for the marathon is something that occurs on a circumstantial basis (and at the same time as the race during which one qualifies). Speed is also a requirement for registering for the Boston marathon, but in this case the relationship is governed by regulations, not circumstances. In particular, while *being fast enough* (at some time) is a necessary condition for registering, it is not an active part of the process of registering. This demonstrates that the dynamic nature of the adjective affects implicative entailments as a secondary consideration, and only in case of circumstantial modality.

Marques's 'evaluative' adjectives are subsumed by the dynamic class described here. Indeed, the issue of 'measurability' – Marques's idea that properties like bravery, cowardice, or intelligence can only be measured with respect to an action which involves them – can be seen as a consequence of the fact that dynamic properties are only manifest insofar as they characterize actions. *Being brave*, in an example like (4.61), characterizes some action or part of the process involved in preparing to or starting to enter the cave. The similarity between this example and the interpretation of (3.15b), where *be brave enough* is replaced by the implicative *dare*, is particularly striking. To *dare* to do something, as discussed in Chapter 3, involves acting in a daring or courageous way as part of the process of realizing the implicative complement: the same is true of the Portuguese *enough* construction with *be brave* in (4.61).

- (4.61) A Ana foi suficientemente corajosa para entrar na gruta, #mas não
 the Ana was.PFV enough brave to enter in.the cave, #but NEG
 a deixaram entrar.
 her allow enter.INF
 'Ana was brave enough to enter the cave, #but she wasn't allowed to enter.'

- (3.15b) Ana dared to enter the cave.

~ *Ana acted courageously in entering the cave*

If we pursue the similarity between dynamic adjectives and lexically-specific implicative verbs farther, the comparison between examples like (4.61) and (3.15b) suggests that the implicative behaviour of dynamic circumstantial *enough/too* constructions arises because, in describing an active part of the process of realizing their complement propositions, dynamic

matrix predicates involve properties (capacities) that are *causally involved* in complement realization. I will argue for this characterization in more detail in Chapter 5. For now, I note that, if this view is correct, then dynamic circumstantial cases share another of the required features of implicative inferences. What remains to be explained, of course, is the question of the ‘disappearing’ sufficiency presupposition, and, relatedly, why causal *enough/too* inferences remain cancellable in English and in the imperfective, while implicative entailments are non-defeasible.

4.3.4 Temporal specification

In addition to perfective aspect, circumstantial modality, and dynamic adjectives, *enough/too* implicative entailments also require – as per Marques (2012) – an overlap between the time of the matrix clause and the (hypothetical) time of the complement eventuality. Two of Marques’s Portuguese examples illustrating this point are given below:

- (4.62) A Ana estudou o suficiente para ter uma boa nota no exame, mas
 the Ana studied.PFV the enough to have a good score at.the exam, but
 teve uma nota péssima.
 had a score bad.

‘Ana studied enough to get a high score on the exam, but she got a bad score.’

- (4.87) No último encontro, ele foi humilhado o suficiente para agora recusar
 in-the last meeting, he was-PFV humiliated the enough to now refuse
 o convite para um novo encontro (mas parece que já se esqueceu,
 the invitation for a new meeting (but appears that already REFL forgot
 porque está a pensar aceitar).
 since is at think accept.INF)

‘In the last meeting, he was humiliated enough to refuse now the invitation for a new meeting (but apparently he already forgot, since he is planning to accept the invitation).’

Building on the idea that the implicativity-inducing properties of dynamic adjectives like *fast* have to do with their active (causal) involvement in the process of realizing the *enough/too* complement, the necessity of a temporal overlap follows quite naturally. Where, in the absence of overt temporal specification, *be fast enough to win the race* indicates that

doing something (presumably running) at a certain speed is involved in bringing about race-winning, the introduction of temporal adverbials forcing a separation between matrix and complement removes the usual implicative interpretation, and eliminates the expected entailment under perfective marking.

- (4.88) a. When I saw her run last week, Juno was fast enough to win today's race, but as it turned out she ran slowly today and did not win after all.
- b. *Quand je l'ai vue courir la semaine dernière, Juno a été assez rapide pour gagner la course d'aujourd'hui, mais il s'est avéré qu'elle a couru beaucoup plus lentement aujourd'hui.*
- ‘When I saw-PFV her run last week, Juno was-PFV fast enough to win today's race, but she ran much more slowly today.’

In order to understand what is happening here, we need to consider how temporal separation in examples like (4.88a)-(4.88b) affects the perceived relationship between the matrix predicate and the complement clause. Nothing about our basic understanding of the process of race-winning needs to change: it is still the case that speed (fast-ness) characterizes the action that is involved in realizing race-winning. However, the difference between (4.5a) and (4.35a), on the one hand, and (4.88a) and (4.88b), on the other, is that in the latter cases, temporal specification precludes the possibility that the matrix event is the same as the relevant speed-characterized event that is part of the winning process at race time.

- (4.5a) Juno was fast enough to win the race. \leadsto *Juno won the race.*
- (4.35a) *Juno a été assez rapide pour gagner la course.*
- ‘Juno was-PFV fast enough to win the race.’ \vdash *Juno won the race.*

In other words, where the matrix clauses in (4.5a) and (4.35a) refer to a characterizing feature of an event which forms a subpart of the complement-realizing process, (4.88a)-(4.88b) instead refer to an event that serves as evidence that Juno (in principle) has the ability to carry out a crucial part of the race-winning process at the time of the race. The default temporal specification of (4.5a) and (4.35a) allows us to interpret the matrix eventuality

as a (causal) part of the process of complement-realization. Under temporal separation, by contrast, the matrix and complement cannot be related in this fashion; instead, the process relationship between speed and race-winning forms part of a ‘general knowledge’ background to the *enough* claim, and the modal relationship between matrix and complement becomes epistemic. Essentially, the speaker in (4.88a)-(4.88b) is conveying a belief that Juno has the relevant speed for race-winning, by referring to a particular piece of evidence that supports this belief. In Section 4.3.1, I observed that use of the perfect *have* in the complement tends to indicate an epistemic interpretation: adding this to (4.88a) provides a very natural paraphrase of the original claim.

(4.88a) When I saw her run last week, Juno was fast enough to win today’s race, but as it turned out she ran slowly today and did not win after all.

(4.89) When I saw her run last week, Juno was fast enough to have won today’s race, but as it turned out she ran slowly today and did not win after all.

Pursuing this analysis, if we move the race time into the future, we find that (4.90a)-(4.91a) are slightly marked, but improve with the addition of *be able* or *pouvoir*, respectively, in the complement clause. This indicates that the matrix provides evidence for future race-winning ability (as far as the speaker’s information goes).

(4.90) a. (?)When I saw her run yesterday, Juno was fast enough to win tomorrow’s race.

b. When I saw her run yesterday, Juno was fast enough to be able to win tomorrow’s race.

(4.91) a. (?)*Quand je l’ai vue courir la semaine dernière, Juno a été assez rapide pour gagner la course de demain.*

‘When I saw-PFV her run last week, Juno was-PFV fast enough to win tomorrow’s race.’

- b. *Quand je l'ai vue courir la semaine dernière, Juno a été assez rapide pour pouvoir gagner la course de demain.*

‘When I saw-PFV her run last week, Juno was-PFV fast enough to can-INF (be able to) win tomorrow’s race.’

The acceptability of *enough/too* constructions with independent temporal specifications for the matrix and complement clauses is another way in which these constructions diverge from lexical implicatives. As noted earlier, lexical implicatives require their matrix and complement clauses to share a temporal specification (Karttunen, 1971; Wurmbrand, 2014). Based on the *enough/too* data, this can now also be seen as a consequence of the causal – and thus process-based – connection that is built into implicative semantics. In the *enough/too* case, we only get implicative readings in case of temporal overlap: in the absence of this overlap, we cannot interpret the matrix-complement relationship in the required fashion. Assuming again, that the process connection is correctly taken to be evidence of a causal relationship, I am suggesting further that Marques’s temporal overlap requirement is an epiphenomenon of the causal modality required to license implicative inferences.

4.3.5 Additional remarks on temporal interpretation

One important condition for implicative inferences has not yet been discussed: tense. For *enough/too* constructions, the inferential patterns we are interested in arise only in the past tense: (4.92) does indicate a prediction or belief about Juno’s race-winning potential, but clearly does not entail its complement (in the same way that *Juno can/is able to win the race* does not entail that she wins/will win).

(4.92) Juno is fast enough to win the race. \nrightarrow Juno wins/will win the race.

Following the Bhatt/Hacquard suggestion that non-implicativity under imperfective marking is due to the (covert) presence of a generic operator, we might explain the lack of implicative behaviour in the present tense as a consequence of the fact that the English present always has a habitual or generic reading, and – as illustrated by the examples in (2.39a) and (2.40a) – does not always require verifying instances.

(2.39a) Sally handles the mail from Antarctica.

(2.40a) This machine crushes oranges.

While this explanation seems promising, it faces the same issue that I raised earlier: implicative verbs still seem to entail in the present tense, or at least (as with the French imperfective versions) to require that a substantial fraction of ‘relevant’ instances be verifying instances with respect to the complement entailment.

- (4.93) a. (Every year,) Juno manages to win the race, (?)but not this year.
 (acceptable if *every year* is interpreted as *every other year*)
- b. ...#but she never wins.
- c. ...#but she only wins once in a while.
- d. ...#but she usually loses.

Compare (4.93) to (4.94):

- (4.94) a. (Every year,) Juno is fast enough to win the race, but this year she lost.
- b. ...but she never wins.
- c. ...but she only wins once in a while.
- d. ...but she usually loses.

In developing a semantic account of *enough/too* constructions, this contrast will need to be explained, alongside the implicative/*enough/too* contrast under imperfective marking (discussed in Section 4.2.2).

Finally, I want to bring attention to an apparent connection between implicative inferences and certain durational (aspectual class) features of the eventuality in an *enough/too* complement.¹⁶ Entailing/implicating examples seem typically to involve punctual or eventive (dynamic) complements, often characterizable as *achievements* (Kenny, 1963; Vendler, 1967; Dowty, 1979). These complements include *win the race*, *enter the cave*, *solve the*

¹⁶Aktionsart and aspectual class features will be discussed more carefully in Chapter 6; for current purposes, it is enough to distinguish between events and states, with the former being in a sense dynamic, and the latter static and/or unchanging.

riddle, *leave early*, and so on. To the extent that we can get implicative inferences from non-eventive (stative) complements, they seem to arise primarily when the complement receives an inchoative interpretation:

(4.95) Nona was smart enough to be on the chess team.

\leadsto *Nona was on the chess team.*

Interpretation: Nona was smart enough to become part of/join the chess team.

If *be on the chess team* is interpreted as describing a particular state of being, rather than its inception (the inchoative interpretation indicated in 4.95), this example instead invokes an ‘idealistic’ modality (cf. Meier 2003), and no inference arises as to whether or not Nona was on the chess team. The non-inchoative interpretation is comparable to the ‘idealistic’ *be clever enough* example discussed earlier:

(4.4b) Juri was clever enough to be a rocket scientist. \nrightarrow *Juri was a rocket scientist.*

Why should the eventive or stative nature of the complement affect implicative inferences? Anticipating the upcoming account, I want to suggest that this is connected to the central claim I have been developing: that implicative inferences depend crucially on a causal relationship between the matrix and complement clauses. For the moment, the connection between a causal relationship and complement eventiveness will need to remain somewhat oblique: the idea is roughly as follows. I characterized the adjectives that participate in implicative inferences as *dynamic*, insofar as *fast*, *slow*, *loud*, *nimble*, and so on characterize actions involved in the process of complement realization in an *enough/too* construction. Thus, in the composition of matrix and complement, and if the complement represents a punctual event, we get a complex event structure which has the overall shape of an accomplishment predicate: that is, a process which culminates in a punctual event (or punctual change of state, as in 4.95). This aligns with the observations made in Section 4.3.2, to the effect that progressively-interpreted *enough/too* constructions require cancellations which indicate that some ongoing process was (unexpectedly) interrupted: the expected entailment

from a causal *enough/too* construction is blocked in the same way that imperfective (progressive) marking can block the expected culmination entailments usually associated with accomplishment predicates.

Several authors have suggested that certain accomplishment predicates embed a causal relationship at the lexical-semantic level: see, e.g., Pustejovsky (1995), Higginbotham (2009), Lyutikova and Tatevosov (2014), and Thomason (2014). On this view, a predicate like *build a house* links some initiating event (building) to a result event (in which a house comes into being) as its cause – that is, *to build a house* means to bring about the creation of a house via action of a certain type. A causal *enough/too* construction like (4.69a), on this template, indicates that Hamlin brought about an event of bronze medal-winning via action characterized by speed (fast-ness).

(4.69a) γ But in Sochi, Hamlin was fast enough to win bronze, . . .

Here, the cause and effect are spread over the *enough/too* matrix and complement, where in an accomplishment predicate the two events come together in the combination of verb and object (or prepositional phrase). This structural similarity is striking, suggesting a link between the causal modality involved in implicative constructions and the decompositional semantics of telic predicates more generally.

4.4 Summary

The key features of implicative entailments, as summarized in Table 4.1, are as follows:

- (i) the existence of a condition that is both necessary and sufficient for the (implicative) complement
- (ii) a causal interpretation of the necessity and sufficiency relations
- (iii) an assertion that resolves the truth status of the necessary and sufficient condition

Having taken an extended tour through their parameters of variation, we can now see how and where these features arise in the composition of *enough/too* constructions.

Section 4.3 established that *enough* and *too* constructions can only license implicative inferences in case they involve circumstantial modality, have a ‘dynamic’ matrix adjective, and indicate a temporal overlap between the matrix and complement eventualities. I have suggested that the combined requirement of a dynamic adjective and temporal overlap in fact points to a broader requirement: that the matrix predicate describe a property that is actively involved in the process of bringing about the *enough/too* complement. In particular, I have suggested that the adjective and temporal features of implicative *enough/too* constructions are reflections of an underlyingly causal relationship between matrix and complement. If this is correct, this will give us feature (ii), above. Moreover, since we have seen that all *enough/too* constructions, regardless of modal flavour, adjective type, or other variations, seem to assert that the sentential subject had (or lacked) some particular degree of the matrix adjective, we seem to also have (iii) (*modulo* the relationship between this degree and the complement).

What is less clear at this stage is where we stand on component (i). Examining deontically-flavoured *enough/too* constructions, and ‘static’ circumstantial cases, it seems uncontroversial to claim that an *enough/too* matrix adjective is always linked to the complement eventuality by a relationship of necessity. Hacquard (2005) provided arguments for this, and we saw, at the beginning of this chapter, that denying a necessity relationship outright resulted in infelicity:

- (4.18) a. Juno was fast enough to win the race, #but speed is not necessary for winning a race.
- b. Juno was not fast enough to win the race, #but speed is not necessary for winning a race.

To add to this, we also observed, in Section 4.3.2, that circumventing or cancelling the implicative inference that would be expected on the basis of such a necessity relationship required (at least in the circumstantial cases) an appeal to abnormality or unexpected circumstances. This motivated the ‘generic’ explanation of non-implicative behaviour from

imperfectively-marked *enough/too* constructions. In the absence of any evidence to the contrary, then, I conclude that *enough* and *too* constructions encode that (some degree of) the matrix adjective was necessary for the realization of the complement, though the flavour of this necessity can vary from one case to another.

We have also seen evidence that *enough* and *too* constructions do not involve sufficiency across the board. A Hacquard-style sufficiency presupposition for *enough* and *too* makes empirically unsupported predictions for deontic constructions, and predicts positive implicative inferences from circumstantial *enough/too* constructions with static adjectives, which also runs counter to the observed data:

(4.80a) Nima was tall enough to reach the top shelf. \nrightarrow Nima reached the top shelf.

Nevertheless, when we look at the inferences associated with dynamic circumstantial (causal) *enough/too* constructions, in particular under the perfective aspect, we find that denying a sufficiency relationship produces infelicity: this parallels the infelicity that arises from attempts to use (two-way) implicative verbs in contexts where some condition other than the lexically-indicated one is left unresolved in context. The crucial *enough/too* example from Section 4.2.2 is repeated below.

(4.50) *Context:* Juno is competing in today's race, which is about to take place. Just before the race begins, an announcement is made that the age qualifications have changed from what was stated on the entry form she filled out in the morning – specifically, that the minimum age for participating has changed. Juno was already right on the cusp of not qualifying due to her age, so after this announcement we are not sure if she meets the qualifications any longer. The gun goes off before we have a chance to figure out anything further. I can see that Juno is clearly the fastest runner, and crosses the finish line first. You did not see the race, because you were looking for an official to find out about the new qualifications, but you have not been successful in this. I report the result to you by saying:

a. ?*Juno a été assez rapide pour gagner la course.*

‘?Juno was-PFV fast enough to win the race.’

Based on data like (4.50), it seems as if implicative *enough/too* constructions do encode a sufficiency presupposition, in parallel with true (two-way) implicatives. This conclusion is at odds, however, with the evidence we have seen that imperfective and English dynamic circumstantial/causal *enough/too* constructions are acceptable with continuations that explicitly leave open some condition independent from the one described by the matrix clause.

(4.7a) Juno was fast enough to win the race, but she chose not to participate.

(4.75) *Juno était assez rapide pour gagner la course, mais elle n'avait pas le droit de participer.*

‘Juno was-IMPF fast enough to win the race, but she was not allowed to participate.’

Table 4.2 summarizes what we have learned, in the case of polarity-preserving *enough* constructions. The conclusions for *too* are similar, *modulo* polarity reversal. Our uncertainty over a sufficiency presupposition is indicated by a question mark (in the causal cases). Based on the available evidence (see examples 4.83-4.84), I have classified the negative inferences of static circumstantial constructions as entailments rather than implicatures. In Table 4.2, the sentential subject is represented by S , complement propositions are indicated by $A(S)$ and the causal condition of a lexical implicative by $H(S)$. I use the symbols \triangleright and \triangleleft to indicate, respectively, sufficiency and necessity relationships without specifying their modal flavour. As before, \blacktriangleright and \blacktriangleleft represent causal sufficiency and necessity, respectively.

The surface-level presence or absence of a sufficiency presupposition in the causal case seems connected to the aspectual marking of the matrix clause, insofar as aspectual marking governs the predicted entailment patterns. If we hope to develop a unified analysis of *enough/too* semantics, then it must be the case that the presence or absence of a sufficiency encoding is in some way governed by aspectual marking. This leaves us with two apparent ways forward. Either causal *enough/too* constructions encode necessity and sufficiency presuppositions as a baseline, and imperfective aspect works, as suggested by Bhatt (1999) and Hacquard (2005, 2006), to lift the expected entailments; on this view, we will need to explain why sufficiency appears in the causal cases, but not under other types of modality. The alternative, which seems even more puzzling, is that the perfective aspect somehow

construction	semantic component			inference	
	<i>mod. flavour</i>	<i>presuppose</i>	<i>assert</i>	<i>pos</i>	<i>neg</i>
implicative	causal, circumstantial	$H(S) \blacktriangleleft_c A(S)$ $H(S) \blacktriangleright_c A(S)$	$H(S)$	$\vdash A(S)$	$\vdash \neg A(S)$
be ADJ enough	epistemic	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	$\not\vdash A(S)$	$\not\vdash \neg A(S)$
	deontic	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	$\not\vdash A(S)$	$\not\vdash \neg A(S)$
	circumstantial static ADJ	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	$\not\vdash A(S)$	$\vdash \neg A(S)$
	circumstantial	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	Eng/IMPF $\rightsquigarrow A(S)$	Eng/IMPF $\rightsquigarrow \neg A(S)$
	dynamic ADJ	$d\text{-ADJ}(S) \triangleleft A(S)$ $?d\text{-ADJ}(S) \triangleright A(S)$	$d\text{-ADJ}(S)$	PFV $\vdash A(S)$	PFV $\vdash \neg A(S)$

Table 4.2: Semantic components of polarity-preserving two-way implicativity, by construction

introduces a sufficiency presupposition – but again, only in the case of causal *enough/too* predicates.

Adjudicating between these two options, and making sense of this puzzle, is the chief task of the next chapter. How can both implicative and non-implicative readings follow from a single underlying representation for (the components of) *enough/too* constructions? Similarly, how does aspectual marking and the semantic contribution or requirements of aspect interact with this underlying representation to produce the puzzling ‘sufficiency’ phenomenon? Looking ahead, these questions are the same as the ones we face in attempting to understand actuality entailments: how can the ‘pure’ ability (*have the ability*) reading and the *did* (opportunity) readings arise from a single underlying representation for the ability modal, and what is the role of aspect in pushing us to one surface interpretation or the other? The answers I will provide in the *enough/too* case over the next two chapters will point us to the answers for ability predicates.

Chapter 5

The semantics of *enough* and *too* constructions

In the last chapter, I surveyed the implicative behaviour of *enough* and *too* constructions and identified the conditions under which these constructions license complement inferences and entailments in the (two-way) implicative pattern. In addition to the type of modality associated with the relationship between an *enough/too* matrix adjective and the complement proposition, I showed that implicative behaviour is sensitive to features of the matrix adjective, to the relative temporal specification of matrix and complement clauses, and finally to viewpoint aspect when it is overtly marked. The findings of Chapter 4 are summarized in Table 5.1. A blank cell (–) in the table indicates that variation along the indicated parameter has no effect on complement inference patterns.

Enough and *too* constructions only display implicative behaviour when a specific set of features coincide. First of all, the modal flavour of the matrix-complement relationship must be circumstantial. Next, the matrix adjective must be dynamic rather than static in nature. The ‘dynamic’ characterization picks out adjectives like *fast*, *nimble*, and *clever*, which at base characterize actions taken by individuals, as opposed to ‘static’ adjectives like *tall* or *old*, which describe stable attributes of objects or individuals. In order to be implicative, circumstantial *enough/too* constructions with dynamic adjectives further require

<i>modal flavour</i>	parameter of variation			inference	
	<i>adj type</i>	<i>temporal spec.</i>	<i>aspect</i>	<i>pos</i>	<i>neg</i>
epistemic	–	–	–	⊄	⊄
deontic	–	–	–	⊄	⊄
circumstantial	static	–	–	⊄	⊢
	dynamic	no overlap	–	⊄	↗
		overlap	unmarked	↗	↗
			imperfective	↗	↗
			perfective	⊢	⊢

Table 5.1: Implicative parameters in *enough* and *too* constructions

some overlap in the temporal specifications of the matrix and complement clauses. Finally, if all of these features come together, *enough/too* constructions defeasibly implicate their complements in English (which does not mark aspect) and under the imperfective aspect in French, and entail in the two-way implicative pattern under perfective marking (cf. Hacquard 2005).

(5.1) Circumstantial modality, dynamic adjective, temporal overlap:

a. English, aspect unmarked:

- i. Juno was fast enough to win the race. \rightsquigarrow *Juno won the race.*
- ii. Juno was not fast enough to win the race. \rightsquigarrow *Juno did not win the race.*

b. French, imperfective aspect:

- i. *Juno était assez rapide pour gagner la course.*
‘Juno was-IMPF fast enough to win the race.’ \rightsquigarrow *Juno won the race.*
- ii. *Juno n’était pas assez rapide pour gagner la course.*
‘Juno was-IMPF not fast enough to win the race.’
 \rightsquigarrow *Juno did not win the race.*

c. French, perfective aspect:

i. *Juno a été assez rapide pour gagner la course.*

‘Juno was-PFV fast enough to win the race.’ \vdash *Juno won the race.*

ii. *Juno n’a pas été assez rapide pour gagner la course.*

‘Juno was-PFV not fast enough to win the race.’

\vdash *Juno did not win the race.*

(5.2) Circumstantial modality, dynamic adjective, no overlap:

a. English, aspect unmarked:

i. When I saw her run last week, Juno was fast enough to win today’s race.

\nvdash *Juno won today’s race.*

ii. When I saw her run last week, Juno was not fast enough to win today’s race.

\leadsto *Juno did not win today’s race.*

b. French, imperfective aspect:

i. *L’année dernière, Juno était assez rapide pour gagner la course d’aujourd’hui.*

‘Last year, Juno was-IMPF fast enough to win today’s race.’

\nvdash *Juno won today’s race.*

ii. *L’année dernière, Juno n’était pas assez rapide pour gagner la course d’aujourd’hui.*

‘Last year, Juno was-IMPF not fast enough to win today’s race.’

\leadsto *Juno did not win today’s race.*

c. French, perfective aspect:

i. *Quand je l’ai vue courir la semaine dernière, Juno a été assez rapide pour gagner la course d’aujourd’hui.*

‘When I saw her run last week, Juno was-PFV fast enough to win today’s race.’

\nvdash *Juno won today’s race.*

(5.3) French, static adjective:

a. *Nima était assez grand pour atteindre l'étagère du haut.*

‘Nima was-IMPF tall enough to reach the top shelf.’

\nVdash *Nima reached the top shelf.*

b. *Nima n'était pas assez grand pour atteindre l'étagère du haut.*

‘Nima was-IMPF not tall enough to reach the top shelf.’

\vdash *Nima did not reach the top shelf.*

No other *enough/too* constructions show implicative inference patterns:

(5.4) Epistemic *enough* constructions:

a. English, aspect unmarked:

i. Lee was mean enough to be/to have been the attacker.

\nVdash *Lee was the attacker.*

ii. Lee was not mean enough to be/to have been the attacker.

\nVdash *Lee was not the attacker.*

b. French, imperfective aspect:

i. *Lee était assez insensible pour être/pour avoir été l'agresseur.*

‘Lee was-IMPF mean enough to be/to have been the attacker.’

\nVdash *Lee was the attacker.*

ii. *Lee n'était pas assez insensible pour être/pour avoir été l'agresseur.*

‘Lee was-IMPF not mean enough to be/to have been the attacker.’

\nVdash *Lee was not the attacker.*

c. French, perfective aspect:

i. *Lee a été assez insensible pour être/pour avoir été l'agresseur.*

‘Lee was-PFV mean enough to be/to have been the attacker.’

\nVdash *Lee was the attacker.*

- ii. *Lee n'a pas été assez insensible pour être/pour avoir été l'agresseur.*

‘Lee was-PFV not mean enough to be/to have been the attacker.’

⊈ *Lee was not the attacker.*

(5.5) Deontic *enough* constructions:

a. English, aspect unmarked:

- i. Amira was old enough to drink alcohol. ⊈ *Amira drank alcohol.*

- ii. Amira was not old enough to drink alcohol.

⊈ *Amira did not drink alcohol.*

b. French, imperfective aspect:

- i. *Amira était assez grande pour boire de l'alcool.*

‘Amira was-IMPF old enough to drink alcohol.’ ⊈ *Amira drank alcohol.*

- ii. *Amira n'était pas assez grande pour boire de l'alcool.*

‘Amira was-IMPF not old enough to drink alcohol.’

⊈ *Amira did not drink alcohol.*

c. French, perfective aspect:

- i. *Amira a été assez grande pour boire de l'alcool.*

‘Amira was-PFV old enough to drink alcohol.’ ⊈ *Amira drank alcohol.*

- ii. *Amira n'a pas été assez grande pour boire de l'alcool.*

‘Amira was-PFV not old enough to drink alcohol.’

⊈ *Amira did not drink alcohol.*

At the end of Chapter 4, I suggested that constructions like those in (5.1c), which feature circumstantial modality, dynamic adjectives, temporal overlap, and are marked with the perfective aspect, behave in an implicative manner because these features conspire to produce the key components of implicative entailments as identified in Chapter 3. The correspondences are indicated in Table 5.2, reproduced from Chapter 4.

On the implicative model, we do not expect entailments from *enough/too* constructions

construction	semantic component			inference	
	<i>mod. flavour</i>	<i>presuppose</i>	<i>assert</i>	<i>pos</i>	<i>neg</i>
implicative	causal, circumstantial	$H(S) \blacktriangleleft_c A(S)$ $H(S) \blacktriangleright_c A(S)$	$H(S)$	$\vdash A(S)$	$\vdash \neg A(S)$
be ADJ enough	epistemic	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	$\not\vdash A(S)$	$\not\vdash \neg A(S)$
	deontic	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	$\not\vdash A(S)$	$\not\vdash \neg A(S)$
	circumstantial static ADJ	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	$\not\vdash A(S)$	$\vdash \neg A(S)$
	circumstantial	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	Eng/IMPF $\rightsquigarrow A(S)$	Eng/IMPF $\rightsquigarrow \neg A(S)$
	dynamic ADJ	$d\text{-ADJ}(S) \triangleleft A(S)$ $?d\text{-ADJ}(S) \triangleright A(S)$	$d\text{-ADJ}(S)$	PFV $\vdash A(S)$	PFV $\vdash \neg A(S)$

Table 5.2: Semantic components of polarity-preserving two-way implicativity, by construction

with epistemic or deontic modality, or even in the general case from those with circumstantial modality. The entailments of lexical implicatives arise from the joint contribution of presupposition and assertion. Two-way implicative verbs presuppose the existence of a condition ($H(S)$ in Table 5.2) which is both causally necessary and causally sufficient for the realization of their complements ($A(S)$ in Table 5.2). Under positive matrix polarity, they assert that this condition was satisfied; under negation, that it was not satisfied.

Crucially, the two-way entailment pattern of lexical implicatives depends on presuppositions of causal necessity and sufficiency between the matrix condition and the complement, and an assertion that resolves the truth of the matrix condition. With these features in place, a positive assertion and the sufficiency presupposition jointly entail the realization of the implicative complement (example 5.6a), while a negative assertion, along with the necessity presupposition, entail that the complement was not realized (example 5.6b). Polarity-reversing implicatives flip the relationship between positive matrix assertions and the polarity of the complement entailment.

- (5.6) a. Ana dared to enter the cave. \vdash *Ana entered the cave.*
 i. *Presupposes:* (acting with) daring/courage is causally sufficient for Ana to enter the cave
 ii. *Asserts:* Ana acted with daring
 b. Ana did not dare to enter the cave. \vdash *Ana did not enter the cave.*
 i. *Presupposes:* (acting with) daring was causally necessary for Ana to enter the cave.
 ii. *Asserts:* Ana did not act with daring.

The at-issue content of an *enough/too* construction seems to be of the same sort as that of a lexical implicative. (5.7a) assigns to Bertha a particular degree of age, while (5.7b) asserts instead that she lacks this degree. This parallels *dare* in examples (5.6a) and (5.6b), above: the positive assertion indicates that Ana acted with or in some other way deployed her courage, while the negative assertion indicates that she did not.

- (5.7) a. Bertha is old enough to drive.
 \sim *Bertha's age in the actual world is at least as great as the legal driving age.*
 b. Bertha is not old enough to drive.
 \sim *Bertha's age in the actual world is less than the legal driving age.*

Like lexical implicatives, *enough* and *too* constructions seem to presuppose that satisfying the matrix condition – i.e., having the asserted degree of the matrix adjective – is necessary in order for the sentential subject to realize the *enough/too* complement. Following Hacquard (2005), we saw that cancelling or overriding the necessity relationship results in infelicity:

- (4.18) a. Juno was fast enough to win the race, #but speed is not necessary for winning a race.
 b. Juno was not fast enough to win the race, #but speed is not necessary for winning a race.

Deontic *enough/too* constructions also indicate a necessity relationship between their matrix and complement clauses. For instance, (5.5a-i)-(5.5c-ii) presuppose the existence of a necessary (minimum) age for drinking.

In comparing *enough* and *too* constructions to lexical implicatives, then, we find the following similarities: both constructions presuppose the necessity of a matrix-specified condition for the realization of their complement clauses, and both resolve the status of this condition in their asserted content. *Enough* and *too* constructions diverge from lexical implicatives in two ways. First, as indicated in Table 5.2, the entailments of lexical implicatives follow from a *causal* interpretation of the matrix-complement relationship; as we have seen, *enough* and *too* constructions do not require this relationship to be causal. Secondly, *enough/too* constructions do not as a rule presuppose that the necessary condition is also a sufficient condition for the *enough/too* complement. On the assumption that *enough/too* complement entailments, where they do arise, are implicative in nature, we have the following puzzle. The two missing pieces, causal modality and the sufficiency presupposition, must somehow be introduced in the set of features that predict implicative behaviour – that is, in the interaction between dynamic adjectives, temporal overlap, and the overt presence of the perfective aspect.

In Chapter 4, I suggested that a causal connection between the matrix and complement clauses can be tied to the combination of a dynamic adjective and an overlap in temporal specification. Dynamic adjectives like *fast* and *nimble* contribute to this interpretation insofar as they are inherently action-oriented: in the context of *enough/too* constructions, they characterize an action that is part of the process of bringing about the *enough/too* complement. Specifically, these adjectives characterize actions potentially taken by the sentential subject en route to complement-realization. Assuming that the temporal specifications of the matrix and complement clauses overlap, then the dynamic adjective applies to an action which is causally involved in the realization of the complement *enough/too* complement. I explore this connection in more detail in Section 5.4.

The source of a sufficiency presupposition is more mysterious. I argued that it cannot be part of *enough/too* semantics across the board, for two reasons. First, while static

circumstantial adjectives like *tall* describe properties that are connected, via necessity, to the realization of the *enough/too* complement, these properties cannot in general be sufficient for the complement. This is intuitively clear from an example like (4.80a); even though the matrix clause attributes to Nima the required shelf-reaching height, we do not conclude that he did in fact reach the shelf.

(4.80a) Nima was tall enough to reach the top shelf. \nrightarrow *Nima reached the top shelf.*

A sufficiency relationship can also be unproblematically denied in deontic constructions. In Section 4.2.2, I showed that coding sufficiency, as Hacquard (2005) does, into the core semantics of *enough* and *too* makes empirically wrong predictions about the implications of deontic *enough/too* constructions (see examples 4.51-4.54).

Finally, we saw that default implicative inferences in the English and imperfective constructions with dynamic adjectives and temporal overlap were easily avoided by denying the sufficiency of the matrix condition for the complement's realization:

(4.7a) Juno was fast enough to win the race, but she was not allowed to participate.

(4.75) *Juno était assez rapide pour gagner la course, mais elle n'avait pas le droit de participer.*

'Juno was-IMPF fast enough to win the race, but she was not allowed to participate.'

The continuations in (4.7a) and (4.75) indicate that some necessary condition other than the one associated with the matrix adjective was not satisfied in the utterance context. This precludes complement actualization. The felicity of these examples also shows that the matrix condition – having a certain degree of speed – cannot be presupposed to be sufficient for the *enough/too* complement. Nevertheless, constructions like (4.7a) and (4.75) are precisely the cases that generate default complement inferences, in the absence of explicit cancellations. This suggests that there is a tendency, in these cases, to assume the sufficiency of the matrix condition for the *enough/too* complement (similar to the tendency observed for one-way implicatives in Chapter 3), which goes away if we replace the dynamic adjective (*fast*) with a static one.

The real trouble arises when we look at dynamic circumstantial *enough/too* constructions under the perfective aspect. From a compositional perspective, we expect that the lexical content and presuppositions of an *enough/too* predicate should remain stable across differences in aspectual marking, since aspect is taken to contribute only to temporal interpretation. Thus, if (4.7a) and (4.75) do not encode a sufficiency presupposition, neither should (4.16a):

(4.16a) *Juno a été assez rapide pour gagner la course, #mais elle était blessée et ne pouvait pas courir (ce jour-là).*

‘Juno was-PFV fast enough to win the race, #but she was injured and could not run (that day).’

But examples like (4.16a), and other dynamic adjective circumstantial constructions (with temporal overlap), do appear to background the sufficiency of their matrix predicates for the *enough/too* complement. This is what produces infelicity in (4.16a), as well as in example (4.50), where the context explicitly leaves open the state of a matrix-independent condition which is necessary for the *enough* complement.

(4.50) *Context:* Juno is competing in today’s race, which is about to take place. Just before the race begins, an announcement is made that the age qualifications have changed from what was stated on the entry form she filled out in the morning – specifically, that the minimum age for participating has changed. Juno was already right on the cusp of not qualifying due to her age, so after this announcement we are not sure if she meets the qualifications any longer. The gun goes off before we have a chance to figure out anything further. I can see that Juno is clearly the fastest runner, and crosses the finish line first. You did not see the race, because you were looking for an official to find out about the new qualifications, but you have not been successful in this. I report the result to you by saying:

a. *?Juno a été assez rapide pour gagner la course.*

‘?Juno was-PFV fast enough to win the race.’

Thus, under the perfective aspect, circumstantial *enough/too* constructions with dynamic adjectives and temporal overlap seem to produce implicative entailments on the basis of the same components as two-way implicative verbs. This is surprising: if *enough/too* constructions do not encode sufficiency conditions, it is difficult to see how the perfective aspect might introduce such a presupposition. This is the same question we faced at the end of Chapter 3, in trying to reconcile the ‘one-way’ implicative analysis of *be able* and ability modals with the sufficiency condition required for two-way implicative behaviour.

The semantics developed in this chapter will put us in a position to answer this question sensibly. Building on von Stechow et al. (2004), I first develop a basic treatment of *enough/too* constructions which captures Meier’s (2003) intuitive paraphrases, but avoids the issues faced by her account, as well as the overgeneration problems resulting from Hacquard’s ‘at-base implicative’ treatment. In addition, I show that this semantics leads naturally to the encoding of a necessity condition that matches the necessity condition proposed by Hacquard. I show that this derives the desired inference patterns for epistemic, deontic, and static circumstantial *enough/too* constructions, improving on both previous analyses. Despite this progress, however, the basic account fails to distinguish between circumstantial cases with static versus dynamic matrix adjectives.

In order to address this issue, I next take a closer look at the connection between dynamic adjectives and the necessity condition, arguing that the action-characterizing nature of these properties, combined with a necessity-encoding semantics (and temporal overlap) induces a presupposition of causal sufficiency between an action characterized by the matrix property and the realization of the *enough/too* complement. This is crucially different from Hacquard’s sufficiency presupposition: where she takes the property attribution to itself be a sufficient condition for the complement, I argue that the sufficient condition is instead a *manifestation* of (some action characterized by) the matrix property.

As a result of this, *enough/too* constructions with dynamic adjectives and temporal overlap are very nearly implicative in composition: they share modal flavour and a combined necessity/sufficiency presupposition, but they differ in what is asserted with respect to this presupposition. Implicatives convey that the causing condition itself occurred, while

‘implicative’ *enough/too* constructions at base attribute to their subjects only the latent capacity for this causing condition to be satisfied – i.e., the capacity of the sentential subject to produce the manifestation which represents the causing condition. On this view, an implicative inference will follow from an *enough/too* construction if the construction is interpreted as describing the causing manifestation, instead of just the subject’s capacity for the manifestation. If, by some means, the causing manifestation is entailed, we expect implicative entailments. At the end of this chapter, I suggest that this is the work done by the overt addition of perfective aspect, accounting for the appearance of sufficiency in the perfective cases. Finally, I sketch an informal account of the interaction between aspect and latent capacity attributions. This leads into Chapter 6, which develops a formal treatment of the semantic contribution and selectional restrictions of viewpoint aspect which are responsible for the surface behaviour observed in the complement entailments of *enough/too* constructions as well as, ultimately, actualized interpretations of ability modals.

5.1 The basic semantic analysis

In developing a semantic treatment of *enough* and *too* constructions, I build primarily on a proposal from von Stechow et al. (2004). Their account is inspired by Meier (2003), but makes use of independent observations about the interpretation of modals in comparative complements (von Stechow, 1984; Heim, 2001) to simplify the underlying structure. On the von Stechow et al. account, the complement of an *enough/too* construction is treated like a goal or purpose clause, and affects the overall interpretation of the construction by restricting the set of worlds under consideration – that is, by modifying the modal base of a modal embedded in the *enough* or *too* operator. Thus, as on Hacquard’s (2005) account, modality is built directly into *enough* and *too*, rather than appearing (potentially covertly) in the complement proposition. While von Stechow et al. do not make this point explicit, their account also improves on Meier’s in that it captures an interpretation for ‘truncated’ (complement-lacking) *enough/too* constructions like (4.36)-(4.37), repeated from Chapter 4. In Section 4.2.1, I suggested that the availability and interpretability of examples like these

argues against any analysis which treats an *enough/too* complement clause as a required component in the syntactic or semantic structure.

(4.36) γ The baby’s mother carried him home and took care of him. And when he was old enough, she took him to the king’s daughter, who adopted him.

(4.37) γ “Pesireron’s punch was powerful, but he was too slow,” Park said later in a nationally televised interview in Chonju, about 125 miles south of Seoul.

Over the next two sections, I first introduce the components of von Stechow et al.’s account, and then discuss how this naturally captures the necessity condition which seems to be encoded in all *enough/too* constructions, regardless of modal flavour, adjective type, aspectual marking, and so on. Section 5.3 examines the truth conditions we predict for *enough/too* constructions with different modal flavours, and assesses where we are with respect to the implicative behaviour summarized in Table 5.2.

5.1.1 *Enough* and *too* as modalized comparatives

Applying Meier’s (2003) hypothesis to the now-familiar deontic *enough* and *too* constructions in (5.8), we get the following intuitive paraphrases:

(5.8) Meier’s (2003) paraphrases:

a. Bertha is old enough to drive.

\sim The **maximum** degree d such that Bertha is d -old in the actual world is at least as great as the **minimum** degree d' such that, if Bertha is d' -old, she can drive (in view of the law).

b. Bertha is too old to drive.

\sim The **maximum** degree d such that Bertha is d -old in the actual world is greater than the **maximum** degree d' such that, if Bertha is d' -old, she can drive (in view of the law).

Meier derives these interpretations by assigning *enough* and *too* semantic analyses on which they both perform a degree comparison and also construct the ‘hidden’ conditional which supplies a modalized degree predicate for comparison with the matrix degree predicate. She achieves this by treating the infinitival complement of an *enough* or *too* construction as an ‘open’ conditional, containing a relational version of the possibility modal which requires an antecedent proposition (actually, a degree predicate) for saturation. As von Stechow et al. point out, this requires that Meier “stipulate the distribution of the minimal-maximal operators” (2004, p.16) in order to produce the interpretations in (5.8). In particular, to get the intuitively correct results, *enough* sentences must involve maximum to minimum comparisons, while *too* sentences involve maximum to maximum comparisons, but there is no independent reason for this distribution of maximal and minimal operators.

Von Stechow et al.’s reanalysis centers on the idea that we can avoid stipulating the distribution of maximal and minimal operators by making use of observations from Heim (2001). Heim shows that maximal and minimal interpretations arise naturally as a consequence of interpreting modal operators under comparatives: in particular, she shows that a universal modal under a comparative gives rise to a minimum-standard reading, as in (5.9), while an existential modal under a comparative instead produces a maximum-standard reading, as in (5.10).

(5.9) The paper is as long as it is required to be.

*The actual length of the paper is greater than or equal to the required **minimum** length.*

(5.10) The paper is longer than it is allowed to be.

*The actual length of the paper is greater than the **maximum** permitted length.*

Von Stechow et al. point out that the comparative claims in (5.9) and (5.10) are readily paraphrased by *enough* and *too* claims, respectively.

(5.11) The paper is long enough. \equiv The paper is as long as it is required to be. (5.9)

(5.12) The paper is too long. \equiv The paper is longer than it is allowed to be. (5.10)

Under the equivalences in (5.11) and (5.12), *enough* claims will receive the desired minimum-standard interpretation in (5.9) if *enough* is treated as an equative operator which embeds a universal modal; *too* claims will receive the maximum-standard interpretation in (5.10) if *too* is treated as a strict comparative embedding an existential. Consequently, given an account of comparatives which derives the readings in (5.9)-(5.10), we can simply combine the contribution of the comparative operator and the right modal to get a semantics for *enough* and *too*.

5.1.2 Gradable adjectives and comparative claims

In order to derive interpretations for modalized comparative statements, we first need to develop the semantic machinery for interpreting gradable adjectives, degree predicates, and standard (non-modal) comparisons. We have already seen how some of these components might work, in Sections 4.2.1-4.2.2, but I set them out more systematically here. I follow von Stechow et al. (2004) and Heim (2001) in using a degree-based semantics (Cresswell, 1976; Kennedy, 2001), in place of the von Stechow (1984) extent semantics adopted by Meier.

Alongside the existing domains of individuals, worlds, and truth values, we first introduce a set D_d of degrees (assigning degrees the type d).¹ For current purposes, it will suffice to treat the set of degrees as isomorphic to the non-negative real numbers $[0, \infty)$, subject to the standard ordering. Degrees are located on *scales*, which have the same interval structure $[0, \infty)$. A (numerical) scale is associated with measurement units of a particular type.² Thus, a *measure function* like HEIGHT will assign to an individual a degree on the scale of spatial distances, while AGE assigns to an individual a degree on an isomorphic but different scale comprised of temporal distances/units (months, years, etc). More precisely, we take measure functions to be functions from a world-individual pair to a unique degree, which is

¹One way of introducing type d without treating degrees as a primitive is to construct them as equivalence classes of individuals with respect to a given property, e.g. *tallness*; see Cresswell (1976).

²Ultimately, the structure of a scale will need to be revised to account for maximum-standard adjectives like *full* as well as minimum-standard adjectives like *wet* or *bent*; the available set of degrees should be isomorphic to the interval between 0 and 1, where the adjective in question specifies whether this interval is closed, open, or half open (and at which end). For present purposes, however, treating scales as uniformly isomorphic to $[0, \infty)$ will suffice. See also Kennedy (2001).

the maximum degree on the relevant scale that the individual possesses in the evaluation world. In some cases, these measure functions have recognizable names, as in (5.13), below. Where they do not, I will represent a measure function as μ_{ADJ} , where ADJ is the gradable adjective with which it is associated.

(5.13) Measure functions:

- a. $\text{SPEED} := \lambda w \lambda x. x$'s speed in w
- b. $\text{HEIGHT} := \lambda w \lambda x. x$'s height in w
- c. $\text{AGE} := \lambda w \lambda x. x$'s age in w

Positive polar adjectives like *fast*, *tall*, and *old* relate individuals to sets of degrees:

(5.14) Positive polar gradable adjectives:

- a. $\llbracket \text{fast} \rrbracket := \lambda w \lambda x \lambda d. \text{SPEED}(x)(w) \geq d$
- b. $\llbracket \text{tall} \rrbracket := \lambda w \lambda x \lambda d. \text{HEIGHT}(x)(w) \geq d$
- c. $\llbracket \text{old} \rrbracket := \lambda w \lambda x \lambda d. \text{AGE}(x)(w) \geq d$

In (5.14), an individual x in a world w is associated with a set of degrees in the form of an interval $[0, n]$ where n is the value assigned to x in w by the measure function associated with the adjective in question. Thus, if a gradable adjective predicate is true for an individual x and degree d at a world w , x possesses at least degree d of the specified property in w , and possibly more.

We can now interpret a simple measure statement with a positive polar adjective. In (5.15), *old* takes as arguments both the measure phrase (18 years) and an individual (Bertha), and returns a truth value as long as *18 years* is a degree on the right scale for the measure function (AGE) associated with *old*. If we feed *old* the wrong kind of measure phrase, as in (5.16), the claim will not be interpretable.

(5.15) Bertha is 18 years old.

- a. $\llbracket \text{old} \rrbracket(w^*)(B)(18\text{-years})$

b. Since *18-years* is on the AGE scale,

$$\llbracket \text{old} \rrbracket(w^*)(B)(18\text{-years}) \equiv \text{AGE}(w^*)(B) \geq 18$$

c. *Bertha has a degree of at least 18 in years on the AGE scale in the actual world.*

(5.16) ??Bertha is 6 feet old.

Next, we consider the interpretation of a basic comparative like (5.17):

(5.17) Bertha is older than Martha.

Intuitively, we want to check how old Bertha is in the evaluation world, compare this to Martha's age in the evaluation world, and return True if the first number is greater than the second. With the apparatus developed, we achieve this result by comparing the set of degrees which *old* relates to Bertha to the set of degrees *old* associates with Martha. Since both sets have the form $[0, n]$, comparing them via set inclusion will, in effect, compare their maximum elements (Seuren, 1984; von Stechow, 1984; Kennedy, 2001). Following von Stechow et al., I make the simplifying assumption that comparison statements are only defined if the two degree predicates pick out intervals on the same scale (but see von Stechow 1984 for a treatment of differential comparatives like *John is wider than he is tall*).

$$(5.18) \quad (5.17) = 1 \text{ iff } \{d : \text{AGE}(B)(w^*) \geq d\} \supset \{d : \text{AGE}(M)(w^*) \geq d\}$$

We therefore want the comparative morpheme *-er* to take two (open) degree predicates and compare them as sets.³ In (5.19), *Q* represents the subject NP, and *P* the *than*-complement.

$$(5.19) \quad \llbracket \text{-er} \rrbracket := \lambda w \lambda P_{dt} \lambda Q_{dt}. Q \supset P.$$

The morpheme *-er* is taken to form a constituent with its (partially-elided) complement. This constituent occupies the position of the measure phrase in a simple measure statement

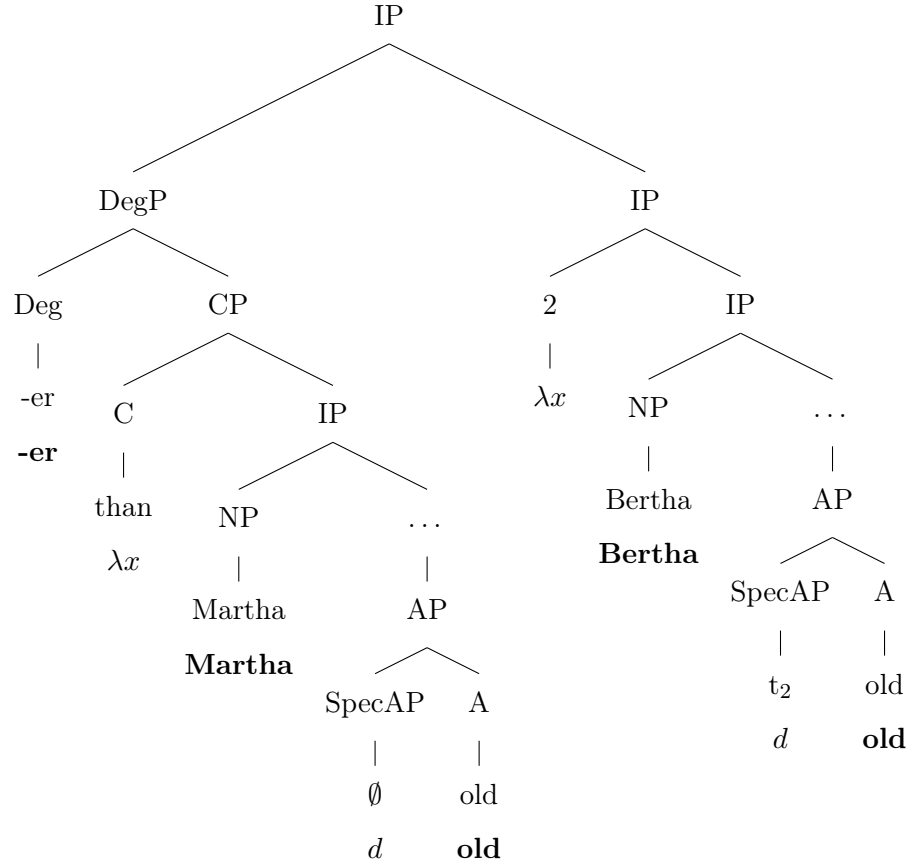
³We saw a different formulation for the comparative *-er*, due to Kennedy (2001), in Chapter 2: it is easy to see that (5.19) and (4.24) will have equivalent truth conditions.

$$(4.24) \quad \llbracket \text{-er} \rrbracket := \lambda w \lambda P_{dt} \lambda Q_{dt}. \forall d [P(d) = 1 \rightarrow Q(d) = 1] \wedge \exists d [Q(d) = 1 \wedge P(d) = 0]$$

like (5.15), but then raises for type reasons, taking the open matrix degree predicate as its second argument.⁴

(5.17) Bertha is older than Martha

- a. \equiv Bertha is d_2 old, where $d_2 = (-er \ \lambda_1 \ (\text{Martha is } d_1 \text{ old}))$
 b. $[-er \ \lambda_1 \ [M \text{ is } d_1\text{-old}] \]_2 \ (B \text{ is } d_2\text{-old})$



- c. $\llbracket (5.17) \rrbracket^{w^*} = \llbracket (-er(\lambda w \lambda d. \text{AGE}(M)(d)(w))(\lambda w \lambda d. \text{AGE}(B)(d)(w))) \rrbracket^{w^*}$
 $= \llbracket -er \rrbracket (w^*)(\lambda w \lambda d. \text{AGE}(M)(d)(w))(\lambda w \lambda d. \text{AGE}(B)(d)(w))$
 $= \{d : \text{AGE}(w^*)(B) \geq d\} \supset \{d : \text{AGE}(w^*)(M) \geq d\}$

- d. *The set of degrees such that Bertha is at least d old in the actual world is a proper superset of the set of degrees such that Martha is at least d old in the*

⁴Note that we can therefore think of comparatives, entirely equivalently, as degree attributions, where the attributed degree is defined by the comparative and its complement.

actual world; equivalently, Bertha has at least d^ degrees of age in the actual world, where d^* is the maximum degree of age that Martha has in the actual world.*

The equative operator *as* (as in *as long as*, *as old as*, etc) is treated similarly. In this case, the comparison set is not required to be a proper subset of the matrix set.

$$(5.20) \quad \llbracket \text{as} \rrbracket := \lambda w \lambda P \lambda Q. Q \supseteq P$$

Thus, an equative comparison like *Bertha is as old as Martha* will be true at a world w if the degree assigned to Bertha in w by AGE is at least as great as the degree assigned to Martha in w by the same measure function.

To handle negative polar adjectives, we take them to represent antonyms of positive polar adjectives, and define them in terms of negation (Heim, 2001, 2006). Thus, *short* will relate an individual x in a world w to the complement (in $[0, \infty)$) of the set that *tall* relates to x in w . Thus, we can think of negative polar adjectives as relating an individual to the set of degrees of a property which they lack in the world of evaluation.

(5.21) Negative polar gradable adjectives:

- a. $\llbracket \text{slow} \rrbracket := \lambda w \lambda x \lambda d. \neg(\text{SPEED}(x)(w) \geq d) \quad \equiv \lambda w \lambda x \lambda d. \text{SPEED}(x)(w) < d.$
- b. $\llbracket \text{short} \rrbracket := \lambda w \lambda x \lambda d. \neg(\text{HEIGHT}(x)(w) \geq d) \quad \equiv \lambda w \lambda x \lambda d. \text{HEIGHT}(x)(w) < d.$
- c. $\llbracket \text{young} \rrbracket := \lambda w \lambda x \lambda d. \neg(\text{AGE}(x)(w) \geq d) \quad \equiv \lambda w \lambda x \lambda d. \text{AGE}(x)(w) < d.$

With the exception of playful uses, we typically do not use negative polar adjectives in precise degree attributions (*??Bertha is 18 years young*), but we can check that comparatives with negative polar adjectives produce the expected interpretations:

(5.22) Martha is younger than Bertha.

- a. $(5.22) \equiv [-\text{er } \lambda_1 [\text{Bertha is } d_1\text{-young}]]_2(\text{Martha is } d_2\text{-young})$
- b. $\llbracket (5.22) \rrbracket^{w^*} = \llbracket (-\text{er}(\lambda w \lambda d. \neg \text{AGE}(B)(d)(w)))(\lambda w \lambda d. \neg \text{AGE}(M)(d)(w)) \rrbracket^{w^*}$
 $= \llbracket -\text{er} \rrbracket (w^*)(\lambda w \lambda d. \text{AGE}(B)(w) < d)(\lambda w \lambda d. \text{AGE}(M)(w) < d)$
 $= \{d : \text{AGE}(M)(w^*) < d\} \supset \{d : \text{AGE}(B)(w^*) < d\}$

- c. *The set of degrees of age that Martha lacks in the real world is a proper superset of the set of degrees of age that Bertha lacks in the real world; thus Martha's actual age is less than Bertha's actual age.*

(5.22) therefore has equivalent truth conditions to (5.17), as expected.

5.1.3 Comparatives with modal complements

The next step is to analyze a comparative like (5.9), in which the first argument of the comparative operator is provided by a modal statement, rather than a degree predicate. This is straightforward with the ingredients defined above. Here, as in (5.17), the comparative and (modal) complement form a constituent which is generated in the measure-phrase slot of the matrix degree predicate, and raises to take the matrix clause as an argument instead.

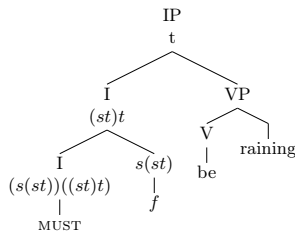
(5.9) The paper is as long as it is required to be.

$\equiv [as\ \lambda_2\ [MUST_{deontic}\ (paper_1\ is\ d_2\text{-long})]]_3\ (paper_1\ is\ d_3\text{-long})$

The use of *required* (as the modal operator) indicates that (5.9) involves deontic modality. We let f be a circumstantial conversational background, fixing a relevant set of facts at any given world, and let g be a deontic conversational background, which picks out the laws or rules (relevant for the paper) at any world.⁵ As in Chapter 4, I abbreviate the set of ideal worlds $Opt_{DEON(w)}(\cap CIRC(w))$ that results from the combination of a circumstantial modal base and a deontic ordering source as $DEON(w)$. (5.9) is interpreted as follows:

⁵Diverging from Kratzer (1981), von Stechow et al. treat f (the conversational background determining the modal base) as a silent argument of the modal, assigning it a place in syntactic structure:

- (i) It must _{f} be raining.



On their view, this makes f available for modification by other syntactic material, such as an optional purpose clause. This contrasts with the conversational background g which determines the ordering source; contra Sæbø (2001), von Stechow et al. claim that overt material cannot directly modify g . I refer to von Stechow et al. (2004, pp.2–6) for the compositional details.

- (5.23) a. $\llbracket (5.9) \rrbracket^{w^*} = \llbracket (\text{as}(\text{MUST}_{\text{deontic}}(\lambda w \lambda d. \text{LENGTH}(\text{paper}_1)(d)(w)))) \rrbracket^{w^*}$
 $(\lambda w \lambda d. \text{LENGTH}(\text{paper}_1)(d)(w)) \rrbracket^{w^*}$
 $= \llbracket \text{as} \rrbracket (w^*)(\lambda w \lambda d. \forall w' \in \text{DEON}(w)[\text{LENGTH}(\text{paper}_1)(w') \geq d])$
 $(\lambda w \lambda d. \text{LENGTH}(\text{paper}_1)(w) \geq d)$
 $= \{d : \text{LENGTH}(w^*)(\text{paper}_1) \geq d\} \supseteq$
 $\{d : \forall w \in \text{DEON}(w^*)(\text{LENGTH}(w)(\text{paper}_1) \geq d)\}$
- b. *The set of degrees d of length that the paper has in the actual world is a superset of the set of degrees d such that in all worlds where the paper-length rules are the same as in ours, and are not violated, the paper has at least degree d of length.*

Let us consider the truth conditions in (5.23c) more closely. The first set is familiar: it is an interval of the form $[0, n]$ where n is the maximum length of the paper in the actual world. The second, modalized set will also be an interval of the form $[0, n]$. It is formed by taking the set of degrees of length that the paper has for each ideal world (where paper-length rules are not violated), and intersecting them, thus returning the set of degrees that the paper has in all (across all) of the ideal worlds. Since each of the intersected sets has the form $[0, n]$, their intersection will simply return the set of degrees of length that the paper has in the ideal world where it is the shortest. Consequently, the set comparison performed by *as* amounts to checking whether the maximum degree of actual length is at least as great as the minimum permissible length, as desired. This gets us the maximum-minimum comparison of Meier's analysis.

A maximum-maximum comparison falls out from interpreting an existential modal in the complement of *-er*:

- (5.10) The paper is longer than it is allowed to be
- a. $(5.10) \equiv [-er \lambda_2 [\text{CAN}_{\text{deontic}}(\text{paper}_1 \text{ is } d_2\text{-long})]]_3 (\text{paper}_1 \text{ is } d_3\text{-long})$
- b. $\llbracket (5.10) \rrbracket^{w^*} = \llbracket (-er(\text{CAN}_{\text{deontic}}(\lambda w \lambda d. \text{LENGTH}(\text{paper}_1)(d)(w)))) \rrbracket^{w^*}$
 $(\lambda w \lambda d. \text{LENGTH}(\text{paper}_1)(d)(w)) \rrbracket^{w^*}$

$$\begin{aligned}
 &= \llbracket \text{-er} \rrbracket (w^*)(\lambda w \lambda d. \exists w' \in \text{DEON}(w)[\text{LENGTH}(\text{paper}_1)(w') \geq d]) \\
 &\quad (\lambda w \lambda d. \text{LENGTH}(\text{paper}_1)(w) \geq d) \\
 &= \{d : \text{LENGTH}(w^*)(\text{paper}_1) \geq d\} \supset \\
 &\quad \{d : \exists w \in \text{DEON}(w^*)[\text{LENGTH}(w)(\text{paper}_1) \geq d]\}
 \end{aligned}$$

- c. *The set of degrees d of length that the paper has in the actual world is a proper superset of the set of degrees d such that there is a world where the paper-length rules are the same as in ours, and are not violated, and the paper has at least degree d of length.*

In this case, the modalized set represents a union of the lengths of the paper across ideal worlds: thus, it corresponds to the interval assigned to the paper in the world where it is longest. Thus, the set comparison amounts to comparing the maximum length of the paper in the actual world with the maximum permissible length. Since the first set is a proper superset of the second, (5.10) is true just in case the paper is longer in the actual world than the allowed maximum.

We now return to the equivalences in (5.11)-(5.12):

$$(5.11) \quad \text{The paper is long enough.} \quad \equiv \quad \text{The paper is as long as it is required to be.} \quad (5.9)$$

$$(5.12) \quad \text{The paper is too long.} \quad \equiv \quad \text{The paper is longer than it is allowed to be.} \quad (5.10)$$

The idea is that the *enough* statement in (5.11) should have the same truth conditions as (5.9), while the *too* statement in (5.12) should be semantically equivalent to (5.10). We achieve this by bundling the work done by the equative and the universal modal together into the lexical entry for *enough*, and the work done by the comparative and existential modal into the lexical entry for *too*.

$$(5.24) \quad \llbracket \text{enough} \rrbracket := \lambda w \lambda Q_{s(dt)}. \{d : Q(d)(w)\} \supseteq \{d : \text{MUST}_{f,g}[Q(d)(w')]\}$$

$$(5.25) \quad \llbracket \text{too} \rrbracket := \lambda w \lambda Q_{s(dt)}. \{d : Q(d)(w)\} \supset \{d : \text{CAN}_{f,g}[Q(d)(w')]\}$$

Finally, what happens with the addition of a complement clause? Von Stechow et al. treat *enough/too* complements as goal or purpose clauses, extending the analogy between *enough/too* statements and standard comparatives with modal complements:

(5.26) The paper is as long as it must be in order to be published.

\equiv The paper is long enough to be published.

(5.27) The paper is longer than it may be in order to be published.

\equiv The paper is too long to be published.

In interpreting the comparatives, we are interested in what must be true (about the degree predicate) in those worlds where the *in order to* clause (the goal) is realized. The idea is to look at the ‘ideal’ worlds in which the goal (the paper being published) is achieved, and see what is true of the length of the paper in these worlds. This is equivalent to adding the purpose clause to the modal base, since we do not consider worlds in which it does hold.

(5.28) The paper is as long as it must be in order to be published.

$$\begin{aligned} &= \{d : \text{LENGTH}(w^*)(\text{paper}_1) \geq d\} \supseteq \\ &\quad \{d : \forall w \in \text{DEON}(w^*)[\text{published}(\text{paper}_1)(w) \rightarrow \text{LENGTH}(\text{paper}_1)(w) \geq d]\} \end{aligned}$$

(5.29) The paper is longer than it may be in order to be published.

$$\begin{aligned} &= \{d : \text{LENGTH}(w^*)(\text{paper}_1) \geq d\} \supset \\ &\quad \{d : \exists w \in \text{DEON}(w^*)[\text{published}(\text{paper}_1)(w) \wedge \text{LENGTH}(\text{paper}_1)(w) \geq d]\} \end{aligned}$$

Enough/too complements can be treated the same way. Since we are interested in those constructions which do have complement clauses, I provide modified lexical entries for *enough* and *too* which accommodate this: P represents the first (complement) argument to *enough/too*, while Q is the matrix clause, as before.

$$\begin{aligned} (5.30) \quad \text{a. } \llbracket \text{enough} \rrbracket &:= \lambda w \lambda P_{st} \lambda Q_{s(dt)}. Q(w) \supseteq \{d : \text{MUST}_{f,g}[P(w) \rightarrow Q(d)(w)]\} \\ \text{b. } \llbracket \text{too} \rrbracket &:= \lambda w \lambda P_{st} \lambda Q_{s(dt)}. Q(w) \supset \{d : \text{CAN}_{f,g}[P(w) \wedge Q(d)(w)]\} \end{aligned}$$

We can now interpret the examples we began with:

(5.31) Bertha is old enough to drive.

$$\begin{aligned} \text{a. } \llbracket (5.31) \rrbracket^{w^*} &= \llbracket \text{enough}(\lambda w. \text{drive}(B)(w))(\lambda w \lambda d. \text{AGE}(B)(w) \geq d) \rrbracket^{w^*} \\ &= \{d : \text{AGE}(w^*)(B) \geq d\} \supseteq \\ &\quad \{d : \forall w \in \text{DEON}(w^*)[\text{drive}(w)(B) \rightarrow (\text{AGE}(w)(B) \geq d)]\} \end{aligned}$$

- b. *Bertha's age in the actual world is at least as great as the minimum age she has in a world where she drives without breaking the laws.*

(5.32) Bertha is too old to drive.⁶

- a. $\llbracket (5.32) \rrbracket^{w^*} = \llbracket \text{too}(\lambda w.\text{drive}(B)(w))(\lambda w\lambda d.\text{AGE}(B)(w) \geq d) \rrbracket^{w^*}$
 $= \{d : \text{AGE}(w^*)(B) \geq d\} \supset$
 $\{d : \exists w \in \text{DEON}(w^*)[\text{drive}(w)(B) \wedge (\text{AGE}(w)(B) \geq d)]\}$
- b. *Bertha's age in the actual world is greater than the maximum age she has in any of the worlds where she drives without breaking the laws.*

These derivations produce the maximum-minimum comparisons argued for by Meier (2003). The tradeoff has been to complicate the analysis of *enough* and *too* by embedding modality. However, this simplifies the overall compositional structure of *enough/too* constructions, and, as discussed in Chapter 4, there are independent reasons to believe that *enough* and *too* are inherently modal operators.

It is worth checking that the new account produces sensible truth conditions when we evaluate *enough/too* statements with a negative polar adjective:

(5.33) Bertha is young enough to drive.

- a. $\llbracket (5.33) \rrbracket^{w^*} = \llbracket \text{enough}(\lambda w.\text{drive}(B)(w))(\lambda w\lambda d.\neg \text{AGE}(B)(d)(w)) \rrbracket^{w^*}$
 $= \{d : \text{AGE}(B)(w^*) < d\} \supseteq$
 $\{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow (\text{AGE}(B)(w) < d)]\}$
- b. *The minimum degree d of age that Bertha lacks in the real world is at least as small as the maximum degree d of age that she lacks in any of the worlds where she drives without breaking the laws.*

In (5.33a), we compare sets of the form (n, ∞) ; the first set will be a superset of the second as long as its minimal element is at least as small as the minimal element of the second set. The first set represents the degrees of age that Bertha lacks in the real world. The second,

⁶Note that, in order for (5.32) to be interpretable on a deontic reading, we must assume that there is some age at which one is no longer legally eligible to drive.

as before, will be formed by the intersection of the degrees of age that she lacks across all worlds where she drives without violating any of the laws: thus, its minimal element is the maximal degree of age she can lack while still driving legally.

(5.34) Bertha is too young to drive.

- a. $\llbracket (5.34) \rrbracket^{w^*} = \llbracket \text{too}(\lambda w. \text{drive}(B)(w))(\lambda w \lambda d. \neg \text{AGE}(B)(d)(w)) \rrbracket^{w^*}$
 $= \{d : \text{AGE}(B)(w^*) < d\} \supset$
 $\{d : \exists w \in \text{DEON}(w^*)[\text{drive}(B)(w) \wedge (\text{AGE}(B)(w) < d)]\}$
- b. *The minimum degree d of age that Bertha lacks in the real world is smaller than the minimum degree d of age that she lacks in any of the worlds where she drives without breaking the laws.*

Replacing *enough* with *too* in (5.34), gives us the truth conditions paraphrased in (5.34b): this is equivalent to the claim that Bertha's actual age is less than the minimal age compatible with legal driving, and thus she cannot drive legally, in view of her age.

Finally, given the interpretations in (5.31)-(5.34), we can check that negating (5.31) will produce equivalent truth conditions to (5.34), and that negating (5.32) will produce equivalent truth conditions to (5.33).

(5.35) Bertha is not old enough to drive.

- a. $(5.35) \equiv \neg(\text{Bertha is old enough to drive})$
- b. $\llbracket (5.35) \rrbracket^{w^*} = \neg \llbracket (5.31) \rrbracket^{w^*}$
 $= \neg[\{d : \text{AGE}(B)(w^*) \geq d\} \supseteq$
 $\{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow (\text{AGE}(B)(w) \geq d)]\}]$
 $= \{d : \text{AGE}(B)(w^*) \geq d\} \not\supseteq$
 $\{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow (\text{AGE}(B)(w) \geq d)]\}$

As previously noted, the sets being compared in (5.35b) are both of the form $[0, n]$, where $n \in \mathbb{R}^{\geq 0}$. Given two sets $[0, n], [0, m]$, where $n, m \in \mathbb{R}^{\geq 0}$, if $[0, n] \not\supseteq [0, m]$ we have $n \not\geq m$,

so $n < m$. But then $[0, n] \subset [0, m]$, so:

$$(5.35b) \equiv \{d : \text{AGE}(B)(w^*) \geq d\} \subset \{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow (\text{AGE}(B)(w) \geq d)]\}$$

Given any two sets A, B which are both subsets of a third set C , such that A is a proper subset of B ($A \subset B$), the set complement \overline{A} of A in C will be a proper superset of the set complement \overline{B} of B in C : $\overline{A} \supset \overline{B}$.⁷ For the sets in (5.35b), the ‘universe’ set C is the domain D_d of degrees, $[0, \infty)$.

$$(5.35b) \equiv \overline{\{d : \text{AGE}(B)(w^*) \geq d\}} \supset \overline{\{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow (\text{AGE}(B)(w) \geq d)]\}}$$

The complement of $\{d : \text{AGE}(B)(w^*) \geq d\}$ is $\{d : \text{AGE}(B)(w^*) < d\}$. For the second set, by construction, we have:

$$\begin{aligned} & \{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow \text{AGE}(B)(w) \geq d]\} \\ &= \bigcap_{w \in \text{DEON}(w^*)[\text{drive}(B)(w)]} \{d : \text{AGE}(B)(w) \geq d\} \end{aligned}$$

For any collection of sets A_1, \dots, A_n, \dots , with $A_i \subseteq C$ for all i , we have $\overline{\bigcap_i A_i} = \bigcup_i \overline{A_i}$.⁸

$$\begin{aligned} & \overline{\{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow \text{AGE}(B)(w) \geq d]\}} \\ &= \bigcup_{w \in \text{DEON}(w^*)[\text{drive}(B)(w)]} \{d : \text{AGE}(B)(w) < d\} \\ &= \{d : \exists w \in \text{DEON}(w^*)[\text{drive}(B)(w) \wedge \text{AGE}(B)(w) < d]\} \end{aligned}$$

Thus, the truth conditions of (5.35) are given by:

$$\llbracket (5.35) \rrbracket^{w^*} = \{d : \text{AGE}(B)(w^*) < d\} \supset \{d : \exists w \in \text{DEON}(w^*)[\text{drive}(B)(w) \wedge \text{AGE}(B)(w) < d]\}$$

⁷ *Proof.* Suppose $A, B \subseteq C$, and $A \subset B$. Then $\forall x \in C$ such that $x \in A$, we have $x \in B$, and $\exists y \in C$ such that $y \in B$ and $y \notin A$. Let $x \in C$ such that $x \in C/B$. Then $x \notin B$, so $x \notin A$, and $x \in C/A$. This gives us $C/A \supseteq C/B$. Then let $y \in C$ be such that $y \in B$ and $y \notin A$. Then $y \in C/A$, but $y \notin C/B$, so $\exists y \in C$ such that $y \in C/A$ and $y \notin C/B$, so $C/A \supset C/B$. \square

⁸ *Proof.* Let $A_1, \dots, A_n, \dots \subseteq C$. Let $x \in C$ be such that $x \in \overline{\bigcap_i A_i}$. By definition, $x \in \overline{\bigcap_i A_i}$ iff $x \notin \bigcap_i A_i$, iff $\exists i$ such that $x \notin A_i$. But this is equivalent to $x \in \overline{A_i}$, so $x \in \bigcup_i \overline{A_i}$. \square

These are precisely the truth conditions given for *Bertha is too young to drive* in (5.34a), so *Bertha is not old enough to drive* is equivalent to *Bertha is too young to drive*, as desired.

Finally, we check (5.36):

(5.36) Bertha is not too old to drive.

a. (5.36) $\equiv \neg(\text{Bertha is too old to drive})$

b. $\llbracket (5.36) \rrbracket^{w^*} = \neg \llbracket (5.32) \rrbracket^{w^*}$
 $= \neg[\{d : \text{AGE}(B)(w^*) \geq d\} \supset$
 $\{d : \exists w \in \text{DEON}(w^*)[\text{drive}(B)(w) \wedge (\text{AGE}(B)(w) \geq d)]\}]$

But:

$$\begin{aligned} & \neg[\{d : \text{AGE}(B)(w^*) \geq d\} \supset \{d : \exists w \in \text{DEON}(w^*)[\text{drive}(B)(w) \wedge (\text{AGE}(B)(w) \geq d)]\}] \\ & \equiv \{d : \text{AGE}(B)(w^*) \geq d\} \not\supset \{d : \exists w \in \text{DEON}(w^*)[\text{drive}(B)(w) \wedge (\text{AGE}(B)(w) \geq d)]\} \\ & \equiv \{d : \text{AGE}(B)(w^*) \geq d\} \subseteq \{d : \exists w \in \text{DEON}(w^*)[\text{drive}(B)(w) \wedge (\text{AGE}(B)(w) \geq d)]\} \\ & \equiv \overline{\{d : \text{AGE}(B)(w^*) \geq d\}} \supseteq \overline{\{d : \exists w \in \text{DEON}(w^*)[\text{drive}(B)(w) \wedge (\text{AGE}(B)(w) \geq d)]\}} \\ & \equiv \{d : \text{AGE}(B)(w^*) < d\} \supseteq \{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow (\text{AGE}(B)(w) \geq d)]\} \end{aligned}$$

The truth conditions for (5.36) are therefore given by:

$$\{d : \text{AGE}(B)(w^*) < d\} \supseteq \{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow (\text{AGE}(B)(w) \geq d)]\}$$

These are identical to the truth conditions for *Bertha is young enough to drive*, given in (5.33a), and we derive the desired equivalence between (5.36) and (5.33). This shows that, on the proposed analysis, *enough* and *too* are dual operators, and we derive the same set of equivalences as we saw for Hacquard's (2005) *enough* and *too* in Section 4.2.2 of Chapter 4 (examples 4.45-4.46).

5.1.4 Additional points

Temporal specification of the complement clause

As noted in Chapter 4, lexical implicatives like *manage* and *dare* require that their matrix and complement clauses overlap temporally (see Section 4.2.3). This is unsurprising on the current analysis, since lexical implicatives background a tight (sufficient as well as necessary) causal relationship between a condition specified in the matrix clause and the realization of the complement proposition. In order for the assertion that the causal condition was satisfied to produce the desired entailment to the implicative complement, it must take place at (roughly) the same time – and, crucially, not after – the complement. In Karttunen’s words, “*managing to do* is inseparable in time and space from *doing*; it is the same event” (1971; p.350).

Karttunen provides two pieces of evidence for his simultaneity claim. First, an implicative complement cannot contain a temporal modifier that conflicts with the matrix tense.

- (5.37) a. #Morgan managed to solve the riddle next week.
 b. #Ana dared to enter the cave tomorrow.

Similarly, overt temporal modifications of the matrix clause also apply to the complement. (5.38) does not entail (5.38a). Instead, it entails (5.38b), in which the temporal adverbial of the original claim is attached to the complement proposition.

- (5.38) Since last year, Morgan hasn’t bothered to solve any riddles.
 a. \nVdash *Morgan hasn’t solved any riddles.*
 b. \vdash *Since last year, Morgan hasn’t solved any riddles.*

As noted in Chapter 4, Karttunen takes these data points to indicate that the (covert) tense of an infinitival implicative complement is identical to or assigned by that of the matrix. Along similar lines, Wurmbrand (2014) classifies lexical implicatives with aspectual verbs like *begin* and *try* as predicates which select for ‘tenseless infinitives’, and which as a result constrain their complements to be simultaneous with the matrix clause.

The co-classification of lexical implicatives with *begin* and *try* is consistent with the idea that temporal overlap is a correlate of the causal relationship between the matrix and the complement clauses. A similar relationship holds between *begin* and its complement, in that the semantics of *begin* must (in some way) pick out the initial stage of an eventuality matching the description in the complement.

(5.39) Morgan began to solve the riddle.

In particular, the *beginning* eventuality in the matrix clause must be the initial stage of the specific riddle-solving eventuality described by the complement clause. Thus, if the beginning takes place within some temporal interval t before utterance time t^* , the temporal trace of the eventuality of riddle-solving must also be initiated within this past interval t (although it will extend beyond the temporal trace of the *beginning* eventuality).

Despite its irrealis component – a *try* eventuality need not result in successful completion of the action being attempted – *try* involves a similar relationship between the matrix eventuality and the (possibly incomplete) complement eventuality (see also Sharvit, 2003).

(5.40) Morgan tried to solve the riddle.

In order for the matrix eventuality in (5.40) to be one of trying to solve the riddle, it must overlap with the temporal trace of the (potential) riddle-solving eventuality described by the complement clause.

We would like to see if there are similar constraints on the relative temporal specification of matrix and complement clauses in *enough/too* constructions. It has already been established that *enough/too* constructions have more freedom than lexical implicatives, insofar as examples like (5.2a-i), (5.2b-i) and (5.2c-i) permit temporal separation.

(5.2a-i) When I saw her run last week, Juno was fast enough to win today's race.

(5.2b-i) *L'année dernière, Juno était assez rapide pour gagner la course d'aujourd'hui.*

'Last year, Juno was-IMPF fast enough to win today's race.'

(5.2c-i) *Quand je l'ai vue courir la semaine dernière, Juno a été assez rapide pour gagner la course d'aujourd'hui.*

‘When I saw her run last week, Juno was-PFV fast enough to win today’s race.’

On the assumption that temporal overlap is correlated with the causal semantics of lexical implicatives – or, more generally, follows from an interpretation on which, *à la* Karttunen, the matrix and complement clauses are components of a single complex eventuality – then the greater temporal freedom of *enough/too* constructions is simply a consequence of their freedom with respect to modal flavour. That is, the availability of temporally-separated *enough/too* constructions follows from the availability of deontic, epistemic, and otherwise non-causal *enough/too* constructions.

Nevertheless, *enough/too* constructions do impose some constraints on the temporal ordering of their matrix and complement clauses. While they diverge from lexical implicatives in permitting temporal separation, any such separation must locate the complement event after the matrix evaluation time. Specifically, *enough* and *too* constructions pattern with lexical implicatives in assigning to their complement clauses the tense of the matrix clause; they diverge in allowing the evaluation time of the complement clause to expand forward from the matrix time. This difference accounts for the fact that future reference is acceptable in the complements of *enough/too* constructions, but not in the complements of lexical implicatives.

Let us see how this works. By default, we evaluate an *enough/too* complement at the same time as the matrix clause. Consider (5.41):

(5.41) Ludo is old enough to vote.

In the absence of any additional context, (5.41) can only reasonably be interpreted to mean that Ludo’s current age is compatible with her voting legally *now*, at or during the time of her current age. It cannot be used out of the blue to mean that Ludo, who is now 17 (in April of 2019), will be able to legally vote in the November 2020 election.

Readings on which the complement event takes place after the matrix time are possible, however. We have already seen this in (5.2a-i)-(5.2c-i). We can get a future-oriented reading

for (5.41) by specifying a salient future election which takes place at a time that does not overlap with the time of Ludo's current age.

(5.42) Ludo is old enough to vote in next year's election.

Compatible with: Ludo, who is now 17, can legally vote in the November 2020 election (because she will be 18 by then).

This interpretation is even possible, albeit somewhat difficult to recover, for (5.41) in a context which makes the November 2020 election extremely salient – for instance, if we are discussing who our friends are likely to vote for in the next presidential cycle, and the issue of Ludo's eligibility comes up.

Backshifted readings are not possible for *enough* and *too* complements. (5.41) cannot in any context indicate that Ludo's current age is compatible with her voting in an election that took place last year. Introducing overt temporal modification does not help matters.

(5.43) #Ludo is old enough to vote last year.

The only way to get the presumed intended reading of (5.43) is to introduce the perfective auxiliary *have* in the complement clause.

(5.44) Ludo is old enough to have voted last year.

Following Condoravdi (2002), I take the perfect to shift the evaluation time of an eventuality in its scope backwards from the reference time. Thus, a simple present-tense example like (5.45) has as its reference time the *now* of utterance (t^*), but its truth depends on the past occurrence of an event of Ludo voting. (5.45) is true just in case we are now in a consequent state of Ludo's vote.

(5.45) Ludo has voted.

What the comparison between (5.43) and (5.44) shows, then, is that the complement clause cannot be backshifted with respect to the time of the *enough/too* matrix clause, since, in order to locate the voting event in the past of the matrix time, we are forced to introduce the

perfect. Crucially, this does not shift the evaluation time of the entire complement clause into the past. Instead, as in (5.45), the truth of the complement becomes contingent on the matrix reference time being included in the temporal trace of a consequent state of Ludo's (past) vote.

We see the same behaviour with circumstantial cases:

(5.46) Ana is brave enough to enter the cave.

(5.46) is compatible with the time of Ana's entering the cave being now, or in the future. As with (5.42), a future interpretation can be made salient contextually (if, for instance, we are discussing our upcoming trip to the supposedly terrifying Mammoth Cave), or simply by use of a future adverbial, as in (5.47).

(5.47) Ana is brave enough to enter the cave next month.

Again, however, past adverbials cannot induce a past interpretation of the complement eventuality; we require the perfect auxiliary *have* in order to interpret the time of potential cave-entering as in the past of the matrix time.

(5.48) a. *Ana is brave enough to enter the cave last year.

b. Ana is brave enough to have entered the cave (last year).

This restriction follows naturally on the semantics we have established. Consider what the interpretation of the comparison set involves: we first find worlds in which the complement clause (at whatever time it is located) is realized, and then look at the value of the degree predicate in those worlds. Thus, the degree predicate must be settled in these worlds at the time of evaluation of the complement, meaning that it cannot be in the future of the complement time. In other words, the time of evaluation of the degree predicate is the earliest possible time of evaluation of the complement clause. But the degree predicate is given by the matrix clause, and thus is evaluated at the time of evaluation in the matrix clause;⁹ as a result, then, the complement clause cannot be evaluated at a time that precedes

⁹If the degree predicate in the accessible worlds was evaluated at a time other than the time at which

the evaluation time of the matrix.¹⁰

Finally, to see that the possibility of future reference is a result of forward expansion, and not forward (tense) shift, we can consider the compatibility of *enough/too* constructions with an adverb like *ever*.

- (5.49) a. Ana wasn't brave enough to ever enter the cave.
b. Ana didn't dare to ever enter the cave.

One interpretation of (5.49a) takes *ever* to scope over the entire *enough* claim, linking individual instances in which Ana lacked bravery to individual (simultaneous) instances of potential cave-entering. To the extent that (5.49b) is acceptable, this is the only reading it can have.

There is a second reading for (5.49a), however, in which *ever* only applies to the complement clause. On this interpretation, the time of the complement clause is expanded forward from the reference time: the past time at which Ana lacked the required degree of bravery corresponds to a single extended interval in which one or many potential cave-entering events might occur. The availability of an interpretation on which *ever* only scopes over the complement clause indicates that *enough* and *too* constructions allow the reference time of their complement clauses to expand forward from the matrix reference time, since *ever* requires this type of forward expansion. This is not an available reading for (5.49b), however, showing that no such expansion is possible for the complements of lexical implicatives. Thus, we

the matrix clause is evaluated – for instance, if it were keyed to the time of evaluation of the complement clause, an example like (5.42) would be false in the given context, since Ludo is 17 in the actual world at evaluation time, but 18 at voting time in all deontically optimal worlds.

¹⁰It is worth noting that this restriction is one way in which *enough* and *too* constructions differ from standard comparative constructions with overt modal complements. Since these constructions involve a full degree predicate, including tense, as the complement of the comparative operator, the tense in the second predicate appears to dictate the temporal specification of the *in order to* clause, crucially allowing it to be freely ordered with respect to the matrix clause.

- (i) a. The paper is as long as it is required to be in order to (now) be published.
b. The paper is as long as it will need to be in order to be published (after the rule change takes effect next year).
c. The paper is as long as it was required to be in order to be published in last year's journal; it is now required to be longer.

have seen that *enough* and *too* predicates require the evaluation time of their complements to be no earlier than the evaluation time of the matrix clause. They allow future reference, but only by means of expanding the evaluation time of the complement into the future of matrix reference time.

In summary, then, I take the following points to represent the important facts about the temporal specification of *enough/too* complement clauses. First, like the complements of implicative verbs, the complements of *enough* and *too* constructions do not have independent tense, and instead get their tense from the matrix clause. We can capture the availability of future shift by allowing the *enough* and *too* operators to expand the evaluation time of the complement clause forward from the reference time, following Condoravdi's (2002) treatment of modals. Moreover, this can be attributed to the modal operator embedded in the semantics of *enough* and *too*. Finally, the infelicity of forward shift and forward expansion (as illustrated by the unacceptability of examples 5.37a-5.37b and 5.49b, respectively) in the complement clauses of implicatives is simply a combination of the same no-earlier-than restriction that we see here, coupled with the semantically-encoded causal interpretation of the relationship between the matrix clause and the complement clause. If, as I have suggested, the causal relationship is associated with the idea that the matrix condition is part of the process of bringing about the complement, this is simply incompatible with separating the two events in time: as suggested by Karttunen (1971), their causal relationship is a reflection of the fact that the matrix condition and the complement eventuality are parts (or subeventualities) of a single complex eventuality. In other words, the apparent requirement of temporal overlap is not directly imposed by the semantics of an implicative verb, but is an epiphenomenon of the relationship that is presupposed between the matrix property and complement clause. Since this type of relationship requires temporal overlap, it is then not surprising that implicative inferences from *enough/too* constructions do not arise in the absence of this feature.

Locating modality

In Section 4.2.1 of Chapter 4, I made two arguments for locating the modality of an *enough/too* construction in the semantics of *enough* and *too* directly, as on the von Stechow et al. analysis, rather than in the complement clause, as proposed by Meier (2003). We have already dealt with the first argument: with modality located in the comparative operators, the semantics developed in this chapter can interpret complement-free ‘truncated’ *enough/too* constructions like (4.36). Consequently, we now predict the felicity of these examples, where Meier did not.

- (4.36) ^γThe baby’s mother carried him home and took care of him. And when he was old enough, she took him to the king’s daughter, who adopted him.

I now turn to the other argument, which concerns the proposed equivalence between ‘bare’ *enough/too* constructions and those with overt existential modals in their complements.

Meier takes it for granted that (4.21a) and (4.21b) are not only intuitively similar in meaning, but in fact semantically equivalent. This leads her to treat the complement of (4.21a) (and other ‘non-modalized’ *enough/too* complements) as including a covert modal with the same force and function as the overt modal in (4.21b).

- (4.21) a. Bertha is old enough to drive.
 b. Bertha is old enough to be allowed to drive.

Although von Stechow et al. move modality to the comparative operators, they also assume the equivalence of (4.21a) and (4.21b). On their analysis, (4.21a) does not involve a covert modal; instead, the overt modal in (4.21b) is taken to be semantically ‘empty’, providing only information about the flavour, but not the force, of the modality involved in the evaluation of the comparative operator (von Stechow et al., 2004, p.23). Thus, *be allowed* in (4.21b) does not contribute a possibility modal of its own, but, since it is only compatible with a deontic interpretation, effectively ‘forces’ the embedded universal to be interpreted deontically. This produces the truth conditions we saw in (5.31).

There are two good reasons to reject the idea that (4.21a) and (4.21b) are semantically equivalent. The first of these was presented in Chapter 4 (Section 4.2.1): if (4.21a) and (4.21b) are equivalent, then (4.34a) and (4.34b) should also be equivalent. This predicts that perfective marking, as shown in (4.35), should affect the interpretation of both claims in the same way.

- (4.34) a. Juno was fast enough to win the race. \leadsto *Juno won the race.*
 b. Juno was fast enough to be able to win the race. \leadsto *Juno won the race.*
- (4.35) a. *Juno a été assez rapide pour gagner la course.* \vdash *Juno won the race.*
 ‘Juno was-PFV fast enough to win the race.’
 b. *Juno a été assez rapide pour pouvoir gagner la course.* \nvdash *Juno won the race.*
 ‘Juno was-PFV fast enough to can-INF win-INF the race.’

This prediction is not borne out: (4.35a) gives rise to an implicative entailment, but (4.35b) does not (see Section 4.2.1 for additional comments).

The second problem comes from von Stechow et al.’s assumption that the overt modal (*to be allowed*) in (4.21b) is semantically empty. As both Meier and von Stechow et al. observe, *enough/too* constructions are felicitous with overt universal modals in their complements. (5.50a)-(5.50b) are from von Stechow et al., and similar examples occur naturally.

- (5.50) a. Emily is clever enough to be required to understand this.
 b. Fritz is too old to be required to serve.
- (5.51) a. γ For those keeping score at home, that’s past the age when the IRS says you’re old enough to be required to take IRA distributions.
 b. γ It’s the first year that both of my children were too old to be required to deliver a card to every classmate.

Von Stechow et al. do not indicate how examples like (5.50a)-(5.50b) are to be analyzed. This presents a puzzle. Taking the overt modal to be empty would predict equivalence between (5.50a) and (5.52a), and between (5.50b) and (5.52b). This is obviously incorrect.

- (5.52) a. Emily is clever enough to understand this.
 b. Fritz is too old to serve.

One way of analyzing these constructions might be to assume that an overt modal in the complement replaces the modal built into the *enough* or *too* operator. This does not get us anywhere. Not only is this solution non-compositional, but it also requires that (4.21b) is interpreted with an existential modal under the comparative, while (4.21a) is interpreted, as above, with the built-in universal of *enough*. This breaks the equivalence between them, which was the starting premise of this line of discussion. More to the point, this approach does not give us sensible truth-conditions for (4.21b) (see 5.53b).

- (5.53) a. Bertha is old enough to drive. ≡ (4.21a)

$$\equiv \{d : \text{AGE}(B)(w^*) \geq d\} \supseteq \{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow \text{AGE}(B)(w) \geq d]\}$$

 b. Bertha is old enough to be allowed to drive. ≡ (4.21b)

$$\equiv \{d : \text{AGE}(B)(w^*) \geq d\} \supseteq \{d : \exists w \in \text{DEON}(w^*)[\text{drive}(B)(w) \wedge \text{AGE}(B)(w) \geq d]\}$$

On this analysis, (4.21b) requires that the maximum degree to which Bertha is old in the actual world is greater than the maximum degree in the set produced by taking the union over worlds w in $\text{DEON}(w^*)[\text{drive}(B)(w)]$ of the sets $\{d : \text{AGE}(B)(w) \geq d\}$. If this set has a maximum, this will be a maximum age d_{\max} such that there are ideal worlds in which Bertha drives at age d_{\max} . In other words, the truth conditions in (5.53b) require that Bertha is at least as old as the maximum legal driving age in the actual world. This would make (5.53b) nonsensical, which it is not.

It seems to me that the only reasonable option, given an inherent modalization for *enough* and *too*, is to take the fully compositional route, on which an overt modal in the *enough/too* complement contributes its usual meaning, thus introducing a second layer of modality. Let us see what this predicts for (4.21b):

- (5.54) Bertha is old enough to be allowed to drive.

$$\begin{aligned}
\text{a. } \llbracket (5.54) \rrbracket^{w^*} &= \llbracket \text{enough}(\text{CAN}_{\text{deontic}}(\lambda w. \text{drive}(B)(w)))(\lambda w \lambda d. \text{AGE}(B)(w) \geq d) \rrbracket^{w^*} \\
&= \{d : \text{AGE}(B)(w^*) \geq d\} \supseteq \{d : \forall w \in \text{Opt}_{\text{DEON}(w^*)}(\cap \text{CIRC}(w^*)) \\
&\quad \underline{[(\exists w' \in \text{Opt}_{\text{DEON}(w)}(\cap \text{CIRC}(w))[\text{drive}(B)(w')]) \rightarrow \text{AGE}(B)(w) \geq d]} \}
\end{aligned}$$

The difference between the truth conditions for (4.21b) in (5.54a) and the truth conditions assigned by von Stechow et al. are located in the underlined condition. On the von Stechow et al. analysis, which would take *to be allowed* to be semantically empty, the underlined clause would simply be the goal condition that Bertha drives in the (ideal) worlds under consideration. In (5.54a), this clause requires that we limit the modal base (and thus the set of ideal worlds) with respect to w^* to just those worlds w in which Bertha *can* drive legally – that is, those worlds w which have their own deontically-accessible world in which Bertha drives.

This is a bit complicated, but it will give us reasonable truth conditions – indeed, amounting to the same interpretation as those assigned to (5.53a) – under two assumptions. A full exploration of the motivation behind these assumptions is beyond the scope of the current investigation, but I attempt to provide a rough justification for them here.

First, I assume that the ordering source for both layers of modality is the same: in particular, that it contains the (relevant) laws of the actual world w^* . The set of optimal worlds with respect to the laws of a world w , given by $\text{Opt}_{\text{DEON}(w)}(\cap \text{CIRC}(w))$, contains worlds which fix relevant circumstances of w and which are ideal with respect to the laws of w . If we take an arbitrary world w' from this set – that is, an ideal world with respect to the laws of w – we have no *a priori* way of knowing what the relevant laws in w' might be. A world which is optimal with respect to w' may in principle violate any or all of the laws of the starting world w . This is evidently not what we want for the interpretation of claims like (4.21b). Intuitively, the ideal worlds in which Bertha is allowed to drive will be worlds where, were she to drive, she would not violate the laws of the actual world. Thus, we want the ordering source to remain constant across both layers of modality. A similar assumption is discussed in greater detail by Zobel (2012), who considers the evaluation of deontic modals appearing in the scope of a generic operator:

“Formally, the deontic interpretation of the possibility modal *können* [...] is determined on the basis of a circumstantial modal base which reflects the circumstances in the worlds of the non-exceptional individuals, and an ordering source which contains the relevant laws [...] in the world of evaluation.”

Zobel (2012, p.224)

I will take this as sufficient motivation for adopting the same assumption here: thus, the worlds which are deontically optimal with respect to $w \in \text{Opt}_{\text{DEON}(w^*)}(\cap \text{CIRC}(w^*))$ will be taken to be worlds in which none of the relevant laws of w^* are violated.

The second problem in interpreting (5.54) has to do with the variation over degrees which is implicitly introduced by the comparative semantics of *enough*. In order to compare Bertha’s actual age to her age in worlds where it is possible for her to drive legally, in view of her age, we necessarily consider worlds in which Bertha’s age is different from what it is in the actual world.¹¹ Thus, we do not want the modal base $\text{CIRC}(w^*)$ to fix Bertha’s age.

We do not want the same freedom for the second layer of quantification. Given $w \in \text{Opt}_{\text{DEON}(w^*)}(\cap \text{CIRC}(w^*))$, we want the circumstantial modal base $f(w)$ for the second quantification to fix certain circumstances of w , including, crucially, the age that Bertha has in w . To see why, suppose Bertha is 15 years old in a world w which is optimal with respect to w^* because Bertha does not drive in w . If $f(w)$ does not fix Bertha’s age, then nothing prevents there being a world w' in which Bertha drives which is deontically optimal with respect to modal base $f(w)$ and ordering source $\text{DEON}(w^*)$ because Bertha is 18 in w' . But then, because Bertha is only 15 in the world w from which we recover the degree set, this will contribute the interval $[0, 15]$ to the intersection of sets of $\{d : \text{AGE}(B)(w) \geq d\}$ over worlds w in $\text{Opt}_{\text{DEON}(w^*)}(\cap \text{CIRC}(w^*))[\exists w' \in \text{Opt}_{\text{DEON}(w^*)}(\cap f(w))[\text{drive}(B)(w')]]$ of $\{d : \text{AGE}(B)(w) \geq d\}$. This intersection makes up the comparison set in (5.54); as a result, the maximum of the comparison set can be no greater than 15, meaning that (4.21b) will be true as long as Bertha is 15 or older.

¹¹If we did not, then there would be no worlds accessible from a world in which Bertha is 17 such that she votes without violating the law. This returns the empty set of degrees for the comparison set, making *Bertha is old enough to drive* vacuously true. The next section takes up how to rule out this sort of context.

We can avoid this problem by requiring the modal base $f(w)$ for the second layer of quantification to fix, among other facts, Bertha's age in w . On closer inspection, what is unusual here is that the reasonable evaluation of the first modal layer requires that the circumstantial modal base $\text{CIRC}(w^*)$ does not fix Bertha's age – that is, that it requires us to 'let go' of certain facts about the actual world that are, in principle, relevant to whether or not Bertha can legally drive.

Again, while it will not be possible to justify this here, we can make sense of this as a consequence of the comparative semantics. Essentially, letting go of facts about Bertha's age is required by the comparative operator, which effectively evaluates the legality of Bertha's driving over a range of alternative ages.¹² We will see, in the next sections, that the sensible evaluation of *enough/too* constructions encodes a necessity presupposition which forces us to abstract away from certain facts about the actual world (whether or not Bertha knows how to drive, whether her eyesight is good enough for her to have a license, etc) in order to evaluate the role played by age.

Under these two assumptions, the comparison set for (5.54) is given by:

$$\bigcap_{w \in \text{DEON}(w^*)} \{d : (\exists w' \in \text{Opt}_{\text{DEON}(w^*)}(\cap \text{CIRC}(w))[\text{drive}(B)(w')]) \rightarrow \text{AGE}(B)(w) \geq d\}$$

I return to abbreviating $\text{Opt}_{\text{DEON}(w^*)}(\cap \text{CIRC}(w^*))$ as $\text{DEON}(w^*)$ to preserve readability. Since $\text{Opt}_{\text{DEON}(w^*)}(\cap \text{CIRC}(w))$ for $w \in \text{DEON}(w^*)$ returns a set of worlds where Bertha's age is the same as in w and in which none of the relevant (driving) laws of w^* are violated, if there is a world w' in $\text{Opt}_{\text{DEON}(w^*)}(\cap \text{CIRC}(w))$ where Bertha drives, then w is necessarily a world in which, according to the laws of the actual world, Bertha's age is such that, were she to drive in w , she would not break any laws. Thus, Bertha's age in w corresponds to Bertha's age in some $w'' \in \text{DEON}(w^*)$ such that Bertha drives in w'' , and the comparison set for (5.54) is equivalent to the set $\{d : \forall w \in \text{DEON}(w^*)[\text{drive}(B)(w) \rightarrow \text{AGE}(B)(w) \geq d]\}$. This

¹²Krasikova (2011) proposes an account of maximal and minimal standard readings of modals in comparative complements which formalizes the idea of variation over degrees as a comparison of alternatives. I will not adopt this account for reasons of space, but it offers an intriguing option for future refinements of the ideas presented here.

is the comparison set for the claim *Bertha is old enough to drive* in (4.21a). Thus, on the assumptions I have made here, *Bertha is old enough to be allowed to drive* (example 4.21b) will be true just in case (4.21a) is true. What this equivalence reflects is that to meet a requirement for legal driving is simply to meet an enabling condition, so the set of qualifying ages does not change if we consider law-upholding worlds in which Bertha drives or law-upholding worlds in which Bertha's age makes it possible for her to drive.

Under the same assumptions, the truth conditions for (4.27) differ from those for (4.21a) and (4.21b), as desired:

(4.27) Bertha is old enough to be required to drive.

$$\begin{aligned} \text{a. } \llbracket (4.27) \rrbracket^{w^*} &= \llbracket \text{enough}(\text{MUST}_{\text{deontic}}(\lambda w. \text{drive}(B)(w))) (\lambda w \lambda d. \text{AGE}(B)(w) \geq d) \rrbracket^{w^*} \\ &= \{d : \text{AGE}(B)(w^*) \geq d\} \supseteq \{d : \forall w \in \text{DEON}(w^*) \\ &\quad \underline{[(\forall w' \in \text{Opt}_{\text{DEON}(w^*)}(\cap \text{CIRC}(w))[\text{drive}(B)(w')]) \rightarrow \text{AGE}(B)(w) \geq d]}]\} \end{aligned}$$

The worlds $w \in \text{DEON}(w^*)$ from which we recover the sets of degrees intersected in the comparison set are those worlds in which Bertha's age requires her to drive in order to uphold the laws of w^* . Thus, (4.27) is only interpretable if there is a law in the world of evaluation which mandates that Bertha drive after a certain age (i.e. there is an age which is sufficient, under the law, for driving). This is what is intuitively required by (4.27), and, crucially, diverges from the truth conditions for both (4.21a) and (4.21b).

The question now is this: if the two-modal approach ensures that (4.21a) is true just in case (4.21b) is true, and vice versa, how can it fare better than Meier's original proposal in deriving the non-equivalence of (4.35a) and (4.35b)? Consider the truth conditions of the sentence radicals in each case:

(5.55) a. Juno be fast enough to win the race.

$$\begin{aligned} &\equiv \{d : \text{SPEED}(J)(w^*) \geq d\} \supseteq \{d : \forall w \in \text{CIRC}(w^*) \\ &\quad [\text{win-race}(J)(w) \rightarrow \text{SPEED}(J)(w) \geq d]\} \end{aligned}$$

b. Juno be fast enough to be able to win the race.

$$\begin{aligned} &\equiv \{d : \text{SPEED}(J)(w^*) \geq d\} \supseteq \{d : \forall w \in \text{CIRC}(w^*) \\ &\quad [(\exists w' \in \text{CIRC}_s(w))[\text{win-race}(J)(w')] \rightarrow \text{SPEED}(J)(w) \geq d]\} \end{aligned}$$

Assuming, as before, that the modal embedded in *enough* does not fix Juno's speed in the accessible worlds, but that the second layer of circumstantial modality does (indicated by CIRC_s), then the set of worlds w in $\text{CIRC}(w^*)$ satisfying $\exists w' \in \text{CIRC}_s(w)[\text{win-race}(J)(w')]$ will be ones in which Juno's speed is compatible with her winning the race, thus returning the same sets of degrees as $\forall w \in \text{CIRC}(w^*)[\text{win-race}(J)(w)]$. Thus, it seems as if (5.55a) should be true just in case (5.55b) is true.

Since we do not yet have an account of the implicative entailment from (5.55a) under perfective aspect, we are not in a position to show precisely how (5.55a) and (5.55b) will come apart under the addition of aspectual marking. However, I want to suggest that the difference in internal composition – which is absent under the Meier and von Stechow et al. analyses – leaves us in a better position with respect to the empirical divergence between (4.35a)-(4.35b). Crucially, (4.35a) requires us to consider only worlds in which Juno actually wins the race. (4.35b), under the analysis in (5.55b), widens the set of worlds under consideration to those in which Juno's winning the race is a possible but not a guaranteed development. Consequently, if the implicative entailment is linked in some way to the universal quantification in (5.55a) – that is, if something forces the actual world to be one of the circumstantially-accessible worlds in which Juno wins the race – we do not expect the same entailment from (4.35b), since the 'goal-realizing' circumstantially-accessible worlds are now just ones in which it is possible for Juno to win the race, in view of her speed.

5.2 The necessity condition

The discussion in Chapter 4 led to the informal conclusion that *enough* and *too* constructions, regardless of modal flavour, adjective type, and other parameters of variation, all involve a necessity relationship between the matrix adjective and the realization of the complement proposition. This relation establishes that there is some degree of the matrix adjective which is required in order for complement realization to be possible at all. Whether this value is a maximum or a minimum (in terms of compatibility with the complement) depends on the polarity of the matrix adjective, and whether the construction involves *enough* or *too*.

- (5.56) Nima is tall enough to reach the top shelf. [pos ADJ/*enough*/MIN]
 \leadsto *There is a minimum height compatible with Nima's reaching the top shelf.*
- (5.57) Nima is small enough to get through the window. [neg ADJ/*enough*/MAX]
 \leadsto *There is a maximum size compatible with Nima's getting through the window.*
- (5.58) Nima is too large to get through the window. [pos ADJ/*too*/MAX]
 \leadsto *There is a maximum size compatible with Nima's getting through the window.*
- (5.59) Nima is too short to reach the top shelf. [neg ADJ/*too*/MIN]
 \leadsto *There is a minimum height compatible with Nima's reaching the top shelf.*

The necessity condition reflected in the existence of these maximums and minimums is, in a sense, the reason that one might use an *enough/too* construction, insofar as it imposes the requirement that the complement's realization is contingent, in a meaningful way, on the matrix property. To see why this should be encoded as a presupposition, rather than a (post-hoc) pragmatic inference, we observe that *enough* and *too* constructions involving complements that are entirely independent of the matrix property appear to be uninterpretable (that is, neither true nor false). (5.60) is an example in which the complement is precluded by the laws of physics, and there is consequently no degree of the matrix adjective which is compatible with its realization. (7.4) illustrates a different way in which the matrix property can be irrelevant. Whether or not one can breathe is entirely orthogonal to one's age, and thus there can be no degree of the matrix adjective which is *a priori* incompatible with the realization of the complement.

(5.60) ??Nima is tall enough to travel faster than the speed of light.

(5.61) ??Nima is old enough to breathe.

While these examples are somewhat contrived, we may, additionally, observe that the infelicity persists in an example like (5.62), where there could potentially be a connection between height and the complement's realization, but this potential effect is precluded by the context:

(5.62) *Context:* The shelf in question has been removed from the bookcase it belongs to and is kept on the floor.

a. ??Nima is tall enough to reach the shelf.

Since *enough* and *too* are duals, (5.56) and (5.59) represent each other's negations, as do (5.57) and (5.58). Thus, the fact that both (5.56) and (5.59) lead to the same inference with respect to the existence of a (minimum) necessary degree, and that both (5.57) and (5.58) suggest the existence of a (maximum) necessary degree indicates that the necessity conditions project through negation, as expected for presuppositional content (Chierchia and McConnell-Ginet, 1990; Tonhauser et al., 2013).

The necessity conditions in (5.56)-(5.59) emerge naturally on the semantics developed so far. This is because the lexical entries for *enough* and *too* in (5.30) involve the evaluation of a contingent relationship between the matrix and complement clauses. The contingent relationship is encoded in the ‘modalized’ comparison set in each case. We collect accessible worlds (the ideal worlds based on a particular modal base and ordering source) in which a further condition is satisfied – the complement clause is realized – and then look at the sets of degrees associated with the matrix adjective in these worlds, in order to determine the relationship between adjective degrees and complement-realization. The necessity condition amounts to the claim that there is a threshold degree d of the matrix adjective, such that all degrees on one side of it (with respect to the standard ordering on the reals) are compatible with the *enough/too* complement, and all degrees on the other side are not.

To see how this condition arises, it will be helpful to work with specific examples. I look first at an example with circumstantial modality and a positive polar adjective.

(5.56) Nima is tall enough to reach the top shelf. [pos ADJ/*enough*/MIN]

a. $\llbracket \text{enough} \rrbracket(w^*)(\lambda w. \text{reach-shelf}(N)(w))(\lambda w \lambda d. \text{HEIGHT}(N)(w) \geq d)$

b. $\equiv \{d : \text{HEIGHT}(w^*)(N) \geq d\} \supseteq$

$\{d : \forall w \in \text{CIRC}(w^*)[\text{reach-shelf}(N)(w) \rightarrow \text{HEIGHT}(N)(w) \geq d]\}$

c. *The set of degrees d such that Nima is at least d -tall in the actual world is a*

superset of the set of degrees of height that Nima has in all circumstantially-accessible worlds where he reaches the top shelf.

Since *tall* is a positive polar adjective, the first set is of the form $[0, n]$, for some $n \in \mathbb{R}^{\geq 0}$. The comparison set, call it $\text{COMP}_{\text{tall}}$, is formed by intersecting the sets of degrees of tall-ness that Nima has across all of the shelf-reaching worlds in the modal base.

$$\text{COMP}_{\text{tall}} = \bigcap_{w \in \text{CIRC}(w^*) : \text{reach-shelf}(N)(w)} \{d : \text{HEIGHT}(N)(w) \geq d\}$$

This is an intersection of sets of the form $[0, n]$; thus, as long as there is at least one world in the modal base in which Nima reaches the top shelf, $\text{COMP}_{\text{tall}}$ will be nonempty, and will therefore contain a maximum element. By construction, this maximum element $d_{\text{nec}} = \text{MAX}(\{d : \forall w \in \text{CIRC}(w^*) [\text{reach-shelf}(N)(w) \rightarrow \text{HEIGHT}(N)(w) \geq d]\})$ is the minimal value which the HEIGHT measure function can assign to Nima while remaining compatible with his realizing the *enough*-complement (in view of his height). To show this, suppose there is a value $d < d_{\text{nec}}$ such that $\exists w \in \text{CIRC}(w^*)$ where $\text{HEIGHT}(N)(w) = d$ and $\text{reach-shelf}(N)(w) = 1$. Then Nima is not d_{nec} -tall in w (since $\text{HEIGHT}(N)(w) < d_{\text{nec}}$), so $d_{\text{nec}} \notin \{d : \text{HEIGHT}(N)(w) \geq d\}$, and since Nima reaches the shelf in w , $d_{\text{nec}} \notin \text{COMP}_{\text{tall}}$ as defined above. This is a contradiction, because d_{nec} is defined as the maximal element of $\text{COMP}_{\text{tall}}$.

The necessity constraint can be stated as follows, for *enough* evaluated with respect to conversational backgrounds f and g :

(5.63) **The necessity condition for *enough*.**

Given a statement of the form: S is ADJ enough to A , evaluated at a world w ,

$$\exists d_{\text{nec}} : \forall w' \in \text{Opt}_{g(w)}(\cap f(w)) [\neg \text{ADJ}(S)(w')(d_{\text{nec}}) \rightarrow \neg A(S)(w')]$$

Notably, this is the same as the necessity condition for *enough* proposed by Hacquard (2005) (see 4.42a in Section 4.2.2).

I took on one assumption in order to arrive at this condition, which is that there is at least one world in the modal base such that Nima reaches the top shelf. This precludes the

possibility that the comparison set $\text{COMP}_{\text{tall}}$ is empty. Since the empty set is a subset of every set, an empty comparison set will (vacuously) satisfy the truth conditions imposed by *enough*, meaning that (5.56) will be evaluated as true even though it is, by assumption, impossible for Nima to reach the shelf in the actual world. (5.60) demonstrated the general infelicity of *enough* constructions with impossible complements; we certainly do not want *enough* sentences of this sort to be automatically evaluated as true. The problem is avoided if the presupposition in (5.63) is adopted, since, for a positive polar adjective, it will necessitate the existence of a maximal element in the comparison (modalized) degree set, which exists as long as this set is nonempty.

Of course, there is a second way in which the matrix property might be irrelevant for the realization of the *enough/too* complement, which we illustrated with (7.4) and (5.62). It is easiest to see what work the necessity presupposition does in these cases by considering an *enough* construction with a negative polar adjective:

- (5.57) Nima is small enough to get through the window. **[neg ADJ/enough/MAX]**
- a. $\llbracket \text{enough} \rrbracket(w^*)(\lambda w. \text{through-window}(N)(w))(\lambda w \lambda d. \text{SIZE}(N)(w) < d)$
 - b. $\equiv \{d : \text{SIZE}(w^*)(N) < d\} \supseteq$
 $\{d : \forall w \in \text{CIRC}(w^*)[\text{through-window}(N)(w) \rightarrow \text{SIZE}(N)(w) < d]\}$
 - c. *The set of degrees d of size that Nima lacks in the actual world is a superset of the set of degrees of size that Nima lacks in all of the circumstantially-accessible worlds where he gets through the window.*

Here, the existence of d_{nec} as defined in (5.63) establishes the existence of an upper bound on the size that Nima can be in order for his size to be compatible with getting through the window: this is, equivalently, a minimum size which precludes his getting through.

- (5.57) Nima is small enough to get through the window.

Presupposes:

$$\exists d_{\text{nec}} : \forall w \in \text{CIRC}(w^*)[\text{SIZE}(N)(w) \geq d_{\text{nec}} \rightarrow \neg \text{through-window}(N)(w)]$$

If there is no degree d_{nec} then, by definition, any degree of size would be compatible with

Nima's going through the window. Apart from the fact that this is exactly the interpretation we have ruled out (and intuitively nonsensical), this would force the comparison set $\text{COMP}_{\text{small}} = \{d : \forall w \in \text{CIRC}(w^*), \text{through-window}(N)(w) \rightarrow \text{SIZE}(N)(w) < d\}$ to be empty. As in (5.56), we form the comparison set here by an intersection of sets, in this case of the form (n, ∞) , for $n \in \mathbb{R}^{\geq 0}$:

$$\text{COMP}_{\text{small}} = \bigcap_{w \in \text{CIRC}(w^*)[\text{through-window}(N)(w)]} \{d : \text{SIZE}(N)(w) < d\}$$

If this intersection is empty, we necessarily have an infinite sequence of worlds where Nima gets through the window, and in which he gets arbitrarily large. Again, if contexts of this type are not ruled out, then, since $\text{COMP}_{\text{small}} = \emptyset$, (5.57) will be evaluated as true. By a similar process of reasoning, statements like (7.4) would also be vacuously true. The necessity presupposition in (5.63) eliminates this problem as well.

As defined in (5.63), the necessity condition for *enough* rules out contexts where the complement is impossible and the matrix adjective has positive polarity: for (5.56), it ensures that there is some degree of height which makes it possible for Nima to reach the shelf. Condition (5.63) also rules out contexts where the complement is trivially achievable, and the matrix adjective has negative polarity: for (5.57), it ensures that there is some degree of size which precludes Nima's getting through the window. (5.63) does not, however, rule out trivial contexts for positive polar adjectives or impossible contexts for negative polar adjectives. That is, it does not ensure, for a claim like (5.56) that there is some degree of height which precludes Nima's reaching the shelf; similarly, it does not ensure, for (5.57), that there is some degree of size that permits getting through the window. This is a consequence of the half-closed nature of our degree scale structure $[0, \infty)$, which establishes the existence of a smallest possible degree. In (5.56), if the smallest degree is one which ensures that Nima can reach the shelf, then there is no degree of height that might preclude the *enough*-complement. In (5.57), if the smallest degree of size is one which precludes getting through the window, then there is no smaller size that will enable the *enough*-complement.

To avoid these situations, we simply add to the presupposition in (5.63) the condition

that the necessary degree is not the smallest possible degree.

(5.64) **The necessity condition for *enough*, version 2:**

Given a statement of the form: *S* is ADJ enough to *A*, evaluated at a world *w*,

$$\exists d_{\text{nec}} > 0 : \forall w' \in \text{Opt}_{g(w)}(\cap f(w))[\neg \text{ADJ}(S)(w')(d_{\text{nec}}) \rightarrow \neg A(S)(w')]$$

With the added stipulation that d_{nec} is greater than 0, (5.64) ensures that, for any *enough* claim, there are degrees compatible with the realization of the complement, as well as degrees which preclude it. In particular, it ensures the existence of a ‘threshold’ degree such that the degree values on one side of the threshold enable the complement, and the degree values on the other side preclude it. The presupposition in (5.64) enforces the intuitive idea we began with, that *enough* constructions are only felicitous in contexts where the property singled out by the matrix clause is potentially decisive (in either a positive or negative direction) for the realization of the complement.¹³

I next check that the semantics for *too* lead to the same sort of necessity condition as (5.64). I take an example with a positive polar adjective first. As we saw at the beginning of the section, we expect (5.58) to give rise to the same maximum condition as the negative polar *enough* construction (5.57).¹⁴

(5.58) Nima is too large to get through the window. [pos ADJ/*too*/MAX]

a. $\llbracket \text{too} \rrbracket(w^*)(\lambda w. \text{through-window}(N)(w))(\lambda w \lambda d. \text{SIZE}(N)(w) \geq d)$

b. $\equiv \{d : \text{SIZE}(w^*)(N) \geq d\} \supset$

$$\{d : \exists w \in \text{CIRC}(w^*)[\text{through-window}(N)(w) \wedge \text{SIZE}(N)(w) \geq d]\}$$

¹³We can also think of the necessity presupposition as ensuring that, whenever an *enough* statement is interpretable, its negation will be as well.

¹⁴We have already seen the relevance of a maximum degree threshold for examples of this sort, in (5.8b). In order to determine whether (5.8b), on a deontic interpretation, is true or false, we have to assume that there is a law mandating that one loses one’s license after reaching a particular age.

(5.8b) Bertha is too old to drive.

In reality, since there is no such law, (5.8b) is infelicitous on a deontic reading. It is, however, acceptable on a circumstantial one, since there is plausibly some age at which, due perhaps to infirmity, it becomes physically impossible for individuals to drive.

- c. *The set of degrees d of size that Nima has in the actual world is a proper superset of the set of degrees of size that Nima has in all of the circumstantially-accessible worlds where he gets through the window.*

The first, non-modalized, degree set has the form $[0, n]$, where $n = \text{SIZE}(N)(w^*) \in \mathbb{R}^{\geq 0}$.

The second set, $\text{COMP}_{\text{large}}$ is in this case a union of sets of the form $[0, n]$:

$$\text{COMP}_{\text{large}} = \bigcup_{w \in \text{CIRC}(w^*)[\text{through-window}(N)(w)]} \{d : \text{SIZE}(N)(w) \geq d\}$$

This will have the form $[0, n]$ as long as two conditions hold: there is at least one world in the modal base such that Nima gets through the window, and it is not the case that any size is compatible with getting through the window.¹⁵ The comparison in (5.64b) then amounts to comparing the maximal elements of the two sets. We let $d_{\text{nec}} = \text{MAX}(\text{COMP}_{\text{large}})$. By construction, this is the largest size that Nima can have which is compatible with his getting through the window. If not, then we would have a world $w \in \text{CIRC}(w^*)$ such that $\text{through-window}(N)(w)$, and $d = \text{SIZE}(N)(w) > d_{\text{nec}}$. But then $d \in \text{COMP}_{\text{large}}$, and since $d > d_{\text{nec}}$, this is a contradiction. This gives us the following:

(5.65) **The necessity condition for *too*, version 1:**

Given a statement of the form: S is too ADJ to A , evaluated at a world w ,

$$\exists d_{\text{nec}} : \neg \exists w' \in \text{Opt}_{g(w)}(\cap(f(w))[\neg \text{ADJ}(S)(d_{\text{nec}})(w') \wedge A(S)(w')])$$

This condition can be reduced:

$$\begin{aligned} & \exists d_{\text{nec}} : \neg \exists w' \in \text{Opt}_{g(w)}(\cap(f(w))[\neg \text{ADJ}(S)(d_{\text{nec}})(w') \wedge A(S)(w')]) \\ & \equiv \exists d_{\text{nec}} : \forall w' \in \text{Opt}_{g(w)}(\cap(f(w))[\neg(\neg \text{ADJ}(S)(d_{\text{nec}})(w') \wedge A(S)(w'))]) \\ & \equiv \exists d_{\text{nec}} : \forall w' \in \text{Opt}_{g(w)}(\cap(f(w))[\text{ADJ}(S)(d_{\text{nec}})(w') \vee \neg A(S)(w')]) \\ & \equiv \exists d_{\text{nec}} : \forall w' \in \text{Opt}_{g(w)}(\cap(f(w))[\text{ADJ}(S)(d_{\text{nec}})(w') \rightarrow \neg A(S)(w')]) \end{aligned}$$

¹⁵In the latter case, we would be taking a union of sets of the form $[0, n]$ in which n can get arbitrarily large, and thus the union need not have an upper bound.

The final formulation is equivalent to the necessity presupposition suggested by Hacquard for *too* constructions, and is consistent with the presupposition in (5.63), since *too* reverses the polarity of inferences to its complement, where *enough* preserves them. Moreover, since positive polar adjectives represent the negation of their negative counterparts, the condition imposed by the *too* presupposition (5.65) on (5.58) is the same as the condition enforced by the *enough* presupposition (5.63) on (5.57). Adding the requirement that there should be some size compatible with getting through the window simply adds the requirement that $d_{\text{nec}} > 0$, as in the modified *enough* presupposition (5.64).

(5.66) **The necessity condition for *too*, version 2:**

Given a statement of the form: *S* is too ADJ to *A*, evaluated at a world *w*,

$$\exists d_{\text{nec}} > 0 : \forall w' \in \text{Opt}_{g(w)}(\cap f(w))[\text{ADJ}(S)(d_{\text{nec}})(w') \rightarrow \neg A(S)(w')]$$

The presupposition in (5.66) also applies to *too* statements with negative polar adjectives.

(5.59) Nima is too short to reach the top shelf. [neg ADJ/*too*/MIN]

a. $\llbracket \text{too} \rrbracket(w^*)(\lambda w. \text{reach-shelf}(N)(w))(\lambda w \lambda d. \text{HEIGHT}(N)(w) < d)$

b. $\equiv \{d : \text{HEIGHT}(w^*)(N) < d\} \supset$

$$\{d : \exists w \in \text{CIRC}(w^*)[\text{reach-shelf}(N)(w) \wedge \text{HEIGHT}(N)(w) < d]\}$$

c. *The set of degrees d of height that Nima lacks in the actual world is a proper superset of the set of degrees of height that he lacks in all circumstantially-accessible worlds where he reaches the top shelf.*

Here, the sets being compared have the form (n, ∞) , as in (5.57). The comparison set, $\text{COMP}_{\text{short}} = \{d : \exists w \in \text{CIRC}(w^*)[\text{reach-shelf}(N)(w) \wedge \text{HEIGHT}(N)(w) < d]\}$ is a union of sets of this form. In order for (5.59) to be interpretable, we require that this union is nonempty (there is at least one shelf-reaching world), and that it is not the entire interval $[0, \infty)$ (there is some degree of height incompatible with shelf-reaching). If this condition is satisfied, $\text{COMP}_{\text{short}}$ will have a lower bound, and this lower bound is necessarily the maximum degree of height that is incompatible with reaching the top shelf. The presupposition (5.66) both

guarantees the existence of this maximum threshold, and that there are degrees on either side of it.

The semantics developed in Section 5.1 (based on von Stechow et al. 2004) do not induce a sufficiency condition. That is, nothing about the basic analysis of *enough* and *too* constructions mandates the existence of a degree d_{suff} of the matrix adjective such that being d_{suff} -ADJ guarantees that the *enough/too* subject will realize the *enough/too* complement. A sufficiency condition of this sort would take the form in (5.67).

(5.67) **The sufficiency condition for *enough*:** (compare 4.42; Hacquard, 2005)

Given a statement of the form: S is ADJ enough to A , evaluated at a world w :

$$\exists d_{\text{suff}} : \forall w' \in \text{Opt}_{g(w)}(\cap f(w))[\text{ADJ}(S)(d_{\text{suff}})(w') \rightarrow A(S)(w')]$$

Empirically, we have seen that arbitrary *enough* and *too* constructions are felicitously used in contexts which do not support a sufficiency condition. For instance, (5.57) is perfectly acceptable in a context in which the window is locked or has bars which Nima is not equipped to remove.

(5.57) Nima is small enough to get through the window.

In evaluating a claim like (5.57), however, the circumstantially-accessible worlds we consider are ones in which the *enough* complement is satisfied – that is, in which Nima gets through the window – and thus will necessarily be worlds in which any size-independent necessary conditions for Nima’s getting through the window are presumed to be met.

This reinforces a point made at the beginning of this section: what *enough/too* constructions evaluate, in the general case, is the ‘enabling’ capacity of the property mentioned in the matrix clause (with respect to a particular type of modality). That is, if a necessary degree of the matrix adjective is present, the complement is possible as far as the role played by that property is concerned. However, complement realization may be still be precluded in actuality by the status of other, unrelated necessary conditions.¹⁶ As above, of course, the

¹⁶To a certain extent, this accounts for both Meier’s (2003) and von Stechow et al.’s (2004) intuition that *enough* and *too* constructions should be paraphrasable by *enough/too* statements with overt possibility modals in their complements: there is a real sense in which what is realized, in view of the matrix property, is simply the possibility of the complement’s realization.

complement-achieving worlds which we consider in evaluating an *enough/too* construction will be ones in which other necessary conditions are met, but the real world, crucially, need not be one of these. As a result, we do not in general expect the matrix condition to be sufficient for realizing the *enough/too* complement.

The semantics developed here – including the necessity presupposition – predicts that *enough* and *too* constructions should be felicitous in contexts where requirements for their complements other than the matrix adjective are unsatisfied. This matches the empirical patterns set out in Chapter 4, except in the case of the special ‘implicative’ subgroup of *enough/too* constructions. From this, it is clear that the semantics of *enough/too* constructions cannot, as a baseline, encode a sufficiency presupposition along the lines of (5.67).

In order to understand what happens in ‘implicative’ cases, we will need to look more closely at their specifics – that is, at those constructions that involve dynamic adjectives, circumstantial modality, and matrix-complement temporal overlap. In the next section, I first review the predictions we make for non-implicative *enough* and *too* constructions, and show that we have improved on the predictions of the Meier (2003) and Hacquard (2005) accounts discussed in Chapter 4. I then turn to the predictions we make for the implicative subgroup, and conclude by establishing where the current account falls short for these cases.

5.3 Predictions for *enough* and *too* complement inferences

The necessity condition gives us a second way of thinking about the claim made by an *enough/too* construction: not as a comparison of sets, but instead as a measure statement, where the measure phrase is provided by the combination of *enough* or *too* with the complement proposition.¹⁷ With the necessity presupposition in place, an *enough* claim like (5.56) can be treated as having the ‘attributive’ truth conditions in (5.68b), below:

$$(5.68) \quad \text{Nima is tall enough to reach the top shelf.} \quad \equiv (5.56)$$

$$\begin{aligned} \text{a. } \{d : \text{HEIGHT}(N)(w^*) \geq\} &\supseteq \\ &\{d : \forall w \in \text{CIRC}(w^*)[\text{reach-shelf}(N)(w) \rightarrow \text{HEIGHT}(N)(w) \geq d]\} \end{aligned}$$

¹⁷This is entirely consistent with the syntactic structure of comparatives

b. $\text{HEIGHT}(N)(w^*) \geq d_{\text{nec}}$, where

$$d_{\text{nec}} = \text{MAX}(\{d : \forall w \in \text{CIRC}(w^*)[\text{reach-shelf}(N)(w) \rightarrow \text{HEIGHT}(N)(w) \geq d]\})$$

In the general case, we get:

$$(5.69) \quad S \text{ is ADJ enough to } A \text{ (in } w) := \text{ADJ}(S)(w)(d_{\text{nec}}),$$

$$\text{where } d_{\text{nec}} = \iota d : \forall w' \in \text{Opt}_{g(w)}(\cap f(w))[\neg \text{ADJ}(S)(d)(w') \rightarrow \neg A(S)(w')]$$

This illustrates a key point of connection with implicative verbs, already indicated in the ‘assertion’ column of Table 5.2. A positive *enough* assertion conveys that the presupposed necessary condition was satisfied, while a negative *enough* claim conveys that it was not. Effectively, the semantics in (5.69) makes *enough* constructions into one-way implicatives like Finnish *jaksaa* (‘have the strength’), *modulo* modal flavour.

- (3.47) a. Hän **jakso-i** noust-a.
 he.NOM have.strength-PST.3SG rise-INF
 ‘He had the strength to rise.’ \leadsto, \nVdash *He rose.*
- b. Hän e-i **jaksa-nut** noust-a.
 he.NOM NEG-3SG have.strength-PP.SG rise-INF
 ‘He did not have strength to rise.’ \vdash *He did not rise.*

This puts us in a good position with respect to deriving the empirical implication patterns in Table 5.2, at least as far as epistemic, deontic, and static adjective circumstantial cases go. The only candidates for implicative entailments should be negative *enough* and positive *too* assertions, since these both deny that a necessary condition was satisfied. Moreover, we only expect entailments to arise in these cases if the set of worlds from which the complement-realizing (comparison) worlds are selected contains the actual world – requiring, at least, that the actual world is included in the modal base.

5.3.1 Predictions for epistemic and deontic *enough* and *too* constructions

Predictions for epistemic constructions

I first look at an epistemic *enough* construction which is compatible with both the perfective and the imperfective aspect.

(5.70) *Lee était assez insensible pour avoir été l'agresseur.*

‘Lee was-IMPF mean enough to have been the attacker.’

(5.71) *Lee a été assez insensible pour avoir été l'agresseur.* ≡ (4.73b)

‘Lee was-PFV mean enough to have been the attacker.’

Epistemic modals are evaluated with respect to an epistemic modal base, which fixes a set of propositions that encode the beliefs of the speaker (see Chapter 2). In this case, since the *enough* complement is about actions that Lee may (or may not) have taken based on his demeanour, I take it that we are concerned with what the speaker’s epistemic state leads us to expect, thus selecting for a stereotypical ordering source, rather than an empty one (cf. Kratzer 2012[1981]). This ordering source will contain information about the normal course of events in the world, such as how Lee might be expected to act if he had (or had not) committed the attack. For a given world w , this combination of an epistemic modal base $\text{EPIS}(w)$ and stereotypical ordering source $\text{NORM}(w)$ will give us the set of worlds that are most normal with respect to the speaker’s beliefs, $\text{Opt}_{\text{NORM}(w)}(\cap \text{EPIS}(w))$. I abbreviate this set of ideal worlds as $\text{EPIS}_N(w)$.

Using the semantics for *enough* in (5.30a), the truth conditions for the sentence radical, *Lee be mean enough to be the attacker*, are given in (5.72). Recall from Section 5.1, that the measure function associated with an arbitrary adjective is indicated by μ_{ADJ} .

$$(5.30a) \quad \llbracket \text{enough} \rrbracket := \lambda w \lambda P_{st} \lambda Q_{s(dt)}. Q(w) \supseteq \{d : \text{MUST}_{f,g}[P(w) \rightarrow Q(d)(w)]\}$$

(5.72) Lee be mean enough to have been the attacker.

$$a. \quad \llbracket \text{enough} \rrbracket (w^*)(\lambda w. \text{been-attacker}(L)(w))(\lambda w \lambda d. \mu_{\text{MEAN}}(L)(w) > d)$$

$$b. \quad \equiv \{d : \mu_{\text{MEAN}}(L)(w^*) > d\} \supseteq \{d : \forall w \in \text{EPIS}_N[\text{been-attacker}(L)(w) \rightarrow \mu_{\text{MEAN}}(L)(w^*) > d]\}$$

$$c. \quad \equiv \mu_{\text{MEAN}}(L)(w^*) \geq d_{\text{nec}}, \text{ where}$$

$$d_{\text{nec}} = \iota d : \forall w \in \text{EPIS}_N(w^*)[\mu_{\text{MEAN}}(L)(w) < d \rightarrow \neg \text{been-attacker}(L)(w)]$$

As far as the truth conditions in (5.72c) go, we do not predict an implicative inference.

(5.72c) tells us to look at the worlds compatible with what the speaker believes, and which develop in the most normal way based on these beliefs, and check if the degree to which Lee is actually mean is at least as great as the degree of meanness that the speaker takes to be compatible with his having been the attacker. Since he is at least this mean, it is possible – as far as the speaker knows – for Lee to have been the attacker, but nothing ensures that he actually was. Indeed, since being d_{nec} -mean is a necessary, but not sufficient condition for being the attacker, it need not even be the case that the speaker believes that Lee was the attacker: her beliefs, might, for instance, include information about Lee’s alibi for the time of the attack.

Applying aspect and tense operators to (5.72c) does not make any difference to this baseline prediction:

(5.70) *Lee était assez insensible pour avoir été l’agresseur.*

‘Lee was-IMPF mean enough to have been the attacker.’

- a. (5.70) $\equiv \text{PST}(\text{IMPF}(\text{Lee be mean enough to have been the attacker}))$
- b. $\llbracket (5.70) \rrbracket^{w^*} = \llbracket \text{PST}(\text{IMPF}(\lambda w \lambda e. (\mu_{\text{MEAN}}(L)(w) \geq d_{\text{nec}})(e))) \rrbracket^{w^*}$
 $= \exists e[\tau(e) \supseteq t\{t \prec_i t^*\} \wedge (\mu_{\text{MEAN}}(L)(w^*) \geq d_{\text{nec}})(e)], \text{ where}$
 $d_{\text{nec}} = id : \forall w \in \text{EPIS}_N(w^*)[\mu_{\text{MEAN}}(L)(w) < d \rightarrow \neg \text{been-attacker}(L)(w)]$
- c. *There is a real-world eventuality whose runtime contains a salient past time, such that this eventuality is an eventuality of Lee being at least as mean as he is in any of the ideal belief-worlds in which he was the attacker.*

(5.71) *Lee a été assez insensible pour avoir été l’agresseur.* $\equiv (4.73b)$

‘Lee was-PFV mean enough to have been the attacker.’

- a. (5.71) $\equiv \text{PST}(\text{PFV}(\text{Lee be mean enough to have been the attacker}))$
- b. $\llbracket (5.71) \rrbracket^{w^*} = \llbracket \text{PST}(\text{PFV}(\lambda w \lambda e. (\mu_{\text{MEAN}}(L)(w) \geq d_{\text{nec}})(e))) \rrbracket^{w^*}$
 $= \exists e[\tau(e) \subseteq t\{t \prec_i t^*\} \wedge (\mu_{\text{MEAN}}(L)(w^*) \geq d_{\text{nec}})(e)], \text{ where}$
 $d_{\text{nec}} = id : \forall w \in \text{EPIS}_N(w^*)[\mu_{\text{MEAN}}(L)(w) < d \rightarrow \neg \text{been-attacker}(L)(w)]$
- c. *There is a real-world eventuality whose runtime is contained in a salient past time, such that this eventuality is an eventuality of Lee being at least as mean*

as he is in any of the ideal belief-worlds in which he was the attacker.

The truth conditions paraphrased in (5.70c) and (5.71c) show that, regardless of aspectual marking, Lee's actual meanness is compatible, as far as the speaker knows, with his having been the attacker. However, nothing either implies or entails that he actually turns out to be the attacker; the only difference between (5.70) and (5.71) is that, in the imperfective case, we are looking at an ongoing eventuality of Lee's being d_{nec} -mean, while in the perfective case, the meanness eventuality is complete.

If we negate (5.70) or (5.71), we get a negative inference, relativized to the speaker's beliefs. The truth conditions under negation are shown for the sentence radical in (5.73):

(5.73) Lee not be mean enough to have been the attacker.

$\equiv \mu_{\text{MEAN}}(L)(w^*) < d_{\text{nec}}$, where

$d_{\text{nec}} = \iota d : \forall w \in \text{EPIS}_N(w^*) [\mu_{\text{MEAN}}(L)(w) < d \rightarrow \neg \text{been-attacker}(L)(w)]$

In this case, Lee's meanness does not meet the necessity threshold. Thus, it is not compatible with the speaker's beliefs that he turns out to have been the attacker, and (5.73), under either imperfective or perfective marking, will suggest that the speaker does not believe that Lee was in fact the attacker. This prediction is supported by the oddness of (5.74), in which the continuation contradicts the belief that the speaker expresses with the main *enough* construction.

(5.74) Lee was not mean enough to have been the attacker, ?but I believe he was the attacker.

Since the speaker's epistemic state may not reflect real-world circumstances – for instance, she may have false beliefs about how mean Lee would need to be in order to have been the attacker – any inferences arising from (5.73) are restricted to belief-worlds. In other words, we do not predict an inference from either (5.75) or (5.76) to the effect that Lee was not actually the attacker.

(5.75) *Lee n'était pas assez insensible pour avoir été l'agresseur.*

'Lee was-IMPF not mean enough to have been the attacker.'

- a. $\equiv \exists e[\tau(e) \supseteq t\{t \prec_i t^*\} \wedge (\mu_{\text{MEAN}}(L)(w^*) < d_{\text{nec}})(e)]$, where
 $d_{\text{nec}} = \text{id} : \forall w \in \text{EPISN}(w^*)[\mu_{\text{MEAN}}(L)(w) < d \rightarrow \neg \text{been-attacker}(L)(w)]$
- b. *There is a real-world eventuality whose runtime contains a salient past time, such that this eventuality is an eventuality of Lee being less mean than he is in any of the ideal belief-worlds in which he was the attacker.*
- (5.76) *Lee n'a pas été assez insensible pour avoir été l'agresseur.*
 'Lee was-PFV not mean enough to have been the attacker.'
- a. $\equiv \exists e[\tau(e) \subseteq t\{t \prec_i t^*\} \wedge (\mu_{\text{MEAN}}(L)(w^*) < d_{\text{nec}})(e)]$, where
 $d_{\text{nec}} = \text{id} : \forall w \in \text{EPISN}(w^*)[\mu_{\text{MEAN}}(L)(w) < d \rightarrow \neg \text{been-attacker}(L)(w)]$
- b. *There is a real-world eventuality whose runtime is contained in a salient past time, such that this eventuality is an eventuality of Lee being less mean than he is in any of the ideal belief-worlds in which he was the attacker.*

It is worth observing that either (5.75) or (5.76) might be uttered in a context where the speaker has just been informed that Lee is, in fact, the attacker, in principle entering this information into her belief set. In such a context, either the imperfective or perfective claim would indicate the speaker's disbelief or incredulity: this is compatible with the truth conditions given above, as well as the oddness of (5.74). However, (5.75) or (5.76) might also conceivably be uttered in a context in which the speaker accepts the new information, and simply intends to express that they felt this outcome to be unlikely. Acceptability in such a context can be explained in terms of the stereotypical ordering source used to evaluate the meanness claims. For (5.75) and (5.76), this ordering source ensures that all of the normally-developing worlds compatible with the speaker's beliefs are those in which Lee did not turn out to be the attacker. Thus, if he has in fact turned out to be the attacker, either of these claims might be used to indicate that, from the speaker's point of view, the real world has veered from the expected course of developments.

Predictions for deontic constructions

We saw the truth conditions for the sentence radical of a deontic *enough/too* construction in Section 5.1 (examples 5.31-5.32). (5.77) gives the denotation for the radical of the deontic construction (4.52), repeated from Chapter 4.

(4.52) *Amira a été assez grande pour boire de l'alcool.*

‘Amira was-PFV old enough to drink alcohol.’

(5.77) Amira be old enough to drink alcohol.

$\equiv \text{AGE}(A)(w^*) \geq d_{\text{nec}}$), where

$d_{\text{nec}} = \iota d : \forall w \in \text{DEON}(w^*)[\text{AGE}(A)(w) < d \rightarrow \neg \text{drink}(A)(w)]$

\sim *Amira's actual age is at least as great as the age she has in any of the worlds in which she drinks alcohol legally.*

The optimal worlds in the deontic case are the ones in which no laws are broken. Thus, if we find optimal worlds in which Amira drinks, these are necessarily worlds in which she has reached the minimum drinking age, d_{nec} . But nothing mandates that the real world is one in which she drinks (let alone doing so legally), since it might well be the case that she has no interest in drinking alcohol, or never has the opportunity to do so, regardless of her age.

As in the epistemic examples above, adding tense and aspect does not change this reasoning:

(5.78) *Amira était assez grande pour boire de l'alcool.*

‘Amira was-IMPF old enough to drink alcohol.’

a. $\equiv \exists e[\tau(e) \supseteq t\{t \prec_i t^*\} \wedge (\text{AGE}(A)(w^*) \geq d_{\text{nec}})(e)]$, where

$d_{\text{nec}} = \iota d : \forall w \in \text{DEON}(w^*)[\text{AGE}(A)(w) < d \rightarrow \neg \text{drink}(A)(w)]$

b. *There is a real-world eventuality whose runtime contains a salient past time such that this eventuality is an eventuality of Amira being at least as old as she is in any of the worlds where she drinks legally.*

(4.52) *Amira a été assez grande pour boire de l'alcool.*

‘Amira was-PFV old enough to drink alcohol.’

a. $\equiv \exists e[\tau(e) \subseteq t\{t \prec_i t^*\} \wedge (\text{AGE}(A)(w^*) \geq d_{\text{nec}})(e)]$, where

$d_{\text{nec}} = \text{id} : \forall w \in \text{DEON}(w^*)[\text{AGE}(A)(w) < d \rightarrow \neg \text{drink}(A)(w)]$

b. *There is a real-world eventuality whose runtime is contained in a salient past time such that this eventuality is an eventuality of Amira being at least as old as she is in any of the worlds where she drinks legally.*

It is worth noting that, in order for perfective aspect to be felicitous in (4.52), the matrix clause must be interpreted as indicating that Amira has just reached the legal drinking age – that is, the past eventuality contained in the reference time is taken to be one of Amira *reaching* the age d_{nec} . This does not affect the status of implicative entailments: the reasons for this interpretation are, however, related to the entailment patterns of dynamic adjective *enough/too* constructions under the perfective aspect, and will be discussed in Section 5.6 and in Chapter 6.

Under negation, we get a negative inference about drinking which is, once again, relativized to the type of modality with which we are dealing. I show this only for the perfective case.¹⁸

(5.79) *Amira n'a pas été assez grande pour boire de l'alcool.*

‘Amira was-PFV not old enough to drink alcohol.’

a. $\equiv \exists e[\tau(e) \subseteq t\{t \prec_i t^*\} \wedge (\text{AGE}(A)(w^*) < d_{\text{nec}})(e)]$, where

$d_{\text{nec}} = \text{id} : \forall w \in \text{DEON}(w^*)[\text{AGE}(A)(w) < d \rightarrow \neg \text{drink}(A)(w)]$

b. *There is a real-world eventuality whose runtime is contained in a salient past time such that this eventuality is an eventuality of Amira being younger than she is in any of the worlds where she drinks legally.*

If Amira is younger than she is in any world where she drinks legally, then it is impossible for the real world to be one in which she drinks legally. I discussed the consequences of

¹⁸Again, as in (4.52), (5.79) must be interpreted to mean that Amira has reached some particular age within reference time, which is crucially less than the legal drinking age.

this in Section 4.2.2 of Chapter 4. In short, since there is no reason to assume that the real world is one in which laws are obeyed, the fact that it is impossible for her to drink alcohol legally does not preclude the possibility that she actually did have a drink.

In Chapter 4 (section 4.3.1), I noted that certain deontic *enough/too* constructions do give rise, under negation, to inferences that their complements were not realized. This is predicted by the current account, once we add a ‘normality’ assumption: the actual world is typically one in which the rules relevant for (4.70a) and (4.70b) are enforced. This assumption follows from world knowledge, in that both blood donation processes and rollercoaster lines typically involve something like a gate-check process, during which one is turned away if one fails to meet the criteria for participation.

- (4.70) a. \neg When I was in JC, I was too light to donate blood.
 \leadsto *I did not donate blood.*
- b. \neg The last time we visited, two years ago, [my son] was not tall enough to ride the ... Spider-Man virtual reality 3D ride.
 \leadsto *My son did not ride the Spider-Man ride.*

It is clear, however, that these inferences arise as a consequence of the normality assumption: i.e., because we know that rules about minimum blood-donation weight and the minimum permitted height for rollercoaster rides are typically enforced. This contrasts with (5.79), since there are many real-world contexts in which laws about the minimum drinking age are not enforced. Additional context might change matters: for instance, if what we know about Amira includes the fact that she never breaks rules, then (5.79) will license the inference that she did not drink in the actual world. Crucially, however, this inference is based on information about the actual world, not on the underlying semantics of the *enough* construction.

Interim summary

The examples in (5.70)-(5.79) show that the semantics developed in Sections 5.1-5.2 derives the empirical patterns in Table 5.1, in the case of *enough* and *too* constructions involving

epistemic and deontic modality. I reproduce just the relevant portions of the table below, as Table 5.3.

parameter of variation				inference	
<i>modal flavour</i>	<i>adj type</i>	<i>temporal spec.</i>	<i>aspect</i>	<i>pos</i>	<i>neg</i>
epistemic	–	–	–	✓	✓
deontic	–	–	–	✓	✓

Table 5.3: Implicative patterns for epistemic and deontic *enough* and *too* constructions

The patterns in Table 5.3 are also compatible with the predictions of Hacquard’s (2005) account, up to a point. This is because Hacquard’s semantics, like the current analysis, rules out complement entailments in epistemic and deontic cases due to the non-reflexivity of the modal accessibility relation. We have, however, improved on Hacquard’s predictions in two key ways. These improvements are both associated with the role of a sufficiency presupposition, which Hacquard builds directly into *enough* and *too*, and which the current account omits.

Since Hacquard encodes both necessity and sufficiency presuppositions in the semantics of *enough* and *too*, her account predicts inferences complement inferences relativized to the speaker for all epistemic constructions. In particular, she not only predicts complement inferences in the negative case (as does the current account), but in addition, she predicts that a positive epistemic claim like (4.73b) will ensure that all of the speaker’s belief-worlds are ones in which being at least d_{nec} -mean is a sufficient condition for Lee’s having been the attacker. Thus, on Hacquard’s analysis, if Lee is at least d_{nec} -mean in the actual world, it should be the case that the speaker believes that Lee was the attacker in the actual world. This prediction is not upheld: as (5.80) shows, it is perfectly reasonable for the speaker to indicate that she does not have this belief. By comparison, this is marked in the negative case (although, as discussed, there are contexts in which the negative example might be used despite real-world context).

(4.73b) *Lee a été assez insensible pour être/pour avoir été l'agresseur.*

‘Lee was-PFV hard-hearted enough to be/to have been the attacker.’

(5.80) Lee is mean enough to have been the attacker, but I don’t believe that he was the attacker.

(5.74) Lee is not mean enough to have been the attacker, ??but I believe that he was the attacker.

In the absence of a sufficiency presupposition, the current account makes only the negative prediction, which is supported by the empirical data.

Secondly, we saw in Chapter 4 (Section 4.2.2) that Hacquard’s account incorrectly predicts the infelicity of a deontic *enough* construction like (4.52) in contexts where it is neither the case that the law mandates drinking after a certain age or in which it is established that the only obstacle to Amira’s drinking is the law. This is also a consequence of her sufficiency presupposition, which forces the ideal worlds under consideration to be ones in which reaching a particular threshold degree not only enables Amira to drink legally, but also requires that she do so. Hacquard’s condition is repeated below.

(4.52) *Amira a été assez grande pour boire de l'alcool.*

‘Amira was-PFV old enough to drink alcohol.’

(*Interpretation:* Amira became old enough to drink alcohol.)

(4.53) Amira be old enough to drink.

Presupposes: $\iota d : \forall w \in \text{DEON}(w^*)[\text{drink}(A)(w) \leftrightarrow \text{AGE}(A)(w) \geq d]$

Since the current analysis presupposes only necessity, and not sufficiency, and thus does not mandate that the ideal worlds are ones in which reaching some condition requires the complement to be realized, it does not predict the same infelicity. Again, since (4.52) is compatible with the claim – as in (4.54) – that Amira did not drink in real-world contexts (which preclude a required drinking age), the prediction is correct.

(4.54) *Amira a été assez grande pour boire d l'alcool, mais elle ne l'a jamais bu.*

‘Amira was-PFV old enough to drink alcohol, but she never drank it.’

5.3.2 Predictions for circumstantial *enough* and *too* constructions

Finally, I consider *enough* and *too* constructions involving circumstantial modality. These are the prime candidates for implicative inferences, since the modal accessibility relation ensures that the real world is included in the set of worlds under consideration.

We take a circumstantial construction with a static adjective first. (5.81) gives the truth conditions for the sentence radical of (4.80a):

(4.80a) Nima was tall enough to reach the top shelf. ≡ (5.56)

(5.81) Nima be tall enough to reach the top shelf.

≡ HEIGHT(N)(w^*) $\geq d_{\text{nec}}$, where

$d_{\text{nec}} = \iota d : \forall w \in \text{CIRC}(w^*)[\text{HEIGHT}(N)(w) < d \rightarrow \neg \text{reach-shelf}(N)(w)]$

The French version of (4.80a) is compatible with the imperfective aspect, yielding the truth conditions in (5.82).

(5.82) *Nima était assez grand pour atteindre l'étagère du haut.*

‘Nima was-IMPF tall enough to reach the topmost shelf.’

a. $\equiv \exists e[\tau(e) \supseteq t\{t \prec_i t^*\} \wedge (\text{HEIGHT}(N)(w^*) \geq d_{\text{nec}})(e)]$, where

$d_{\text{nec}} = \iota d : \forall w \in \text{CIRC}(w^*)[\text{HEIGHT}(N)(w) < d \rightarrow \neg \text{reach-shelf}(N)(w)]$

b. *There is an eventuality which contains a salient past time which is an eventuality of Nima's being at least as tall as he is in any world in which he reaches the top shelf.*

In this case, the eventuality of Nima being at least d_{nec} tall is ongoing from the perspective of the reference time. However, since being a certain height is not sufficient for reaching the shelf (though it is circumstantially necessary), no inference about reaching the shelf follows.

To the extent that (4.80a) is compatible with the perfective aspect, we get the same effect as above: all that the perfective aspect does is contain the eventuality of being d_{nec} -tall within the past reference time.¹⁹ Since the real world may be one in which, for instance,

¹⁹In order for this to work, we have to interpret (4.82) as referring to the (past) time at which Nima

Nima does not make any attempt to reach the shelf, no complement inference arises, only the inference that his height would not preclude him from reaching the top shelf, were he to be in a position to try to do so.

Under negation, however, we do get an implicative inference, which, as noted in Chapter 4, appears to be an entailment. We derive this entailment under the current semantics. From (5.83), we can see that the denotation of the negative sentence radical in (4.80b) provides that Nima does not reach the shelf in any of the circumstantially-accessible worlds in which he has at most his actual height. Since the real world is included in the set of accessible world, we are forced to conclude that the actual world is one in which Nima does not (and cannot) reach the shelf. This entailment will persist regardless of aspectual marking.

(4.80b) Nima was not tall enough to reach the top shelf.

(5.83) Nima not be tall enough to reach the top shelf.

$$\equiv \text{HEIGHT}(N)(w^*) < d_{\text{nec}},$$

$$\text{where } d_{\text{nec}} = \text{id} : \forall w \in \text{CIRC}(w^*) [\text{HEIGHT}(N)(w) < d \rightarrow \neg \text{reach-shelf}(N)(w)].$$

The predictions for static circumstantial *enough* and *too* constructions thus support the current account. We run into trouble, however, when we look at circumstantial *enough/too* constructions that meet the criteria set out at the end of Chapter 4: i.e., those that involve a dynamic adjective, temporal overlap between the matrix clause and the complement, and are marked with perfective aspect. Table 5.4 shows just the empirical patterns for circumstantial constructions.

If we treat dynamic adjective constructions in the same way as those involving static adjectives, then we will predict the same inference patterns for the ‘implicative’ *enough/too*

reached the necessary height for shelf-reaching. This is similar to what happens with (4.52) under perfective aspect, but (4.82) remains somewhat pragmatically odd under this interpretation since growing taller is typically a slow process, whereas becoming a certain age is typically observed on a particular day (i.e., a specific point in time):

- (4.82) ?*Nima a été assez grand pour atteindre l'étagère du haut.*
 ‘Nima was-PFV tall enough to reach the topmost shelf.’

<i>modal flavour</i>	parameter of variation			inference	
	<i>adj type</i>	<i>temporal spec.</i>	<i>aspect</i>	<i>pos</i>	<i>neg</i>
circumstantial	static	–	–	$\not\vdash$	\vdash
		no overlap	–	$\not\vdash$	\leadsto
	dynamic		unmarked	\leadsto	\leadsto
		overlap	imperfective perfective	\leadsto \vdash	\leadsto \vdash

Table 5.4: Implicative patterns for circumstantial *enough* and *too* constructions

constructions. In other words, we will fail to predict implicative entailments for perfectly-marked positive *enough* and negative *too* assertions, but we will, again incorrectly, predict entailments across the board from negative *enough* and positive *too* constructions (in particular, in English and under imperfective aspect as well as under perfective marking).

The incorrect predictions hinge on two basic problems. First, we predict entailments, currently, only on the basis of modal flavour, rather than any interaction between aspectual marking and other features of the construction. Secondly, insofar as both static and dynamic adjective *enough/too* constructions are taken to involve circumstantial modality, we have not yet developed any means for distinguishing between the two cases, whether on their own terms, or on the basis of interactions with aspect and modality.

Take (4.35a). If we assume that the time of the complement clause overlaps with the time of the matrix clause, the set of race-winning worlds under consideration are restricted to those in which Juno wins the race contemporaneously with the matrix eventuality (of being at least $d_{\text{nec-fast}}$). Those accessible race-winning worlds will also be ones in which any other conditions for the win were satisfied. However, as in the static adjective example (4.80a)/(5.56), there is no reason why those conditions should be taken to be satisfied in the actual world, and so the semantics above give us no reason to derive an entailment that the actual world was one of the race-winning ones. All that (4.35a) is expected to convey is that Juno’s actual speed is compatible with her winning the race.

(4.35a) *Juno a été assez rapide pour gagner la course.*

‘Juno was-PFV fast enough to win the race.’

- a. $\llbracket (4.35a) \rrbracket^{w^*} \equiv \llbracket \text{PST}(\text{PFV}(\text{Juno be fast enough to win the race})) \rrbracket^{w^*}$
- b. $= \exists e[\tau(e) \subseteq t\{t \prec_i t^*\} \wedge (\text{SPEED}(J)(w^*) \geq d_{\text{nec}})(e)]$, where
 $d_{\text{nec}} = \text{id} : \forall w \in \text{CIRC}(w^*)[\text{SPEED}(J)(w) < d \rightarrow \neg \text{win-race}(J)(w)]$
- c. *There is an eventuality contained in a salient past time which is an eventuality of Juno being at least as fast as she is in any circumstantially-accessible world in which she wins the race.*

In the negative case, the claim is that Juno’s speed at race-time is incompatible with her winning the race. As in the static adjective shelf-reaching example (4.80b), the asserted content of (5.84) should force the entailment that the real world is not one in which race-winning was achieved, and this is what we get from the truth conditions in (5.84b).

(5.84) *Juno n’a pas été assez rapide pour gagner la course.*

‘Juno was-PFV not fast enough to win the race.’

- a. $\llbracket (5.84) \rrbracket^{w^*} \equiv \llbracket \text{PST}(\text{PFV}(\text{Juno not be fast enough to win the race})) \rrbracket^{w^*}$
- b. $= \exists e[\tau(e) \subseteq t\{t \prec_i t^*\} \wedge (\text{SPEED}(J)(w^*) < d_{\text{nec}})(e)]$, where
 $d_{\text{nec}} = \text{id} : \forall w \in \text{CIRC}(w^*)[\text{SPEED}(J)(w) < d \rightarrow \neg \text{win-race}(J)(w)]$
- c. *There is an eventuality contained in a salient past time which is an eventuality of Juno being slower than she is in any circumstantially-accessible world in which she wins the race.*
- d. \vdash The real world is not one in which Juno won the race.

The problem, of course, is that the entailment in (5.85d) follows from the semantics of the sentence radical alone. Imperfective marking will not change the underlying entailment relationship, which is imposed by the reflexive nature of circumstantial modality.

(5.85) *Juno n’était pas assez rapide pour gagner la course.*

‘Juno was-IMPF not fast enough to win the race.’

- a. $\llbracket (5.85) \rrbracket^{w^*} \equiv \llbracket \text{PST}(\text{IMPF}(\text{Juno not be fast enough to win the race})) \rrbracket^{w^*}$
- b. $= \exists e[\tau(e) \supseteq t\{t \prec_i t^*\} \wedge (\text{SPEED}(J)(w^*) < d_{\text{nec}})(e)]$, where
 $d_{\text{nec}} = \iota d : \forall w \in \text{CIRC}(w^*)[\text{SPEED}(J)(w) < d \rightarrow \neg \text{win-race}(J)(w)]$
- c. *There is an eventuality containing a salient past time, which is an eventuality of Juno being slower than she is in any circumstantially-accessible world in which she wins the race.*
- d. \vdash The real world is not one in which Juno won the race.

This does not accord with the empirical data:

(4.77) *Juno n'était pas assez rapide pour gagner la course, mais la coureuse en tête a trébuché dans la dernière manche, et donc, Juno a gagné (après tout).*

‘Juno was-IMPF not fast enough to win the race, but the lead runner tripped on the final lap, and so, Juno won (after all).’

(4.76b) *Juno n'était pas (généralement) assez rapide pour gagner, mais ses concurrents étaient malades cette journée-là et ils ont couru lentement.*

‘Juno was not (ordinarily) fast enough to win, but her competitors were ill that day, and ran slowly.’

We might appeal to the Bhatt-Hacquard explanation to account for the cancellability of the expected negative inference from (5.85), since (4.77) seems to convey that something unusual occurred, which intervened on the expected outcome (Juno’s not winning the race). However, if (4.77) is to be explained along these lines, it is not clear how we should account for the non-defeasibility of the negative inference in examples like (4.80b), where the dynamic matrix property is replaced by a static one.²⁰

Thus, while the semantics developed in Sections 5.1-5.2 predicts the correct inference patterns for epistemic, deontic, and static circumstantial constructions, it does not as it stands differentiate between the static and dynamic circumstantial cases. As a result, we

²⁰This is not unrelated to the problem noted in Chapter 4, Section 4.2.2: appealing to a generic or habitual interpretation of the imperfective does not explain why true implicative verbs entail regardless of aspectual marking.

fail to predict the correct inference patterns for ‘implicative’ *enough/too* constructions. In the case of positive assertions like (4.35a) (as well as negative *too* assertions), we fail to derive the expected entailment under perfective aspect.

(4.35a) *Juno a été assez rapide pour gagner la course.*

‘Juno was-PFV fast enough to win the race.’

\vdash *Juno won the race.*

In the negative *enough* (and positive *too*) cases, we have the reverse problem: we predict uncancellable inferences to the negation of the *enough/too* complement, regardless of language or aspectual marking, when these entailments in fact arise only under the perfective aspect.

We have improved on the at-base implicative treatment proposed by Hacquard (2005), insofar as dropping the sufficiency condition avoids making the wrong predictions for deontic *enough/too* constructions, as well as for circumstantial constructions with static adjectives. However, if we wish to make the correct predictions in the remaining (dynamic) cases, two things will be required.

First, based on the truth conditions we derive for (4.35a), it seems clear that the only way an implicative entailment can arise is if this construction does not only assert that a necessity condition is met, but conveys that this necessary condition is also a sufficient one for the realization of the complement. That is, given the parallel between the basic semantics of *enough/too* constructions and one-way implicatives, the ‘missing piece’ in the two-way implicative pattern is the identification of the necessity condition as a sufficiency condition as well. In a sense, we would like to revert to Hacquard’s analysis, but only under very specific circumstances. Crucially, we need a way of encoding the missing sufficiency condition so that it is only ‘triggered’ by circumstantial *enough/too* constructions involving dynamic adjectives, and then only in case there is a temporal overlap between the matrix and complement clauses, and the matrix verb is in the perfective aspect.

Secondly, we need to explain the cancellability of complement inferences in (4.77), in view of the evidence that negative inferences from static-adjective constructions are not similarly cancellable. In particular, then, we need to explain why circumstantial *enough/too*

constructions with dynamic adjectives should be sensitive to both interruptions (as in 4.77) as well as to ‘normality’ assumptions (as in the cancellation in 4.76b), where the static cases show no such sensitivity.

In Chapter 4 (Section 4.3.3), and in the introduction to this chapter, I suggested that the difference between static and dynamic adjective constructions has to do with the relationship between dynamic adjectives and actions – in particular, that dynamic adjectives are conducive to a causal interpretation of the matrix-complement relationship in an *enough/too* construction. I take up this argument in more detail in the next section, and argue that the fundamental nature of a dynamic adjective like *fast* contributes to the selective appearance of a sufficiency condition, as well as the sensitivity to interruptions and unusual circumstances.

5.4 Dynamic properties and causal sufficiency

5.4.1 Acting to bring about the *enough/too* complement

In Chapter 4 (Section 4.2.2), I showed why we cannot take Hacquard’s route and adopt a sufficiency presupposition along the lines of (5.67) as part of the lexical encoding of *enough* and *too*. Deontic *enough/too* constructions which do not involve sufficiency (i.e., laws about one what must do, as opposed to what one may do) are evidently felicitous. Moreover, we saw that the sufficiency presupposition incorrectly predicts infelicity from an example like (4.52) in any context where the complement happens not to be realized.

(5.67) The sufficiency condition for *enough*:

Given a statement of the form: *S* is ADJ enough to *A*, evaluated at a world *w*:

$$\exists d_{\text{suff}} : \forall w' \in \text{Opt}_{g(w)}(\cap f(w)) [\text{ADJ}(S)(d_{\text{suff}})(w') \rightarrow A(S)(w')]$$

(4.52) *Amira a été assez grande pour boire de l'alcool.*

‘Amira was-PFV old enough to drink alcohol.’

To this objection, we can add that an across-the-board sufficiency condition also makes

the wrong predictions for static circumstantial cases like (4.80a)/(5.56), since these constructions do not entail the realization of their complements despite the reflexive nature of the modal accessibility relation.

(4.80a) Nima was tall enough to reach the shelf. ≡ (5.56)

Moreover, unless the utterance context supplies the information that Nima intended or attempted to reach the shelf, (4.80a) does not necessarily license even a defeasible implicature to the realization of the complement. This is because, even if Nima has the necessary height for reaching the shelf, he must ultimately take some action towards reaching it, and (4.80a) is not in itself informative as to whether or not such an action is taken.

The observation that some action is required for the realization of the complement proposition reveals another drawback of Hacquard's 'fully-implicative' treatment. Even where adding a sufficiency presupposition derives the correct results (that is, in perfectly-marked circumstantial *enough/too* constructions involving dynamic adjectives), it does not do so in an intuitively coherent way. Crucially, an attribution of speed, like an attribution of height, does not in itself establish that any action was taken towards realizing the complement proposition.

(4.5a) Juno was fast enough to win the race.

The problem is this: Juno's having the (latent) capacity to perform actions characterized by the necessary race-winning speed is not, by itself, enough to bring about the event of her winning the race. Being d_{nec} -fast can only be instrumental in race-winning if Juno actually manifests or exercises her speed. Just as in (4.80a), then, an interpretation on which (4.5a) entails or even implicates its complement requires the prior entailment or implication that the subject took some action (towards the complement). If we have no information about whether or not such an action took place, we simply cannot draw any conclusions about whether or not Juno's speed actually brought about winning the race or not.

The importance of action illuminates the basic difference between circumstantial *enough* and *too* constructions with static versus dynamic adjectives. Both types require some action

from the sentential subject supplementary to the attributed property in order for their complements to be realized. However, static and dynamic adjectives stand in a markedly different relationship to this action. Reaching the top shelf, in (4.80a), involves motion towards the shelf – raising one’s arms, standing on one’s toes, etc. The success of an attempt to reach the shelf is either enabled or precluded based on the height of the agent – this is ensured by the necessity presupposition – but the attempt itself is not fundamentally characterized by height. Similarly, winning a race, as in (4.5a), requires not just the capacity for speed, but also that an attempt to win the race is made. However, in order for the attempt to be successful in this case, it must be characterized by speed (and, in particular, by a speed of at least d_{nec}). Thus, the ‘missing’ action in dynamic *enough/too* constructions is, precisely, the manifestation of the latent capacity described by the matrix adjective. There is no similarly tight connection between the ‘missing’ action and the matrix adjective in static constructions.

To see how sufficiency factors into this, let us consider more carefully what work the necessity presupposition does when we evaluate an *enough/too* construction. We saw, in the previous section, that circumstantial constructions are infelicitous in ‘impossible’ contexts where complement realization is precluded by some immutable factor independent of the matrix property: the markedness of examples like (5.60) provided evidence in support of the necessity presupposition (5.64).

(5.60) ??Nima is tall enough to travel faster than the speed of light.

(5.64) **The necessity condition for *enough*, version 2:**

Given a statement of the form: x is ADJ enough to P , evaluated at a world w ,

$$\exists d_{\text{nec}} > 0 : \forall w' \in \text{ACC}_H(w), \neg \text{ADJ}(x)(w')(d_{\text{nec}}) \rightarrow \neg P(x)(w').$$

Suppose instead that we are in a context where the circumstances of the world prevent the realization of the complement for reasons that are more mutable than the laws of physics – that is, for reasons that might conceivably be different without changing the nature of reality. For instance, suppose (4.80a) is uttered in a context that establishes that the shelf in question is in a locked room to which Nima does not have the key.

(4.80a) is not infelicitous in such a context. This illustrates an important feature of the (partially) realistic modal base involved in evaluating the claim. If we are to satisfy the necessity presupposition (thus admitting at least one shelf-reaching world), we cannot allow the modal base to include propositions that contain information about circumstances like the locked door. In other words, the worlds we want to look at are those worlds that are compatible with some of the facts of the actual world – e.g., the distance between the ground and the top shelf – but which do not fix circumstances which preclude shelf-reaching, as long as these circumstances could plausibly be different in the actual world. The question we are attempting to answer, by looking at shelf-reaching worlds that are as close to reality as possible, is whether or not Nima’s height would permit him to reach the shelf, *were it the only condition in question* for the realization of the complement – if all other relevant conditions were to be determined in a manner conducive to Nima’s reaching the shelf. In other words, if everything else was settled – the accessibility of the room with the shelf, Nima’s ability to move his hands and legs, and, crucially, his intention and the associated attempt to reach the shelf – the truth of (4.80a) would indicate that Nima’s height is a sufficient condition for shelf-reaching. The real world need not – and most likely will not – settle all of the other conditions, but the worlds we consider in evaluating the comparative claim are, necessarily, worlds in which all other conditions are settled in the right way. Viewed this way, we can see that *enough/too* constructions are not only claims about the status of a necessary condition, but are also claims about *hypothetical sufficiency*.

The same reasoning applies to *enough/too* constructions with dynamic adjectives. Fixing certain circumstances of the actual world – the length of the race, the set and speeds of other participants, and so on – we find those worlds in which Juno wins the race, and see what is true of her speed in all of these worlds. In order for the race-winning worlds to be (partially) realistic, however, we must assume that certain other conditions are also satisfied: Juno must be eligible to enter the race, and – crucially – must participate and make an attempt to win. Assuming the race in question is a foot race, participation and an attempt to win involve running, which is then the action that must be characterized by (at least) the necessary speed. Again, the question being answered by *enough/too* constructions is a hypothetical

one: were speed the only factor in question for Juno's win, would her speed be sufficient? The difference between this and the static example (4.80a) is that, in the dynamic adjective case, the sufficiency of the speed is conceptually inseparable from the sufficiency of the potential action which brings about race-winning. If Juno does not run, her latent, unexercised speed cannot bring about a win; if she does run, it is this action which is necessarily d_{nec} -fast.

The key point is that, for *enough/too* constructions with dynamic adjectives, the 'hypothetical sufficiency' contexts which must hold in the complement-realizing worlds are the *only* realistic contexts where race-winning is possible. Whether or not Juno had the necessary speed to win will always be the last question that is settled, since – in a world that involves race-winning – it is settled on the basis of the last, potentially sufficient action. In other words, the basic connection between the property and the action which finally brings about or produces the complement event seems to necessitate an interpretation on which (hypothetical) sufficiency – sufficiency of the adjective-characterized action – is baked into *enough/too* constructions with dynamic adjectives. Speed may not, as a latent property, be sufficient for race-winning, but its manifestation (at race time) will be.

This discussion shows why sufficiency conditions only seem to appear when an *enough* or *too* construction involves a dynamic adjective. For a property like height or weight, the last piece of the process involved in bringing about (any) complement event will be one whose success is affected by the degree of the property that is present, but not one which is characterized by it. Another way of thinking about this is that the question of height, at the time of shelf-reaching, can be settled without 'running a simulation': we can simply measure it in isolation. While we may have opportunities to measure or assess Juno's speed outside of the race, it is the last, potentially sufficient action (running) that determines whether or not her speed *at race time* crosses the d_{nec} boundary. This is simply another way of saying that speed is the last thing to be settled, and thus, coupled with its manifestation, is understood to be not only necessary, but also sufficient.

Thus, the sufficiency condition we are looking for does not emerge from the semantics of *enough* or *too* alone (as per Hacquard), but rather from the combination of a dynamic matrix property, the necessity-encoding semantics of the modalized comparative operators,

and world knowledge about what actions must take place in order for the complement to be realized. This last piece amounts to an understanding of the causal relationships (normally) involved in bringing about the complement. The manifestation of the dynamic property, which represents the sufficient action, is in fact a *causally sufficient* condition. This establishes the final parallel between dynamic circumstantial *enough/too* constructions and implicative verbs: both constructions involve a causal connection between the condition described in the matrix clause and the realization of the complement proposition.

- (5.86) Given a statement of the form: *S* is ADJ enough to *A*, evaluated at a world *w*, where ADJ is a dynamic (action-characterizing) adjective:

$$\exists d_{\text{suff}} : \text{INST}(\text{ADJ}(S)(d_{\text{suff}})) \blacktriangleright A(S)$$

That is, there is a particular degree d_{suff} of the matrix adjective such that a manifestation $\text{INST}(\text{ADJ}(S)(d_{\text{suff}}))$ of d_{suff} -ADJ by the sentential subject is **causally sufficient** for the realization of the *enough*-complement. Moreover, the preceding discussion established that, in evaluating whether or not an agent's actual degree of ADJ meets the (presupposed) necessity threshold, we are in essence evaluating the hypothetical sufficiency of that degree for the realization of the complement. In other words, the degree d_{nec} of a dynamic matrix adjective which is necessary for the realization of the *enough*-complement is precisely the degree of the matrix adjective which, in manifestation, is causally sufficient for the complement.

5.4.2 Causal sufficiency of dynamic adjective manifestations

In this section, I present some evidence in support of the view that the 'implicative' *enough/too* constructions involve not only sufficiency, but in particular the causal sufficiency of (a manifestation of) the matrix property for the *enough/too* complement.

Consider the ways in which we can reasonably cancel complement inferences from positive *enough* cases, in English and under imperfective marking. The 'generic' examples in (5.87) indicate that some necessary condition other than speed precluded the possibility of Juno's winning the race: in so doing, they favour an interpretation of the *enough* claim on which it simply attributes a (latent) speed capacity to Juno, but on which – crucially – she

never attempts to run in the race. This supports the idea that dynamic adjective *enough* constructions can only be interpreted as conveying that the adjective-characterized action took place if it is, in fact, a sufficient condition for the complement's realization, by virtue of being the last necessary condition to be settled.

(5.87) 'Generic' interpretations:

- a. Juno was fast enough to win the race, but she was injured and could not run (that day). ≡ (4.15)
- b. *Juno était assez rapide pour gagner la course, mais elle était blessée et ne pouvait pas courir (ce jour-là).* ≡ (4.16b)
 'Juno was-IMPF fast enough to win the race, but she was injured and could not run (that day).'

It is possible, of course, to indicate that the failure of some other necessary condition was discovered after the race time. Consider, for instance, a version of the qualifying scenario (example 4.50, from Chapter 4) in which we find out, only after Juno has completed the race and finished first, that she was not in fact qualified to participate, and therefore is not eligible for the first-place prize. In this context, the claim that Juno was fast enough to win the race is marked even in English; it can be improved only if we make a distinction between 'winning the race' in the sense of finishing first and 'winning the race' in the sense of being awarded the prize.

- (5.88) *Context:* Juno competed in today's race, which has just taken place. Just before the race began, an announcement was made that the age qualifications were changed from what was stated on the original entry form – the minimum age for participation was raised. Since Juno was already close to the minimum age requirement, we were not sure after this announcement if she would still qualify. The gun went off before this question was resolved. I saw that Juno was the fastest runner, and crossed the finish line first. You did not see the race. Afterwards, we find out that the change to the qualifications did, in fact, mean that Juno was not eligible. I report the situation to you by saying:

- a. #Juno was fast enough to win the race, but as it turned out, she was not eligible to win.
- b. Juno was fast enough to win the race, but, as it turned out, she was not eligible for the prize.

The French imperfective cannot be used appropriately in this context (that is, to refer to the actual race-event in which Juno ran). The perfective version of (5.88a) is contradictory, but the perfective counterpart of (5.88b) is acceptable, in accordance with the judgements for the first version of the qualifying scenario.

This indicates that, if the basic dynamic adjective *enough* claim in (4.5a) (*Juno was fast enough to win the race*) is to be interpreted as describing a situation in which the race occurred and Juno participated, then it must be the case that her action/participation was taken to be sufficient for the *enough* complement; suggesting even after the fact that it was not sufficient, in view of some other missing requirement, is contradictory. The contrast between (5.87) and (5.88) highlights the hypothetical nature of the proposed sufficiency presupposition. The action characterized by the dynamic adjective is the action presupposed to be (causally) sufficient for the realization of the complement, but the latent capacity for this action is not, by itself, a sufficient condition. In other words, in the examples in (5.87), *to be fast enough/être assez rapid(e)* is to be capable of performing a speed-characterized causally-sufficient action for the realization of the complement.

There is a second way in which the implicative inferences of positive *enough* constructions can be cancelled. This involves an apparently progressive interpretation of the *enough* claim, followed by some type of ‘interruption’.

(5.89) ‘Progressive’ interpretations:

- a. Juno was fast enough to win the race, but she tripped near the finish line, and did not win.²¹

²¹While a progressive interpretation of this is possible in French (see example 5.89b), it is not clear that this is an available reading of the English version. While (5.89a) felicitously describes a situation in which Juno was running fast enough to win the race at the moment that she tripped (and, indeed, must describe such a situation in order to be interpreted coherently), the *enough* construction seems to default to an interpretation on which it simply describes Juno’s general speed capacity, as in (5.87a).

- b. *Juno était assez rapide pour gagner la course, mais elle est tombée près de la ligne d'arrivée et n'a pas gagné.* ≡ (4.79)

‘Juno was-IMPF fast enough to win the race, but she fell near the finish line, and did not win.’

These examples suggest that something changed during the course of the race, which intervened on or interrupted the presupposed chain of causation between the sufficient action (running at a speed of at least d_{nec}) and its result (race-winning). The sense of unexpectedness is associated with this change in context. The examples in (5.89) indicate that some event occurred which was not ordinarily (or even at the start of the race) predictable, but which ultimately exerted a causal influence on the outcome of the race.

As noted in Chapter 4, this is precisely the scenario involved in the imperfective paradox. Statements like (5.90a) are taken to indicate that the initiation of some process – e.g., walking out into the street – led to some culmination point – reaching the other side. However, under the progressive (imperfective in French), this normal entailment can be cancelled, in view of the intervention of some event which was not predicated at initiation time, and which impacts the chain of causation between the initiation point and its ordinary culmination.

- (5.90) a. Juno crossed the street.
 ~ *Juno walked or otherwise moved into the street, and traveled across it until she reached the other side.*
 b. Juno was crossing the street when she was hit by a bus.

The parallel between these two cases, and the fact that, in both cases, the interruption is understood as being unexpected or not predicted at the time of initiation, supports the idea that circumstantial, dynamic adjective *enough/too* constructions presuppose that an action characterized by the matrix adjective is (in general) sufficient to bring about the complement. Insofar as analyses of the imperfective paradox involve the causal relationship between the initiation of an accomplishment, its expected result or culmination, and some intervening event, the parallel also supports a causal interpretation of the apparent

sufficiency relationship.²²

The causal component of a sufficiency relationship is also supported by the pragmatic oddness of examples like (5.91), as compared to (4.5a).

(5.91) (?)Juno was loud enough to win the race.

(4.5a) Juno was fast enough to win the race.

(4.5a) is easily reconciled with a causal interpretation, since being fast is, in general, understood to be a cause of race-winning. On the other hand, the oddness of (5.91) seems to be due to the difficulty of imagining a context in which being loud (also a dynamic property) could be a cause of race-winning.

We do better with a different dynamic property, which is more easily taken to be causally involved in race-winning:

(5.92) Juno was strong enough to win the race.

By contrast with being loud, it is relatively easy to imagine contexts in which being strong might reasonably characterize the final, sufficient action in the race-winning process. Such a context might, for instance, involve an endurance race (such as an ultramarathon, or a Spartan race), potentially making the strength of a participant at least as instrumental in the race-winning process as speed. Crucially, for (5.92) to be felicitous even in such a context, we must interpret the action characterized by strength as the last thing to be settled in the race-winning process: (5.92) will be infelicitous in contexts where the question of whether or not Juno has the necessary speed is left open, or where her speed is explicitly stated to be less than the necessary degree.

(5.93) Juno was strong enough to win the race, ??but she wasn't fast enough, so she came in second.

The same point is reinforced when we modify dynamic *enough/too* constructions with *because*-clauses:

²²For causal analyses of the imperfective paradox, see Dowty (1979), Landman (1992), Condoravdi (2009), and Copley and Harley (2015), among others. Dowty's account is discussed in Chapter 6 (Section 6.3.3).

- (5.94) a. ??Because it was cheap, Morgan was smart enough to buy the ring.
 b. Because it was empty, Olga was strong enough to lift the fridge.

(5.94a) is odd because it suggests that the ring's price affected Morgan's (use of) intelligence in buying the ring. As with implicative verbs, the *because*-clause is taken to modify an existing causal chain between intelligence and ring-buying, but there is no obvious way in which the price of the ring might do this. (5.94b), on the other hand, is perfectly acceptable: the emptiness of the fridge affects its weight, and thus has an impact on the causal relationship between Olga's strength and fridge-lifting, since it lowers the bar for the degree of strength that is required to characterize the lifting action.²³

Finally, this discussion shows why a temporal overlap between the matrix and complement clauses is also essential for *enough/too* implicativity. Given an *enough/too* construction which satisfies the other requirements – circumstantial modality, a dynamic matrix adjective, and even perfective marking – an explicit temporal separation between the matrix and complement clauses, as in (4.88) will not change our basic understanding of the causal relationship between manifesting speed and winning a race. However, the temporal specification of the speed attribution, and in particular its separation from the time of the race-win, rules out any possibility that the matrix eventuality refers to the particular speed-characterized action which, at race time, is a causal precursor to Juno's winning the race. In (4.88), the matrix speed attribution simply provides evidence of Juno's speed capacity, and thus evidence for the claim that Juno has the capacity for the d_{nec} -fast action which will be sufficient for a win at race time. Due to the temporal separation, the matrix clause in (4.88) cannot, under any circumstances, refer directly to an action which is causally sufficient for (that is, which brings about) the win.

- (4.88) a. When I saw her run last week, Juno was fast enough to win today's race, but

²³Note, also, that replacing *empty* in (5.94b) with *full* again results in oddness, in this case because full things are typically assumed to be heavier than less full ones. This should not work to make Olga's strength sufficient if it was not independently so; thus, it should not be a positive influence on the causal-sufficiency relationship presupposed by the *enough/too* construction, which the *because*-clause suggests that it is.

- (i) ??Because it was full, Olga was strong enough to lift the fridge.

as it turned out she ran slowly today and did not win after all.

- b. *Quand je l'ai vue courir la semaine dernière, Juno a été assez rapide pour gagner la course d'aujourd'hui, mais il s'est avéré qu'elle a couru beaucoup plus lentement aujourd'hui.*

‘When I saw-PFV her run last week, Juno was-PFV fast enough to win today’s race, but it turned out that she ran much more slowly today.’

Thus, while our interpretation of the examples in (4.88) is influenced by the causal relationship between manifestations of speed and race-winning (encoded, perhaps, in a stereotypical ordering source), the temporal separation in these examples pushes us to interpret it with respect to epistemic, rather than circumstantial modality.

5.5 Necessity, sufficiency, and causally optimal worlds

5.5.1 An implicative proposal for *enough* and *too* constructions

The preceding discussion motivates the following proposal for *enough* and *too* constructions. For simplicity of presentation, and in order to highlight the parallels between this proposal and the ‘prerequisite’ proposal for two-way polarity-preserving implicative verbs (Proposal 3.50), I focus only on *enough* constructions:

- (5.95) **The ‘implicative’ semantics for *enough* constructions.** (Proposal)

Let P be a proposition of the form

$$P = S \text{ be ADJ enough to } A$$

where S is an agent, ADJ a relation between individuals and sets of degrees, and A a property of individuals (one-place predicate). Evaluated with respect to a world w , background situation c , and conversational backgrounds f, g :

- i. P presupposes the existence of a degree d_{nec} that is necessary for $A(S)$:

$$\exists d_{\text{nec}} : \forall w' \in \text{Opt}_{g(w)}(\cap f(w)) [\neg \text{ADJ}(S)(d_{\text{nec}})(w') \rightarrow \neg A(S)(w')]$$

- ii. P asserts that S is/has d_{nec} -ADJ in w :

$$\text{ADJ}(S)(d_{\text{nec}})(w)$$

- iii. In case ADJ is a dynamic (action-characterizing) property, P additionally presupposes the contextual causal sufficiency of a manifestation of d_{nec} -ADJ for $A(S)$:

$$\text{INST}(\text{ADJ}(S)(d_{\text{nec}})) \blacktriangleright_c A(S)$$

Clauses (5.95-i) and (5.95-ii) are the semantics established in Sections 5.1 and 5.2. Clause (5.95-i) establishes that some degree of the matrix adjective represents a necessary condition for the realization of the *enough*-complement: this is the necessity presupposition discussed in Section 5.2. The context-dependent choice of conversational backgrounds f and g determines whether this necessity is to be interpreted as epistemic, deontic, or circumstantial. According to clause (5.95-ii), a positive *enough* assertion attributes to its subject at least the necessary degree of the matrix adjective; this follows the von Stechow et al.-style semantics discussed in Section 5.1.

Clause (5.95-iii) is new. It spells out the proposed sufficiency condition associated with *enough* constructions involving dynamic adjectives. If Proposal 5.95 is correct, circumstantial *enough* constructions which meet the dynamic adjective and temporal overlap conditions will be predicted to generate implicative inferences if, for some reason, the matrix clause is interpreted as describing a manifestation of d_{nec} -ADJ by the *enough* subject, instead of as simply attributing to this subject the capacity for actions characterized by (at least) degree d_{nec} of the matrix adjective.

As we saw in Section 5.4, the sufficiency presupposition is directly associated with the conceptual relationship between a dynamic adjective and the *enough* complement. This

means that, even in the absence of overlapping temporal specifications, a dynamic adjective *enough* construction will still invoke the sufficiency presupposition in clause (5.95-iii). However, since the property instantiation which is taken to be sufficient for the *enough* complement is necessarily one which occurs at a time overlapping the complement time, a temporally-separated matrix assertion cannot possibly be interpreted as a realization of the causing condition. Thus, even though the sufficiency presupposition is relevant for dynamic adjective constructions that fail the temporal overlap condition, it does not predict implicative entailments in the absence of temporal overlap.

The ‘implicative’ proposal in 5.95 brings the causal dependence relations defined in Chapter 3 together with the modal premise semantics introduced in Chapter 2. Up to this point, the analysis of *enough* and *too* constructions has relied entirely on the premise semantics, in order to capture the variability in modal flavour associated with *enough* and *too* constructions as opposed to lexical implicatives. Proposal 5.95 thus raises the question of how a causal sufficiency presupposition is to be understood from the premise-semantics perspective, and, more specifically, how the connection between general circumstantial modality and causal dependency relations is to be understood.

In evaluating epistemic, deontic, or static adjective circumstantial *enough* and *too* constructions, we saw that the premise semantics in effect required us to consider hypothetical scenarios in which the attribution of some degree d_{nec} of the *enough/too* matrix adjective would be sufficient (or insufficient) for the realization of the complement. This is what the necessity condition in clause (5.95-i) amounts to: whether or not the degree of ADJ attributed to the sentential subject would be sufficient to permit the realization of the complement, in the event that all other conditions for the complement were met. This set of conditions, in any plausible model of the world, includes some action taken by the subject which aims (intentionally or otherwise) at the realization of the implicative complement.

Depending on the modal flavour of the adjective-complement relationship, this ‘hypothetical’ sufficiency can be epistemic, deontic, or circumstantial. Intuitively, causal (dynamic adjective) *enough/too* constructions are a subclass of the circumstantial cases, which are distinguished from the static-adjective examples by one critical feature: in dynamic adjective

examples, the agent’s potential action towards the *enough/too* complement is characterized by the matrix adjective. The causal cases are causal in view of this feature, which ties the matrix adjective to a causally necessity condition (action) for the *enough* complement. If, as discussed in Section 5.4, this action is necessarily the last condition to be met in a process of realizing the *enough* complement, then the general ‘hypothetical’ sufficiency invoked by *enough/too* modality in this case becomes a relation of causal sufficiency between a potential instantiation of the matrix adjective, and the realization of the complement clause. Conceptually, then, while the necessity presupposition for dynamic adjective constructions can be framed in non-causal terms, as a circumstantial necessity between the latent capacity attribution and the realization of the *enough* complement, we can equally well think of this as establishing the causal necessity of the instantiation in clause (5.95-iii); specifically, the necessity of $d_{\text{nec-ADJ}}$, in these cases, is in view of the necessity of manifesting at least d_{nec} of the matrix adjective in the action which aims at realizing the *enough/too* complement.

Taking causal necessity and causal sufficiency to represent special cases of circumstantial necessity and sufficiency, we would like to have a means of interpreting these relations in the premise semantics framework. In the remainder of this section, I outline one way in which a causal model of the sort introduced in Chapter 3 can be used to define a causal premise semantics. This outline is based on ideas from Kaufmann (2013). I then discuss how the relations of causal necessity and sufficiency are to be evaluated in such a framework. Finally, I suggest that this approach makes good on the intuitions discussed in Section 5.4, with respect to the relationship between the causal sufficiency of an instantiation of the matrix property, and the ‘hypothetical’ sufficiency reasoning associated with *enough/too* constructions in the general case, and that it can predict some of the puzzling empirical differences between perfective and imperfective *enough/too* claims that we have seen over the course of the last two chapters.

5.5.2 Causally optimal worlds

The basic idea is to use the structure of a causal model to define the modal base and ordering source with respect to which a (causal) modal claim is evaluated. In reasoning

about causation, we start from a certain set of assumptions about facts in the world: a causal premise semantics will therefore draw on a circumstantial modal base. Given this modal base (a background situation), we determine what is possible and what is necessary on the basis of a set of causal laws. This means that it is the causal laws encoded by a particular model which will – in some way – determine the appropriate ordering source for a causal modality.

Causal laws encode information about the way in which (we believe) events in the world influence one another. That is, they encode our expectations about the normal sequence of events, or the *normal causal developments* of a particular background situation. From this perspective, a causal conversational background determined by the laws of a causal model corresponds to a *stereotypical* causal background as described by Kratzer (2012[1981]). Definition 5.1 is repeated from Chapter 2:

Definition 5.1 (Stereotypical conversational backgrounds). *A stereotypical conversational background is a function h such that for any world w , $h(w)$ represents what is normal in w according to some suitable normalcy standard for w .* (Kratzer, 2012[1981], p.37)

Using a causal dynamics to structure an ordering source is one way of formalizing intuitive ideas about ‘stereotypical’ reasoning. In a causal premise semantics, the optimal worlds should be those which best adhere to the normal causal developments of a starting situation. Thus, if we take the (relevant) facts for a particular utterance – those facts established at reference time – as our circumstantial modal base, and let the ordering source be a set of propositions describing the causal laws, our causally optimal worlds – those worlds that are maximally causally normal from the perspective of the modal base – will be worlds that fix the normal causal developments of the modal base. Anything that is causally consistent with the facts of a causally optimal world will be causally possible, by this metric; anything that is true in all of the causally optimal worlds will be a causal necessity.

If we begin with a circumstantial modal base, then causal reasoning involves our expectations about how the actual world will develop.²⁴ To get this to work within the

²⁴A causal ordering source might also stand in for the stereotypical ordering source associated with certain epistemic modal claims; in this case, causal reasoning involves our expectations based on a particular

premise semantics framework, we will need to make one additional assumption. Specifically, if causally-possible and causally-necessary (possibility and necessity with respect to causally optimal worlds) are to inform us about real-world developments, we must *de facto* assume that the actual world is maximally causally normal, and therefore will always belong to the set of optimal worlds that are considered in the evaluation of a causal claim.

This is a reasonable assumption. As discussed in Chapter 3, we take it for granted that the real world obeys the laws of causation, as they actually are. If and when we find that events deviate from our expectations, we do not conclude that the world around us is causally deficient, but instead that there was some event or information that our causal model failed to take into account. To put it another way, the laws of causation, whatever they may be, are assumed to determine how events proceed in the world. In order to reason about causation, we make the assumption that a mental model of causal information (the contextually-developed dynamics available at a given moment) is an accurate representation of the actual causal laws, and is complete with respect to any relevant causal background. A consequence of this assumption is that the real world is expected to be maximally causally normal in our model; in other words, the assumption we make in reasoning about causation is that the model predicts what is *actually* causally normal. If it turns out that this assumption is incorrect – if the events of the actual world diverge from the predicted normal causal developments – this is not because the real world is somehow causally aberrant, but rather due to incompleteness or inaccuracy in our starting model.²⁵

5.5.3 Causal premise semantics

Kaufmann’s (2013) **causal premise semantics** integrates the structure of a Pearl-style (Bayesian) causal network with the possible worlds framework for modality. If we assume

knowledge of information state, represented by the set of belief-worlds picked out by an epistemic modal base.

²⁵One consequence of this built-in repair mechanism is that we might expect to have ways of indicating or signaling changes to the model, or points at which new information triggered an update. It will not be possible to explore this idea, but Section 6.3.3 of Chapter 6 suggests that one potential use of progressive marking is to signal in this way, offering a possible account of *imperfective paradox* effects (Dowty, 1979).

that a dynamics \mathcal{D} , or any other representation of causal information, is a discourse parameter which is built up and manipulated by discourse contributions, then the idea that we draw on the structure of \mathcal{D} to determine the appropriate modal base and ordering source for evaluating causal claims is entirely continuous with the idea that a discourse context supplies the correct conversational backgrounds for evaluating modal claims.

Kaufmann's framework is implemented on the basis of a set of natural correspondences between the structure of a probabilistic (Bayesian) network and the possible worlds setup. Here, I restrict attention to Schulz's (2011) deterministic framework, which was introduced in Chapter 3, and simplify the presentation as much as possible. I refer to Kaufmann (2013) for a less restricted model, including a generalization of the basic premise semantics.

The key concepts from Chapter 2 are repeated below. Recall that modal claims are evaluated with respect to two conversational backgrounds, which are functions from worlds to sets of propositions. One background, f , determines a *modal base*; for any world w , the set of propositions $f(w)$ picks out a set of worlds, $\cap f(w)$. The second conversational background, g , determines an *ordering source*, which is used to rank the worlds, and to determine the optimal worlds among those picked out by the modal base.

Definition 5.2. *Let g be a conversational background. Then, for any world w , the ordering relation $\leq_{g(w)}$ is defined:*

$$\forall v, u \in W, v \leq_{g(w)} u \text{ iff } \{\phi \in g(w) \mid v \in \phi\} \subseteq \{\phi \in g(w) \mid u \in \phi\}$$

Given the ordering relation $\leq_{g(w)}$, we define the *optimal worlds* with respect to f and g :

Definition 5.3 (Optimal worlds). *Let w be a world and f and g be conversational backgrounds. Then the optimal worlds with respect to the modal base $f(w)$ and ordering source $g(w)$ are given by:*

$$Opt_{g(w)}(\cap f(w)) = \{v \in \cap f(w) \mid \forall u \in \cap f(w), u \leq_{g(w)} v \rightarrow v = u\}$$

Finally, the modal operators *must* and *can* are quantifiers over the set of optimal worlds.

Definition 5.4 (Modals). *Let p be a proposition. Let f, g be conversational backgrounds. Then:*

- (a) $\llbracket \text{MUST}(p) \rrbracket^{f,g} := \lambda w. \forall w' \in \text{Opt}_{g(w)}(\cap f(w)), p(w') = 1$
- (b) $\llbracket \text{CAN}(p) \rrbracket^{f,g} := \lambda w. \exists w' \in \text{Opt}_{g(w)}(\cap f(w)), p(w') = 1$

A dynamics in the possible-worlds framework

Let W be the set of possible worlds. In Chapter 3, we defined a dynamics over a finite set of propositional variables P , which could be valued from the three-way Kleene logic (see Table 3.1 in Chapter 3). A variable X is *determined* if it has either a 0 or 1 valuation. Thus, a determination for a propositional variable X corresponds to a proposition in the possible worlds framework, and picks out the set of worlds in W where X has the determined truth value. The opposite determination for X picks out the complementary set of worlds. We can therefore treat a variable X as a bipartition of W , $X = \langle x, \bar{x} \rangle$, where $\bar{x} = \neg x$ represents the complement of x in W .

Given this correspondence between variables and propositions, we can define a dynamics with respect to W :

Definition 5.5 (Dynamics for W). *A **dynamics** for W is a tuple $\mathcal{D}_W = \langle P, B, F \rangle$, where:*

- (a) P is a finite set of bipartitions in W
 - (b) $B \subseteq P$ is the set of background variables
 - (c) F is a function that maps elements X of $I = P - B$ to tuples $\langle Z_X, f_X \rangle$, where
 - i. Z_X is an n -tuple of elements of P
 - ii. $f_X : \{0, 1\}^n \rightarrow \{0, 1\}$ is a two-valued truth function from n -tuples on $\{0, 1\}$ to $\{0, 1\}$.
- F is rooted in B

Since P is finite, but W need not be, the dynamics is not necessarily defined over the set of all possible propositions. The variables in P correspond to a set of **causally relevant propositions**:

Definition 5.6. (*Causally relevant propositions*) For a set W of worlds, a dynamics $\mathcal{D} = \langle P, B, F \rangle$, and a world $w \in W$:

- (a) The set $\Pi^{\mathcal{D}}$ of **causally relevant propositions** is the set of all propositions x such that $\langle x, \bar{x} \rangle = X$ or $\langle \bar{x}, x \rangle = X$ for $X \in P$. Thus, $\Pi^{\mathcal{D}}$ is a set of propositions which is closed under negation.
- (b) The set $\Pi^{\mathcal{D}}(w)$ of **causally relevant truths** is the set of causally relevant propositions which are true at w . (compare Kaufmann, 2013, p.1152)

In the Schulz (2011) framework, a full valuation of P from $\{u, 0, 1\}$ is called a **situation**. Here, I refer to such a valuation as a **causal situation**. A causal situation s corresponds to a set of propositions, $s \subseteq \Pi^{\mathcal{D}}$, so $\cap s$ represents a set of worlds in W . Since a causal situation allows undetermined (u) assignments, $\cap s$ may contain worlds that disagree on the value of x for some $x \in \Pi^{\mathcal{D}}$. The set $\cap s$ contains x -worlds as well as \bar{x} -worlds for some variable $X = \langle x, \bar{x} \rangle$ in P just in case $s(X) = u$.

Previously, we referred to a determination (a $\{0, 1\}$ valuation) of P as a world. We now allow for the existence of propositions that are not in $\Pi^{\mathcal{D}}$; I will therefore call a full determination of P a **total causal situation**. For any world $w \in W$, the set $\Pi^{\mathcal{D}}(w)$ of causally relevant truths is a total causal situation. An arbitrary causal situation s is always a subset of some total causal situation; in other words, s is a subset of $\Pi^{\mathcal{D}}$ such that, for any $x \in \Pi^{\mathcal{D}}$, at most one of x or its complement \bar{x} is in s . A causal situation is **realistic** with respect to w if and only if $s \subseteq \Pi^{\mathcal{D}}(w)$.

We define the causal update operator $\mathcal{T}_{\mathcal{D}}$ in the same manner as before:

Definition 5.7 (Causal update). Let \mathcal{D} be a dynamics, with s a situation. We define the situation $\mathcal{T}_{\mathcal{D}}(s)$ by:

- (a) if $X \in B$, then $\mathcal{T}_{\mathcal{D}}(s)(X) = s(X)$
- (b) if $X \in I$, with $Z_X = \{X_1, \dots, X_n\}$, then
 - i. if $s(X) = u$ and $f_X(s(X_1), \dots, s(X_n))$ is defined, $\mathcal{T}_{\mathcal{D}}(s)(X) = f_X(s(X_1), \dots, s(X_n))$
 - ii. if $s(X) \neq u$ or $f_X(s(X_1), \dots, s(X_n))$ is undefined, $\mathcal{T}_{\mathcal{D}}(s)(X) = s(X)$.

The set P of (causally relevant) propositional variables remains finite, so, as in Chapter 3, $\mathcal{T}_{\mathcal{D}}$ has a fixed point s^* for any starting causal situation s .

Definition 5.8 (Causal entailment). *Let \mathcal{D} be a dynamics over W . A causal situation s **causally entails** a proposition ϕ iff ϕ is true at the least fixed point s^* of $\mathcal{T}_{\mathcal{D}}$ relative to s :*

$$s \models_{\mathcal{D}} \phi \text{ iff } s^*(\phi)$$

Causal modality

In evaluating causal claims as modal claims, we want to start from a set of real-world facts – a background situation – and use the structure of a causal model to tell us what follows from these facts in a (maximally) causally normal world. Since we take causal modality to be a subtype of circumstantial modality, we let the background situation be determined by a realistic conversational background, CIRC. For any world w , the expected causal consequences of CIRC(w) will depend entirely on the set of causally relevant propositions in CIRC(w), that is, on $s_{\text{CIRC}(w)} = \text{CIRC}(w) \cap \Pi^{\mathcal{D}}$. CIRC(w) is circumstantial, so $s_{\text{CIRC}(w)}$ will be realistic, with $s_{\text{CIRC}(w)} \subseteq \Pi^{\mathcal{D}}(w)$. The set of causal consequences of CIRC(w) is then given by the least fixed point $s_{\text{CIRC}(w)}^*$ of $\mathcal{T}_{\mathcal{D}}$ on $s_{\text{CIRC}(w)}$. The set of **causally optimal worlds** with respect to \mathcal{D} and CIRC(w) should also preserve any non-causal information in CIRC(w); thus, the set of consequences of CIRC(w) with respect to \mathcal{D} is given by $\text{CIRC}(w) \cap s_{\text{CIRC}(w)}^*$. The set of worlds corresponding to the consequences, $\cap(\text{CIRC}(w) \cap s_{\text{CIRC}(w)}^*)$, are our candidates for the causally optimal worlds.

Our next task is to introduce a causal ordering source, which will rank these worlds according to their ‘closeness’ to normality. This ordering source, $\text{CAUS}_{\mathcal{D}}(w)$, will prefer worlds that more closely adhere to the laws of a causal dynamics, \mathcal{D} ; that is, which break the fewest causal laws. Thus, in the dynamics framework, we want $\text{CAUS}_{\mathcal{D}}(w)$ to capture the dependencies encoded in the function F as defined in Definition 5.5.

Kaufmann proposes, informally, the following means of encoding the dependencies of a structural equation causal model. For any inner variable $X \in P - B$, Definition 5.5 gives us

a function f_X which establishes the causal correspondences between $\{0, 1\}$ valuations of the set Z_X of X 's immediate causal ancestors and determinations of X . A determination of Z_X corresponds to a set $\mathbf{z}_X \subseteq \Pi^{\mathcal{D}}$ such that \mathbf{z}_X is a causal situation containing exactly one of z, \bar{z} for all $Z = \langle z, \bar{z} \rangle$ with $Z \in Z_X$, and no other propositions. The set of all determinations of \mathbf{z}_X is given by \mathbf{Z}_X . Each element corresponds, by f_X , to a particular value for X ; we want $\text{CAUS}_{\mathcal{D}}(w)$ to contain all of these correspondences.

Definition 5.9 (Causal ordering source). *Given a dynamics $\mathcal{D} = \{P, B, F\}$ in a world w , the **causal ordering source** $\text{CAUS}_{\mathcal{D}}(w)$ is given by:*

$$\text{CAUS}_{\mathcal{D}}(w) = \bigcup_{X \in P-B} \{(\bigwedge \mathbf{z}_X) \rightarrow f_X(\mathbf{z}_X) \mid \forall \mathbf{z}_X \in \mathbf{Z}_X\}$$

Since \mathcal{D} is a contextual parameter, which depends on the utterance context and world of evaluation, the causal ordering source will always depend on w .

Thus, given a dynamics \mathcal{D} and a world w , the set $\text{C-OPT}_{\mathcal{D}}(w)$ of causally optimal worlds is given by $\text{C-OPT}_{\mathcal{D}}(w) = \text{Opt}_{\text{CAUS}_{\mathcal{D}}(w)}(\cap \text{CIRC}(w))$, or the subset of worlds in $\text{CIRC}(w)$ which are maximal with respect to $\leq_{\text{CAUS}_{\mathcal{D}}(w)}$. This set will also be a subset of $\cap s_{\text{CIRC}(w)}^*$. In many cases, in fact, $\text{C-OPT}_{\mathcal{D}}(w)$ will be a proper subset of $\cap (\text{CIRC}(w) \cup s_{\text{CIRC}(w)}^*)$, the set of worlds consistent with the causal consequences of $\text{CIRC}(w)$. To see why this is the case, and to understand the work done by the causal ordering source, it will be helpful to consider a toy example.

Causally optimal worlds in a toy dynamics

Let $\mathcal{D} = \langle P, B, F \rangle$ where $P = \{X, Y, Z\}$ and $B = \{X, Y\}$. Let F be the single pair $\langle Z_Z, f_Z \rangle$, where f_Z is given by the structural equation $X \wedge Y = Z$. This dynamics is represented in Figure 5.1.

By Definition 5.9, the causal ordering source for \mathcal{D} is given by:

$$\text{CAUS}_{\mathcal{D}}(w) = \{(x \wedge y) \rightarrow z, (\bar{x} \wedge y) \rightarrow \bar{z}, (x \wedge \bar{y}) \rightarrow \bar{z}, (\bar{x} \wedge \bar{y}) \rightarrow z\}$$

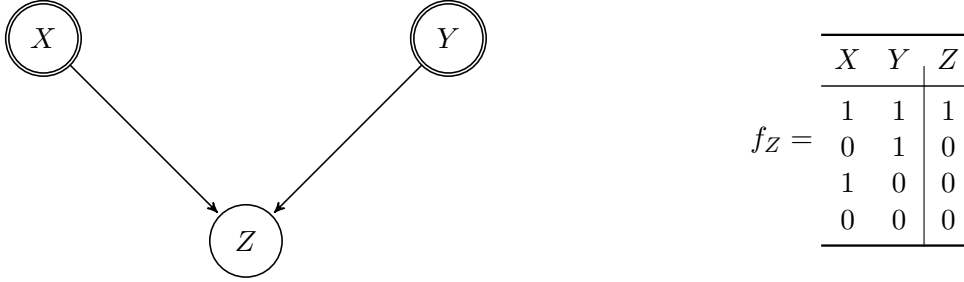


Figure 5.1: A toy dynamics

Suppose $\text{CIRC}(w) \cap \Pi^D = \{x, z\}$. Then $s_{\text{CIRC}(w)} = \{x, z\}$, and the least fixed point $s_{\text{CIRC}(w)}^*$ of $\mathcal{T}_{\mathcal{D}}$ on $s_{\text{CIRC}(w)}$ is $\{x, z\}$. The causal situation $s_{\text{CIRC}(w)}^*$ corresponds to a set of total causal situations, each of which is one possible extension of $s_{\text{CIRC}(w)}^*$.

$$\mathbf{s}^* = \{\{x, y, z\}, \{x, \bar{y}, z\}\}$$

Since a total causal situation is a set of (causally relevant) propositions, it corresponds to a set of worlds. $\text{CAUS}_{\mathcal{D}}(w)$ ranks worlds in terms of their faithfulness to the function F . Thus, any world which does not validate the causal consequences of $s_{\text{CIRC}(w)}$ (i.e., any world $w \notin \cap \{x, z\}$) will be less optimal than a world which does validate $s_{\text{CIRC}(w)}^*$. In other words, the only reasonable candidates for causally optimal worlds are those worlds picked out by some total causal situation in \mathbf{s}^* . Moreover, since two worlds corresponding to the same total causal situation necessarily agree on P , they will be ranked equivalently by $\text{CAUS}_{\mathcal{D}}(w)$, and the causally optimal set of worlds with respect to \mathcal{D} and $\text{CIRC}(w)$ will be those worlds in $\cap \text{CIRC}(w)$ which are also picked out by the optimal total causal situation(s) in \mathbf{s}^* .

In this example, the two situations in \mathbf{s}^* are not equally optimal. Worlds in $\cap \{x, y, z\}$ satisfy all of the propositions in $\text{CAUS}_{\mathcal{D}}(w)$, but worlds in $\cap \{x, \bar{y}, z\}$ do not satisfy $(x \wedge \bar{y}) \rightarrow \bar{z}$. Thus, the set $\text{C-opt}_{\mathcal{D}}(w) = \cap \{x, y, z\}$.

Using a dynamics to define an ordering source thus lets us extract more information than simply calculating the downstream causal consequences of a starting situation: the set $\text{C-OPT}_{\mathcal{D}}(w)$ is in this case a proper subset of those worlds compatible with the causal consequences of $\text{CIRC}(w)$. This is because $s_{\text{CIRC}(w)}^*$ does not by itself determine Y , but does

determine a propositional variable, Z , that is causally downstream of Y . Since Z depends on both X and Y , worlds which have Y set in the ‘right’ way to produce z (given x) are more in line with our causal expectations than worlds which settle Y in the wrong way. The determination for Y in the causally-optimal worlds thus represents a type of ‘backwards’ causal reasoning, which, as we will see, does some important work for us.

Causal dependence relations in causally optimal worlds

Finally, we redefine causal necessity and causal sufficiency with respect to the set of causally optimal worlds.

Definition 5.10 (Causal necessity and sufficiency). *Let W be the set of worlds, \mathcal{D} a dynamics for W . Let c be a consistent set of propositions, and $x, y \in \Pi^{\mathcal{D}}$ be propositions such that the causal situation $s_c = c \cap \Pi^{\mathcal{D}}$ has $s_c \not\models_{\mathcal{D}} x, \bar{x}, y$. Then:*

(a) x is **causally sufficient** for y with respect to c iff $\forall w \in \text{Opt}_{\text{CAUS}_{\mathcal{D}}(w)}(\cap c)[x \rightarrow y]$

$$x \blacktriangleright_c y \text{ iff } \forall w \in \text{Opt}_{\text{CAUS}_{\mathcal{D}}(w)}(\cap c)[x \rightarrow y]$$

(b) x is **causally necessary** for y with respect to c iff $\forall w \in \text{Opt}_{\text{CAUS}_{\mathcal{D}}(w)}(\cap c)[\neg x \rightarrow \neg y]$

$$x \blacktriangleleft_c y \text{ iff } \text{Opt}_{\text{CAUS}_{\mathcal{D}}(w)}(\cap c)[\neg x \rightarrow \neg y]$$

Given the way in which we have defined causal modality, if we let $c = \text{CIRC}(w)$, then $x \blacktriangleright_c y$ is equivalent to $\text{MUST}_{\text{CAUS}}[x \rightarrow y]$; similarly, $x \blacktriangleleft_c y$ is equivalent to $\text{MUST}_{\text{CAUS}}[\neg x \rightarrow \neg y]$. The definitions in Definition 5.10 are related, but not fully equivalent to the definitions of causal necessity and causal sufficiency offered in Chapter 3; as we will see in Section 5.5.4, the differences have positive consequences with respect to the predicted behaviour of ‘implicative’ *enough* and *too* claims.

We need one further restriction. As we saw in the illustration using Figure 5.1, our notion of causally optimal worlds admits ‘backwards’ causal reasoning. However, we do not want to allow causal sufficiency and causal necessity to run backwards. To avoid the

situation in which a proposition x is found to be causally necessary or causally sufficient for an upstream proposition y , we restrict Definition 5.10 to cases where $Y = \langle y, \bar{y} \rangle$ is not in the set of causal ancestors of $X = \langle x, \bar{x} \rangle$ – that is, where the variable Y which has proposition y as one of its cells is not in the set of causal ancestors of the variable X which has x as one of its cells. The set A_X of causal ancestors for a variable X is defined as in Chapter 3.

Definition 5.11 (Causal ancestors). *Let $D = \langle P, B, F \rangle$ be a dynamics, and let R_F be the relation that holds between $X, Y \in P$ if $Y \in Z_X$. Let R_F^T be the transitive closure of R_F . Then, for any variable $X \in P - B$, the set A_X of **causal ancestors** of X is given by $A_X = \{Y \in P \mid R_F^T(X, Y)\}$.*

Adding this restriction to Definition 5.10 enforces the intuitive idea that reasoning about causal necessity and causal sufficiency should only proceed in the direction of causation. If we assume that causal effects do not temporally precede their causes, this also ensures that an event e_2 will never be causally necessary or causally sufficient for an event e_1 where $\tau(e_1) \prec_i \tau(e_2)$.

Definition 5.10 also restricts consideration to cases where the causing proposition x is causally consistent with the background situation s_c : we require that $s_c \not\models_{\mathcal{D}} x, \bar{x}$. There may be cases, however, where we want to consider the necessity or sufficiency of x for y in a context which already precludes x ; to do so, we need a way of revising the background situation. We want to preserve causal structure and causal consistency in performing these revisions: the idea is, if a determination for X must be ‘let go’ in order to calculate the consequences of x , we revise the background situation in such a way that it also removes any determinations for propositions that are causally determined by x .

Definition 5.12 (Closure under ancestors). *Let $\Pi^{\mathcal{D}}$ be the set of causally relevant propositions for a dynamics $\mathcal{D} = \langle P, B, F \rangle$ over W , and let s be a causal situation for \mathcal{D} . A subsituation $s' \subseteq s$ is **closed under ancestors** iff for all $X = \langle x, \bar{x} \rangle$ and $Y = \langle y, \bar{y} \rangle$ in P such that $Y \in A_X$ and X, Y are determined in s , if X is determined in s' , then Y is also determined in s' .*

I refer to Kaufmann (2013, p.1153) for a more detailed discussion of revisions in a causal premise semantics.

5.5.4 *Enough* and *too* implicative inferences in causally optimal worlds

The previous section provides an outline for a system which integrates the tools of a causal model with the premise semantics for modal expressions and the general semantic interpretation system introduced in Chapter 2. Developing a more complete model goes beyond the scope of the current project. However, the sketch provided, and in particular the revised definitions for causal necessity and causal sufficiency, will allow us to get a better understanding of the ‘implicative’ proposal (Proposal 5.95) for *enough* constructions, and to establish a clearer picture of the ways in which this proposal aligns the implicative behaviour of certain *enough* and *too* constructions with the behaviour of lexical implicatives, as well as how it differentiates the two predicate types.

This is best illustrated with reference to an example. Proposal 5.95 assigns to the *enough* sentence radical in (5.96) the necessity presupposition (5.96a), the sufficiency presupposition (5.96c) and the asserted content (5.96b).

(5.96) Juno be fast enough to win the race.

a. *Presupposes:*

$$\exists d_{\text{nec}} : \forall w \in \text{CIRC}(w^*) [\text{SPEED}(J)(w) < d_{\text{nec}} \rightarrow \neg \text{win-race}(J)(w)] \quad [\text{necessity}]$$

b. *Asserts:* $\text{SPEED}(J)(w^*) \geq d_{\text{nec}}$ [degree attribution]

c. *Presupposes:* $\text{INST}(\text{SPEED}(J) \geq d_{\text{nec}}) \blacktriangleright_c \text{win-race}(J)$ [sufficiency]

We have seen ample evidence for the validity of the necessity presupposition in (5.96a), as well as for the assertion (5.96b). These contributions are common to all *enough/too* constructions, *modulo* modal flavour. Since (5.96) involves a dynamic, action-oriented adjective, Proposal 5.95 adds to the core *enough/too* content the sufficiency presupposition (5.96c), that a (race time) instantiation of the necessary speed d_{nec} by Juno is causally sufficient, in context, to bring it about that she wins the race. As per the discussion in Section 5.4, this presupposition is associated with the ‘hypothetical sufficiency’ reasoning induced by the

necessity condition for *enough/too* constructions across the board. In general, the necessity of a particular degree of an *enough/too* matrix adjective for the *enough/too* complement is assessed with respect to a set of optimal worlds in which the complement is achieved. Logically, these worlds must be ones in which any and all other (circumstantially) necessary conditions for the *enough/too* complement are satisfied, including, crucially, the condition that the sentential subject takes some action towards the realization of the *enough/too* complement. In a deontic *enough* construction like (4.21a), for instance, the goal-achieving worlds we consider are ones in which Bertha drives without violating the law.

(4.21a) Bertha is old enough to drive. [deontic]

(4.80a) Nima is tall enough to reach the top shelf. \equiv (5.56) [static circumstantial]

While there may equally well be worlds in which it is legal for her to drive but she refrains from doing so, these worlds do not figure into our assessment of the *enough* construction because they do not belong to the set of optimal goal-achieving worlds. Intuitively, the only deontically-optimal worlds under consideration are ones in which it is not only legal for Bertha to drive in view of her age, but also in which she makes the effort and/or takes any actions associated with driving a car. When an *enough* construction involves a dynamic adjective, as in (5.96), the connection between the complement-achieving actions and the matrix adjective is tighter than in (4.21a) or (4.80a), because the action that must be taken towards the complement is itself characterized by the matrix adjective.

One immediate difference between the presuppositions and assertions in (5.96) and the presuppositional and asserted content of a polarity-preserving lexical implicative has to do with the apparent relationship between the necessity and sufficiency conditions (5.96a) and (5.96c). In Chapter 3, I argued that a key component of implicativity is that the condition presupposed to be causally sufficient in (5.96c) is the same as the condition presupposed to be causally necessary in (5.96a), in particular in view of being the ‘last’ open causally necessary condition for the realization of the implicative complement. In (5.96), the necessity condition is formulated in terms of ‘pure’ circumstantial modality, which at least at first glance, appears to distinguish it from the condition taken to be causally sufficient in (5.96c).

On closer inspection, however – and as suggested in Section 5.5.1 – it is clear that the necessity condition can just as reasonably be formulated in terms of the causal necessity of Juno’s (race time) instantiation of speed of at least degree d_{nec} . The core of the distinction between a lexical implicative and an ‘implicative’ *enough/too* construction lies not in differences in presupposed content, but instead in the content of the assertion. The baseline assertion of an *enough/too* construction, before we consider the potential effects of aspectual marking, and independently of adjective type and modal flavour, is simply a degree attribution. When the matrix adjective represents a dynamic, action-characterizing property like speed, the degree attribution is a capacity attribution, indicating the subject’s potential for performing an action (or actions) characterized by some particular degree of the matrix adjective. In other words, dynamic adjective constructions carry, as asserted content, an indication of their subject’s potential for performing the causally sufficient and causally necessary action for the realization of the *enough/too* complement.

In other words, the presupposition of ‘pure circumstantial’ necessity in (5.96a) holds in view of the causal necessity of an action characterized by at least degree d_{nec} of speed for the realization of the *enough* complement. Thus, there is no real difference between the presuppositional content of a two-way polarity-preserving lexical implicative and the presuppositional content of a dynamic adjective *enough* construction. In the latter case, as in the former, the presupposed content involves an action which is causally necessary for the realization of the complement, and which is also causally sufficient (in view of being the last causally necessary condition to be resolved). Implicative verbs lexicalize the (circumscriptive) sufficiency condition; in the case of dynamic adjective *enough* constructions, sufficiency arises from common-sense reasoning about the causal processes which lead to the realization of the complement. As we saw in Section 5.4, *enough* constructions like (5.91) are marked when the ‘last’ condition relationship is difficult to recover pragmatically.

(5.91) (?)Juno was loud enough to win the race.

The distinction between *enough/too* constructions and lexical implicatives rests in their asserted content. This distinction has to do with the nature of degree attributions, which

separate out the (latent) capacity for a causing action from the actual performance of the action. In examples like (5.96), the baseline assertion only attributes the capacity for the causing action to the sentential subject. In the lexical implicative case, as we saw in Chapter 3, the assertion establishes the realization of the causing action, which then, via the calculation of causal consequences, leads to the characteristic implicative entailment. Since, in the *enough/too* case, the relevant action requires a particular degree of the matrix adjective, the capacity attribution is by itself enough to block the possibility of complement realization, in case it assigns to the sentential subject only a capacity for action characterized by an insufficient (or excessive, depending on adjective polarity) degree of the matrix adjective.²⁶

We can think of this as follows. In assessing the necessity condition for any *enough/too* construction, we look at worlds in which the complement (goal) is realized. If the set of optimal worlds under consideration are causally-optimal ones, they must satisfy all of the causally-necessary conditions for the complement. Thus, the necessity presupposition, for a dynamic adjective construction, has two parts: the non-causal degree condition, and the action which is characterized by a particular degree. In the presence of the action, but lacking the requisite degree, the *enough/too* complement cannot be realized. It is equally clear that, in the presence of the degree but the absence of action, the complement also will not be realized – if Juno has the capacity to run d_{nec} fast at race time, but she does not do so, she certainly will not win the race. The connection between polarity-preserving implicatives and dynamic adjective *enough* constructions, then, is in the idea that the sufficiency of the degree attribution – that is, its sufficiency in worlds where all other conditions for the

²⁶This discussion shows that one issue to be resolved in the elaboration of a causal premise semantics has to do with the representation of dependencies between causally-relevant propositions and propositions that are not really causal in nature. For instance, if Juno's race time manifestation of speed is causally involved in the realization of her race win, we want to include a variable R standing in for this manifestation in the set P associated with a causal dynamics. R in turn depends on two types of information: first, the action-based 'causal' component, and secondly, the degree-based non-causal component. The degree component in some sense makes R in part a background variable with respect to the dynamics. One way of capturing this would be to make R dependent on two variables: a variable I_R standing in for Juno's impulse or action-adjacent intention, and a 'dummy' background variable, S , which will be true if the non-causal background information assigns Juno at least d_{nec} degrees of speed, but false if her speed capacity is less than d_{nec} . Strictly speaking, however, S is not a causal ancestor of R , and a reasonable system would then need to find a means for excluding it from consideration in the calculation of causal dependence relations (other than as a component of the causally-relevant variable R).

enough complement are met – is tied to a causal sufficiency condition because the last causally necessary condition to be resolved is the degree-characterized action.

If the presupposed content of dynamic adjectives and lexical implicatives is equivalent, as suggested, we need to explain the following contrast between dynamic adjective *enough/too* constructions and lexical implicative constructions. In Chapter 3, we saw that contexts which explicitly leave open a non-matrix necessary condition for an implicative complement are infelicitous contexts for lexical implicatives. The same infelicity does not arise across the board with dynamic adjective *enough/too* constructions. To reinforce this point, we can compare (3.57), from Chapter 3, which involves an infelicitous use of the two-way Finnish implicative *ehtii* ('have the time') to the French imperfective and English examples in (5.97), where a potential inference to the complement is cancelled by explicit indication that some non-speed-related necessary condition for race-winning went unsatisfied.

- (3.57) *Context:* A hunter in the forest had lost count of the number of times he had fired his gun and was not sure if he had used all the bullets or not. He decided to check after eating something, and put the gun down to get some food from his bag. While he had both hands in the bag, he caught sight of a bear coming towards him.

a. #Hän **eht-i** ampu-a karhu-n.
 he.NOM have.time-PST.3SG shoot-INF bear-GEN/ACC
 'He had enough time to shoot the bear.' † *He shot the bear.*

- (5.97) a. Juno was fast enough to win the race, but she was delayed in traffic and did not make it to the starting line on time, so she did not win.
 b. *Juno était assez rapide pour gagner la course, mais elle n'a pas pris le départ à temps, et elle n'a donc pas gagné.*
 'Juno was-IMPF fast enough to win the race, but she did not reach the start on time, and so she did not win.'

Deepening the puzzle, we have also seen that perfectly marked dynamic adjective constructions (assuming temporal overlap), which do generate implicative entailments in the full two-way implicative pattern, pattern with lexical implicatives in contexts like (3.57)

and (5.97), and are judged to be infelicitous against a background which explicitly leaves open a non-matrix necessary condition for the realization of the *enough/too* complement. Example (4.50), which was used to illustrate this point in Chapter 4, is repeated below.

- (4.50) *Context:* Juno is competing in today's race, which is about to take place. Just before the race begins, an announcement is made that the age qualifications have changed from what was stated on the entry form she filled out in the morning – specifically, that the minimum age for participating has changed. Juno was already right on the cusp of not qualifying due to her age, so after this announcement we are not sure if she meets the qualifications any longer. The gun goes off before we have a chance to figure out anything further. I can see that Juno is clearly the fastest runner, and crosses the finish line first. You did not see the race, because you were looking for an official to find out about the new qualifications, but you have not been successful in this. I report the result to you by saying:

a. ?*Juno a été assez rapide pour gagner la course.*

‘?Juno was-PFV fast enough to win the race.’

If dynamic adjective *enough* constructions share the presupposed content of lexical implicatives, and in particular if the causal sufficiency presupposition in (5.96c) is real, then it seems as if we should expect the same infelicity effects in both cases: *enough/too* constructions, regardless of aspectual marking, should be marked in any context which does not support the causal sufficiency of a (complement-overlapping) instantiation of the matrix adjective for the truth of the complement – that is, in any context where an instantiation will not guarantee the complement, counter to what we observed.

In fact, as I will now explain, the presupposition of causal sufficiency, as defined with respect to a set of causally optimal worlds, predicts the observed contrasts between (3.57) and (4.50), on the one hand, and (5.97), on the other. Since, as I will show, the addition of the sufficiency presupposition in clause (5.95-iii) of Proposal 5.95 predicts the ‘vanishing’ infelicity effects associated with dynamic adjective *enough/too* constructions, these data ultimately provide support for an ‘implicative’ treatment of *enough/too* constructions. To

see how this works, let us consider what sufficiency, as defined in Definition 5.10, actually requires of a context for (5.96).

Let $R = \langle r, \bar{r} \rangle$ be the variable that stands for an instantiation of the necessary race-winning speed. We assume that R , as an event variable, comes with a temporal specification, and since R represents the causally-necessary instantiation of speed, we further assume that this specification overlaps with the specification of $V = \langle v, \bar{v} \rangle$, which stands in for the win (Juno's race victory).²⁷ Crucially, since the asserted content (5.96b) is a degree attribution, not an instantiation, the assumption that R temporally overlaps V is distinct from the assumption that the matrix clause of (5.96) temporally overlaps with the complement clause. This distinction is important since the claim in Proposition 5.95 is that *all* circumstantial, dynamic adjective *enough* constructions are associated with the causal sufficiency presupposition, regardless of temporal specification. According to the sufficiency presupposition (5.96c), the background situation c as determined at the reference time for a (temporally marked) assertion of (5.96) must support $r \blacktriangleright_c v$.

What does this relationship require, in terms of the structure of a causally optimal world? On Chapter 3's definition of causal sufficiency, we evaluated $r \blacktriangleright_c v$ by simply adding r to the set of facts established by c (replacing any previous determination for r), and then calculating the causal consequences, via $\mathcal{T}_{\mathcal{D}}$, of the situation $c[r]$ which augmented c by simply replacing any existing determination for R with r . The relation $r \blacktriangleright_c v$ holds, in this system, just in case $v \in c[r]^*$, where $c[r]^*$ is the least fixed point of $\mathcal{T}_{\mathcal{D}}$ on $c[r]$.

As the example with the toy dynamics in Figure 5.1 showed, however, the set of causally optimal worlds can be a strict subset of the set of worlds determined by the causal consequences of a particular situation. This is because encoding the causal laws in the ordering source $\text{CAUS}_{\mathcal{D}}(w)$ allows us to 'backfill' undetermined information about the causal ancestors of propositions in $c[r]$ in a causally-consistent way, in particular eliminating worlds from the set $\text{C-OPT}_{\mathcal{D}}$ which, for instance, 'break' causal laws en route from the background situation

²⁷A proper means of dealing with the temporal specifications of events, and how to map this onto the causal progression of a dynamics will also be part of a complete system for causal premise semantics; see Schulz (2007) for a version of the dynamics framework which incorporates time. Van Lambalgen and Hamm (2005) also take up the issue of time in the treatment of events.

c to the augmented situation $c[r]$. With respect to causally optimal worlds, then, evaluating the consequences of $c[r]$ involves considering just those causally optimal worlds – from the perspective of reference time – in which r is realized; in other words, what the causal sufficiency of r for v with respect to context c now requires is that all of the developments of c which realize r in a causally optimal way are also worlds in which v is realized (downstream of r).

The key point here is that the pathway from c to $c[r]$ must proceed in a maximally causally consistent manner; in other words, the presupposition in (5.96c) requires that, given a background context c (such that $c \not\models_{\mathcal{D}} r, \bar{r}$), if the world develops normally to a point at which the variable R is determinable, then this point must be one at which a positive determination of R ensures a (downstream) positive determination of V . Since r is also causally necessary for v , we also require that a negative determination \bar{r} ensures the downstream realization of \bar{v} . At the reference time which establishes c , however, there may be causally optimal ways for the world to develop which do not either lead to r or even necessarily to a point at which the variable R is determinable. Informally speaking, the sufficiency presupposition for an *enough* in a causal premise semantics is not ‘active’ in the same way as a sufficiency presupposition for a lexical implicative: causal sufficiency now need only become active at the point at which the causing variable can be determined. Since lexical implicatives assert the realization of their causing actions, they necessarily invoke a background situation in which the value of the causing action is determinable; but since, as we have seen, *enough* constructions at base only attribute to their subjects a capacity (or lack thereof) for the causing action, it need not be the case that this action is determinable in the reference context c .

In other words, when we consider what is required by causal sufficiency in a premise semantics approach as sketched out in this section, it becomes clear that it involves precisely the sort of ‘hypothetical sufficiency’ condition associated with non-implicative *enough* constructions: that is, a sufficiency which is only relevant or active if the world should develop to a point at which the subject is in a position to act towards realizing the *enough* complement. Moreover, this view of the causal sufficiency condition confirms the connection

between an instantiation of degree d_{nec} of the matrix adjective as representing the last open causally-necessary condition for the *enough/too* complement. This has to do with the kind of information that can be backfilled by filtering, with $\leq_{\text{CAUS}_{\mathcal{D}}(w)}$, for causally optimal worlds. Any propositions not set by $c[r]$ which are set in all of the causally optimal worlds, and which are not consequences of either c or r , or a combination of the propositions in c and r , are necessarily propositions which lie along the path from c to a causally optimal c -world which realizes r . Thus, if the sufficiency relationship is not ‘active’ at reference time – as in examples like (5.97) – the presupposition (5.96c) requires that all of the necessary conditions for v left open by c are determined en route to the normal realization of r . In other words, r is the ‘last’ causally necessary condition for v partly in view of being causally downstream of other necessary conditions for v . In order to reach the point in a causal system at which R is determinable, we require that all of the other necessary conditions have been satisfied. The upshot of this is that, in examples like (5.97a) and (5.97b), where R need not be determinable at the reference time, the causal sufficiency of r for v does not need to be ‘active’ at reference time. As a result, the presupposition does not necessarily lead to infelicity effects in cases where r cannot guarantee v at reference time, but requires instead that the causal structure of the world is such that the only causally normal developments of a background situation which lead to a point at which the speed instantiation is determinable are worlds in which the speed instantiation will decide whether or not Juno wins the race.

This requirement not only predicts that *enough* constructions need not be infelicitous in contexts where non-matrix necessary conditions for their complement are left open, but in fact predicts the infelicity alternation between perfective and imperfective uses of dynamic adjective *enough/too* constructions, in cases where the matrix clause temporally overlaps with the complement clause. Consider what the aspectual semantics contributes:

- (2.23) a. $\llbracket \text{PFV} \rrbracket := \lambda w \lambda t_i \lambda P_{et}. \exists e [\tau(e) \subseteq t \wedge P(w)(e)]$
 b. $\llbracket \text{IMPF} \rrbracket := \lambda w \lambda t_i \lambda P_{et}. \exists e [\tau(e) \supseteq t \wedge P(w)(e)]$

Under perfective marking, an assertion of (5.96) will contain the time of the degree attribution within the reference time which determines the background situation c . If the runtime

of the matrix attribution additionally overlaps with the complement clause – that is, with the time at which the *enough* complement may be realized, then the reference time also necessarily overlaps with the complement time. But, by presupposition, the instantiation r is both causally necessary and causally sufficient for v . In other words, if V is determinable within reference time, R must be as well, and we expect the sufficiency presupposition to be active, and to produce reference time infelicity effects, as we see in (4.50).

On the other hand, if the reference time is contained within the runtime of the degree attribution, as in imperfectly marked uses of (5.96) (*Juno be fast enough to win the race*), then a temporal overlap between the degree attribution and the complement event does not force the reference time to be a time at which either the complement or the causing instantiation is decidable. In these cases, we expect the ‘hypothetical’ sufficiency condition to hold – that is, we expect the sufficiency condition to mandate that the normal causal developments of the world have a particular structure – but we do not expect reference-time infelicity effects. To explain the contrast between perfective cases and the English examples, we simply assume that the reference/event time relationship in English can go either way, depending on contextual information.

In the context of a causal premise semantics, then, the ‘implicative’ proposal (Proposal 5.95) for *enough* constructions predicts not only the observed contrasts between lexical implicatives and dynamic adjective *enough* constructions, but in addition predicts the infelicity contrasts between perfective and imperfective/English uses of *enough* constructions. Moreover, since the difference between implicative assertions and *enough* assertions is the difference between an active sufficiency condition, linked to an assertion which directly determines the causing action and a hypothetical sufficiency condition, associated only with a capacity attribution, we can begin to see where the contrast between two-way implicatives and the hypothetical sufficiency/hypothetical guarantee structure associated with ability predicates in Chapter 2 might reside. I set this question aside for now and return to it at the end of Chapter 6, and in Chapter 7, after we have established the final component of an implicative analysis of the inferential patterns of *enough* and *too* constructions.

Although the discussion in this section illustrates how the temporal semantics of the

perfective aspect is connected to the ‘activation’ of backgrounded necessity/sufficiency conditions in ‘implicative’ *enough/too* constructions, we do not yet have a full explanation of *enough* and *too* implicativity. The activation of causal sufficiency in perfective uses, as it stands, predicts only felicity judgements of the sort in (4.50). It is not enough to predict the emergence of implicative entailments under perfective marking. This is due, again, to the core contrast between lexical implicatives and *enough/too* predicates: the baseline contribution of an *enough/too* predicate does not establish the occurrence of the causing condition, which would then guarantee complement realization. In other words, dynamic adjective *enough/too* constructions still lack one of the three components of implicativity as established in Chapter 3: their asserted content does not resolve the truth status of the causally necessary and causally sufficient condition for their complements. Instead, *enough* and *too* constructions establish only the capacity of their subjects to realize this causing condition. Thus, as noted at the end of Section 5.5.1, we will only predict a full implicative entailment if something forces this capacity attribution to be interpreted as the causing instantiation itself. Temporal overlap between the matrix and complement clause gets us closer to this point, but does not get us all the way there.

As the last piece of an implicative analysis of the inferential patterns of *enough* and *too* constructions, then, we need it to be the case that perfective marking somehow forces us to interpret the underlying capacity attribution of a dynamic adjective *enough/too* construction as an instantiation. I propose that the perfective aspect has precisely this ‘instantiating’ effect when combined with the core capacity attributions of dynamic adjective *enough* and *too* predicates. In the next section, I provide an outline of the arguments for this proposal, and sketch how the account works. This outline sets the stage for a more thorough examination of the interactions between grammatical aspects and the underlying properties of the events and situations they modify, which I undertake in Chapter 6.

5.6 Aspect and instantiation

Returning to the implicative proposal in Section 5.5.1, we can see more clearly why dynamic *enough/too* constructions might default to implicative interpretations, and also why these inferences are (often) defeasible.

(5.95) **The ‘implicative’ semantics for *enough* constructions.** (Proposal)

Let P be a proposition of the form

$$P = S \text{ be ADJ enough to } A$$

where S is an agent, ADJ a relation between individuals and sets of degrees, and A a property of individuals (one-place predicate). Evaluated with respect to a world w , background situation c , and conversational backgrounds f, g :

- i. P *presupposes* the existence of a degree d_{nec} that is necessary for $A(S)$:

$$\exists d_{\text{nec}} : \forall w' \in \text{Opt}_{g(w)}(\cap f(w)) [\neg \text{ADJ}(S)(d_{\text{nec}})(w') \rightarrow \neg A(S)(w')]$$

- ii. P *asserts* that S is/has d_{nec} -ADJ in w :

$$\text{ADJ}(S)(d_{\text{nec}})(w)$$

- iii. In case ADJ is a dynamic (action-characterizing) property, P additionally *presupposes* the contextual causal sufficiency of a manifestation of d_{nec} -ADJ for $A(S)$:

$$\text{INST}(\text{ADJ}(S)(d_{\text{nec}})) \blacktriangleright_c A(S)$$

The attribution of a dynamic adjective is in principle compatible with two possible interpretations: one on which the property is instantiated by the sentential subject, and one on which it remains latent. We predict implicative inferences in case the manifestation is entailed, in which case an *enough/too* construction will behave in the two-way implicative

fashion. In addition, we will predict a (defeasible) implicative inference if an instantiated interpretation is contextually favoured, but not entailed. Assuming either interpretation is possible, contexts which establish that some other necessary condition for the *enough/too* complement is not met will preclude the possibility of an instantiated interpretation.

At the beginning of this chapter, it seemed as if pursuing the implicative route meant that the perfective aspect introduced a sufficiency presupposition, but only in a select set of cases. Now, the basic problem we are faced with with respect to aspect has changed. The connection that now emerges is much more plausible: the perfective aspect is associated with a sufficiency condition in view of confining the reference time to a point at which the manifestation is determinable. In order for the sufficiency condition to be ‘active’ in deriving the implicative entailment, however, we need it to also trigger a manifestation interpretation. In the next chapter, I argue in detail that this is precisely what it does.

To fully cash out how the perfective aspect interacts with the interpretation of a dynamic capacity, we will need to develop a proper treatment of grammatical aspect. This is the focus of Chapter 6. In order to better map out the road ahead, however, and to motivate the semantics we will develop, I present here an informal sketch of the solution: that is, of how aspect interacts with the proposal in (5.95) to produce implicative entailments in dynamic *enough/too* constructions.

We take dynamic adjectives, at base, to attribute to an individual some latent capacity (e.g. for a specific degree or range of degrees of speed). At this level, the attribution describes a particular state for the sentential subject; that is, it represents a **stative predicate**, which for now we take simply to be a predicate which satisfies the subinterval property (Bennett and Partee, 1972[2004]):

(5.98) **The subinterval property** (formulation based on Bhatt and Pancheva, 2005)

A predicate (of eventualities) P has the subinterval property if, whenever P holds of an eventuality e , then P also holds of every subeventuality $e' \sqsubseteq e$.

Perfectively-marked propositions, however, are interpreted as **eventive**: the situations they describe do not satisfy the subinterval property. This is true even when the perfective is

composed with underlyingly stative predicates like *love*. If such a combination is felicitous, it is interpreted in some way as a ‘happening’, rather than as a state. For an example like (5.99), the eventive interpretation describes an initial stage of the *love*-state.

- (5.99) *Jupiter a aimé Europa.* \rightarrow *Jupiter fell in love with Europa.*
 ‘Jupiter loved-PFV Europa.’

Some authors take the ‘bounding component’ of the perfective to be responsible for the shift in interpretation (i.e., the semantic component of the perfective aspect which locates the runtime of an eventuality *within* the reference time), while others treat the perfective as a ‘conversion’ operator, which maps any eventuality in its scope to eventive predicates of time. Abstracting away from the details, however, the upshot of these analyses is the same: the perfective aspect, in one way or another, *coerces* an eventive interpretation in case it combines with a predicate that is underlyingly stative. (5.99) illustrates that one type of coercion results in **inchoative**, initial point interpretations. Another option is a maximal-state interpretation, which indicates that the complete stative eventuality began and ended during the reference time, giving rise to inferences that the state in question no longer holds.

Dynamic adjective attributions are prime candidates for aspectual coercion or conversion, since they are inherently associated with actions, which are eventive. The claim I wish to make is that, in these cases, the default interpretation under perfective aspect is neither inchoative nor maximal, but *instantiative*. Interpretations of this sort have been observed by Homer (2011) (who refers to it as ‘actualistic’ coercion). Crucially, action-oriented predicates are interpreted, under perfective marking, as describing an action which is characterized by the property in question.

- (5.100) a. *Jean a eu du tact.* \rightarrow *Jean acted tactfully.*
 ‘Jean had-PFV tact.’
 b. *Juno a été rapide.* \rightarrow *Juno did something quickly.*
 ‘Juno was-PFV fast.’

- c. *Olga a été bruyante.* \rightarrow *Olga did something loudly.*
 ‘Olga was-PFV loud.’

This is really all we need: when the perfective combines with a dynamic adjective *enough* construction which attributes to its subject the capacity for action characterized by at least degree d_{nec} of the matrix adjective ADJ (as per Proposal 5.95), the *enough* assertion can no longer describe a latent capacity, but must describe the adjective-characterized action.

- (5.101) *Juno a été assez rapide pour gagner la course.* \equiv (4.32a)
 \rightarrow *Juno acted (ran) at a speed of at least d_{nec}*
 ‘Juno was-PFV fast enough to win the race.’

As a result, the perfective marking entails an instantiation of the matrix property. But, by presupposition, this is the causally sufficient condition for the *enough/too* complement, and so the combination of the perfective assertion and the sufficiency presupposition produces the complement entailment, just as it does for lexical implicatives.

The imperfective aspect, by contrast, is compatible with stative predicates, and thus does not default to the instantiative interpretation. As a result, it does not trigger the sufficiency presupposition. It is, as we have seen, compatible with a habitual/generic interpretation, which for a latent attribution may simply refer to an extended period of time.

- (5.3a) *Nima était assez grand pour atteindre l'étagère du haut.*
 ‘Nima was-IMPF tall enough to reach the top shelf.’

We have also seen, however, that the imperfective aspect is compatible in French with a progressive interpretation, leading to the ‘interruption’-style cancellations discussed earlier. A full treatment of this is postponed until the next chapter, but the basic idea is that the progressive, like the perfective, produces an eventive interpretation but – as with imperfective paradox – allows us to get ‘inside’ the event and thus to describe changes to the causal structure or interruptions to the expected or normal course of events that occurred during the runtime of the *enough/too* eventuality.

English *enough/too* inferences are defeasible for the simple reason that English has no overt grammatical means of forcing the eventive interpretation of latent capacity attributions. English attributions are systematically ambiguous between the eventive and stative interpretations we have been discussing.

(5.102) Juno was fast.

- a. *Eventive*: Juno did (something) fast/quickly.
- b. *Stative*: Juno had the capacity to do (something) fast/quickly.

Contexts which privilege the eventive interpretation will defeasibly activate the sufficiency presupposition, thus pushing an implicative interpretation of the full claim. This is not an entailment, because the manifestation is a pragmatic effect, and not an entailment itself. Any overt cancellation pushes us to (re)interpret the main clause statively, which explains the across-the-board defeasibility of *enough/too* complement inferences in English.

5.7 Summary

This chapter developed a semantics for *enough/too* constructions which predicts the inference patterns in the updated Table 5.5.

The necessity presupposition, on which a particular degree of the matrix adjective is taken to be required for the realization of the *enough/too* complement, holds for all *enough/too* constructions. However, its effects vary on the basis of modal flavour. We saw that, in general, assessing *enough/too* claims involves considering situations in which everything except the matrix property is settled, and this in turn led us to the basic distinction between static and dynamic adjectives in circumstantial *enough/too* constructions. Both cases require action as the last step in causing or bringing about complement; in dynamic cases, however, this last action is characterized by the matrix adjective, thus inducing a sufficiency presupposition between a manifestation of the adjective and the realization of the *enough/too* complement. Unlike with implicative verbs, however, we saw that this does not automatically produce complement entailments, because adjective attributions need not

construction	semantic component			inference	
	<i>mod. flavour</i>	<i>presuppose</i>	<i>assert</i>	<i>pos</i>	<i>neg</i>
implicative	causal, circumstantial	$H(S) \blacktriangleleft_c A(S)$ $H(S) \blacktriangleright_c A(S)$	$H(S)$	$\vdash A(S)$	$\vdash \neg A(S)$
	epistemic	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	$\not\vdash A(S)$	$\not\vdash \neg A(S)$
be ADJ enough	deontic	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	$\not\vdash A(S)$	$\not\vdash \neg A(S)$
	circumstantial static ADJ	$d\text{-ADJ}(S) \triangleleft A(S)$	$d\text{-ADJ}(S)$	$\not\vdash A(S)$	$\vdash \neg A(S)$
	circumstantial, dynamic ADJ +	$\text{INST}(d\text{-ADJ}(S)) \blacktriangleleft_c A(S)$	Eng/IMPF: $d\text{-ADJ}(S)$	$\leadsto A(S)$	$\leadsto \neg A(S)$
	temp overlap = causal	$\text{INST}(d\text{-ADJ}(S)) \blacktriangleleft_c A(S)$ $\text{INST}(d\text{-ADJ}(S)) \blacktriangleright_c A(S)$	PFV: $\text{INST}(d\text{-ADJ}(S))$	$\vdash A(S)$	$\vdash \neg A(S)$

Table 5.5: Semantic components of polarity-preserving two-way implicativity, by construction, refined

be interpreted as active or eventive instantiations of the properties they describe.

In the final section of this chapter, I proposed that the aspectually-driven implicative contrasts observed for French *enough/too* constructions (Hacquard, 2005) follow from the effects of combining overt aspectual marking with dynamic property attributions. Under perfective marking, a dynamic property (capacity) attribution is interpreted as an instantiation or manifestation of the property it describes; under imperfective marking, there is more flexibility in interpretation. Crucially, by taking a closer look at the semantics of *enough/too* necessity conditions, and the role played by dynamic adjectives, I showed that the rather perplexing question we began with – how does the perfective aspect introduce a sufficiency presupposition – instead reduces to the more sensible question of how and why the perfective aspect forces the instantiated reading.

The discussion illustrates, centrally, the crucial interaction between the causal structure of the relevant *enough/too* constructions and the semantics of aspectual marking. In the static-adjective cases, we do not get entailments because the connection between the property and the realization of the complement does not involve a manifestation of the property (though it does involve an action of some sort). Similarly, in the absence of overt aspectual marking, we at most expect defeasible complement implicatures, even given the correct

causal structure.

We can also now see the key difference between two-way implicatives and implicating *enough/too* constructions (which are underlying one-way implicatives in which the modal flavour can vary). With all of the relevant parameters in place (dynamic adjective, temporal overlap, perfective aspect), *enough/too* constructions are implicative – or, rather, their entailments arise from the same underlying combination of presupposition, assertion, and causal structure. However, in English and under the imperfective aspect, the asserted content of an ‘implicative’ *enough/too* construction and a true implicative verb is not identical. *Enough/too* constructions may simply establish the capacity or possibility for the complement to be realized, in view of the property attributed to the sentential subject, but do not necessitate that the causal chain is set in motion. This difference is responsible for the difference in inference cancelability.

The final steps in the analysis of *enough* and *too* constructions, then, are as follows. We need to develop a formal account of the interactions between grammatical aspects and the underlying *aspectual class* properties of the situation and event descriptions with which they combine. The next chapter begins by introducing the basic ideas of lexical aspect and the aspectual class features to which grammatical aspects appear to be sensitive. I then look more closely at the various interpretations of event and situation predicates under viewpoint aspect, and, drawing on accounts from Moens (1987)/Moens and Steedman (1988), de Swart (1998), and Bary (2009), develop a framework for *aspectual coercion* in which the instantiative coercion central to *enough/too* entailments can be formally analyzed. Finally, armed with a theory of aspectual coercion, I verify that that the account as developed predicts the empirical implicative inference patterns described in the last two chapters, and provide explanations for the key contrasts – between the French perfective and imperfective constructions, between the English and French constructions, and, finally, between lexical implicatives and the ‘implicative’ class of *enough* and *too* constructions. The conclusion of Chapter 6 reviews the full account of *enough/too* constructions, and considers its ramifications for the investigation of actuality inferences and ability predicates with which the dissertation began.

Chapter 6

Aspect and actuality inferences

We are now very close to a full account of the implicative behaviour of *enough/too* constructions. At the beginning of Chapter 5, we were faced with a curious problem: while *enough/too* constructions in general appear only to background the necessity of (a particular degree of) their matrix properties for the realization of their complements, the ‘implicative’ subclass – *enough/too* constructions involving (i) circumstantial modality, (ii) dynamic adjectives, and (iii) temporal overlap between matrix and complement times – seem to background a sufficiency condition as well, but only in case they are marked with the perfective aspect. On an analysis in which aspectual operators simply situate event time with respect to reference time, there is no obvious way for the perfective to modify the underlying *enough/too* construction by introducing a sufficiency condition.

Now that we have taken a closer look at the semantics of *enough/too* constructions, however, we can see that, in the ‘implicative’ subgroup, a sufficiency presupposition is not introduced externally, but is instead inherently associated with the construction, induced in the combination of features (i)-(iii) stated above. More specifically, ‘implicative’ *enough/too* constructions are implicative in the following sense: they attribute to their subjects a certain degree *d* of a property that characterizes an action taken to be both causally necessary and causally sufficient for the realization of the *enough/too* complement. In other words, the action associated with a dynamic adjective *enough/too* predicate bears the same relationship

to the *enough/too* complement as the matrix condition backgrounded by a lexical implicative bears to the implicative complement. In the *enough/too* case, however, causal sufficiency is not baked into the semantics of the complex predicate, but arises from a modalized comparative operator – which, as we saw in Section 5.4, introduces reasoning about the hypothetical sufficiency of the matrix property for the complement eventuality – in combination with an inherently action-oriented adjective, and an overlap in the temporal specification of matrix and complement clauses. The comparative operator and dynamic adjective combination invites an interpretation on which an action of the type characterized by the adjective is taken to be sufficient (as well as necessary) for the *enough/too* complement; when the matrix and complement clauses additionally overlap temporally, the matrix clause can be interpreted as referring to the specific action which is (or will be) causally sufficient for the complement, as opposed to simply describing an action of the right type.

With a sufficiency condition in place, the chief difference between an implicative *enough/too* construction and a lexical implicative construction is that, where the lexical implicative always asserts the (eventive) realization of the causing event for its complement, the *enough/too* construction at base only attributes to its subject the *capacity* to perform the relevant causing action. Thus, we expect an *enough/too* construction to behave exactly like an implicative construction if, for some reason, the matrix property attribution is interpreted as describing the causing action itself, rather than as describing a latent capacity for this action.

More generally, an *enough/too* construction with subject S and matrix adjective ADJ asserts that an eventuality with the description $\text{ADJ}(d_{\text{nec}})(S)$ obtains in the world of evaluation, where d_{nec} is defined as the necessary degree of ADJ that S must have in order to achieve some salient goal, potentially provided overtly by a complement proposition. This eventuality, as a property attribution, at base represents a state (i.e., a state of being for S). If the matrix adjective is static, representing a stable or unchanging property (e.g., *tall*, *old*), then the eventuality $\text{ADJ}(d_{\text{nec}})(S)$ has no non-state interpretation. However, when the matrix adjective is dynamic (i.e., inherently action-oriented, like *fast* or *loud*), there are two interpretations available for $\text{ADJ}(d_{\text{nec}})(S)$. In English, for instance, the property claim S be $d_{\text{nec}}\text{-fast}$ is ambiguous between an interpretation on which the subject simply has the

capacity to perform actions characterized by speed of at least d , and one on which S actually performs such an action. The implicative behaviour of the ‘implicative’ subgroup of *enough/too* constructions is contingent on the second interpretation.

This puts us in a position to answer the original question: how can the perfective aspect introduce a sufficiency condition for implicative *enough/too* constructions? The answer is that it does not do so at all. Instead, as I suggested in Section 5.6, perfective aspect works to ‘unwrap’ or uncover an implicit sufficiency condition, by forcing us to interpret the dynamic adjective attribution as describing an action by the *enough/too* subject, rather than simply as a capacity of this subject. As long as the temporal overlap condition also holds, this action then represents an instantiation of the causing condition for the *enough/too* complement, and thus licenses and implicative-style complement entailment. At the end of Chapter 5, I provided some empirical evidence that the perfective aspect induces eventive interpretations for underlyingly stative predicates, and, in particular, that it induces an ‘instantiated’ interpretation of dynamic adjective attributions. This approach is promising, but there is still some work to be done to complete the picture. At this point, there are two things we would like to understand. First, why does the perfective aspect coerce ‘eventive’ interpretations for these kinds of predicates? Secondly, how does this process take place, at the semantic level?

This chapter addresses these two questions. Up to this point, I have dealt only with grammatical (viewpoint) aspect, and have only discussed aspectual class properties – such as the distinction between stative and eventive predicates – informally. We have now seen that these class distinctions play a role in the actuality inference phenomenon. It is therefore time to take a closer look at aspectual class, and in particular at how aspectual class features interact with the temporal/perspectival contribution of the perfective and imperfective operators. The central issue to be examined is how particular interpretations – e.g., habitual or progressive interpretations for imperfective sentences, or maximal or inchoative interpretations for perfective sentences – follow from the interaction between the semantics of viewpoint aspects, and underlying aspectual class features of situation/event predicates in the scope of viewpoint aspect.

I first provide an overview of lexical aspect and the analytical questions raised by the interaction between aspectual class features and viewpoint aspect. This discussion shows that viewpoint aspects are sensitive to certain features of the predicates in their scope, and in some cases may alter or shift these inherent properties in systematic ways. I then introduce a theory of aspectual coercion to handle these systematic shifts, based on ideas from Moens (1987)/Moens and Steedman (1988), de Swart (1998), and Bary (2009). I show how coercion operations account for the maximal, inchoative, and habitual interpretations we have seen, and then develop a representation for the coercion operator which applies to action-oriented predicates like *be fast*, *be loud*, and produces the ‘instantiated’ interpretations which are central to *enough/too* implicativity and actuality inferences more broadly.

Finally, I examine how aspectual coercion works in the interpretation of *enough/too* constructions, focusing on the ‘implicative’ subgroup. I show that the account of aspect developed in the first part of the chapter works as outlined in Section 5.6, giving us the final piece of the puzzle in explaining the implicative interpretation of perfectly-marked circumstantial *enough/too* constructions with dynamic adjectives. I then show how we avoid entailments under both positive and negative *enough/too* assertions with imperfective marking, despite the fact that *enough* and *too* background a necessity relationship between their matrix predicates and complement propositions, and discuss what happens in cases where the *enough/too* construction is interpreted progressively. Finally, I show that the account of aspect, taken together with the accounts of implicative and *enough/too* constructions developed over the course of the dissertation, predicts the contrast between ‘true’ implicative entailments and the (defeasible) implicative inferences from *enough/too* constructions under imperfective marking. In the conclusion, I review the full account developed in Chapters 4–6, and then discuss the implications of this analysis for the original problem: the aspect-sensitive actuality entailments of ability modals.

6.1 Lexical aspect

I noted in Chapter 2 that the term *aspect* in fact refers to two different concepts, both dealing with temporal or durational properties. **Grammatical**, or **viewpoint aspect**, by now familiar, works to locate the runtime of a situation with respect to the reference time supplied by tense. It can do this in one of two ways, either by containing the event time within reference time, or by containing reference time within event time. Thus, grammatical aspects provide us either with an ‘external’ view of a situation or event (under perfective marking), or an ‘internal’ perspective (under imperfective marking).

Events and situations – henceforth, **eventualities**, to use a cover term introduced by Bach (1986) – also have inherent temporal properties. For instance, they can be punctual (occurring at a particular moment) or persistent; they might have an internal ‘arc’, comprising different stages, or they might instead be uniform across their runtime. Properties of this sort constitute the domain of **lexical aspect**, also known as **aspectual class** or **aktionsart**. I first introduce the basic contrasts in which we are interested, and then show that grammatical aspect is sensitive to these aspectual class features in systematic ways.

6.1.1 Aspectual class

The most prominent aspectual classification system is due to Vendler (1957), who divides verbal predicates on the basis of two binary distributional criteria. First, he considers whether or not a predicate can combine with “continuous tenses” (e.g., the English progressive; Vendler 1957, p.144). Secondly, he considers whether or not a predicate can be felicitously modified by durative temporal adverbials, such as *for an hour*. Vendler’s classes are shown in Table 6.1.

The progressive criterion distinguishes between *activities* and *states*, on the one hand, and between *accomplishments* and *achievements* on the other.

- (6.1) a. *Activity*: Juno was running.
 b. *State*: *Nima was knowing the national anthem.

Aspectual class	<i>progressive</i>	<i>durative mod.</i>	examples
Activities	yes	yes	<i>run, swim, sing</i>
Accomplishments	yes	no	<i>run a mile, build a house</i>
States	no	yes	<i>love, know</i>
Achievements	no	no	<i>win, reach</i>

Table 6.1: Vendler's aspectual classes

- (6.2) a. *Accomplishment*: Juno was running a mile.
 b. *Achievement*: *Nima was reaching the summit.

This test singles out predicates that “consist of successive phases following one another in time” (1957, p.144), selecting for predicates that describe eventualities with internal structure that varies or changes over time. Thus, it cannot apply to predicates of states, which hold or obtain in a uniform manner, but cannot be said to be ‘happening’ or ‘occurring’ at any point during their runtime. It also does not apply to predicates of achievements, which lack internal variation by virtue of being punctual and therefore having no duration to begin with.

The durative adverbial criterion picks out predicates of eventualities which lack a “set terminal point,” and thus have no inherent limits on their persistence in time (Vendler 1957, pp.145–146). Achievements are again excluded on the basis of their punctuality. Accomplishment predicates are also excluded, since they describe eventualities which are oriented towards a goal, and which thus terminate at the point at which the goal is reached.

- (6.3) a. *Activity*: Juno ran for an hour.
 b. *Accomplishment*: *Juno ran a mile for an hour.
- (6.4) a. *State*: Nima knew the national anthem for a year.
 b. *Achievement*: *Nima reached the summit for an hour.

A number of changes, modifications, and alternatives have been proposed to the taxonomy in Table 6.1. Some authors, like Bach (1986), argue for a finer-grained division of predicates; see Figure 6.1.

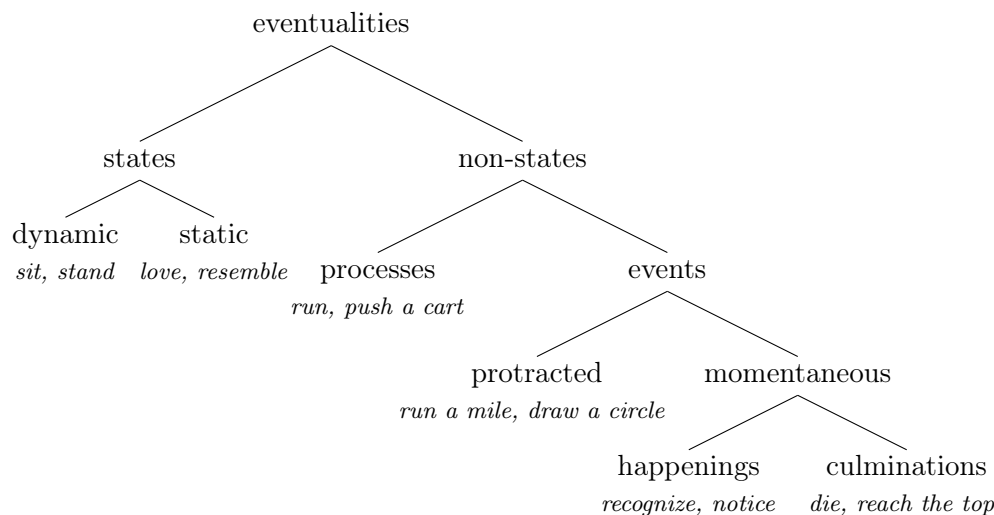


Figure 6.1: Bach's (1986) eventuality types

Others add aspectual classes to the Vendlerian catalog (Comrie, 1976),¹ or propose to eliminate or merge certain categories (e.g., Verkuyl, 1993). Although Vendler's taxonomy is by no means the last word on aspectual class distinctions, the chief contrasts in which we are interested can be distilled from the properties picked out by his two criteria.

In targeting “processes going on in time” (Vendler 1957; p.144) – that is, eventualities which have variable structure with respect to the passage of time – the progressive criterion highlights a basic distinction between those predicates that describe eventualities which can be said to happen or occur, and those which describe eventualities that can only be said to hold or obtain at a given time (or temporal interval). Vendlerian states (Bach's ‘static’ states) are eventualities of the second type; while the remaining Vendlerian classes, including achievements, fit the ‘occurrence’ description, and are thus dynamic or **eventive**, as opposed to **stative** (see also Bennett and Partee 1978, Kamp and Reyle 1993, von Stechow 2009). Eventive predicates describe eventualities that involve motion or change during their

¹Most notably, Comrie (1976) proposes a class of **semelfactives**, including predicates like *blink*, *cough*, or *knock*. Semelfactives are basically punctual, but differ from Vendler's class of punctual *achievements* in two important ways. First, they do not (necessarily) involve a change of state. Secondly, they are readily understood in an iterated sense, as in *Lucy knocked on the door*, where achievements resist this type of interpretation. See also Smith (1991).

runtime, while stative predicates describe static or unchanging eventualities, which look the same at any and all subintervals of their runtime.²

The durative-modifier criterion focuses on a different contrast, between those predicates that describe (potentially) persistent eventualities, and those that describe eventualities that have inherent endpoints or culminations. Persistent predicates describe **atelic** eventualities, such as eventualities of *running* or *knowing*. The complement class of **telic** predicates describe eventualities like *running a mile* or *winning a race*, and thus encompass Vendler's accomplishment and achievement classes (Bach's *events*). The presence of an inherent endpoint associates telic predicates with changes of state, by distinguishing the state prior to the endpoint from the state that obtains immediately after the endpoint is reached. While atelic predicates may describe eventualities with limited duration, these eventualities are not associated with changes of state as part of their core descriptions.³ The distinction between telic and atelic predicates is also often referred to as the distinction between *bounded* and *unbounded* predicates.

By using both the stative/eventive and telic/atelic contrasts, we arrive at a commonly-used three-way aspectual classification (see also Bach 1986, Krifka 1989, Piñón 1995, de Swart 1998). This classification is presented in Table 6.2. *States* in Table 6.2 correspond to Vendler's states, or Bach's static states; *processes* to activities (combining Bach's processes and dynamic states) and *events* correspond to both accomplishments and achievements

² As one way of formalizing this distinction, Kamp and Reyle (1993) characterize eventive predicates as having a structure involving three phases: a preparatory phase, a culmination point, and a result state (see also Moens and Steedman 1988): different types of eventive predicates differ in which of these phases they are taken to pinpoint. For instance, punctual achievements pick out only the culmination point, while activities pick out the preparatory phase (or process). Accomplishments can be seen to encompass the entire structure. On this approach, states are characterized not only by their lack of internal structure, but also by the fact that they can serve as proper subparts of eventive predicates.

³ As per Vendler (1957), atelic predicates combine readily with durative temporal adverbials headed by *for* (*for an hour*, *for five minutes*). Telic predicates can be diagnosed either by their resistance to durative modification, or by their ability to combine felicitously with *in*-adverbials, which pick out a span of time during which the inherent endpoint was approached and reached. (i) illustrates that telic and atelic predicates appear in complementary distribution with *in* and *for* adverbials.

- (i) a. *Telic*: Juno ran a mile in an hour/*for an hour.
- b. *Atelic*: Juno ran *in an hour/for an hour.

(Bach’s events, both protracted and momentaneous). Thus the three-way classification essentially collapses Vendler’s accomplishments and achievements, but otherwise preserves the divisions in Table 6.1.

<i>atelic</i>	state	<i>stative</i>
	process	<i>eventive</i>
<i>telic</i>	event	

Table 6.2: Three-way eventuality classification

Bach (1986) notes a parallel, foreshadowed by Verkuyl (1972), between the telic/atelic distinction and the distinction between *count* and *mass* objects in the nominal domain (Link, 1983). Capitalizing on this parallel, Krifka (1998) formalizes telicity properties in terms of a contrast between **quantized** (count) and **homogeneous** (mass) predicates.⁴ Roughly, a predicate P is *quantized* if the eventualities it denotes are such that none of their proper subparts can also be in the extension of P . A homogeneous predicate has the opposite property: a predicate P is *homogeneous* if the eventualities it denotes are such that their proper subparts are also in the extension of P . The definitions below are Krifka’s.

Definition 6.1 (Quantization and homogeneity). *Let P_{et} be a predicate of eventualities, with \sqsubseteq the subpart relationship between eventualities. Then:*

- (a) P is **quantized** iff for all e, e' , if $P(e)$ and $e' \sqsubseteq e$, then $\neg P(e')$.
- (b) P is **homogeneous** iff for all e, e' if $P(e)$ and $e' \sqsubseteq e$, then $P(e')$.

Homogeneity corresponds to the *subinterval property*, as given in Section 5.6:

⁴Krifka (1998) develops a theory of *aspectual composition* motivated by the mass/count parallel (first noted by Bach 1986). Subsequent to Vendler (1957), a number of authors have noted that aspectual features seem to arise in the combination of a verb and its arguments, rather than being tied only to the verb – thus *eat cake* is a process or activity, but *eat a cake* is an accomplishment, despite involving the same verb (Verkuyl, 1972; Dowty, 1979). Theories of aspectual composition aim to derive the properties of verbal predicates compositionally, from the combined features of the main verb and its arguments. On a theory like Krifka’s, the distinction between the activity/process denoted by, e.g., *eat cake*, and the accomplishment *eat a cake* can be traced to the fact that the activity predicate involves the use of *cake* as a substance or mass noun, whereas the accomplishment predicate involves a version of *cake* having discrete, countable units, and as such representing an object with clearly delineated boundaries.

(5.98) **The subinterval property** (Bennett and Partee, 1972[2004])

A predicate of eventualities P_{et} has the subinterval property if, whenever P holds of an eventuality e , then P also holds of every subeventuality $e' \sqsubseteq e$.

Bary (2009) proposes a way of formalizing the stativity/eventivity distinction, pointing out that the crucial feature of stative properties is that they describe eventualities which are *fully divisive*. In other words, stative properties describe eventualities which ‘look the same’ (can have the same description) at *all* subintervals of their runtime, down to the temporal point (see also Egg, 2005). In a sense, being fully divisive is the real ‘subinterval’ property, while (5.98) represents a weaker ‘subeventuality’ property that applies to both states and processes.

Definition 6.2 (Stativity). *Let P_{et} be a predicate of eventualities, with \sqsubseteq the subpart relation between eventualities. Then P is **stative** iff*

- i. $\forall e \in \mathcal{E}$ such that $P(e)$ and $\tau(e) = t$, we have $\forall t' \subseteq t, \exists e' \in \mathcal{E}$ with $e' \sqsubseteq e$ and $P(e')$.
- ii. $\exists e \in \mathcal{E}$ such that $P(e)$ and $\exists e'$ such that $e' \sqsubset e$.

Based on this definition, stative predicates are fully divisive, as well as non-punctual.⁵ Event predicates are excluded because they are either non-divisive (accomplishments) or punctual (achievements). Process predicates fail clause (i) in that they involve dynamicity or change of some sort. In particular, process predicates will not be true at all temporal subintervals of the eventualities they describe: for instance, if e is an eventuality of Juno running, e has subeventualities, say, of Juno lifting her foot from the ground, which in isolation do not satisfy the description *Juno run*, although they constitute an essential part of it.

6.1.2 Interaction with grammatical aspect

Grammatical aspect enters the picture at this point, taking as its input predicates of eventualities, and instantiating them by situating them with respect to reference time. The definitions in (2.23) are repeated from Chapter 2.

⁵Clause (i) in Definition 6.2 is modified from Bary’s original proposal. She aims to capture divisivity in terms of homogeneity; this will not work given the definition of homogeneity in Definition 6.1, since it subsumes both processes and states.

- (2.23) a. $\llbracket \text{PFV} \rrbracket := \lambda w \lambda t_i \lambda P_{et}. \exists e [\tau(e) \subseteq t \wedge P(w)(e)]$
 b. $\llbracket \text{IMPF} \rrbracket := \lambda w \lambda t_i \lambda P_{et}. \exists e [\tau(e) \supseteq t \wedge P(w)(e)]$

As previously discussed, the inclusion relationships in (2.23) give us different perspectives on an eventuality. By containing event time within reference time, the perfective aspect gives us an ‘external’ or completed view of an eventuality; the imperfective aspect, by containing reference time within event time, instead gives us an ‘internal’ or ongoing perspective. The precise way in which these perspectives are realized, however, varies from one case to another, depending at least in part on the aspectual class features of the predicate of eventualities with which a grammatical aspect combines.

If we apply the perfective as defined in (2.23a) to a predicate of events like *Juri eat an apple*, we derive the intuitively correct interpretation, on which the French example (6.5) describes a complete past eventuality of Juri eating an apple.

(6.5) *Juri a mangé une pomme.*

‘Juri ate-PFV an apple.’

- a. $(6.5) \equiv \text{PST}(\text{PFV}(\text{Juri eat an apple}))$
 b. $\llbracket (6.5) \rrbracket^{w*} = \llbracket \text{PST}(\text{PFV}(\lambda w \lambda e. \text{eat-apple}(J)(w)(e))) \rrbracket^{w*}$
 $= \exists e [\tau(e) \subseteq t \{t \prec_i t^*\} \wedge \text{eat-apple}(J)(w^*)(e)]$
 c. *There is a salient past temporal interval which contains a real-world event of Juri eating an apple.*

Things are not as straightforward when we combine the perfective aspect with homogeneous predicates, however. The intuitive interpretation of a state predicate like *Anne être triste* (‘Anne be sad’) under perfective marking describes a complete past event of Anne’s being sad, which crucially both begins and ends during the (past) reference time. This is not what we get from a straightforward application of PFV.

(6.6) *Anne a été triste.*

‘Anne was-PFV sad.’

- a. $(6.6) \equiv \text{PST}(\text{PFV}(\text{Anne be sad}))$

- b. $\llbracket (6.6) \rrbracket^{w^*} = \llbracket \text{PST}(\text{PFV}(\lambda w \lambda e. \text{sad}(A)(w)(e))) \rrbracket^{w^*}$
 $= \exists e[\tau(e) \subseteq t\{t \prec_i t^*\} \wedge \text{sad}(A)(w^*)(e)]$
- c. *There is a past time interval t such that t contains the runtime of a real-world eventuality of Anne being sad.*

While (6.20b) does instantiate an eventuality of Anne's being sad within the past reference time, nothing about the truth conditions paraphrased in (6.20c) mandates the *completeness* of this period of sadness. That is, nothing ensures that Anne's sadness as a whole begins or ends during reference time.

The problem is that, due to the homogeneity of *Anne be sad*, any subpart of an eventuality of Anne being sad is also an eventuality of Anne being sad. Therefore, the eventuality in (6.20c) need not be maximal with respect to Anne's sadness: it could simply be part of a larger, ongoing sadness eventuality, which is not fully contained in the reference time. In effect, the homogeneity of the stative predicate *Anne be sad* overrides the external perspective which the perfective aspect supplies.

In order to capture the observed interpretation, we want the combination of *Anne be sad* with perfective marking to describe a maximal sadness eventuality, contained within reference time. We might achieve this by adding a maximality constraint to the perfective: the new condition is underlined in (6.7).

$$(6.7) \quad \llbracket \text{PFV}_{\max} \rrbracket := \lambda w \lambda t \lambda P. \exists e[\tau(e) \subseteq t \wedge P(w)(e) \wedge \underline{\forall e' : e \sqsubset e' \rightarrow \neg P(w)(e')}]$$

The maximality constraint filters out any non-maximal P -eventualities by discarding any P -eventualities which are contained within larger P -eventualities. Thus, in (6.6), PFV_{\max} takes a predicate of Anne's sadness states, and returns a maximal state contained within reference time.

The maximality constraint does not change anything for the perfective event description in (6.5), since events are inherently maximal.⁶ Process predicates will be affected in the

⁶One instantiation of an event of Juri eating an apple, for instance, cannot be fully contained within another.

same way as state predicates, deriving the intuitively correct interpretation for a process description like (6.8).

(6.8) *Juno a couru.*

‘Juno ran-PFV.’

- a. (6.8) $\equiv \text{PST}(\text{PFV}(\text{Juno run}))$
- b. $\llbracket (6.8) \rrbracket^{w^*} = \llbracket \text{PST}(\text{PFV}(\lambda w \lambda e. \text{run}(J)(w)(e))) \rrbracket^{w^*}$
 $= \exists e [\tau(e) \subseteq t \{t \prec_i t^*\} \wedge \text{run}(J)(w^*)(e) \wedge \forall e' : e \sqsubseteq e' \rightarrow \neg \text{run}(J)(w^*)(e')]$
- c. *There is a past time interval t such that t contains the runtime of a real-world eventuality of Juno running, which is not contained in any larger eventuality of Juno running.*

Unfortunately, if we adopt PFV_{\max} , as defined in (6.7), to capture the manner in which an external perspective is realized for the homogeneous predicate descriptions in (6.6) and (6.8), we will have to define additional perfective operators to capture alternative ways in which the external perspective is empirically realized. Consider (6.9). With the addition of the temporal adverbial *soudain* (‘suddenly’), perfective marking on *Anne be sad* no longer results in a maximal interpretation. Instead, (6.9) is interpreted *inchoatively*, locating the time at which Anne became sad or began to be sad within the reference interval, but failing to license any inferences about the endpoint of this sadness eventuality.

(6.9) *Soudain, Anne a été triste.*

‘Suddenly, Anne was-PFV sad.’

Interpretation: Anne suddenly became sad

Imperfectively-marked sentences also give rise to a range of interpretations. Combining IMPF with a process predicate like *Juno run* derives the intuitive ongoing (or progressive) interpretation, shown in (6.10).

(6.10) *Juno courait.*

‘Juno ran-IMPF.’

- a. (6.10) $\equiv \text{PST}(\text{IMPF}(\text{Juno run}))$
- b. $\llbracket (6.10) \rrbracket^{w^*} = \llbracket \text{PST}(\text{IMPF}(\lambda w \lambda e. \text{run}(J)(w)(e))) \rrbracket^{w^*}$
 $= \exists e[\tau(e) \supseteq t\{t \prec_i t^*\} \wedge \text{run}(J)(w^*)(e)]$
- c. *There is a salient past time at which an eventuality of Juno running was taking place.*

IMPF as defined will also return a progressive interpretation for the event predicate *Jean buy groceries at the corner store* (example adapted from de Swart, 1998). This is the right interpretation for (6.11a). However, if we change the temporal adverbial to one describing a significantly longer stretch, as in (6.11b), a progressive interpretation no longer makes sense. Instead, we get a habitual interpretation, on which eventualities of Jean grocery shopping are iterated over some period of time which includes the reference time.

- (6.11) a. *À dix heures, Jean faisais ses courses chez l'épicier du coin.*
 'At ten o'clock, Jean got-IMPF his groceries at the store on the corner.'
Interpretation: At ten o'clock, Jean was in the process of getting his groceries at the corner store.
- b. *Dans sa jeunesse, Jean faisais ses courses chez l'épicier du coin.*
 'In his youth, Jean got-IMPF his groceries at the store on the corner.'
Interpretation: In his youth, Jean used to get his groceries at the corner store.

An approach which involves defining a range of perfective and imperfective operators to capture these varied interpretations loses sight of a central generalization. In each of (6.6), (6.9), and (6.11b), the 'reinterpretation' of the underlying predicate – filtering for maximal eventualities, picking out initial points, and iteration, respectively – in a sense is what makes the underlying predicate compatible with the temporal perspective provided by grammatical aspect. Maximal and inchoative readings are unified by their compatibility with the external perspective associated with the perfective aspect. Similarly, habitual and progressive readings are unified by their compatibility with the imperfective's internal perspective. Ideally, then, we want to maintain the definitions of PFV and IMPF in (2.23)

as the core contributions of the grammatical aspects, and attribute the variability in interpretations to systematic processes of ‘reinterpretation’ that modify or reshape eventuality predicates in such a way that the eventualities they describe ‘fit’ the temporal perspective of the grammatical aspect applied to them.

These reinterpretations are not random, but instead systematically linked to features of the context (both linguistic and non-linguistic). Thus, in (6.9), an inchoative interpretation, which describes short eventualities, is preferred in the presence of *soudain* (‘suddenly’). Similarly, since an interpretation for (6.11b) on which Jean’s entire youth is contained within a single eventuality of grocery-shopping is implausible, the event predicate gets reinterpreted in a manner that ‘fits’ over the long reference time in a sensible way. In building a theory of the interaction between lexical and grammatical aspect, then, what we are after is an understanding of the principles and processes that govern these reinterpretations. This is the goal of a theory of aspectual coercion, which is the topic of the next section.

6.2 Aspectual coercion

The situation is as follows. Both perfective and imperfective aspects can give rise to different types of interpretation, depending on features of the predicate in their scope. We do not want to explicate this in terms of an ambiguity in the aspectual markers, because the available readings for perfective (inchoative, maximal) are unified in providing an external (completed, bounded) view of an eventuality, while the available readings for imperfective aspect (habitual, progressive) are unified in providing an internal viewpoint. Thus, we need a principled way to link features of the input predicates, taken along with contextual information, to the output interpretations. We do this by taking grammatical aspects to have selectional restrictions, which trigger the reinterpretation or **coercion** of eventuality predicates in case of a feature mismatch.

6.2.1 Coercion in a transition network

Use of the term **coercion** to describe aspect-driven reinterpretation is due to Moens and Steedman (Moens, 1987; Moens and Steedman, 1988).⁷ Although their approach to the semantic contribution of the perfective and imperfective aspects diverges from the Klein/Kratzer approach adopted in Chapter 2 (see definitions 2.23a-2.23b), the overall architecture of Moens and Steedman’s coercion framework provides some insight into the basic ideas behind aspectual coercion, and is worth discussing briefly here.

Moens and Steedman treat grammatical aspects, aspectual modifiers, aspectual auxiliaries, and certain temporal modifiers as functions from predicates of eventualities to predicates of eventualities, potentially changing aspectual class features along the way. Crucially, each function specifies an input and output type. In case of a mismatch between an input eventuality and the required input type, these functions can coerce the input eventuality to one of the correct type. Possibilities for coercion are not freely available, but rather correspond to a set of permissible transitions between eventuality types in an *aspectual network*, shown in Figure 6.2 (reproduced from Moens 1987, p.61).

The transitions in Figure 6.2 are governed by relationships between different component parts of a generalized eventuality structure which Moens and Steedman call a *nucleus*. A nucleus comprises a preparatory process, a culmination (event), and a consequent state.⁸ Permissible transitions involve either decomposing a complex input eventuality into its nuclear constituents, and then moving to a particular part of the eventuality structure, or, alternatively, composing a new nucleus by (reinterpreting) an input eventuality as a complex culmination, and then moving to some part of the new structure – i.e., to either a related preparatory or consequent component.

Transitions are triggered by mismatches between the features of an input eventuality and the selection restrictions of the (aspectual) function being applied to it. For instance, Moens and Steedman propose that the English progressive is a function from processes to a

⁷This term is chosen by “loose analogy with type-coercion in programming languages” (Moens and Steedman 1988, p.17).

⁸This is similar to the three-part ‘phase’ structure Kamp and Reyle (1993) assign to eventive predicates.

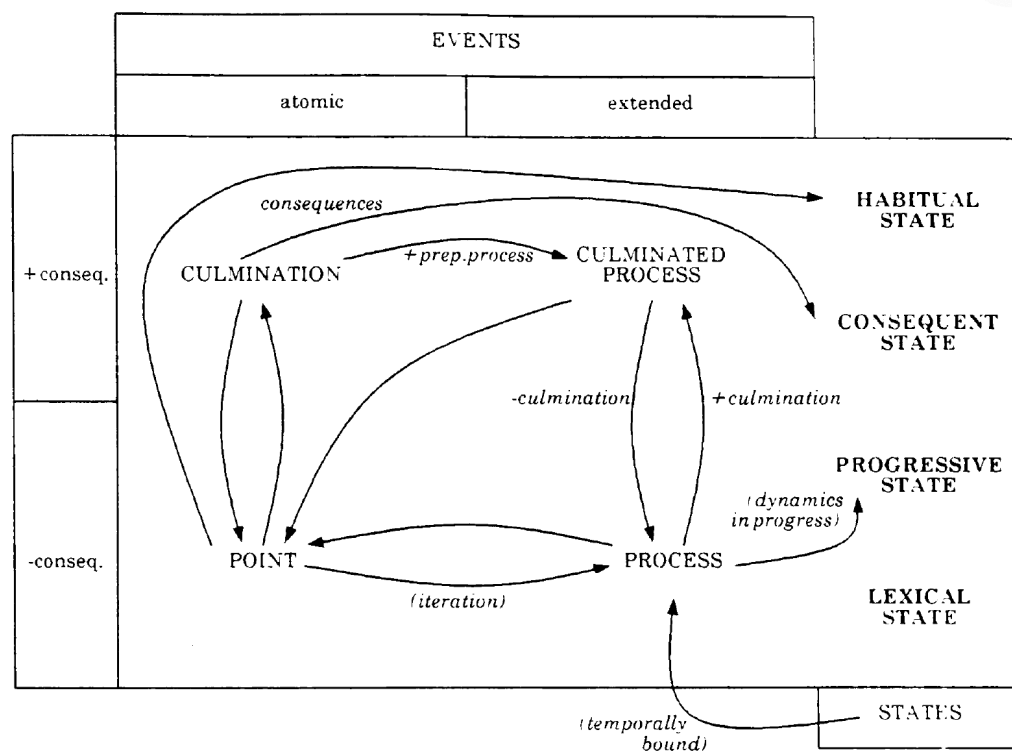


Figure 6.2: The Moens/Steedman aspectual transition network

particular kind of state (labeled as a *progressive state* in Figure 6.2). If we feed a predicate of processes like *Juno run* to the progressive function, composition is straightforward, returning an ongoing state in which Juno is running. However, if the input eventuality is not a process, coercion must take place before the progressive can apply. Moens and Steedman provide the example in Figure 6.3 for the sentence radical *Sandra hiccup*, which they take to describe a ‘point eventuality’ (Moens and Steedman, 1988, p.18).⁹

$$\begin{array}{c}
 (\text{point } (Sandra \text{ hiccup})) \\
 \downarrow \\
 (\text{process } (\text{iteration } (\text{point}(Sandra \text{ hiccup})))) \\
 \downarrow \\
 (\mathbf{progressive} \text{ (process (iteration (point } (Sandra \text{ hiccup}))))}) \\
 \equiv Sandra \text{ is hiccuping.}
 \end{array}$$

Figure 6.3: Moens/Steedman transitions for a progressively-marked punctual predicate

Referring to Figure 6.2, we see that one way to move from a point to a process is through the ‘iteration’ transition. This returns a process which is an (unbounded) series of hiccups. We now have the right type of input, and so the progressive transition applies, returning the progressive state described by *Sandra is hiccuping*.

If, by contrast, we start with a culminated process (an accomplishment) such as *Juno run a mile*, then one route through the network to a process is provided by the ‘–culmination’ transition, which strips off the endpoint or culmination (returning *Juno run*); $\text{PROG}(\text{Juno run a mile})$ thus returns *Juno was running a mile*, which indicates a progressive state of Juno running, but does not include the culmination point of the original input in this state.¹⁰

Finally, given a punctual culmination predicate (an achievement) like *Nima reach the top of the mountain*, there are two possible routes through the transition network to get to a process. The culmination can be reinterpreted as a point predicate, which is then iterated to return a process of repeatedly reaching the top. This is one possible interpretation for

⁹This predicate would be treated as a semelfactive on the extended Vendler classification scheme, or simply a punctual event on the three-way scheme in Table 6.2.

¹⁰By defining ‘–culmination’ as a possible transition, the Moens and Steedman network obviates any independent explanation of the imperfective paradox.

Nima is reaching the top (if, for instance, he keeps stepping forwards and backwards), but it is not particularly pragmatically plausible without a supporting context. On the other hand, we might instead transition from the original culmination to a culminated process, by adding the preparatory process for Nima's achievement – i.e., the process of climbing the mountain. We can then get to a process predicate by stripping off the culmination point, as in the case of *Juno run a mile*, and get back *Nima is reaching the top* from the progressive, interpreted as the progressive state of Nima's climbing the mountain en route to the top. This is much more plausible, and, in the absence of very specific contextual cues, will be the default interpretation for *Nima is reaching the top*.

These examples illustrate two key features of a coercion account of aspectual modification. First, coercion is a 'triggered' process, or a type of repair operation. In principle, then, coercion operations should not be triggered if there is no mismatch between the input restrictions of a function and the type of its input argument in the first place. Secondly, the 'best route' through the network – that is, the type of transition we make in case of multiple routes – is governed by context and world knowledge. Ultimately, then, Moens and Steedman's account suggests that pragmatic considerations will need to figure into any coercion account of aspectual transitions – however, the fact that their account relies on a set of governing principles for allowable transitions reflects that these pragmatic processes are constrained by features of the predicates of eventualities involved.

6.2.2 Defining coercion operations

Returning to the larger picture, we are in search of an operation of aspectual coercion that will account for the eventive, instantiated readings of dynamic adjective attributions under the perfective aspect. In order to pinpoint such an operation, we need to establish two things. First, we would like to understand how coercion of this sort is triggered – in other words, to establish what the selectional restrictions of the perfective aspect are. Second, we need to understand how coercion operates: in particular, what semantic contribution is made by a coercion operator that instantiates dynamic adjective predicates, and how this changes those properties that are incompatible with the perfective aspect in the first place.

Starting from the basic insights of the transition system, we now want to narrow in on its specifics. A first step towards this goal comes from de Swart (1998), who implements a system of aspectual transitions in the spirit of Moens and Steedman within the framework of Discourse Representation Theory (Kamp and Reyle, 1993).

Coercion classes and composition: de Swart (1998)

De Swart's system differs from the transition network system in one important way. Moens and Steedman treat all aspectual operators as functions from predicates of eventualities to predicates of eventualities, which contribute to meaning by changing the feature specification of the input predicate. De Swart distinguishes between grammatical aspect operators like the perfective and imperfective, whose primary function is to locate an eventuality in time,¹¹ and a class of operators – including the coercion transition operators – which contribute to meaning by performing aspectual transitions. Grammatical aspects in principle preserve the aspectual class features of their inputs, but bring about feature transitions by means of their selectional restrictions. These restrictions are encoded in terms of the quantization/homogeneity and eventivity/stativity contrasts that define the three-way event ontology in Table 6.2. As in Moens and Steedman's system, a mismatch between the features of an input predicate and the selectional restrictions of an operation can trigger aspectual coercion. Coercion operations are transition functions, which handle feature mismatches by mapping a predicate of eventualities to a predicate with the required aspectual features, prior to composition with the selecting operation.

De Swart divides coercion operators into classes, in terms of the type of mismatch they repair. $C_{q \rightarrow h}$, for instance, represents any one of a set of transitions which turn quantized event predicates into homogeneous predicates. $C_{h \rightarrow q}$ represents a set of transitions which go in the opposite direction, while $C_{s \rightarrow ns}$ represents a set of transitions which map stative predicates onto non-stative (eventive) ones. Each class of coercion operations contains a number of different realizations, corresponding in concept to different routes through the

¹¹In de Swart's system, the French perfective and imperfective are treated as aspectually sensitive tense operators, rather than as relations between event times and reference times, but this difference does not affect the discussion here.

aspectual network in Figure 6.2. As for Moens and Steedman, coercion operations are not freely applied, but must be triggered by feature mismatches. Once a coercion operation of a particular class has been triggered, the reinterpretation process is governed in two ways. First, a language cannot employ as a silent coercion operation any transition for which it has an overt grammatical marking; for instance, if a language has an overt progressive marker, then the operation PROG will never be available in the absence of this marking.¹² Secondly, the choice of a realization for a triggered coercion operator is governed by pragmatic considerations.

“We want to preserve the insight that the interpretation in terms of coercion is fully compositional, but the value of the hidden operator is dependent on linguistic context and world knowledge, and is determined only when the [Discourse Representation Structure (DRS)] is embedded in the model. At this point, coercion of an event into a state or process leads to a choice among the set of possible mappings {ITER, HAB, PROC, ... }, and coercion of a state or process into an event leads to a choice among the set {BOUND, INCHO, ADD-CUL, ... }. If the linguistic and extra-linguistic context do not support any aspectual transition which satisfied the aspectual restrictions on the operator, there is no proper embedding of the DRS into the model, which means that it cannot be verified. Thus the well-formedness of the DRS can be saved by the introduction of coercion operators, but its verification is dependent on the felicity of specific aspectual transitions in the context.”

de Swart (1998, pp.363–364)

In cases where coercion is triggered but no available operator results in a pragmatically reasonable interpretation, the combination of the overt aspectual operator and underlying

¹²Thus, a language like Hindi, which employs distinct morphological marking for progressives and (habitual) imperfectives (Bhatt, 1999), cannot on de Swart’s view apply unmarked coercion operations to turn processes into (progressive) states; this seems to be empirically upheld. The presence of an overt progressive marker then explains why imperfective marking has no progressive interpretation in Hindi. In French, however, which lacks overt progressive, we expect PROG to be a possible realization of $C_{ns \rightarrow s}$, the class of coercion operators that map eventive (non-stative) predicates to stative predicates.

predicate will be ungrammatical or uninterpretable. This is how de Swart's system accounts, for instance, for the unacceptability of certain stative predicates under the English progressive (analyzed as an aspectual transition operator which maps non-stative to stative predicates): none of the available operations in the $C_{s \rightarrow ns}$ class offer a pragmatically sensible realization of *Nima be tall* as an eventive predicate.

(6.12) ??Nima is being tall.

Where the English progressive transition is sensitive to the distinction between stative and eventive predicates (see also Smith 1991), de Swart argues that the French perfective¹³ and imperfective markers are instead sensitive to the distinction between quantized and homogeneous predicates. These restrictions can be determined by examining the possible combinations of aspect and predicate types, and considering the common features of the output in each case. De Swart argues that perfective sentences always describe events, and imperfective sentences describe either states or processes, regardless of the properties of the input predicates to which they apply.

- | | | | | | | |
|--------|----|---------------------------------|---------|--------|----|----------------------|
| (6.13) | a. | <i>Anne a été triste.</i> | ≡ (6.6) | (6.14) | a. | <i>Juno a couru.</i> |
| | | ‘Anne was-PFV sad.’ | | | | ‘Juno ran-PFV.’ |
| | b. | <i>Anne était triste.</i> | | | b. | <i>Juno courait.</i> |
| | | ‘Anne was-IMPF sad.’ | | | | ‘Juno ran-IMPF.’ |
| (6.15) | a. | <i>Ludo a traversé la rue.</i> | | | | |
| | | ‘Ludo crossed-PFV the street.’ | | | | |
| | b. | <i>Ludo traversait la rue.</i> | | | | |
| | | ‘Ludo crossed-IMPF the street.’ | | | | |

In (6.13), the predicate of states (*Anne be sad*) is reinterpreted under the perfective, but not under the imperfective. As we saw in Section 6.1.2 (example 6.6), the default

¹³Perfective aspect, for de Swart is represented by the French simple past (*passé simple*); since this has largely been supplanted by the *passé composé*, I assume that her judgements apply to the usage of the *passé composé* that we are interested in.

interpretation under perfective marking will be one on which (6.13a) describes a maximal event of Anne's being sad. Under the imperfective in (6.13b), no properties change. The process predicate in (6.14) (*Juno run*) shows the same behaviour: the perfective example (6.14a) defaults to a maximal interpretation, but the imperfective interpretation does not force any changes. Conversely, an underlying predicate of events, *Anne cross the street* simply returns a completed event in which Anne crossed the street under perfective marking, but turns into an ongoing (and not necessarily completed) process of crossing the street under the imperfective

No coercion need apply if the perfective is given an input with the right features: this is what happens in (6.15a). On the other hand, if we feed the perfective marker the 'wrong' type of eventuality predicate, as in (6.13a), a coercion operation is triggered between the predicate and the aspectual marker. In this case, the operation required is $C_{h \rightarrow q}$, which takes a homogeneous predicate and returns a quantized one. There are two particularly salient ways to do this, corresponding to the inchoative and maximal interpretations discussed in Section 6.1.2. The maximal reading will result if $C_{h \rightarrow q}$ is realized as the coercion operator BOUND, while the inchoative interpretation is produced if $C_{h \rightarrow q}$ is realized instead as INCHO.

(6.16) Two realizations of $C_{h \rightarrow q}$: (de Swart, 1998, p.383)

- a. BOUND is a function from $S \cup P$ to E which maps state/process descriptions onto event descriptions in such a way that the event consists of a bounded, quantized portion of the state/process.
- b. INCHO is a function from $S \cup P$ to E which maps state/process descriptions onto event descriptions in such a way that the event describes the onset of the state or process. This interpretation generates the entailment that the state/process holds after the inchoative event.

The choice of a specific operation is determined on the basis of both linguistic and extra-linguistic context. This explains why the default interpretation for (6.13a) changes with modification by *soudain* ('suddenly'). On the assumption that this adverb favours punctual predicates, it will, together with the perfective aspect, trigger the INCHO realization of $C_{h \rightarrow q}$.

(6.9) *Soudain, Anne a été triste.*

‘Suddenly, Anne was-PFV sad.’

$\equiv \text{PST}(\text{PFV}(C_{h \rightarrow q}(\text{Anne be sad suddenly})))$

$\longrightarrow \text{PST}(\text{PFV}(\text{INCHO}(\text{Anne be sad suddenly})))$

Interpretation: At some time before utterance time, Anne suddenly started to feel sad.

For imperfective sentences with underlyingly quantized predicates, the coercion operator $C_{q \rightarrow h}$ is triggered. One realization of this corresponds to the progressive, introduced by PROG. An alternative is the habitual interpretation: this corresponds to the operator HAB.

(6.17) Two realizations for $C_{q \rightarrow h}$: (de Swart, 1998, p.383)

- a. PROG is a function from $E \cup P$ to S which maps eventive descriptions onto stative descriptions in such a way that the state describes the process or event as being in progress. For event predicates, the progressive sentence is interpreted as a development which would eventually lead to a culmination point (although that need not be reached in the real world).
- b. HAB is a function from $E \cup P \cup S$ to S which maps eventuality descriptions onto state descriptions. HAB functions like an implicit adverb of quantification similar to *always*, and is interpreted as a default operator (universal quantification unless there is evidence to the contrary).

In line with the empirical observations in Section 6.1.2, PROG will be selected in a context like (6.11a), where the temporal adverbial indicates that some particular instance is being discussed. By contrast, a context like (6.11b), where the temporal adverbial renders a progressive interpretation nonsensical, will instead select for HAB.

(6.11) a. *À dix heures, Jean faisais ses courses chez l'épicier du coin.*

‘At ten o'clock, Jean got-IMPF his groceries at the store on the corner.’

$\equiv \text{PST}(\text{IMPF}(C_{q \rightarrow h}(\text{Jean get groceries})))$

$\longrightarrow \text{PST}(\text{IMPF}(\text{PROG}(\text{Jean get groceries})))$

Interpretation: At ten o'clock, Jean was in the process of getting his groceries at the corner store.

- b. *Dans sa jeunesse, Jean faisais ses courses chez l'épicier du coin.*

'In his youth, Jean got-IMPF his groceries at the store on the corner.'

$\equiv \text{PST}(\text{IMPF}(\text{C}_{q \rightarrow h}(\text{Jean get groceries})))$

$\longrightarrow \text{PST}(\text{IMPF}(\text{HAB}(\text{Jean get groceries})))$

Interpretation: During his youth, Jean regularly got his groceries at the corner store.

The coercion approach to aspectual interpretation is motivated by the goal of preserving a single semantic analysis for each of the perfective and imperfective operators, while simultaneously accounting for the variable interpretations of aspectually marked predicates. De Swart's approach achieves this by attributing reinterpretation operations to the selection restrictions of perfective and imperfective operators. To govern this process, she draws on Moens and Steedman's idea that coercion cannot occur with complete freedom, but must be triggered; that is, reinterpretation can only take place in cases where a mismatch between the aspectual class features of an input predicate and the selection requirements of an aspectual operator requires a 'repair' operation. This gives us a principled and natural explanation for the absence of certain interpretations. For instance, we never observe an inchoative interpretation for event predicates under the perfective aspect:

- (6.18) *Soudain, Ludo a écrit une lettre.*

'Suddenly, Ludo wrote-PFV a letter.'

\nrightarrow Suddenly, Ludo began to write a letter.

(6.18) can never be used to describe a situation in which the sudden event was one in which Ludo sat down to write her letter, but the letter itself took an extended period of time. The only interpretation for (6.18) involves the entire letter-writing event being treated as sudden: since writing a letter is usually not a brief undertaking, this interpretation requires some contextual support. Since the inchoative interpretation is *a priori* more plausible than the actual interpretation, these facts are rather puzzling in the absence of a trigger requirement

for aspectual coercion. However, if inchoative coercion can only apply in case of a feature mismatch between the input predicate and the perfective aspect, we have an immediate explanation for the absence of the intended inchoative interpretation.

The last task in developing a coercion analysis is to formalize the actual coercion operations. Although de Swart provides the structure for a compositional coercion account, along with clear descriptions of the coercion operators which lead to the observed interpretations, she falls short of offering full semantic analyses for these reinterpretation operators. The next step, therefore, is to translate her descriptions into formal semantic representations.

Refining the coercion account: Bary (2009)

In her account of aspectual interpretation in Ancient Greek, Bary (2009) provides the type of formal representation we are interested in. En route to developing her coercion operators, however, she raises two objections to the aspectual coercion analysis as it stands; I discuss these, and Bary's refinements to the approach, before proceeding to formalization.

As discussed above, the 'trigger' requirement is central to the success of a coercion approach, allowing us to make clear predictions about when and where coercion will apply. This does important work in explaining why certain types of reinterpretation are blocked, such as the inchoative interpretation for (6.18), above, despite the fact that these interpretations might, as in (6.18) be pragmatically plausible.

Bary points out, however, that the trigger requirement leads to trouble when we consider the available interpretations for process predicates under imperfective marking. Since the imperfective selects for homogeneous predicates on the current analysis, neither state nor process predicates should ever undergo reinterpretation when combined with the imperfective. This prediction is not upheld: as the examples in (6.19) show, imperfectively marked process predicates can give rise to habitual interpretations.

(6.19) a. *Dans sa jeunesse, Juno courait.*

'In her youth, Juno ran-IMPF.'

Interpretation: There was a past period during which Juno was young and in

which she had the habit of running.

- b. *Quand j'étais petit, je ne dormais pas bien.* (Bary, 2009, p.53)

‘When I was-IMPF young, I did not sleep-IMPF well.’

Interpretation: The past period during which I was young was one in which I regularly slept badly.

If we eliminate the trigger requirement to allow coercion in these cases, we lose an explanation for the letter-writing example (6.18). We might get around this by simply stipulating that inchoative interpretations are only available for homogeneous predicates, but since – as noted – they are often pragmatically plausible for event predicates, this is not a very satisfactory explanation.

To deal with this problem and maintain the benefits of a trigger requirement, Bary posits an additional means by which coercion can be triggered: incompatibility between the durational properties of an input predicate as opposed to what is contributed by its modifiers. In order to motivate a durational trigger, she points out that the pragmatic reasoning which leads us to prefer a habitual to an ongoing reading for a process predicates is essentially the same as the reasoning which favours habitual over progressive coercion in the case of imperfectly marked event predicates like (6.11b).

- (6.11b) *Dans sa jeunesse, Jean faisais ses courses chez l'épicier du coin.*

‘In his youth, Jean got-IMPF his groceries at the store on the corner.’

$\equiv \text{PST}(\text{IMPF}(\text{C}_{q \rightarrow h}(\text{Jean get groceries})))$

$\longrightarrow \text{PST}(\text{IMPF}(\text{HAB}(\text{Jean get groceries})))$

Interpretation: During his youth, Jean regularly got his groceries at the corner store.

The choice of HAB over PROG in this example is associated with the intuition that the duration of Jean’s youth is significantly longer than the standard duration associated with a single grocery-shopping event.¹⁴ In other words, the pragmatic information governing the

¹⁴It is worth pointing out that this is precisely the type of reasoning employed in Chapter 1, in order to disambiguate the actualized or abilitative interpretations of English *was able* claims.

choice in (6.11b) is about *duration* – and, in particular, about the relative duration of the reference interval (Jean’s youth) and typical eventualities of (Jean) getting groceries.

‘Untriggered’ habitual interpretations for the process predicates in (6.19) arise for similar reasons. While the process predicate *Juno run* is, in terms of aspectual class features, compatible with imperfective marking, we know that Juno’s youth is an implausibly long time for her to have been engaged in a single, continuous process of running. Similarly, outside of fairy-tale contexts, one typically does not sleep for years at a time, pushing us to prefer a habitual interpretation of (6.19b) over the ‘ongoing’ interpretation made available by a direct application of the imperfective aspect. Thus, in each of (6.11b), (6.19a), and (6.19b), the choice of a habitual interpretation is associated with information about the typical length of eventualities in the denotation of the input predicates, as compared to the duration of the salient reference interval, which – as a result of imperfective marking – must be contained within the runtime of the described eventuality.

Bary follows Egg (2005) in adopting a **duration principle** as the coercion trigger which accounts for interpretations like (6.19a) and (6.19b):

(6.20) **Duration principle.** (Egg, 2005, p.189)

Semantic constructions may only combine expressions if they do not introduce conflicting information on the duration of an eventuality.

Egg takes the Duration Principle (6.20) to be a constraint on interpretation which, in addition to influencing cases of aspectual coercion (as in example 6.11b), can also trigger reinterpretations/coercion operations on its own.¹⁵ He formalizes this by encoding information about temporal granularity as part of the representation of various expressions (for details, see Egg, 2005, pp.192–197). For Bary, and for the current account, the crucial point is that the ‘imperfective’ coercion operators, HAB and PROG, both have an effect on the typical duration of the eventualities in the denotations of the predicates to which they apply – HAB renders a typically short eventuality type compatible with a longer interval, while

¹⁵ “[The Duration Principle] is not part of aspectual semantics itself but functions as a constraint on the range of feasible reinterpretations within the realm of aspect. The reason for this is that aspectual reinterpretations often change the typical duration involved in the affected predicates” (Egg, 2005, p.191).

PROG tends to shorten the length of associated eventualities.¹⁶

Adopting the Duration Principle as a coercion trigger thus obviates the need to posit selectional restrictions for the imperfective aspect in the first place. Bary regards this as a positive outcome, since, as she points out, there is no obvious reason why the grammatical aspects, as ‘viewpoint’ operations, or relations between event and reference times, should have selectional restrictions in the first place.¹⁷

There is, of course, some natural affinity between quantized predicates and a perfective marker which effectively ‘bounds’ eventuality time within reference time: however, since a feature of homogeneous predicates is that they contain subevents with the same description, there is no *a priori* reason why the perfective could not simply locate bounded subeventualities of larger unbounded eventualities within reference time. No ‘completion’ inference would be expected to arise in this case. We saw this, in fact, in Section 6.1.2: from the standpoint of the interpretation system, nothing goes wrong in the direct composition of *Anne be sad* with the perfective aspect. Nevertheless, this does not produce the empirically observed interpretation, and is evidently blocked for some reason.

(6.6) *Anne a été triste.*

‘Anne was-PFV sad.’

a. (6.6) \equiv PST(PFV(*Anne be sad*))

¹⁶Principle (6.20) not only explains the habitual interpretations in (6.19a) and (6.19b), but also makes sense of the observation that the temporal modifier *soudain/suddenly* favours an inchoative (as opposed to a maximal) reinterpretation for atelic predicates under perfective marking. Assuming that *soudain/suddenly* picks out relatively short reference intervals, a coercion operator like INCHO, which shortens the duration associated with a predicate, will be a more compatible choice than MAX, which, by definition, selects eventualities in the predicate which are as long as possible. Adopting the Duration Principle as a constraint on aspectual interpretation may also provide an explanation of the apparent unavailability of perfective (completed) propositions in the present tense; see Wurmbrand (2014) for a discussion and alternative account of these restrictions.

¹⁷Bary notes the following claim to the contrary from Gerö and von Stechow (2003) about the inclusion relation assigned to the imperfective:

“As a consequence, the embedded Vendlerian Aktionsart must have the subinterval property. If the VP expresses a state or an activity, this raises no problems. But if it is an accomplishment or achievement, we must stativize it by means of a semantic operation ...”

Gerö and von Stechow (2003, p.263)

They offer no deeper explanation for this claim, however.

- b. $\llbracket (6.6) \rrbracket^{w^*} = \llbracket \text{PST}(\text{PFV}(\lambda w \lambda e. \text{sad}(A)(w)(e))) \rrbracket^{w^*}$
 $= \exists e[\tau(e) \subseteq t\{t \prec_i t^*\} \wedge \text{sad}(A)(w^*)(e)]$
- c. *There is a past time interval t such that t contains the runtime of a real-world eventuality of Anne being sad.*
- d. \neq *There is a past interval t such that t contains a complete (maximal) event of Anne's being sad.*

Similarly, when we try to combine event predicates with the imperfective aspect, there is no reason why reference time cannot simply be included within event time, as long as the predicate of eventualities which describes the relevant event does not exclusively pick out punctual eventualities. In the absence of a selectional restriction, we would predict progressive/ongoing interpretations for quantized predicates under the imperfective aspect, but would fail to account for the emergence of habitual readings.

Since the Duration Principle offers us an independent explanation for the habitual interpretation of an example like (6.11b), it eliminates the need to associate a selectional restriction with imperfective aspect. However, the Duration Principle does not help us explain reinterpretation processes under perfective marking. In particular, if we assume that the perfective aspect lacks a selectional restriction, then nothing explains the absence of an inchoative interpretation for quantized predicates like *Ludo write a letter* in (6.18). Similarly, nothing should force a maximal interpretation for stative predicates, as we see in (6.6).

In fact, Bary uses this last point to motivate a selectional restriction for the perfective aspect. Without restrictions, applying the perfective aspect to homogeneous predicates would give rise to interpretations that are indistinguishable from the interpretation of homogeneous predicates under the imperfective aspect, obviating the use of perfective in these cases (and, as noted in Section 6.1.2, effectively erasing the primary contribution of perfective marking). A selectional restriction, which restricts the perfective to quantized predicates, avoids this

situation. In essence, this account takes the restriction to represent something like a grammaticalization or lexicalization of a pragmatic strengthening operation.¹⁸ The restriction forces ‘specialization’: since the perfective *can* identify discrete (maximal) entities, whereas the semantics of the imperfective cannot, the perfective becomes specialized to the former function, which cannot be achieved by other means.

Having motivated the selection restrictions of the perfective aspect, and adopted the Duration Principle in (6.20) as a potential coercion trigger, the coercion analysis of aspectual interpretation does what we want. First, it allows us to maintain a single analysis for each of the perfective and imperfective aspects. Secondly, it offers a principled way of linking the input and output features of eventuality descriptions under aspectual marking, as well as of predicting the distribution of available and unavailable interpretations. Finally, from de Swart, we have a system which explains the compositional process of coercion, while leaving room for the influence of pragmatic considerations in the interpretation process. The only task that remains, then, is to complete the compositional picture by specifying the semantic contribution of the coercion operators.

Semantics for MAX, INCHO, and HAB

Bary formalizes maximal, inchoative, and habitual coercion operators within the framework of Compositional Discourse Representation Theory (Muskens, 1996). The formalizations I provide here are influenced by her proposals, but modified to the current framework and presented in static form.

We have already seen one way of formalizing a MAX operation (de Swart’s BOUND), in Section 6.1.2. Adding the maximality constraint directly to the perfective aspect was not a viable option, since it ruled out empirically-observed inchoative readings. However, if this constraint is applied as a coercion operator, independently of the temporal semantics of the perfective, it does exactly what we want.

¹⁸Providing some support for this idea, the restriction of the perfective to quantized predicates may be language-specific: Mucha (2015), for instance, observes that stative predicates under perfective marking in Hausa and Medumba are compatible in certain contexts with imperfective-style interpretations.

$$(6.21) \quad \llbracket \text{MAX} \rrbracket := \lambda w \lambda P \lambda e. [P(w)(e) \wedge \forall e' : e \sqsubset e' \rightarrow \neg P(e')(w)]$$

(6.22) shows how this works. The mismatch between perfective aspect and the homogeneity of *Anne be sad* triggers a coercion operation in the $C_{h \rightarrow q}$ family, which is resolved in this context as MAX, resulting in the truth conditions in (6.22b).

$$(6.22) \quad \textit{Hier, Anne a été triste.} \quad \equiv (6.6)$$

‘Yesterday, Anne was-PFV sad.’

- a. $(6.22) \equiv \text{PST}(\text{PFV}(C_{h \rightarrow q}(\text{Anne be sad yesterday})))$
 $\rightarrow \text{PST}(\text{PFV}(\text{MAX}(\text{Anne be sad yesterday})))$
- b. $\llbracket (6.22) \rrbracket^{w^*, \text{yest}} = \llbracket \text{PST}(\text{PFV}(\text{MAX}(\lambda w \lambda e. \text{sad}(A)(w)(e)))) \rrbracket^{w^*, \text{yest}}$
 $= \llbracket \text{PST}(\text{PFV}(\lambda w \lambda e [\text{sad}(A)(e)(w) \wedge \forall e' : e \sqsubset e' \rightarrow \neg \text{sad}(A)(e')(w)])) \rrbracket^{w^*, \text{yest}}$
 $= \exists e [\tau(e) \subseteq (t = \text{yest}) \{t \prec_i t^*\} \wedge$
 $\quad [\text{sad}(A)(e)(w^*) \wedge \forall e' : e \sqsubset e' \rightarrow \neg \text{sad}(A)(e')(w^*)]]$
- c. *There is an eventuality contained within yesterday such that that eventuality is a maximal eventuality of Anne being sad in the actual world.*

For INCHO, the idea is to map a set of eventualities in the extension of a predicate to the set of associated ‘begin’ eventualities. Begin eventualities for a predicate P can be defined as those whose runtime is the initial bound of an interval that is the runtime of a P eventuality. De Swart’s INCHO in (6.16b) expresses a similar idea. More specifically, given a predicate P , the begin eventualities we want are those that transition from a time that is not contained in the runtime of a P -eventuality to a time that is in the runtime of a P -eventuality. Thus, we first need to filter for maximal P -eventualities, and then collect their left bounds. As defined below, INCHO picks out the transition points as punctual events; thus, since process predicates may not be true at a temporal point, I do not require that the output eventualities match the original description.¹⁹

¹⁹ An alternative approach would pick out the smallest initial subeventualities of maximal P -eventualities: I use (6.23) in this chapter, but the choice of that representation over (i) does not represent any theoretical commitments. Use of the minimum operation in definitions (6.23) and (i) assumes that the temporal traces of state and process eventualities are closed temporal intervals; we might also replace MIN with GLB, the greatest lower bound operation to avoid making this assumption.

$$(6.23) \quad \llbracket \text{INCHO} \rrbracket := \lambda w \lambda P \lambda e. [\tau(e) = \text{MIN}(\{\tau(e') | P(e')(w) \wedge \forall e'' : e' \sqsubset e'' \rightarrow \neg P(e'')(w)\})]$$

Thus, INCHO returns a predicate of eventualities e for which the temporal trace of e is the initial point of a maximal eventuality in P . The derivation for (6.9) is given in (6.24): in this case, $C_{h \rightarrow q}$ is realized as INCHO.

$$(6.24) \quad \textit{Soudain, Anne a été triste.} \quad \equiv (6.9)$$

‘Suddenly, Anne was-PFV sad.’

- a. $(6.24) \equiv \text{PST}(\text{PFV}(C_{h \rightarrow q}(\text{Anne be sad suddenly})))$
 $\rightarrow \text{PST}(\text{PFV}(\text{INCHO}(\text{Anne be sad suddenly})))$
- b. $\llbracket (6.24) \rrbracket^{w*} = \llbracket \text{PST}(\text{PFV}(\text{INCHO}(\lambda w \lambda e. \text{sad}(A)(w)(e)))) \rrbracket^{w*}$
 $= \llbracket \text{PST}(\text{PFV}(\lambda w \lambda e. [\tau(e) =$
 $\text{MIN}(\{\tau(e') | \text{sad}(A)(w)(e') \wedge \forall e'' : e' \sqsubset e'' \rightarrow \neg \text{sad}(A)(w)(e''))\})] \rrbracket^{w*}$
 $= \exists e [\tau(e) \subseteq t \{t \prec_i t^*\} \wedge$
 $\tau(e) = \text{MIN}(\{\tau(e') | \text{sad}(A)(w^*)(e') \wedge \forall e'' : e' \sqsubset e'' \rightarrow \neg \text{sad}(A)(w^*)(e'')\})]$
- c. *There is an eventuality contained within a salient past interval such that the runtime of that eventuality is the initial point of a maximal real-world eventuality of Anne being sad.*

Finally, Bary offers a definition of HAB that takes a predicate P and returns a predicate of eventualities e such that, for every contextually-relevant subinterval of the runtime of e , there is an eventuality in the denotation of P . The output eventualities do not themselves satisfy P , and there are at least two different contextually relevant subintervals, thus ensuring that output eventualities contain ‘gaps’ with respect to P . The only modification I make to HAB is to relax the quantification from every contextually-relevant subinterval to most contextually-relevant subintervals; this does not represent a strong commitment.²⁰

(i) $\llbracket \text{INCHO}' \rrbracket := \lambda w \lambda P \lambda e. [P(w)(e) \wedge \forall e_1 : e_1 \sqsubset e \rightarrow \neg P(e_1)(w) \wedge$
 $\text{MIN}(\tau(e)) = \text{MIN}(\{\tau(e_2) | P(e_2)(w) \wedge \forall e_3 : e_2 \sqsubset e_3 \rightarrow \neg P(e_3)(w)\})]$

²⁰See Deo (to appear) for an overview of recent approaches to the imperfective aspect, including a proposal for uniting the habitual and progressive interpretations under a single lexical entry.

$$(6.25) \quad \llbracket \text{HAB} \rrbracket := \lambda w \lambda P \lambda e [\llbracket \text{MOST}(t) \subset \tau(e) : \text{C-rel}(t) \rightarrow \exists e' : t = \tau(e') \wedge P(w)(e') \rrbracket \wedge \\ \neg P(w)(e) \wedge \exists t', t'' \subset \tau(e) : \text{C-rel}(t'), \text{C-rel}(t'') \wedge t' \neq t'']]$$

(6.26) derives a habitual interpretation of the event predicate *Jean get groceries* under imperfective marking.

(6.26) *Jean faisait ses courses.*

‘Jean got-IMPF groceries.’

$$a. (6.26) \equiv \text{PST}(\text{IMPF}(\text{C}_{q \rightarrow h}(\text{Jean get groceries})))$$

$$\longrightarrow \text{PST}(\text{IMPF}(\text{HAB}(\text{Jean get groceries}))))$$

$$b. \llbracket (6.26) \rrbracket^{w*} = \llbracket \text{PST}(\text{IMPF}(\text{HAB}(\lambda w \lambda e. \text{get-groc}(J)(w)(e)))) \rrbracket^{w*}$$

$$= \llbracket \text{PST}(\text{IMPF}(\lambda w \lambda e.$$

$$[\text{MOST}(t) \subset \tau(e) : \text{C-rel}(t) \rightarrow \exists e' : t = \tau(e') \wedge \text{get-groc}(J)(w)(e')] \wedge$$

$$\neg \text{get-groc}(J)(w)(e) \wedge \exists t', t'' \subset \tau(e) : \text{C-rel}(t'), \text{C-rel}(t'') \wedge t' \neq t'') \rrbracket^{w*}$$

$$= \exists e [\tau(e) \supset t \{ t \prec_i t^* \} \wedge$$

$$[\text{MOST}(t') \subset \tau(e) : \text{C-rel}(t) \rightarrow \exists e' : t = \tau(e') \wedge \text{get-groc}(J)(w^*)(e')] \wedge$$

$$\neg \text{get-groc}(J)(w^*)(e) \wedge \exists t', t'' \subset \tau(e) : \text{C-rel}(t'), \text{C-rel}(t'') \wedge t' \neq t'']]$$

c. *There is an eventuality e containing a salient past interval such that most of the contextually-relevant temporal intervals within the runtime of e correspond to the runtime of an eventuality of Jean getting groceries and such that e is not itself an eventuality of Jean getting groceries and there are at least two separate contextually-relevant subintervals during the runtime of e .*

This is a bit technical, but ultimately gives us what we want: the eventuality instantiated by the imperfective aspect is one in which Jean gets groceries at ‘relevant’ subintervals, but which does not comprise a single eventuality of continuous grocery-getting.

The semantics of the imperfective operator, as defined, since they include the reference time within event time, will naturally give rise to an ‘ongoing’ interpretation without further coercion or modification. I set aside the definition of a progressive (coercion) operator here, and return to this in the discussion of progressive interpretations with *enough/too*

constructions.

6.2.3 Instantiative coercion

With this framework in hand, let us return to the central goal: establishing a coercion operator which accounts for the ‘instantiated’ interpretations of dynamic adjective state predicates like *Juno be fast*. To review the narrative so far: in Chapter 5, I argued that the *enough/too* constructions which generate implicative inferences and entailments are exactly the subset of those circumstantial *enough/too* constructions involving dynamic adjectives in which temporal overlap between the matrix and complement clauses supports a causal interpretation of the relationship between the matrix property and the realization of the complement. In particular, I argued that this relationship is not just one of necessity, but also of causal sufficiency, insofar as the matrix property attributes to the sentential subject the capacity to perform an action – characterized by the dynamic adjective – which, at the point of occurrence, is taken to be the last necessary event for bringing about the complement’s realization. Evaluating a claim like (4.5a) with respect to a causal circumstantial modality, then, establishes that Juno’s capacity for speed is such that, from the perspective of the reference time, all causally-optimal worlds in which Juno manifests her speed in a salient action (presumably running), are ones in which performing this action guarantees that she wins the race.

(4.5a) Juno was fast enough to win the race.

Assuming the real world is maximally causally normal, then, we have that if Juno manifests her speed, it will bring about the realization of the *enough* complement. Thus, an ‘implicative’ *enough/too* constructions will entail its complement just in case the matrix clause is interpreted as describing a manifestation of the matrix adjective, instead of being understood as simply attributing the capacity for such actions. The possibility of this type of interpretation is peculiar to dynamic adjectives, since these are specifically those adjectives/properties which are inherently associated with actions.

On this view, the key to explaining the aspect-driven nature of *enough/too* implicative

entailments is to establish a connection between the eventive ‘manifestation’ interpretation and the use of the perfective aspect. In section 5.6 of Chapter 5, I suggested that, while English attributions like *Juno be fast* are ambiguous between eventive and stative readings, combining overt perfective marking with a dynamic adjective attribution forces an ‘instantiated’ interpretation, thus producing an implicative-style complement entailment as a consequence of the backgrounded causal sufficiency relationship.

We can now see more clearly how this works. The perfective aspect contributes to semantic interpretation by containing the runtime of the ‘speed’ event within its scope. In addition to this, following the coercion analyses of Moens and Steedman, de Swart, and Bary, the perfective encodes a selectional restriction for quantized predicates of eventualities. When the perfective is combined with a homogeneous predicate, this restriction triggers a coercion operation in the $C_{h \rightarrow q}$ family, as long as a pragmatically sensible operation is available.

Dynamic adjective attributions are homogeneous predicates, and thus trigger coercion operations under the perfective aspect.²¹ The issue we now face, of course, is that while we have established the existence of two coercion operators in the $C_{h \rightarrow q}$ group, and provided explicit representations for these operations, neither MAX nor INCHO will produce an interpretation for (5.100b) which describes an event of Juno instantiating her speed.

(5.100b) *Juno a été rapide.*

‘Juno was-PFV fast.’

MAX simply returns a maximal eventuality of the original predicate – which in this case would be a maximally-extended state of Juno having the capacity to manifest speed. INCHO would return a begin eventuality of Juno’s having this capacity. While there are certainly contexts in which perfective dynamic adjective attributions might get either of these readings, neither gives us the meaning we are after. What we need, therefore, is

²¹To see that dynamic adjective attributions are homogeneous – in fact, stative – we observe that they are *fully divisive*, as per clause (i) of Definition 6.2: for a predicate like *Juno be fast*, we have that every subinterval of an eventuality of Juno’s having the capacity to perform fast actions is also an eventuality of Juno’s having this capacity.

a new coercion operator, which modifies dynamic-adjective predicates by shifting them to manifestations of the capacity established by the stative predicate. I refer to this new operator as **instantiative** coercion, representing it by INST, as indicated in Chapter 5. Since its successful application evidently depends on the availability of a ‘manifestation’ of the basic stative property – not a possible reading, for instance, *Nima be tall* – we can see already that it will be limited in its applicability as a coercion operator, working on just those predicates which can be interpreted as conveying actionable capacities.

While instantiative coercion has not featured prominently in treatments of aspectual coercion, there is ample evidence for its existence. Moens, for instance, observes that the availability of stative predicates in the English progressive is “determined by the ease with which one can think of the state as having successive stages;” that is, the ease with which one can recover from the state a heterogeneous or dynamic reading (Moens 1987, pp.80–82; see also Sag 1973). Bary makes a similar point, attributing the acceptability of (6.27a) versus (6.27b) to the ready availability of actions associated with (or describable as) being funny, while no such action springs to mind for *be tall*.

- (6.27) a. Nima was being funny. → *Nima was doing something funny.*
 b. *Nima was being tall.

Goldsmith and Woisetschlaeger also allude to the existence of instantiative coercion, noting that in pairs like (6.28), “the non-progressive characterizes a person; the progressive reports on behaviour” (1982, p.85; observation first attributed to Jespersen 1909[1949]).²²

- (6.28) a. Alvin is polite. (as a general fact about Alvin)

²²Goldsmith and Woisetschlaeger suggest that the use of the progressive in examples like (6.28b) gives rise to an “implication of insincerity,” to the effect that, while what Alvin is doing at the moment referred to might have the character of politeness, the speaker may not necessarily wish to commit to characterizing Alvin himself as polite. I would characterize this implication instead as a version of the upcoming cessation inference that is often associated with the progressive. In the property attribution cases we are interested in, we can see that this is in fact an effect associated with the ‘dynamicization’ of an underlyingly stative predicate: while *Juno was fast*, meant statively, indicates a general ability of Juno’s, the eventive reading of *Juno was fast* has no ‘generalized ability’ implication. This evidently parallels the alternation seen with *be able* and ability modal ability attributions and discussed in Chapters 1 and 2, on which a general ability interpretation contrasts with episodic, actualized interpretations which do not license inferences about repeatability or consistency.

- b. Alvin is being polite. (e.g., by giving up his subway seat)

Indeed, although she does not discuss it in the body of the paper, de Swart (1998) offers in an appendix an informal definition of a coercion operator called DYNAMIC:

- (6.29) DYNAMIC is a function from S to $P \cup E$ which maps state descriptions onto dynamic descriptions in such a way that the state is presented as a process or event that the agent is actively involved in.

DYNAMIC seems to be the same coercion operator we are after (although, by defining it as a function from S to $P \cup E$, de Swart includes it in the class $C_{s \rightarrow ns}$, rather than $C_{h \rightarrow q}$). Notably, it links dynamic interpretations to the involvement of an agent, to whom actionable capacities can be attributed. Both (6.27a) and the perfective example (6.30) describe eventualities (ongoing and complete, respectively), in which Nima was the agent of some (past) action (telling a joke, doing an impression) that can itself be described as funny. The dynamic instantiation of *Nima be funny* is precisely this action: being funny, on the eventive reading, is doing something that is funny. DYNAMIC captures this at the descriptive level, but does not make it clear how we might implement it formally.

- (6.30) *Nima a été drôle.* \rightarrow *Nima did something funny.*
 ‘Nima was-PFV funny.’

Discussion of instantiative (dynamic) coercion appears on the whole to have been limited to its effect as triggered by the English progressive. As far as I am aware, Homer (2011) is the first to point out that this type of predicate reinterpretation also occurs under perfective marking. His examples include the following:

- (6.31) a. *La maison a coûté 100,000 euro.* \vdash The house was bought.
 ‘The house cost-PFV 100,000 euro.’
 b. *La maison coûtait 100,000 euro.* \nvdash The house was bought.
 ‘The house cost-IMPF 100,000 euro.’

- (5.100a) *Jean a eu du tact.* \vdash Jean acted tactfully.
 ‘Jean had-PFV tact.’
- (6.32) *Jean a été intelligent.* \vdash Jean did something intelligent.
 ‘Jean was-PFV intelligent.’

Homer characterizes the coercion operator involved in (6.31a), (5.100a), and (6.32) as applying to stative predicates to yield a reading on which “the existence of some pragmatically determined event is entailed” (2011; p.111). He calls this **actualistic** coercion, proposing to capture it with the following operator:

$$(6.33) \quad \llbracket \text{ACT} \rrbracket := \lambda w \lambda P_{et} \lambda Q_{et} \lambda e. Q(e) \wedge e \text{ in } w \wedge \forall e' [e' \sqsubset e \rightarrow \neg Q(e')] \wedge \\ \exists e'' [P(e'') \wedge \tau(e) = \tau(e'')]$$

Here, P is the original stative predicate, while Q is treated as a free variable, whose value, according to Homer, is set by the context. As a result, ACT filters P -eventualities for just those which also verify the salient predicate Q . The third conjunct in (6.33) requires that Q is quantized. Finally, the eventualities in the denotation of the output predicate must also be contemporaneous with some eventuality in the denotation of the original predicate P .

While ACT represents a start on the operator we are after, I believe that it is too general as a potential definition of INST. Looking at the progressive examples (6.27a), (6.28b), and the perfective cases (6.30), (6.31a), (5.100a), and (6.32), we can see that there is a tight connection between the ‘pragmatically determined’ event and the original predicate, in that, while an eventive interpretation of, e.g., *Nima be funny* might be an event of joke-telling, it is also, in itself, an event of actively being funny by virtue of telling a joke. In other words, the pragmatically-determined event is not completely free, but must also be the sort of event that can reasonably be characterized by the original predicate. This is, presumably, what the requirement that eventualities in the denotation of $\text{ACT}(P)$ be contemporaneous with eventualities in the denotation of P is aiming at. However, this requirement fails to enforce any non-temporal connection between the two eventualities, including the idea that eventualities returned by coercion should not only be describable by Q , but also in some sense be describable by P in virtue of the Q description.

The absence of a non-temporal connection has an undesirable consequence.²³ While Homer observes that not all stative predicates are candidates for actualistic (instantiative) coercion, he does not indicate what the restrictions might be, or how they are determined. The discussion in Chapters 4 and 5 suggests that instantiative coercion is limited to the class of stative predicates which involve dynamic properties (or, more broadly, stative predicates in contexts where they can be taken to refer to exercisable properties). Nothing about ACT captures this, however. In particular, there is no *a priori* reason why ACT, as defined, should not apply to static adjectival predicates, just in case the context provides a possible referent for *Q*. But this is precisely the sort of context offered by a static adjective *enough/too* constructions like (4.82), which are unacceptable.

(4.82) **/?Nima a été assez grand pour atteindre l'étagère du haut.*

‘Nima was-PFV tall enough to reach the topmost shelf.’

Here, the linguistic context itself provides a salient event: Nima’s reaching the shelf. Since *Nima be tall* is stative, and thus fully divide, and since we also take height to be stable as a property of individuals, the proposed event of shelf-reaching will coincide with a state of being d_{nec} tall. Thus, if ACT is an available coercion operation, we expect the mismatch between *Nima be tall* and the requirements of the perfective aspect to be resolved on a reading which entails that Nima reaches the shelf. There is no such reading, however. (4.82) remains infelicitous even in contexts which establish that Nima did in fact reach the shelf. Moreover, it is infelicitous for the same reason that (6.27b) is infelicitous: there is no recoverable event which itself is characterized by tallness/height. It is difficult to imagine what sort of action might satisfy this requirement for *Nima be tall*.

Actualistic coercion, then, cannot be the instantiative operator we are after. DYNAMIC comes closer in spirit, insofar as it specifies that eventualities in the predicate returned by coercion should present the original stative property itself as an eventive (dynamic, non-stative) property. There is one other attempt to formulate an instantiative coercion operator

²³Actually, for Homer, this is a feature of the account, not a bug. This is because he attributes the actuality entailments of ability modals directly to actualistic coercion, arguing that the modal preajacent represents a pragmatically-supplied event which can satisfy the requirements of ACT. Such a resolution would be analogous to the unavailable reading of (4.82), below.

in the literature, appearing briefly in Egg (2005, p.130). Egg suggests that the reinterpretation involved in the progressive reading of *Charlotte be silly* – described as meaning that Charlotte was *acting* silly – involves MAX. The idea, attributed partly to Herweg (1990), is that maximal states of silliness presuppose intervals of non-silliness, thus capturing the notion (cf. Goldsmith and Woisetschlaeger 1982) that the progressive interpretation of stative predicates licenses an inference that the predicate does not hold as a general (individual-level) characterization of the sentential subject. The problem with this approach, however, is that there is no need for maximal phases of the *stative* interpretation of *Charlotte be silly* to be picked out by instantiative coercion: Charlotte may be silly, as a general or persistent feature of her character, while also only acting silly at specific times. We do not want the instantiative operator to entail the cessation of the stative description at the end of the runtime of the relevant non-stative eventuality. This is even clearer with an example like (6.32), where an event of Jean’s active cleverness – thinking up a solution to a problem, saying something smart – does not entail that he is not, as a general characterization, intelligent. I am not, of course, saying that the cessation inference cannot hold, only that it need not do so, and that we therefore do not want to encode it as a requirement of instantiative coercion.

What emerges from this discussion is the idea that dynamic adjective predicates at some level simply have both an eventive and a stative meaning, which stand in a particular relationship with one another. Consider *fast*, in a predicate like *Juno be fast*. The stative interpretation, annotated by $fast_s$, attributes to Juno the capacity to perform actions – the nature of which may be influenced by context, as per Homer – which are in the denotation of the eventive interpretation, $fast_{ns}$:

$$(6.34) \quad \llbracket fast_s \rrbracket := \lambda w \lambda e \lambda x. \Diamond \exists e' [e' \sqsubseteq e \wedge fast_{ns}(w)(e') \wedge AGENT(e') = THEME(e) = x]$$

(6.34) is a first attempt at capturing this relationship, and will presumably bear refinement.

While the type of relationship indicated in (6.34) is the sort we have been interested in, in looking at predicates like *be silly*, *be funny*, *be smart*, *be fast*, which are attributed in their stative version to animate individuals, instantiative coercion also seems to be at

work in Homer’s example (6.31). The relationship between a hypothetical $cost_s$ and $cost_{ns}$ will necessarily differ from the relationship in (6.34). However, a house that (statively) costs 100,000 euros will, similarly to (6.34), have the possibility of participating in an event of active costing (e.g., an event in which 100,000 euros are paid for the house). What is common to these two relationships is the idea that the eventive interpretation acts as a witness for the stative description – an eventuality satisfying the eventive description is, necessarily, also an eventuality in the denotation of the stative description. Let us assume a relation, WITNESS between predicates of eventualities, such that if WITNESS(Q , P), we have that P holding of an eventuality licenses the description Q for that eventuality. Assuming WITNESS, I propose (6.35) as a provisional definition of INST. To ease readability, I encode the quantization requirement with QUANT.

$$(6.35) \quad \llbracket \text{INST} \rrbracket := \lambda w \lambda Q \lambda P \lambda e. \exists e' [e \sqsubseteq e' \wedge Q(e)(w) \wedge \text{QUANT}(Q) \wedge P(e')(w) \wedge \text{WITNESS}(Q, P)]$$

The idea behind (6.35) is to define INST so that it takes in a stative predicate with an internal structure that is compatible with the witness relation, and returns a predicate of (sub)eventualities of the eventualities in the original predicate such that the output eventualities have an eventive description licensing the input stative description. As formulated, INST remains somewhat imprecise, but is intended to allow the eventive description some degree of freedom – since, for instance, an eventive interpretation of *Juno be fast* might involve Juno running quickly or Juno repairing cars quickly, depending on context. I leave a more precise refinement of this for future work.

We may wish to make one other refinement to INST. The requirement that Q be quantized was adopted directly from Homer’s proposal for ACT; however, referring back to de Swart’s DYNAMIC, we see that this, by contrast, belongs to the coercion class $C_{s \rightarrow ns}$, which sends stative to non-stative (not necessarily quantized) predicates. While it is true that the perfective aspect does select for quantized predicates, we already have operators which map from homogeneous to quantized predicates – MAX, for instance. The key feature of instantiative coercion is that it picks out the active – dynamic – interpretation of a stative predicate.

Thus, we do not necessarily want to force it to return a quantized predicate, simply a non-stative one. This also accommodates the role of instantiative coercion under (covert or overt) progressive marking, which does not necessarily require (and by some analyses does not accept; e.g., Moens and Steedman 1988) quantized inputs. As a consequence of making this modification we have to assume that, if necessary, coercion operators can be ‘stacked’: while we have not looked at any formal examples of this, it seems to be in the spirit of Moens and Steedman’s aspectual transition network. Moreover, it allows us to define a single instantiative coercion operator, rather than having two operators, one shifting stative predicates to quantized predicates and the other shifting them simply to dynamic predicates (which would in many cases be redundant).²⁴ This would give us the following revised definition for instantiative coercion, using STAT to stand in for the full expression of stativity given in Definition (6.2); I call this INST’ to distinguish it from the operation which returns a quantized predicate of eventualities.

$$(6.36) \quad \llbracket \text{INST}' \rrbracket := \lambda w \lambda P \lambda Q \lambda e. \exists e' : e \sqsubseteq e' \wedge Q(e)(w) \wedge \neg \text{STAT}(Q) \wedge P(e')(w) \wedge \text{WITNESS}(Q, P)$$

Let’s see how the original proposal, INST, works in a simple example involving a dynamic adjective predicate. Suppose (6.30) is applied in a context in which Nima has told a joke. We assume that Q , in this case, picks up the predicate *tell a joke*. Applying INST to (6.30), we get the following:

$$(6.30) \quad \text{Nima a été drôle.}$$

‘Nima was-PFV funny.’

- a. $(6.30) \equiv \text{PST}(\text{PFV}(\text{C}_{s \rightarrow q}(\text{Nima be funny})))$
 $\longrightarrow \text{PST}(\text{PFV}(\text{INST}(\text{Nima be funny}_s)))$
- b. $\llbracket (6.30) \rrbracket^{w*} = \llbracket \text{PST}(\text{PFV}(\text{INST}(\lambda w \lambda e. \text{funny}_s(N)(w)(e)))) \rrbracket^{w*}$

²⁴More generally, a full theory of coercion operators might, like the transition network, require that coercion operators change only one aspectual feature at a time. This would require the stacking of coercion operators, but in a principled way, which would further constrain the types of coercion available.

$$\begin{aligned}
&= \llbracket \text{PST}(\text{PFV}(\lambda w \lambda e. [\exists e' [e \sqsubseteq e' \wedge Q(e)(w) \wedge \text{QUANT}(Q) \wedge \\
&\quad \text{funny}_s(N)(e')(w) \wedge \text{WITNESS}(Q, \text{funny}_s)])) \rrbracket^{w*} \\
&= \exists e [\tau(e) \subseteq t \{t \prec_i t^*\} [\exists e' [e \sqsubseteq e' \wedge Q(e)(w^*) \wedge \text{QUANT}(Q) \wedge \\
&\quad \text{funny}_s(N)(e')(w^*) \wedge \text{WITNESS}(Q, \text{funny}_s)]]]
\end{aligned}$$

c. *There is a salient past time t such that there is an event of Q contained in t in w^* , and e is a subeventuality of an eventuality of Nima being funny_s and Q is a witness for Nima be funny_s.*

\rightarrow *There is an eventuality contained within a salient past time such that it is an eventuality of Nima telling a joke, where Nima tell a joke is a witness for Nima be funny_s.*

\sim *There is a complete past event of Nima exercising the capacity to be funny by telling a joke.*

Thus, assuming that the context supplies a relevant referent for Q , INST produces the interpretation we are after. Of course, this is not the only possible reinterpretation for dynamic adjective predicates under the perfective aspect. I assume, based on the fact that INST can only apply to predicates which are able to enter into the ‘witness’ relationship, that instantiative coercion is a default for dynamic adjective/capacity predicates, applied in the absence of contextual cues selecting for, e.g., INCHO or MAX.

6.3 Actuality inferences from *enough* and *too* constructions

Now that we have developed a treatment of aspect, and provided a (provisional) representation for the crucial instantiative operator, I reexamine the predictions made for implicative inferences and entailments of causal *enough/too* constructions.

6.3.1 Complement entailments under the perfective aspect

We first consider the effect of instantiative coercion on the central cases: implicative *enough/too* constructions under perfective marking. We can already see how this is going to work: since

the perfective aspect coerces an instantiation of dynamic predicates in cases like (6.30), the event resulting from instantiative coercion in an *enough/too* construction with a dynamic adjective ADJ_d will be one in which the subject manifests ADJ_d of (at least as great as, or less than, depending on the polarity of the adjective) degree d_{nec} , where d_{nec} is as defined in Chapter 5.

Let us see how this works with a familiar example. (4.32a) decomposes as in (6.37a), triggering a coercion operator which can map the stative predicate supplied by the sentence radical to a quantized predicate.

$$(6.37) \quad \text{Juno a été assez rapide pour gagner la course.} \quad \equiv (4.32a)$$

‘Juno was-PFV fast enough to win the race.’

$$\begin{aligned} \text{a. } (4.32a) &\equiv \text{PST}(\text{PFV}(C_{s \rightarrow q}(\text{Juno be fast enough to win the race}))) \\ &\rightarrow \text{PST}(\text{PFV}(C_{h \rightarrow q}(C_{s \rightarrow ns}(\text{Juno be fast enough to win the race})))) \\ &\rightarrow \text{PST}(\text{PFV}(\text{MAX}(\text{INST}'(\lambda w \lambda e. (\text{SPEED}(J)(w) \geq d_{\text{nec}})(e))))), \text{ where} \\ d_{\text{nec}} &= \iota d : \forall w' \in \text{C-OPT}_{\mathcal{D}}(w) [\text{SPEED}(J)(w') < d \rightarrow \neg \text{win-race}(J)(w')] \end{aligned}$$

Since PFV selects for quantized predicates, this triggers a coercion operator which can map a stative predicate to a quantized one. We have three options: MAX, INCHO, and INST – or rather, INST', coupled with MAX. Let us assume, in addition, that the predicate Q supplied by the context is *run*. With INST', the truth conditions of (4.32a) are given by (6.38):

$$\begin{aligned} (6.38) \quad \text{a. } \llbracket (4.32a) \rrbracket^{w*} &= \llbracket \text{PST}(\text{PFV}(\text{MAX}(\text{INST}'(\lambda w \lambda e. (\text{SPEED}(J)(w) \geq d_{\text{nec}})(e)))) \rrbracket^{w*} \\ &= \llbracket \text{PST}(\text{PFV}(\text{MAX}(\lambda w \lambda e. [\exists e' [e \sqsubseteq e' \wedge Q(e)(w) \wedge \neg \text{STAT}(Q) \wedge \\ &\quad (\text{SPEED}(J)(w) \geq d_{\text{nec}})(e') \wedge \text{WITNESS}(Q, \text{SPEED}(J) \geq d_{\text{nec}})])) \rrbracket^{w*} \\ &=_{Q \rightarrow \text{run}} \llbracket \text{PST}(\text{PFV}(\text{MAX}(\lambda w \lambda e. [\exists e' [e \sqsubseteq e' \wedge \text{run}(J)(e)(w) \wedge \\ &\quad (\text{SPEED}(J)(w) \geq d_{\text{nec}})(e') \wedge \text{WITNESS}(\text{run}(J), \text{SPEED}(J) \geq d_{\text{nec}})])) \rrbracket^{w*} \\ &= \llbracket \text{PST}(\text{PFV}(\lambda w \lambda e. [\exists e' [e \sqsubseteq e' \wedge \text{run}(J)(e)(w) \wedge \forall e'' \sqsupset e, \neg \text{run}(J)(w)(e'') \wedge \\ &\quad (\text{SPEED}(J)(w) \geq d_{\text{nec}})(e') \wedge \text{WITNESS}(\text{run}(J), \text{SPEED}(J) \geq d_{\text{nec}})])) \rrbracket^{w*} \\ &= \exists e. [\tau(e) \subseteq t\{t \prec_i t^*\} \wedge [\exists e' [e \sqsubseteq e' \wedge \text{run}(J)(e)(w^*) \wedge \forall e'' \sqsupset e, \neg \text{run}(J)(w^*)(e'') \\ &\quad \wedge (\text{SPEED}(J)(w^*) \geq d_{\text{nec}})(e') \wedge \text{WITNESS}(\text{run}(J), \text{SPEED}(J) \geq d_{\text{nec}})]]] \\ &\text{where } d_{\text{nec}} = \iota d : \forall w \in \text{C-OPT}_{\mathcal{D}}(w^*) [\text{SPEED}(J)(w) \geq d \leftrightarrow \text{win-race}(J)(w)] \end{aligned}$$

- b. (4.32a) \sim *There is an event e contained in some salient past interval such that e is a maximal event of Juno running at a speed at least as great as d_{nec} , where d_{nec} is the speed whose instantiation is causally necessary and causally sufficient for Juno to win the race.*

We saw that *enough/too* constructions can only behave in an implicative fashion in case there is temporal overlap between the matrix and complement clause: this is because temporal separation rules out the possibility of a causal relationship. Thus, assuming that the temporal specification of the matrix clause of (4.32a) overlaps with the specification of the complement clause – that is, assuming that the race time overlaps with matrix clause time – it will be within the bounded runtime of the instantiation of speed that is at least d_{nec} . Moreover, since the entailed instantiation of speed is bounded, the causal relationship ensures that it is bounded by the end of the race. Since (4.32a), additionally, backgrounds the causal sufficiency of the instantiation for a race win, the truth conditions for (4.32a) in (6.38) give us that all of the maximally causally normal worlds in which an instantiation of speed (of at least d_{nec}) occurs are ones in which Juno wins the race. As we can see from (6.38), instantiative coercion entails that the actual world is one in which the instantiation occurs. Thus, if the real world is causally optimal, it must also be one in which Juno wins the race. Additionally, since the temporal overlap situates the end of the race within the bounded instantiation of speed, it also follows that Juno’s win takes place in the past of utterance time, as desired.

In the reverse direction, the negation of *Juno be fast enough to win the race* also returns a predicate which establishes Juno’s capacity for actions characterized by speed; in this case, however, by a speed of less than d . Thus, if *Juno be d-fast* is stative, $\text{NEG}(\text{Juno be } d\text{-fast})$ is also a stative predicate, and triggers coercion under perfective marking.

$$(6.39) \quad \text{Juno n’a pas été assez rapide pour gagner la course.} \quad \equiv (5.1c\text{-ii})$$

‘Juno was-PFV not fast enough to win the race.’

- a. (5.1c-ii) $\equiv \text{PST}(\text{PFV}(C_{s \rightarrow q}))(\text{NEG}(\text{Juno be fast enough to win the race}))$

$$\begin{aligned}
\text{b. } \llbracket (5.1\text{c-ii}) \rrbracket^{w^*} &\equiv \exists e [\tau(e) \subseteq t\{t \prec_i t^*\} \wedge \\
&\quad [\exists e' [e \sqsubseteq e' \wedge \text{run}(J)(e)(w^*) \wedge \forall e'' \sqsupset e, \neg \text{run}(J)(w^*)(e'') \wedge \\
&\quad (\text{SPEED}(J)(w^*) < d_{\text{nec}})(e') \wedge \text{WITNESS}(\text{run}(J), \text{SPEED}(J) < d_{\text{nec}})]]] \\
&\quad \text{where } d_{\text{nec}} = \text{id} : \forall w \in \text{C-OPT}_{\mathcal{D}}(w^*) [\text{SPEED}(J)(w) \geq d \leftrightarrow \text{win-race}(J)(w)]
\end{aligned}$$

Instantiative coercion, in this case, will return a manifestation of speed less than d_{nec} , the speed that is necessary for winning the race. Thus, while the presupposition associated with causal *enough/too* constructions establishes that Juno's instantiation of speed is the last thing in question for the realization of her race win, (5.1c-ii) establishes that Juno manifests a speed that is less than what is required. In other words, the causally necessary condition for race-winning is not satisfied, and the causally normal developments of this situation establish that Juno does not win the race.

As noted, instantiative coercion is not the only option for dynamic predicates under perfective marking. The aspectual coercion account, moreover, emphasizes the influence of context in determining how predicates are reinterpreted when coercion is triggered. Thus, this account of *enough/too* implicative inferences predicts that there should be contexts in which some other coercion operator is preferred to INST, lifting the entailment. This prediction is upheld.

In Section 6.2, we saw that modification with *soudain* ('suddenly') privileges an inchoative reinterpretation of stative predicates under perfective aspect – due in part, presumably, to the role of the Duration Principle (6.20).

(6.9) *Soudain, Anne a été triste.*

'Suddenly, Anne was-PFV sad.'

$\equiv \text{PST}(\text{PFV}(C_{h \rightarrow q}(\text{Anne be sad})))$

$\longrightarrow \text{PST}(\text{PFV}(\text{INCHO}(\text{Anne be sad})))$

Interpretation: At some time before utterance time, Anne suddenly began to be sad.

The same thing happens when we modify an otherwise implicative *enough/too* construction with *soudain* ('suddenly').²⁵ With inchoative coercion, (6.40) returns the following interpretation:

(6.40) *Olga a soudain été assez forte pour soulever un frigo.*

'Olga was-PFV suddenly strong enough to lift a fridge.'

a. (6.40) \equiv PST(PFV($C_{h \rightarrow q}$ (Olga be strong enough to lift a fridge)))

\longrightarrow PST(PFV(INCHO(Olga be strong enough to lift a fridge)))

b. $\llbracket (6.40) \rrbracket^{w^*} =$

$\exists e[\tau(e) \subseteq t\{t \prec_i t^*\} \wedge \tau(e) = \text{MIN}(\{\tau(e') \mid (\text{STRENGTH}(O)(w^*) \geq d_{\text{nec}})(e') \wedge$

$\forall e'' : e' \sqsubset e'' \rightarrow \neg(\text{STRENGTH}(O)(w^*) \geq d_{\text{nec}})(e'')\}$

where $d_{\text{nec}} = \text{id} : \forall w \in \text{C-OPT}_{\mathcal{D}}(w^*)[\text{STRENGTH}(O)(w) \geq d \leftrightarrow \text{lift-fridge}(O)(w)]$

c. *There is an eventuality contained within a (short) salient past interval which is the initial point of a maximal eventuality of Olga being at least d_{nec} strong, where d_{nec} is the degree of strength whose manifestation is causally necessary and causally sufficient for Olga to lift a fridge.*

This is the empirically-observed interpretation for (6.40), and does not generate the entailment that Olga lifted a fridge.

Similarly, if a particular time interval is supplied, the MAX reading may instead be triggered: since MAX returns locally maximal eventualities of the original predicate, this establishes a locally maximal eventuality of Olga's capacity for instantiating at least the necessary strength for lifting a fridge, and no *enough/too* entailment is predicted.

(6.41) *Pendant deux heures ce matin, Olga a été assez forte pour soulever un frigo.*

'For two hours this morning, Olga was-PFV strong enough to lift a fridge.'

²⁵In Chapter 2, we saw that the introduction of *soudain* ('suddenly') has a similar effect on perfectly marked ability attributions, eliminating the expected actualization in favour of an inchoative interpretation:

(2.45) *Olga a soudain pu soulever un frigo, mais elle ne l'a pas fait.*

'Olga could-PFV suddenly lift a fridge, but she did not do it.'

Interpretation: Olga suddenly developed the capacity for fridge-lifting, but she did not exercise this capacity.

Interpretation: This morning contained a maximal state of Olga having the necessary strength for lifting a fridge.

Finally, aspectual coercion also explains the interpretation we noted in Chapter 5 for (4.52): the inference that Amira has (within reference time) just reached the minimum legal drinking age is a consequence of inchoative aspectual coercion, inducing a begin eventuality of the state of being at least d_{nec} (21, for instance) years old.

(4.52) *Amira a été assez grande pour boire de l'alcool.*

‘Amira was-PFV old enough to drink alcohol.’

Interpretation: Amira became old enough to drink alcohol.

A static adjective construction like (4.82) can also be interpreted under the perfective aspect if we provide a context which supports an inchoative interpretation:

(4.82) **/?Nima a été assez grand pour atteindre l'étagère du haut.*

‘Nima was-PFV tall enough to reach the topmost shelf.’

(6.42) *L'année dernière, Nima a été enfin assez grand pour atteindre l'étagère du haut.*

‘Last year, Nima was-PFV finally tall enough to reach the topmost shelf.’

Interpretation: Last year, Nima finally became tall enough to reach the topmost shelf.

(6.42) suggests that, during the last year, Nima finally grew (became) tall enough to reach the top shelf: thus, that last year contains a (bounded) begin eventuality of Nima being the height d_{nec} required to reach the shelf. While there are also conceivable contexts in which a MAX reading is supported, this is less likely as a coercion option for these cases, because the positive polarity of the matrix adjective in both (4.52) and (4.82) means that the matrix clause attributes to the sentential subject a value for ADJ which is greater than or equal to d_{nec} ; typically, one does not decrease in either height or age, meaning that there is no obvious upper bound for the state supplied by the matrix predicate.

Turning to English, finally, we recall the observation from Section 5.6 of Chapter 5 that

the interpretation of dynamic adjective predicates is systematically ambiguous between an eventive and a stative interpretation.

(5.102) Juno was fast.

- a. *Eventive*: Juno did (something) fast/quickly.
- b. *Stative*: Juno had the capacity to do (something) fast/quickly.

Certain contexts seem to favour eventive readings, producing implicative inferences when dynamic adjectives appear in *enough/too* attributions. This is the case, for instance, in (6.43), where the context provides a reference time during which running events (by Juno or otherwise) were taking place. Other contexts, such as the context for *Marja be strong enough* in (6.44), support the stative reading, indicating simply that Marja was a strong swimmer in her youth, but not necessarily that she ever swam across Lake Nokomis.²⁶

(6.43) At the track meet last week, Juno was fast enough to win the 5K, ?but she didn't win/?but she didn't run.

(6.44) When she was young, Marja was strong enough to swim across Lake Nokomis, but she always swam in Lake Harriet instead.

Assuming, after Moens and Steedman, de Swart and Bary, that aspectual coercion needs to be triggered, this ambiguity suggests that, despite the lack of overt aspectual marking, English does have aspectual operators. If (6.43) is taken to involve a (covert) perfective marker, then the input requirements of perfective aspect will trigger coercion, and instantiative coercion will give us the implicative interpretation. The presence of an aspectual marker can be supported or indicated by particular types of temporal modification. However, since there is no overt way of fixing the marking, there is no entailed reading on which the matrix clause represents the causally-sufficient manifestation of the dynamic adjective. In (6.43), the context makes a cancellation of the implicative inference pragmatically odd

²⁶Compare (6.44) with the case of a general ability attribution in (1.6) from Chapter 1:

(1.6) In her twenties, Marja was able to swim across Lake Nokomis, but she always chose to do laps of Lake Harriet instead.

(or at least surprising), but not outright contradictory: the lack of overt aspectual marking, then, is responsible for the across-the-board defeasibility of *enough/too* implicative inferences in English.

6.3.2 Complement cancelability under imperfective marking

Analyzed as underlyingly stative, no coercion needs to take place for any *enough/too* predicate to combine with imperfective marking. With static circumstantial constructions like (5.3a), the imperfective aspect can simply apply directly, returning a state of Nima being at least d_{nec} tall, which extends past the reference time.

(5.3a) *Nima était assez grand pour atteindre l'étagère du haut.*

‘Nima was-IMPF tall enough to reach the top shelf.’

$\equiv \exists e[\tau(e) \supseteq t\{t \prec_i t^*\} \wedge (\text{HEIGHT}(N)(w^*) \geq d_{\text{nec}})(e)]$, where

$d_{\text{nec}} = \iota d : \forall w \in \text{CIRC}(w^*)[\text{HEIGHT}(N)(w) < d \rightarrow \neg \text{reach-shelf}(N)(w)]$

\sim *There is an eventuality containing a salient past time t such that it is an eventuality of Nima having the necessary height to reach the top shelf.*

‘Implicative’ (dynamic adjective) constructions look the same at first glance. In the positive direction, (5.1b-i) indicates that a state of Juno having the capacity for speeds greater than or equal to d_{nec} held at the reference time. This is parallel to the static case because, while she has the capacity to perform the action presumed to be causally sufficient, nothing entails that she either performs this action, or was in a position to do so.

(5.1b-i) *Juno était assez rapide pour gagner la course.*

‘Juno was-IMPF fast enough to win the race.’

$\equiv \exists e[\tau(e) \supset t\{t \prec_i t^*\} \wedge (\text{SPEED}(J)(w^*) \geq d_{\text{nec}})(e)]$, where

$d_{\text{nec}} = \iota d : \forall w \in \text{C-OPT}_{\mathcal{D}}(w^*)[\text{SPEED}(J)(w) < d \rightarrow \neg \text{win-race}(J)(w)]$

\sim *There is an eventuality containing a salient past time which is an eventuality of Juno having the capacity to manifest a speed at least as great as the speed (whose manifestation is) causally sufficient and necessary to win the race.*

The background assumption is that events in the world are causally connected in such a way that, when Juno is in the position to manifest her speed, it will be the last necessary (and therefore also sufficient) cause of her winning the race. Since no manifestation is entailed, this assumption does not have any force here. In other words, the relevant background situation s for the causal modality in (5.1b-i) is not forced to be one in which all other necessary conditions for the *enough* complement are satisfied. This explains the availability of cancellations like (4.75), seen in Chapters 4 and 5.

(4.75) *Juno était assez rapide pour gagner la course, mais elle n'avait pas le droit de participer.*

‘Juno was-IMPF fast enough to win the race, but she was not allowed to participate.’

In (4.75), while we do, as usual, assume that we are in a causally optimal world, we need not be in a causally optimal world in which Juno wins the race (or even in one in which we get to the point at which she can manifest her speed). It remains the case that the causally normal worlds accessible from the initiation time of the eventuality in (4.75) are such that all those in which Juno wins the race are ones in which she not only has speed greater than or equal to d_{nec} but moreover has manifested it. Imperfective marking does not rule out that we are in a causally-normal race-winning world, but it does not require it. Thus, if some other necessary condition for Juno’s race win is not met, as in (4.75), we infer that she does not manifest the speed that she has the capacity for, and thus that she did not win the race.

In the negative cases, the inferences associated with static and dynamic *enough* constructions come apart. In (5.3b), the matrix assertion conveys that a (circumstantially) necessary condition for the complement was not met:

(5.3b) *Nima n'était pas assez grand pour atteindre l'étagère du haut.*

‘Nima was-IMPF not tall enough to reach the top shelf.’

$\equiv \exists e[\tau(e) \supseteq t\{t \prec_i t^*\} \wedge (\text{HEIGHT}(N)(w^*) < d_{\text{nec}})(e)],$ where

$d_{\text{nec}} = \text{id} : \forall w' \in \text{CIRC}(w)[\text{HEIGHT}(N)(w') < d \rightarrow \neg \text{reach-shelf}(N)(w')]$

~ There is an eventuality which contains a salient past time that is an eventuality of Nima being shorter than the minimum necessary height to reach the top shelf.

Thus, since Nima lacks the necessary height for shelf-reaching, we infer that he did not reach the shelf, as expected. We saw in Chapters 4 and 5 that this is not, on the whole, a defeasible inference. The only possible ‘cancellations’ involved cases like (4.84), in which the marked oddness is associated with the fact that the condition referred to in the matrix clause (Nima’s height as a stand-alone condition) is not the same as the height condition implicated in the cancellation.

(4.84) *?Nima n’était pas assez grand pour atteindre l’étagère du haut, mais avec un tabouret et en se tenant sur ses orteilles, il a réussi à l’atteindre.*

‘?Nima was-IMPF not tall enough to reach the top shelf, but by using a stepstool and standing on his toes, he managed to reach it.’

On the other hand, negative inferences in dynamic adjective constructions do appear to be defeasible:

(5.1b-ii) *Juno n’était pas assez rapide pour gagner la course.*

‘Juno was-IMPF not fast enough to win the race.’

$\equiv \exists e[\tau(e) \supset t\{t \prec_i t^*\} \wedge (\text{SPEED}(J)(w^*) < d_{\text{nec}})(e)]$, where

$d_{\text{nec}} = \text{id} : \forall w \in \text{C-OPT}_{\mathcal{D}}(w^*)[\text{SPEED}(J)(w) < d \rightarrow \neg \text{win-race}(J)(w)]$

~ There is an eventuality containing a salient past time which is an eventuality of Juno’s having the capacity to manifest a speed strictly less than the speed (whose manifestation is) causally sufficient and causally necessary to win the race.

At face value, this is puzzling, because – just as in (5.3b) – the negative assertion conveys that Juno lacks the capacity for the speed that is necessary to win. Thus, we expect that, in the causally optimal worlds, Juno’s capacity for speed precludes that she wins the race. However, as we have seen, it is possible to follow a negative imperfective assertion like (5.1b-ii) with the claim that Juno did, in fact, win the race.

Let us consider one such cancellation of the negative inference, from Chapter 4:

- (4.76) a. Juno was not (really/actually) fast enough to win the race, but her competitors were ill that day, and ran unusually slowly.
- b. *Juno n'était pas (généralement) assez rapide pour gagner la course, ses concurrents étaient malades cette journée-là et ils ont couru lentement.*
- ‘Juno was not (ordinarily) fast enough to win the race, but her competitors were ill that day, and ran slowly.’

I observed that, in the English example, (4.76a), a modifier like *really*, *ordinarily*, or *actually* seems to be obligatory to license the continuation. This suggests that the cancellation is licensed in view of a habitual interpretation of the main claim: that is, that the ‘cancellable’ readings are ones on which the coercion operator HAB takes effect between the *enough/too* sentence radical and imperfective aspect.

- (6.45) *Juno n'était pas assez rapide pour gagner la course.*

‘Juno was-IMPF not fast enough to win the race.’

- a. (6.45) \equiv PST(IMPF(HAB(NEG(Juno be fast enough to win the race))))
- b. $\llbracket (6.45) \rrbracket^{w^*} = \exists e[\tau(e) \supset t\{t \prec_i t^*\} \wedge$
 $[[\text{MOST}(t) \subset \tau(e) : \text{C-rel}(t) \rightarrow \exists e' : t = \tau(e') \wedge (\text{SPEED}(J)(w^*) < d_{\text{nec}})(e')] \wedge$
 $\neg(\text{SPEED}(J)(w^*) < d_{\text{nec}})(e) \wedge \exists t', t'' \subset \tau(e) : \text{C-rel}(t'), \text{C-rel}(t'') \wedge t' \neq t'']],$
 where $d_{\text{nec}} = \text{id} : \forall w \in \text{C-OPT}_{\mathcal{D}}(w^*)[\text{SPEED}(J)(w) \geq d \leftrightarrow \text{win-race}(J)(w)]$
- c. *There is real-world eventuality e containing a salient past interval which is an eventuality of Juno regularly having the capacity to manifest a speed less than the speed whose manifestation is causally sufficient and causally necessary to win the race (at time t).*

The appearance of HAB is presumably triggered by the Duration Principle (6.20), since the underlying stative predicate (NEG(*Juno be fast enough to win the race*)) is directly compatible with the imperfective. Under the habitual interpretation, we have that the reference time is included within some longer state in which Juno, at a particular set of contextually-relevant intervals, lacked the capacity to manifest a speed of degree d_{nec} or

higher, and therefore to win the race. However, there is no reason why the reference interval for the cancellation is necessarily included in such a contextually-relevant (or regular) interval – indeed, in the examples in (4.76), the continuation suggests that unusual circumstances were in play in the particular context to which the reference time corresponds. Thus, the habitual reading is compatible with Juno’s having won the race during a particular (potentially unusual) interval, and no contradiction arises with respect to the main sentence.

The question, of course, is why a similar habitual interpretation does not have the same effect for static adjective constructions. I believe that the habitual interpretation here is blocked, essentially, by the nature of static properties. For instance, in (5.3b), the property – height – associated with the matrix adjective is a persistent, individual-level property. Typically, changes in the degree of this property associated with an individual move in the upwards direction alone. As a result, there is no reasonable habitual interpretation for a height attribution, since an individual’s height does not vary and return to a standard at regular intervals. On the other hand, as a capacity rather than an inherent physical property, speed can very well vary in both an upwards and a downwards direction over time. In fact, this variation is to be expected, which makes a habitual interpretation of a speed attribution quite natural. Similarly, while the height required to reach a fixed shelf should also remain constant over time, we generally expect that the precise speed required to win a race will vary over an extended time period. Thus, negative implicative inferences from dynamic adjective constructions are available on the basis of a habitual reading; they are not available for static adjective constructions because no such reading is plausible here.²⁷

Since, as noted earlier, English *enough/too* constructions are ambiguous between the relevant stative and eventive interpretations, nothing further needs to be said to explain the cancellability of negative implicative inferences, or the lack of positive inferences, in these cases: where an implicative inference is defeasible, we assume that the matrix clause involves imperfective aspect.

²⁷We may also note that the habitual reading is presumably triggered by a particularly long reference interval for the main clause, in particular since we do expect variations in speed and speed requirements over time. On the other hand, there is no particular length of time which need trigger a habitual interpretation for a height predicate, since we expect height, at least in adults, to remain constant for indefinitely long intervals.

Finally, this explanation has something in common with Bhatt’s (1999) and Hacquard’s (2005; 2006) genericity-based accounts of defeasible actuality inferences. However, the habitual coercion operator is distinct from GEN (as defined by Hacquard) in that it appeals to contextually relevant intervals, rather than to a set of ‘normal’ worlds.

$$(2.41) \quad \llbracket \text{GEN} \rrbracket := \lambda w \lambda p \lambda q. \forall w' [w' \in \text{NORM}(w) \wedge p(w')], q(w') \quad (\text{Hacquard, 2005})$$

HAB must be triggered, which accounts – in a way that the generic explanation does not – for the fact that dynamic adjective *enough/too* constructions show a defeasible inference pattern in the negative direction, while static adjective constructions do not. By appealing to habitual coercion, we can explain the observed inference patterns without introducing an additional layer of quantification. Ultimately, this analysis will also allow us to explain the contrast between implicative entailments and *enough/too* implicative inferences, which was a problem for the generic accounts as offered by both Bhatt and Hacquard. I discuss this in Section 6.3.4.

6.3.3 Progressive interpretations

Progressive under imperfective aspect

Certain imperfectively-marked *enough/too* constructions suggest the availability of a progressive interpretation. These are the cases in which a complement cancellation appears to involve an ‘interruption’ of the process normally expected to lead to the realization of the complement, as in (4.79): in Chapters 4 and 5, I compared these to instances of the imperfective paradox with accomplishment or other telic predicates under imperfective/progressive marking.

- (4.79) *Juno était assez rapide pour gagner la course, mais elle est tombée près de la ligne d'arrivée et n'a pas gagné.*

‘Juno was-IMPF fast enough to win the race, but she fell near the finish line, and did not win.’

Interpretation: Juno was running fast enough to win the race, but ...

On de Swart's coercion analysis, it would be difficult to see how such a reading might arise. Since stative predicates are assumed to be compatible with the imperfective aspect, nothing in the combination of *Juno be d_{nec} -fast* and the imperfective aspect should trigger a coercion operator: we expect simply to get an interpretation on which the reference interval for (4.79) is included within a state of Juno having the relevant capacity. With the Duration Principle in place, however, we can explain the existence of such interpretations as follows: the time during which a particular stative capacity typically holds is understood to be significantly longer than a single manifestation.²⁸ Thus, if the reference interval is particularly short, we might expect it to trigger an interpretation which reduces the typical duration associated with an instance of the stative predicate. In other words, a short reference interval could trigger a progressive interpretation of a dynamic adjective construction. This interpretation will only be available with dynamic adjective predicates since, as per Moens and Steedman and de Swart, the progressive operator requires an eventive (non-stative) predicate for its input. (6.17a) repeats de Swart's informal definition of the progressive operator. For de Swart, PROG is a 'free' (unmarked) transition in French, which does not have a dedicated progressive marker, but is only an available interpretation in the presence of overt progressive marking in English.²⁹

- (6.17a) PROG is a function from $E \cup P$ to S which maps dynamic eventuality descriptions onto state descriptions in such a way that the state describes the process or event as being in progress. For event predicates, the progressive sentence is interpreted as a development which would eventually lead to a culmination point (although that need not be reached in the real world).

On the progressive interpretation, then, a dynamic adjective attribution will first be

²⁸The contrast in duration is also reflected in the suggested relationship between stative and eventive dynamic adjective predicates, as given in (6.34).

(6.34) $[[fast_s]] := \lambda w \lambda e \lambda x. \Diamond \exists e' [e' \sqsubseteq e \wedge fast_{ns}(w)(e') \wedge AGENT(e') = THEME(e) = x]$

²⁹It is worth noting that, on this analysis, overt progressive marking is taken to have the same effect as the progressive coercion operator. This has a specific theoretical consequence: we do not take PROG to be a grammatical aspect operator in the sense of PFV and IMPF, but instead treat it as a general 'aspectual operator' whose primary function is to change certain features of a predicate of eventualities.

coerced, via INST', into a manifestation of the causally sufficient/causally necessary condition for the realization of the *enough/too* complement, and then interpreted as a 'progressive state' (Moens and Steedman 1988).

As we can see from (6.17a), the progressive maps from predicates of non-statives to predicates of statives. As a first attempt at formalizing this definition, Bary suggests (6.46), from Krifka (1998).³⁰

$$(6.46) \quad \llbracket \text{PROG}^K \rrbracket := \lambda P \lambda e. \exists e' : e \sqsubseteq e' \wedge P(e')$$

PROG^K takes a predicate of eventualities and returns a predicate describing subeventualities of the original set. Crucially, eventualities in the output denotation do not need to satisfy the original description.

In the absence of any selectional restrictions, the application of PROG^K to homogeneous predicates will be vacuous. This follows from the subinterval property of homogeneous predicates: any subeventuality of a state or process also corresponds to an eventuality in the denotation of the original predicate. This is not quite what we want for process predicates since it fails to remove maximal eventualities, which do not provide an 'ongoing' slice of the original eventuality. Bary suggests modifying the progressive operator to pick out non-final subeventualities of the original set. She simply introduces a non-final subeventuality relation, $\dot{\sqsubseteq}$, to represent this, but it is straightforward to define such a relation.

$$(6.47) \quad \forall e, e' \in \mathcal{E}, e \dot{\sqsubseteq} e' \text{ iff } e \sqsubseteq e' \wedge \exists t \in \tau(e') : t \notin \tau(e) \wedge \tau(e) \prec_i t$$

$$(6.48) \quad \llbracket \text{PROG} \rrbracket := \lambda w \lambda P \lambda e. \exists e' : e \dot{\sqsubseteq} e' \wedge P(w)(e')$$

If we wish to capture the empirical distribution of progressive readings using (6.48), we will need to add a selectional restriction. As noted by Vendler, the progressive selects for predicates of eventualities that have variable internal structure, and presents them as in the process of happening ("going on in time"; 1957, p.144); that is, PROG selects for non-stative

³⁰On Krifka's (1998) analysis of aspect, the grammatical aspects are taken to have the same type as coercion operators (in particular, are taken to be functions from predicates of eventualities to predicates of eventualities). Thus, PROG^K is in fact his proposal for the imperfective marking, and is paired with a perfective operator which contributes the semantics we have assigned to the MAX coercion operator here.

predicates. This restriction allows us to explain the incompatibility of overt progressive marking with static adjective predicates like *Nima be tall*, since stable properties do not have pragmatically sensible eventive interpretations in most contexts. If the progressive selects for eventive predicates, we also predict that dynamic adjective stative predicates will permit progressive interpretations, via the application of INST'. (6.27a) shows that this prediction is upheld.

- (6.27) a. Nima was being funny. \rightarrow *Nima was doing something funny.*
 b. *Nima was being tall.

In French, certain contexts seem to favour a progressive interpretation of dynamic adjective attributions under imperfective marking. This is to be distinguished from the ongoing interpretation available for dynamic adjective predicates under the direct application of imperfective marking. In the absence of PROG, imperfective marking returns an ongoing eventuality of, e.g., Juno's having the capacity to perform actions characterized by a certain speed. On a progressive interpretation, imperfective marking is associated with an ongoing, eventive instantiation of this capacity. The progressive interpretation is favoured in contexts that link the reference interval to a specific point in time, and in which the interval is relatively short. (6.49) shows how the progressive interpretation is derived, via the joint application of INST' and PROG. I assume again that the pragmatically-determined predicate is *run*.

- (6.49) (*Pendant les premières minutes,*) *Juno était assez rapide pour gagner la course.*

‘(During the first minutes,) Juno was-IMPF fast enough to win the race.’

Interpretation: During the first minutes, Juno was running fast enough to win the race.

- a. (6.49) \equiv PST(IMPF(PROG(INST'(Juno be fast enough to win the race))))
 b. $\llbracket (6.49) \rrbracket^{w*} = \llbracket \text{PST}(\text{IMPF}(\text{PROG}(\text{INST}'(\lambda w \lambda e. (\text{SPEED}(J)(w) \geq d_{\text{nec}})(e)))) \rrbracket^{w*}$
 $= \llbracket \text{PST}(\text{IMPF}(\text{PROG}(\lambda w \lambda e. [\exists e' : e \sqsubset e' \wedge Q(e)(w) \wedge \neg \text{STAT}(Q) \wedge$
 $(\text{SPEED}(J)(w) \geq d_{\text{nec}})(e) \wedge \text{WITNESS}(Q, \text{SPEED}(J)(w) \geq d_{\text{nec}})))) \rrbracket^{w*}$

$$\begin{aligned}
&=_{Q \rightarrow \text{run}} \llbracket \text{PST}(\text{IMPF}(\text{PROG}(\lambda w \lambda e. [\exists e' : e \sqsubset e' \wedge \text{run}(e)(w) \wedge \\
&\quad (\text{SPEED}(J)(w) \geq d_{\text{nec}})(e) \wedge \text{WITNESS}(\text{run}, \text{SPEED}(J)(w) \geq d_{\text{nec}})))] \rrbracket^{w*} \\
&= \llbracket \text{PST}(\text{IMPF}(\lambda w \lambda e. [\exists e'' : e \dot{\sqsubset} e'' \wedge [\exists e' : e'' \sqsubset e' \wedge \text{run}(e'')(w) \wedge \\
&\quad (\text{SPEED}(J)(w) \geq d_{\text{nec}})(e') \wedge \text{WITNESS}(\text{run}, \text{SPEED}(J)(w) \geq d_{\text{nec}})])]) \rrbracket^{w*} \\
&= \exists e [\tau(e) \supseteq t \{t \prec_i t^*\} \wedge [\exists e'' : e \dot{\sqsubset} e'' \wedge [\exists e' : e'' \sqsubset e' \wedge \text{run}(e'')(w^*) \wedge \\
&\quad (\text{SPEED}(J)(w^*) \geq d_{\text{nec}})(e') \wedge \text{WITNESS}(\text{run}, \text{SPEED}(J)(w^*) \geq d_{\text{nec}})]]], \\
&\text{where } d_{\text{nec}} = \iota d : \forall w \in \text{C-OPT}_{\mathcal{D}}(w^*) [\text{SPEED}(J)(w) \leftrightarrow \text{win-race}(J)(w)]
\end{aligned}$$

- c. *There is a real-world eventuality e containing a salient past time such that e is a non-final subeventuality of an eventuality which is an eventuality of Juno running at a speed at least as great as the causally necessary and causally sufficient speed to win the race.*

Explaining how this interpretation arises on a coercion theory requires a trigger along the lines of the Duration Principle (6.20), since there is no *a priori* feature mismatch between *Juno be fast enough to win the race* and the imperfective aspect.

Let us consider the result of (6.49) more carefully. At first glance, since (6.49) has Juno instantiating her speed, and thus performing the action that is causally necessary and causally sufficient to bring about a race win, it seems as if (6.49) should entail that she ultimately won the race. Examples like (4.79) show that no such entailment arises.

(4.79) *Juno était assez rapide pour gagner la course, mais elle est tombée près de la ligne d'arrivée et n'a pas gagné.*

‘Juno was-IMPF fast enough to win the race, but she fell near the finish line, and did not win.’

The acceptability of (4.79) on a progressive interpretation highlights the connection between non-implicative and non-actualized progressive uses of *enough/too* constructions, and the **imperfective paradox** associated with the interpretation of quantized (telic) predicates under the English progressive and under the imperfective aspect in languages lacking a

progressive marker. This comparison was mentioned in Chapter 4.³¹

‘Paradoxical’ interpretations of telic predicates are interpretations on which the culmination associated with a predicate does not necessarily obtain, even though this culmination is entailed under simple past or perfective marking. This is paradoxical in view of the requirement that the eventuality returned by PROG, as above, is contained within a larger eventuality meeting the full description of the original predicate.

- (6.50) a. Juri drew a circle. \vdash *Juri completed the circle.*
 b. Juri was drawing a circle. \nvdash *Juri completed the circle.*

Dowty (1979) suggests that paradox effects follow from intensionality in the denotation of the progressive operator:

- (6.51) **The semantics of the progressive.** (Proposal; Dowty, 1979, p.149)
 [PROG ϕ] is true at a pair $\langle I, w \rangle$ iff for some interval I' such that $I \subset I'$, and I is not a final subinterval for I' , and for all w' such that $w' \in \text{Inr}(\langle I, w \rangle)$, ϕ is true at $\langle I', w' \rangle$.

In (6.51), the pair $\langle I, w \rangle$ represents a temporal interval and a world (of evaluation); $\text{Inr}(\langle I, w \rangle)$ represents the set of **inertia worlds** that are exactly like the world w up to I , and which develop subsequently to I in “the ways most compatible with the past course of events” (Dowty 1979, p.148). That is, the inertia worlds are those which are identical to the world of evaluation until reference time, and which develop in the ‘normal’ or ‘expected’ fashion after that (see also Landman 1992). Incorporated into the definition in (6.48), this gives us (6.52), which establishes that the eventuality satisfying the original predicate of eventualities is instantiated in the set of inertia worlds at the time of the subeventuality and the world of evaluation.

- (6.52) $\llbracket \text{PROG}^D \rrbracket := \lambda w \lambda P \lambda e. \forall w' \in \text{Inr}(\langle \tau(e), w \rangle), \exists e' \dot{\sqsubset} e' \wedge P(e')(w)$

³¹More broadly, this comparison suggests a connection between *enough/too* constructions, ability predicates, and non-modal telic predicates. I discuss this further in Chapter 7.

The description of inertia worlds as ‘normal’ worlds is suggestive. Dowty further borrows a description from Lewis, calling these worlds ones in which the “natural course of events” takes place (Dowty 1979, p.148). Inertia worlds fit the description of Kratzer’s (2012[1981])’s *stereotypical worlds*; thus, following the discussion of causation and stereotypical modality in Chapter 5 (Section 5.5.2), we might equate $\text{Inr}(\langle t, w \rangle)$ with the set $\text{C-OPT}_{\mathcal{D}}(w)$ of **causally optimal worlds** (from the perspective of w at a particular time t , or with respect to a particular background situation). That is, it is natural to think of Dowty’s inertia worlds as the worlds in which events proceed as predicted by a context-sensitive dynamics.

This connection points to a potentially simplified explanation for the imperfective paradox. Since dynamic adjective *enough/too* predicates involve reasoning about causally optimal worlds, we do not need to intensionalize the progressive to explain Juno’s failure to win the race in (4.79). I repeat the truth conditions of the main claim, as in (6.49), below:

$$(6.49b) \quad \llbracket (6.49) \rrbracket^{w^*} = \exists e[\tau(e) \supseteq t\{t \prec_i t^*\} \wedge [\exists e'' : e \dot{\sqsubset} e'' \wedge [\exists e' : e'' \sqsubset e' \wedge \text{run}(e'')(w^*) \wedge (\text{SPEED}(J)(w^*) \geq d_{\text{nec}})(e') \wedge \text{WITNESS}(\text{run}, \text{SPEED}(J)(w^*) \geq d_{\text{nec}})]]],$$

where $d_{\text{nec}} = \text{id} : \forall w \in \text{C-OPT}_{\mathcal{D}}(w^*)[\text{SPEED}(J)(w) \leftrightarrow \text{win-race}(J)(w)]$

By presupposition, Juno’s manifestation of speed is sufficient for her to win the race in all of the causally optimal worlds, from the perspective of the background situation at the reference time. That is, all of the causally optimal worlds as determined by the background situation at reference time are such that, if we get to the point at which Juno manifests a speed of at least d_{nec} , she will win the race. The truth conditions in (6.49b) instantiate this speed, we have that, at reference time, Juno is running at the speed that is assumed, as per the dynamics, to guarantee her a win.

Crucially, however, the set of causally optimal worlds is determined by a background situation and a dynamics at a particular moment. Since the progressive interpretation of (6.49) points to a (presumably short) interval during which Juno is manifesting her speed – that is, to a point on the causal path from her instantiation to her win – all that we require is that the causally optimal worlds develop in a particular way based on the information at that point in time. In (4.79), entailment of the *enough* complement is blocked by means of

an interrupting or intervening event: that is, an event which affects the causal development of Juno's run, but which at least potentially was not expected or predictable from the point of view of the dynamics and background situation pair at the reference time.

I have been treating a dynamics as a contextual parameter, which forms part of the common ground in a discourse context. Thus, if the utterance time for an example like (4.79) is – as it must be – after the point at which the ‘intervention’ occurred, it seems reasonable to assume that the default dynamics ought to include the intervention. The suggestion I am making is that, under certain discourse conditions, the dynamics to which a speaker appeals in projecting the set of causally optimal worlds may instead be tied to the perspective of the reference time. If this suggestion is on the right track, then one potential discourse function for the progressive would be to indicate this type of perspective shift, and to pinpoint a particular moment at which new (causal) information was introduced which resulted in an update or change to the assumed dynamics.³²

Dowty's ‘inertia worlds’ analysis focuses on the imperfective paradox as it arises with accomplishment predicates like *John draw a circle*, as in (6.50). His treatment of these predicates involves breaking them down into a component involving the atomic relation CAUSE, and a component involving a BECOME relation, which I will not explain here. We have seen that the *enough/too* predicates we are interested in build in a causal modality, which captures the connection between a body ‘process’ and the culmination point, on a structure parallel to that of accomplishments. Thus, the preceding discussion of the imperfective paradox suggests that a similar solution might be found by replacing the CAUSE of Dowty by a causal dependence relation like causal sufficiency; this idea is in keeping with the treatment of *cause* and *make* proposed in Lauer and Nadathur (2018, 2019). Developing a complete explanation of the imperfective paradox along these lines is outside the scope of this project, and a comparison between this approach and analyses which argue against the idea that paradox effects are truly associated with ‘normality’ assumptions will have

³²A conceptually similar idea, on which the imperfective paradox is analyzed as an instance of the *frame problem* associated with objects that change gradually under the influence of external forces (Stenning and van Lambalgen, 2005; van Lambalgen and Hamm, 2005; Baggio and van Lambalgen, 2007), is discussed in Hamm and Bott (2018).

to await future work (see Ogihara, 1990; Bonomi, 1997; Naumann and Piñón, 1997, among others).

Progressive readings in English

It is also possible to use an interrupting or intervening event to preclude *enough/too* complement entailments in English, as demonstrated by (6.53).

- (6.53) Juno was fast enough to win the race, but she fell near the finish line and did not win.

The correct analysis of these cases seems to diverge from the progressive account of the French ‘interruption’ examples given above. Even though the context makes clear that (6.53) refers to a specific episode in which Juno had the race-winning speed, it is difficult to interpret the *enough* claim as describing an ongoing instantiation of this speed, rather than simply attributing a capacity to Juno. A de Swart-style coercion analysis predicts this, insofar as the overt progressive marker in English is expected to ‘block’ progressive interpretations in unmarked cases.

Assuming, therefore, that (4.7b) does not involve the progressive reading, the only sensible interpretation is the ‘regular’ (imperfective) ongoing interpretation. This predicts the cancellability of a complement inference, as we saw in the previous section, since imperfective marking does not force the causing event to be instantiated, only the state of Juno’s capacity.

The French example above only looked at the interruption of a positive *enough* assertion. Similar examples arise for negative assertions in both English and French:

- (4.17) *Juno n’a été pas assez rapide pour gagner la course, #mais la coureuse en tête a trébuché dans la dernière manche et donc Juno a gagné après tout.*

‘Juno was-PFV not fast enough to win the race, #but the lead runner tripped on the last lap, and so Juno won after all.’

- (4.7b) Juno was not (really) fast enough to win the race, but the lead runner tripped on the final lap, and so Juno won after all.

In the French example, we can appeal to the same explanation as in the positive case, since the progressive will do the same work: instantiating a manifestation of speed which fails the causally necessary condition for winning as evaluated with respect to the causal model at reference time. As before, however, we assume that the model can change or be updated after reference time, and that this is a potential reason for the use of imperfective marking (on a progressive interpretation). In the English example (4.7b), by contrast, we find that even the ‘interruption’ examples are improved by the inclusion of a modifier such as *really* or *actually*, which suggests that these cases involve a habitual interpretation, rather than a progressive interpretation.³³

6.3.4 Comparison with lexical implicatives

One of the major objections to Hacquard’s (2005) account of *enough* and *too* implicativity, as well as to Bhatt’s (1999) proposal for the actuality entailments of ability modals was the inability of these proposals to predict the empirical contrast between *enough/too* complement entailments and the entailments of lexical implicatives under imperfective marking. We can now explain the observed data.

On the current account, the core contrast between implicative verbs and implicative *enough/too* constructions lies in the content of the matrix assertion. While implicative

³³ Not all dynamic adjective predicates in English permit progressive readings. While (6.27a) is perfectly acceptable, combining the progressive with *Juno be fast*, as in (i), is highly marked, if indeed it is acceptable at all.

- (6.27a) Nima was being funny. \rightarrow *Nima was doing something funny.*
 (i) ??Juno was being fast.

A full explanation of the contrast between (6.27a) and (i) requires closer examination, which I will not undertake here. However, it seems plausible that the markedness of (i) is due to some kind of frequency or pragmatic blocking effect, rather than to a basic incompatibility between *Juno be fast* and the progressive marker. Specifically, while (ii-a) and (ii-b) are much more natural than (i) as a means of describing an ongoing instantiation of Juno’s speed, we find the reverse relationship between (6.27a) and (iii). This contrast might be explained, then, on the view that – for some reason – being fast is associated with ‘canonical’ manifestations, but being funny is not.

- (ii) a. Juno was running fast.
 b. Juno was walking fast.
 (iii) ??Nima was telling jokes funnily.

verbs assert the satisfaction of a causally necessary and causally sufficient condition for their complements, implicative *enough/too* constructions, as underlyingly stative, assert instead their subject's capacity to realize the sufficient/necessary condition. In certain cases, this assertion is interpreted as an instantiation or manifestation, but this is not the only available interpretation. Implicatives, on the other hand, have only one interpretation, which is eventive. As per analysis developed in Chapter 3 (Proposal 3.50), lexical implicatives assert the realization of an event in which the implicative subject realizes the specified matrix condition. It is this difference that explains the inferential contrast between implicatives and dynamic adjective *enough/too* constructions under imperfective marking.

- (4.58) a. Morgan was clever enough to solve riddles, but she never solved any.
 b. *Morgan était assez intelligente pour résoudre les énigmes, mais elle ne résolvait jamais d'énigmes.*
 'Morgan was-IMPF clever enough to solve riddles, but she never solved any.'
- (4.59) a. Morgan (usually) managed to solve riddles, #but she never solved any.
 b. *Morgan réussissait à résoudre les énigmes, #mais elle ne résolvait jamais d'énigmes.*
 'Morgan managed-IMPF to solve riddles, #but she never solved a riddle.'

The issue for Hacquard is her appeal to an additional layer of modal quantification introduced by GEN, which ties a hard-coded *enough/too* complement entailment to 'normal' worlds, and thus potentially divorces it from events in the actual world. If *enough* and *too* constructions are basically implicative, then the acceptability of examples like (4.58a)-(4.58b) predicts – incorrectly – the same judgements for (4.59a)-(4.59b). The same issue arises for Bhatt, in the comparison between his implicative predicate ABLE, which does not entail under the imperfective aspect and lexical implicatives like *manage*, which do (see Chapter 3, Section 3.1).

On the analysis developed over the last three chapters, (4.58a) and (4.58b) involve stative predicates and thus describe general capacities – states of Morgan's being at least d_{nec} clever – but do not force any causing or complement-entailing action to take place. (4.59a)

and (4.59b), on the other hand, involve the combination of the imperfective aspect with underlyingly eventive implicative predicates. This forces a reinterpretation operation, which coerces *manage* or *réussir* into a habitual interpretation. As per the definition of HAB, this interpretation requires actual instantiations of the ‘habit’ in question, at least some of which must be in ‘contextually-relevant’ intervals. By presupposition, the realization of the causing action in these instances causally entails riddle-solving, meaning that the habitual instantiation of the matrix condition in (4.59a)-(4.59b) also produces habitual riddle-solving. This is compatible with a single or even a small number of complement denials, but precludes across-the-board cancellations of the complement entailment, since this would contradict the content of the ‘habit’. Indeed, as we saw in Chapter 4, even slightly weaker denials than those in (4.59) are infelicitous:

- (4.57) a. Morgan *(generally) managed to solve riddles, but on this occasion, the riddle was too difficult for her.
- b. *Morgan réussissait à résoudre les énigmes, mais cette énigme-là était trop difficile pour elle.*
 ‘Morgan managed-IMPF to solve riddles, but this riddle was too difficult for her.’
- (4.60) a. Morgan (usually) managed to solve riddles, #but most of the time she did not solve them.
- b. *Morgan réussissait à résoudre les énigmes, #mais d’habitude, elle n’en résolvait jamais.*
 ‘Morgan managed-IMPF to solve riddles, #but usually she did not solve them.’

It appears, then, as if the habitual interpretation requires that ‘contextually relevant’ instantiations of a predicate outnumber instantiations taking place in an aberrant period, commensurate with the intuitive notion of what it means to be a habit.

Although eventivity in principle renders lexical implicatives compatible with aspectual operators that select for quantized predicates, implicative constructions seem for the most part to resist progressive marking.

(6.54) ?Ana was daring to enter the cave.

This may have to do with the type of event associated with instantiations of bravery; as pointed out by Vendler (1957), the progressive is not only incompatible with states, but with punctual predicates as well. If we can, by some means, force the causing event in an implicative claim to have some duration, as in (6.55), the progressive improves.

(6.55) Morgan was managing to wiggle a key into the warped lock when the door opened suddenly, knocking the key out of her hand.

Moreover, to the extent that an example like (6.55) is acceptable, we see that progressive uses of implicatives seem to permit complement denials, by means of ‘paradoxical’ interruptions: this is also as predicted.

The current analysis of *enough* and *too* constructions thus permits an explanation both for their implicative entailments as well as for the cases where an expected inference is defensible, without requiring an appeal to the generic operator. As a result, while we maintain the Bhatt/Hacquard intuitions that *enough/too* complement inferences are driven by a connection with implicativity, and cancellability under imperfective marking is associated with some type of ‘regularity’ interpretation, the account also predicts the aspectually-driven contrast between *enough/too* and lexical implicative entailment patterns imperfective marking, where the account from GEN does not.

6.4 Summary and outlook

This chapter completes the account of implicative behaviour in *enough* and *too* constructions begun in Chapter 4. In that chapter, I established the parameters of variation involved in *enough/too* implicative inferences, and showed that the central constructions for investigation were those which combined dynamic adjectives, circumstantial modality, and temporal overlap between the matrix and complement clauses. Table 6.3, which summarizes these findings, is reproduced below from Chapter 5.

<i>modal flavour</i>	parameter of variation			inference	
	<i>adj type</i>	<i>temporal spec.</i>	<i>aspect</i>	<i>pos</i>	<i>neg</i>
epistemic	–	–	–	⊄	⊄
deontic	–	–	–	⊄	⊄
circumstantial	static	–	–	⊄	⊢
	dynamic	no overlap	–	⊄	∼
		overlap	unmarked	∼	∼
			imperfective	∼	∼
			perfective	⊢	⊢

Table 6.3: Implicative parameters in *enough* and *too* constructions

In Chapter 5, starting from a proposal from von Stechow et al. (2004), I developed an account of the semantics of *enough/too* constructions. I showed that this account naturally associates *enough/too* constructions with a necessity presupposition that parallels the necessity presupposition associated with implicative verbs, as discussed in Chapter 3. This account improved on the predictions from Hacquard’s (2005) ‘at-base implicative’ analysis of *enough/too* constructions, but by itself was not able to account for the entailment contrasts between circumstantial *enough/too* constructions with static versus dynamic adjectives (see Table 6.3). Following a closer examination of the dynamic adjective constructions, I argued that these cases exhibit implicative behaviour because, like implicative verbs, they involve a relationship of both causal sufficiency and causal necessity between the property referenced in the matrix clause and the realization of the *enough/too* complement. Where implicative verbs assert the realization of their causing conditions, however, ‘implicative’ *enough/too* constructions at base asserts only the capacity of the subject to realize the causal condition.

In this chapter, I proposed that the difference between a capacity assertion and an instantiation involves the distinction between a stative and an eventive interpretation of a dynamic adjective attribution. Drawing on the aspectual coercion analyses of Moens and Steedman (1988), de Swart (1998), and Bary (2009), I argued that the perfective aspect selects for eventive predicates, triggering reinterpretation processes when it is applied to a

stative predicate of eventualities. When combined with property attributions involving dynamic adjectives like *fast* and *loud*, which are inherently action-oriented, perfective marking coerces interpretations on which the sentential subject instantiates the relevant property. Section 6.2 proposed a definition for the instantiative coercion operator. Finally, I reviewed the *enough/too* data which was not explained by the basic semantics from Chapter 5, and showed that the ‘implicative’ proposal advanced in Section 5.4, when considered together with the effects of aspectual coercion, predicts the empirical patterns of entailment and defeasibility in the outstanding cases. I also suggested that the causal modality involved in the interpretation of *enough/too* predicates obviated the need to intensionalize a progressive operator to explain imperfective paradox effects, while maintaining the spirit of Dowty’s (1979) treatment. While it is beyond the scope of the current investigation to pursue a detailed treatment of the imperfective paradox in general, this suggests that the relevant telic predicates might be amenable to a compositional analysis in terms of causal dependence relations as defined in Chapter 3, and updated in Chapter 5.

We are now ready to return to the bigger picture. An investigation of *enough* and *too* constructions was motivated, at the outset, by the idea that the actuality inferences of ability predicates should receive a similar analysis to the complement entailments associated with the implicative verb class. Chapter 3 identified the semantic components of *implicativity*. With this in hand, the compositional structure of variably implicative *enough/too* predicates offered a means of looking ‘under the hood’ of an implicative entailment, in order to isolate and identify those components responsible for the aspectual sensitivity displayed by both *enough/too* predicates and ability modals. The analysis developed over the last three chapters shows that the inferential patterns of *enough/too* constructions arise from the composition of an underlyingly implicative causal structure with the action-oriented nature of dynamic adjective predicates and the coercion effects associated with (overt) aspectual marking. Thus, on the assumption that actuality inferences, like *enough/too* complement inferences, are implicative in nature, abilitative predicates should involve the same kind of causal structure as *enough* and *too* constructions.

At the end of Chapter 3, we had two separate proposals for the analysis of ability-attributing predicates (Bhatt’s 1999 ABLE). The challenge we faced was in finding a way to reconcile the ‘one-way’ implicative approach in (3.68) with the hypothetical guarantee structure motivated in Chapter 2.

(3.68) ***Be able as a one-way implicative.*** (Proposal, to be revised)

For an agent S , and a one-place predicate A , the claim that S *is able to* A :

- i. *Presupposes:* The existence of a predicate H such that $H(S)$ is causally necessary for $A(S)$ in the utterance context. $H(S) \blacktriangleleft_c A(S)$
- ii. *Asserts:* $H(S)$

(3.71) ***Can/be able as a hypothetical guarantee.*** (Proposal, to be revised)

For an agent S and a one-place predicate A , the claim that S *can/is able to* A is true just in case S has an available action, H' , such that $H'(S)$ is causally sufficient for (guarantees) $A(S)$.

While these proposals are strikingly similar in structure, insofar as they both invoke a causing condition $H(S)$ for the complement $A(S)$, it was not immediately obvious how we might combine them to fully account for the behaviour of ABLE. On the one-way implicative analysis, the condition $H(S)$ is taken to be causally necessary for $A(S)$, but crucially cannot be causally sufficient, if we are to avoid predicting implicative entailments from positive ABLE assertions across the board, in the pattern of two-way implicatives like *manage*. On the other hand, we seem to require a relationship of causal sufficiency in order to explain the two-way implicative pattern that arises from ability modals under perfective marking. Moreover, the ‘hypothetical’ sufficiency condition in (3.71) was motivated, in Chapter 2, by the need to explain the sense of reliability or regularity associated with pure (non-actualized) ability readings for both ability modals and *be able*.

The analysis developed for *enough* and *too* constructions now illuminates the way forward. In an *enough/too* construction with a dynamic adjective, the condition invoked by the matrix clause is of the same type as the matrix condition invoked by a lexical implicative,

insofar as it identifies an (agentive) action which is both causally necessary and causally sufficient for the realization of the *enough/too* complement. However, as we saw in Chapter 5, the at-base stative (capacity-attributing) assertion of an *enough/too* construction distinguishes this causing condition from the implicative condition by effectively making the sufficiency relationship a hypothetical one. That is, in the absence of an assertion which directly realizes the causing condition, the sufficiency presupposition requires only that the causing condition is sufficient for the realization of the complement proposition in case the world continues in a causally optimal manner which leads to the realization of the causing condition. In other words, an implicative presupposition of causal sufficiency turns into a hypothetical guarantee in case the asserted content establishes the potential for an agent to realize the causally-sufficient condition, but does not necessarily require that the agent actually does so. If this capacity assertion is interpreted as an instantiation of the causing condition – whether this is induced by aspectual coercion under perfective marking, or by some other means – the causal sufficiency relationship will cease to be hypothetical, and implicative inferences are predicted.

Bringing these ideas to bear on the analysis of the original actuality inference problem, the next step is to link proposals (3.68) and (3.71) by assigning ABLE the same basic semantic structure as an *enough/too* dynamic capacity attribution. ABLE is implicative both in its restricted modal flavour (as compared to *enough/too* constructions in general), and with respect to the underlying causal structure it invokes; it is non-implicative in the same sense as *enough* and *too* constructions are non-implicative, i.e., in view of contributing a stative capacity-attributing assertion, as opposed to an eventive capacity-realizing assertion. The key point in bringing (3.68) and (3.71) together, and in accounting for the aspect-driven alternation of implicative-style entailments, is that, if we are to explain actuality inferences as implicative in nature, it must be the case that ABLE, like *be fast enough*, *be brave enough*, and so on, attributes to an agent the capacity for action which stands in a specific relationship to the ability complement: the potential for action is at the core of the hypothetical guarantee structure. The next chapter explores the consequences of extending the implicative proposal for *enough* and *too* constructions to the semantic analysis of *be able* and ability modals.

Chapter 7

Ability, actuality, and implicativity

Let us remind ourselves of the original puzzle. As observed by Thalberg (1972) and Bhatt (1999), past tense uses of *be able* in some contexts produce an interpretation which can be paraphrased by *had the ability*, and in others give rise to ‘actualized’ interpretations, which indicate the realization of their complements.

- (1.4) Marja was able to swim across Lake Nokomis.
- a. In her twenties, Marja was able to swim across Lake Nokomis.
 ~ *In her twenties, Marja had the ability to swim across Lake Nokomis.*
 - b. Yesterday morning, Marja was able to swim across Lake Nokomis.
 ~ *Yesterday morning, Marja swam across Lake Nokomis.*

Bhatt (1999) shows that the ability/actuality alternation arises systematically across a range of languages and ability-attributing predicates, including abilitative uses of the possibility modal in aspect-marking languages like French, Greek, and Hindi. In these languages, the interpretation of an ability modal is governed by grammatical aspect: imperfectively-marked ability modals give rise to pure ability interpretations, but perfectly-marked modals produce actualized interpretations, entailing the realization of their complements.

- (1.9) The French ability modal *pouvoir* under imperfective and perfective marking:
- a. *Marja pouvait traverser le lac Nokomis à la nage, mais elle ne l'a pas traversé.*
 'Marja could-IMPF swim across Lake Nokomis, but she did not cross it.'
 - b. *Marja a pu traverser le lac Nokomis à la nage, #mais elle ne l'a pas traversé.*
 'Marja could-PFV swim across Lake Nokomis, #but she did not cross it.'

Bhatt compares the actualized interpretations of *be able* and ability modals (ABLE) to the interpretation of the implicative verb *manage*, proposing to treat actuality inferences on par with the complement entailments of implicative verbs.

- (7.1) a. Marja managed to swim across Lake Nokomis, #but she did not cross it.
 b. Marja didn't manage to swim across Lake Nokomis, #but she crossed it.

While I argued against Bhatt's proposal to capture the comparison between ABLE and *manage* in terms of a lexical semantic equivalence, I proposed in Chapter 3 to take seriously the idea that actuality inferences represent instances of implicative behaviour. I suggested that actuality inferences should be analyzed as compositional cases of implicativity, with the essential components of implicative semantic structure coming together in the joint contribution of an ability modal and the perfective aspect.

The last four chapters advanced the investigation of ability and actuality inferences by developing a detailed account of implicativity at both the lexical and compositional levels. Chapter 3 proposed a new account of implicative verbs, on which their characteristic complement entailments follow from relations of causal necessity and causal sufficiency embedded in their lexical semantics. On the basis of Proposal 3.50 for lexical implicatives, I identified three core components of implicative behaviour, summarized below and in Table 7.1.

- (i) the existence of a condition that is both necessary and sufficient for the (implicative) complement
- (ii) a causal interpretation of the necessity and sufficiency relations
- (iii) an assertion that resolves the truth status of the necessary and sufficient condition

construction	semantic component			inference	
	<i>mod. flavour</i>	<i>presuppose</i>	<i>assert</i>	<i>pos</i>	<i>neg</i>
implicative	causal, circumstantial	$H(S) \blacktriangleleft_c A(S)$ $H(S) \blacktriangleright_c A(S)$	$H(S)$	$\vdash A(S)$	$\vdash \neg A(S)$

Table 7.1: The semantic components of polarity-preserving two-way implicativity

At the end of Chapter 3, I motivated an investigation of the variably implicative behaviour of *enough* and *too* constructions on the basis of the similarities between *enough/too* predicates and lexical implicatives, on the one hand, and the parallel inferential profiles of *enough/too* constructions and ability modals, on the other. In particular, while *enough/too* predicates, like lexically-specific implicatives, reference particular properties, attributes, or characteristics of an agent, the aspectually-driven alternation of *enough/too* complement inferences, where these inferences appear, matches the aspectually-driven alternation in the actuality entailments of ability modals.

$$(7.2) \quad \text{a. } \textit{Jean \u00e9tait assez rapide pour s'enfuir, mais il ne s'est pas enfui.} \quad \equiv (4.11)$$

‘Jean was-IMPF fast enough to escape, but he did not escape.’

$$\text{b. } \textit{Jean a \u00e9t\u00e9 assez rapide pour s'enfuir, \#mais il ne s'est pas enfui.} \quad \equiv (4.9a)$$

‘Jean was-PFV fast enough to escape, #but he did not escape.’

Over the course of Chapters 4 to 6, I established that implicative entailments follow from *enough* and *too* claims in the presence of a dynamic, action-oriented matrix adjective (like *fast*), which induces a causal interpretation of the relationship between the matrix and complement clauses, and under perfective marking, which triggers an ‘instantiated’ reinterpretation of the core property attribution of a dynamic adjective predicate. *Enough/too* entailments also require temporal overlap between the matrix and complement clauses, which allows the eventualities they describe to be linked in a single causal chain of events at reference time. These parameters, and the associated inference patterns, are indicated in Table 7.2. On this account, the key to explaining aspect sensitivity in *enough/too* complement inferences lies in the ‘dynamic’, actionable nature of the matrix adjective, which renders

the core property attribution subject to instantiative coercion under perfective marking, as shown in Chapter 6.

parameter of variation				inference	
<i>modal flavour</i>	<i>adj type</i>	<i>temporal spec.</i>	<i>aspect</i>	<i>pos</i>	<i>neg</i>
epistemic	–	–	–	⊄	⊄
deontic	–	–	–	⊄	⊄
circumstantial	static	–	–	⊄	⊢
	dynamic	no overlap	–	⊄	∼
		overlap	unmarked	∼	∼
			imperfective perfective	∼ ⊢	∼ ⊢

Table 7.2: Implicative parameters in *enough* and *too* constructions

The goals of this chapter are simple. I bring the investigation of implicativity and implicative causal structure to bear on the analysis of ability attributing predicates, using Chapter 5’s proposal for the semantics of *enough* constructions as a template for an implicative proposal for ABLE. I show that a causal implicative analysis merges the key features of the two proposals for ABLE established at the end of Chapter 3, thus deriving both ability and actuality interpretations from a single underlying representation. I then explore some of the consequences of pursuing an implicative account of ability. I show that this kind of analysis predicts certain properties of abilitative predicates, and accounts for a number of observations and puzzles associated with the divergent ability/actuality interpretations, including the apparently contradictory logical behaviour of ability predicates on actualized versus abilitative readings. At the end of the chapter, I set out the challenges to be addressed in developing a complete ‘implicative’ account of ability and actuality inferences, and suggest some potential routes for pursuing an integration of the implicative proposal with the standard possible worlds semantics for possibility modals.

7.1 An implicative structure for ability

Bhatt (1999) motivates an implicative account of ability in terms of the inferential similarities between past-tense *be able* claims and past-tense *manage* claims.

- (7.3) a. Yesterday, at the apple-eating contest, a fireman was able to eat five apples.
 b. Yesterday, at the apple-eating contest, a fireman managed to eat five apples.

He observes that (7.3a) and (7.3b) not only both license the inference that a (specific) fireman ate five apples yesterday, but moreover indicate that this feat was in some way effortful. The inference of effort behaves like a presupposition. Actions that are, *a priori*, assumed to be trivially or effortlessly achievable are infelicitous in the complements of both ABLE and *manage*, as illustrated by (7.4). The infelicity is immediately resolved with the introduction of evidence that “sustained (non-minimal) effort” was required for complement realization (Bhatt, 1999, p.5).

- (7.4) a. #Timmy was able to breathe. (Bhatt, 1999, p.11)
 b. #Timmy managed to breathe.

- (7.5) *Context:* Timmy had a bad car accident as a result of which he lost control over most of his muscles for several hours.
 a. Thankfully, Timmy was able to breathe.
 b. Thankfully, Timmy managed to breathe.

Bhatt’s proposal derives the similarities in (7.3)-(7.5) by assigning *be able* the same semantics as *manage* (drawing on Karttunen and Peters’s 1979 ‘direct assertion’ account of *manage*; see Section 3.2.2). The chief problem encountered for this proposal, or indeed any account which makes ABLE and *manage* equivalent at the lexical semantic level, has to do with an empirical contrast in the strength of complement inferences from ABLE and *manage*. Denying the realization of a past-tense use of English *be able* might be pragmatically marked, as in (7.6), but is never fully contradictory; denying the complement of a past-tense *manage* claim is always contradictory.

- (7.6) a. Marja was able to swim across Lake Nokomis, but she never did it.
 b. Marja managed to swim across Lake Nokomis, #but she never did it.

In aspect-marking languages, the strength contrast appears under imperfective marking: imperfective ability modals are compatible with interpretations on which their complements were never realized, but imperfectively marked implicatives (French *réussir*, in example 4.59b) are not.

- (7.7) *Morgan pouvait résoudre les énigmes, mais elle ne résolvait jamais d'énigmes.*
 ‘Morgan could-IMPF solve riddles, but she never solved riddles.’
 (4.59b) *Morgan réussissait à résoudre les énigmes, #mais elle ne résolvait jamais d'énigmes.*
 ‘Morgan managed-IMPF to solve riddles, #but she never solved a riddle.’

At the end of Chapter 3, I suggested that one way of capturing the differences between ABLE and *manage/réussir* might be to treat ABLE as a one-way implicative verb, which entails the negation of its complement under matrix negation, but at best implicates complement realization under positive matrix polarity (cf. Karttunen 1971, 2012). On the causal ‘prerequisite’ analysis of lexical implicatives (Proposal 3.50), this gives us the following:

- (3.68) ***Be able as a one-way implicative.*** (Proposal, to be revised)

For an agent S , and a one-place predicate A , the claim that S is able to A :

- i. *Presupposes*: The existence of a predicate H such that $H(S)$ is causally necessary for $A(S)$ in the utterance context. $H(S) \blacktriangleleft_c A(S)$
- ii. *Asserts*: $H(S)$

A one-way implicative analysis for ABLE predicts the contrasts in (7.6) and between (7.7) and (4.59b). It also gives us an immediate explanation for the defeasible complement inferences associated with positive assertions of *be able*, on which they are taken to be instances of the ‘circumscriptive’ reasoning which produces positive complement inferences from one-way implicatives in general (see Section 3.6.3 of Chapter 3).

There are a few problems with a one-way implicative analysis. First, it does not give us an obvious way to explain the ‘strengthening’ of pragmatically-derived complement inferences to full entailments under perfective marking: there is no reason that the perfective should introduce the missing sufficiency presupposition which would turn (3.68) into a two-way implicative account. The second problem is inherited from Bhatt, in that an implicative proposal seems to divorce the semantics of ABLE from the possible-worlds semantics associated with possibility modals like French *pouvoir* on non-abilitative uses. Finally, this account does not derive the pure ability interpretations of ABLE, in particular failing to capture the sense of reliability required by (un-actualized) ability attributions.

In Chapter 2, pursuing ‘reliability’ in ability meanings led us to a *hypothetical guarantee* proposal for ABLE, along the lines proposed by Brown (1988); Louie (2014); Mandelkern et al. (2017); Maier (2018b), and others. The idea behind (3.71) is that pure ability can be attributed to an agent just in case she has a reliable strategy or means of ensuring that she realizes the ABLE complement: (3.71) encodes the guarantee as a relationship of causal sufficiency between an action available to the agent and the complement proposition.

(3.71) ***Can/be able as a hypothetical guarantee.*** (Proposal, to be revised)

For an agent S and a one-place predicate A , the claim that S *can/is able to* A is true just in case S has an available action, H' , such that $H'(S)$ is causally sufficient for (guarantees) $A(S)$.

While a hypothetical guarantee structure captures both possibility (encoded, as per Louie 2014, as existential quantification over the actions available to an agent; see Chapter 2) and reliability (in terms of causal sufficiency), it offers no clear explanation for the existence of actualized interpretations for ABLE, and the associated impression of effort.

The task I set out at the end of Chapter 3 was to develop an account of ABLE which preserved the desirable features of each of the proposals in (3.68) and (3.71), while also accounting for the effects of aspectual marking in languages like French. This led to an investigation of the aspectually-sensitive complement inferences of *enough* and *too* constructions. Now, the implicative analysis of *enough/too* constructions, developed over the course

of Chapters 4 to 6, provides the template for a ‘unified’ theory of ABLE.

Proposal 5.95 restates the ‘implicative’ account of *enough* constructions from Chapter 5:

(5.95) **The ‘implicative’ semantics for *enough* constructions.** (Proposal)

Let P be a proposition of the form

$$P = S \text{ be ADJ enough to } A$$

where S is an agent, ADJ a relation between individuals and sets of degrees, and A a property of individuals (one-place predicate). Evaluated with respect to a world w , background situation c , and conversational backgrounds f, g :

- i. P *presupposes* the existence of a degree d_{nec} that is necessary for $A(S)$:

$$\exists d_{\text{nec}} : \forall w' \in \text{Opt}_{g(w)}(\cap f(w)) [\neg \text{ADJ}(S)(d_{\text{nec}})(w') \rightarrow \neg A(S)(w')]$$

- ii. P *asserts* that S is/has d_{nec} -ADJ in w :

$$\text{ADJ}(S)(d_{\text{nec}})(w)$$

- iii. In case ADJ is a dynamic (action-characterizing) property, P additionally *presupposes* the contextual causal sufficiency of a manifestation of d_{nec} -ADJ for $A(S)$:

$$\text{INST}(\text{ADJ}(S)(d_{\text{nec}})) \blacktriangleright_c A(S)$$

We are interested just in those *enough* and *too* constructions which involve dynamic matrix adjectives, and therefore, as argued in Chapter 5, invoke the full causal presuppositional structure of a two-way implicative. In these cases, the matrix degree attribution, in clause (5.95-ii), represents a capacity attribution, asserting the potential for the agent S to take actions characterized by at least degree d_{nec} of ADJ (assuming ADJ is a positive polar adjective). The sufficiency presupposition in clause (5.95-iii) further establishes that the

attributed capacity is, in particular, a capacity for actions of the same type as the action presupposed to be causally sufficient for bringing about the *enough* complement.

Taken together, then, clauses (5.95-ii) and (5.95-iii) encode a hypothetical guarantee, in the same sense as (3.71). If the matrix attribution of (7.8a), attributes to Ana the capacity for action characterized by at least degree d_{nec} of bravery, and the sufficiency presupposition establishes that an action (by Ana) characterized by at least this degree of bravery is sufficient to bring it about that she enters the cave, then (7.8a) in effect describes Ana's *ability* to enter the cave, by means of acting on a particular personal attribute. On this view, a dynamic adjective *enough* construction is a lexically specific ability attribution, just as *dare*, in (7.9a), is a lexically specific version of the implicative *manage*. *Enough* constructions establish not just the existence and causal relevance of a particular causing action, but in addition tell us something about the condition and/or the properties of the agent in view of which the ability is attributed.

(7.8) a. Ana was brave enough to enter the cave.

b. Ana was able to enter the cave.

(7.9) a. Ana dared to enter the cave.

b. Ana managed to enter the cave.

Enough and *too* constructions also encode necessity conditions, as a consequence of the basic comparative semantics of the *enough* and *too* operators (Bierwisch, 1987; Meier, 2003; von Stechow et al., 2004; Hacquard, 2005; Schwarzschild, 2008, and others). In dynamic adjective examples, this condition amounts to the presupposed causal necessity of an action characterized by at least degree d_{nec} of the matrix adjective for the comparative complement. Thus, taking clauses (5.95-i) and (5.95-iii) together, *enough* constructions encode the full presuppositional structure associated with lexical implicatives in Chapter 3. The crucial difference between (7.8a) and (7.9a), on this account, lies in asserted content. *Dare*, in (7.9a), asserts the realization of its causing condition indicating that Ana in some way deployed her bravery; *be brave enough* simply establishes the potential for Ana to take action characterized by at least degree d_{nec} of bravery. Chapter 6 showed how this difference

in asserted content derives the inferential contrasts between *enough* and two-way polarity-preserving lexical implicatives like *dare* under imperfective marking in French, as well as in the aspectually-unmarked English cases.

Once we have seen the parallels between (7.8a) and (7.8b), on the one hand, and between (7.9a) and (7.9b), on the other, the outline of an implicative style proposal for ABLE is straightforward. My claim is that the relationship between *be able* and *manage* should be understood in precisely the same way as the relationship between *be brave enough* and *dare*. Both ABLE and *manage* background the existence of an action H for S such that $H(S)$ is causally necessary and causally sufficient for the realization of their complements. ABLE at base works like a dynamic adjective attribution, assigning to the sentential subject the capacity for $H(S)$ but not requiring that this capacity is acted on. In English, action-able capacity attributions are ambiguous between stative (capacity-only) interpretations and eventive (instantiated) interpretations. Under the perfective aspect, in view of its selectional requirements, the ambiguity is, by default, resolved to the eventive interpretation. The instantiated interpretation, in combination with the causal presuppositions, derives actuality entailments. The stative interpretation, by contrast, gives us a hypothetical guarantee. More broadly, then, I suggest that an implicative account of ABLE gives us a unified semantics for ability on which the observed possibility, ability, and actuality meanings all emerge from a single, complex, and inherently causal implicative structure.

7.1.1 Proposal

Proposal 7.10 sets out an implicative account for ability attributions, modeled after the analysis of *enough* constructions in Proposal 5.95.

(7.10) **The ‘implicative’ account of ABLE.** (Proposal)

Let P be a proposition of the form

$$P = S \text{ ABLE } A$$

where S is an individual, and A a property of individuals. Evaluated with respect

to a world w (in background situation c) and a dynamics \mathcal{D} :

- i. P presupposes the existence of an action H for S such that $H(S)$ is causally necessary for $A(S)$.

$$\exists H(S) : H(S) \blacktriangleleft_c A(S)$$

- ii. P asserts that S has the capacity for H in w :

$$\Diamond H(S)(w)$$

- iii. P presupposes the causal sufficiency of $H(S)$ for $A(S)$:

$$H(S) \blacktriangleright_c A(S)$$

Clause (7.10-i) states the existence and necessity presupposition common to both the one-way implicative analysis and the implicative proposal for *enough* constructions. Clause (7.10-iii) states the implicative sufficiency condition, backgrounding $H(S)$ as not only causally necessary in context for $A(S)$, but causally sufficient as well – i.e., establishing that $H(S)$ is the last causally necessary condition to be resolved. As we saw in Chapter 5, the sufficiency relationship amounts to the requirement that all causally optimal developments of the reference context which lead to the realization of $H(S)$ will also be worlds in which $A(S)$ occurs, as a guaranteed causal consequence of $H(S)$.

The capacity attribution in clause (7.10-ii) differentiates ABLE from a two-way lexical implicative like *manage*. In dynamic adjective *enough* constructions, the asserted capacity comprises a degree attribution, establishing an individual's potential to take actions characterized by a particular degree of the matrix adjective. In Proposal 7.10, I represent the capacity attribution with the logical possibility operator, \Diamond . At minimum, \Diamond should be understood to represent circumstantial possibility. More specifically, the parallel with *enough* constructions suggests that it should be understood as existentially quantifying over possible actions for the agent S , in the same sense as the outer layer of quantification in Louie's

(2014) formalization of the hypothetical guarantee analysis. (2.52)-(2.53) were introduced in Chapter 2.

(2.52) **Action instantiation.** (Louie, 2014, p.14)

$R(a_\alpha, x_e, w_s, t_i) :=$ The action a is instantiated by x in w at t (where t is the runtime of the event instantiating a)

(2.53) $\llbracket \text{can}_{\text{ability}}^L \rrbracket := \lambda P \lambda x \lambda t \lambda w. \exists a [\forall w' [R(a, x, w', t) \wedge w' \in \text{Opt}_\emptyset(\cap \text{CIRC}(w))] \rightarrow P(x, w', t)]$

\sim *There is an action a , available to x in w at t , such that all of the worlds with instantiations of that action by x at t and which are compatible with x 's circumstances in w are P -worlds.* (Proposal; Louie, 2014, p.15)

The idea behind clause (7.10-ii), taken in combination with the sufficiency presupposition in clause (7.10-iii), is extremely similar to the paraphrase offered in (2.53), and, more generally, to the idea behind a hypothetical guarantee account of ability. In Proposal 7.10, as well as in (2.53) and (3.71), the possibility of $A(S)$ exists in view of the possibility that the agent S takes some action $H(S)$ which represents a guaranteeing condition for $A(S)$.

(3.71) **Can/be able as a hypothetical guarantee.** (Proposal, to be revised)

For an agent S and a one-place predicate A , the claim that S *can/is able to* A is true just in case S has an available action, H' , such that $H'(S)$ is causally sufficient for (guarantees) $A(S)$.

Clause (7.10-ii) indicates that the agent S of an ABLE claim has the (non-specific) causing condition $H(S)$ as an available action. The ‘guarantee’ – represented in (2.53) by the embedded universal quantifier – is in the causal sufficiency of $H(S)$ for $A(S)$. On a causal premise semantics as outlined in Chapter 5, clause (7.10-iii) can be equivalently represented as the requirement that, in context c , $\text{MUST}_{\text{caus}}[H(S) \rightarrow A(S)]$. Taken together with clause (7.10-iii), the necessity presupposition in clause (7.10-i) assigns ABLE the full causal presuppositional structure of a two-way implicative. As we will see, adding the causal necessity

presupposition to a hypothetical guarantee structure allows us to fully account for the parallels between ABLE and *manage* noted by Bhatt, and in particular derives the ‘effort’ (or non-triviality) inference that is shared by *manage* claims and actualized interpretations of ABLE.

Fleshing out the idea that the relationship between ABLE and *manage* runs parallel to the relationship between *be brave enough* and *dare*, Proposal 7.10 treats ABLE on a par with *enough* dynamic adjective attributions. In particular, Proposal 7.10 takes the baseline assertion of ABLE to represent a stative predicate of eventualities; the simultaneous homogeneity and action-orientation of this predicate can then be recruited to explain the systematic, aspectually-governed variation in ABLE’s complement inferences. Since perfective marking selects for quantized predicates of eventualities, we expect coercion effects for ABLE under perfective marking, just as we observe coercion effects for dynamic adjective *enough* constructions in the perfective aspect.

The crucial coercion operator for actuality inferences is the same instantiative operator that is responsible for *enough/too* implicative inferences. Applied to a dynamic adjective attribution, INST (or rather, INST’, coupled with MAX; Section 6.2.3), returns an eventive instantiation of the adjective-characterized capacity. Applied to ABLE, as it is analyzed on Proposal 7.10, we expect INST to return an instantiation of the capacity for $H(S)$; that is, an instantiation of $H(S)$.¹

If instantiative coercion is involved in the derivation of actuality inferences, contexts for perfective ABLE claims which privilege alternative coercion operators should not produce actuality entailments, but instead return inchoative or maximal ability attributions. Chapter 6 showed how this works for *enough/too* constructions. In (7.11), the temporal modifier *soudain* (‘suddenly’) favours inchoative coercion: (7.11) is interpreted as describing a point

¹Treating the capacity for the causing action $H(S)$ in the same terms as a dynamic adjective capacity requires, at least on the current proposal for INST/INST’ + MAX, that any potential for action is understood as having both eventive and stative interpretations, and in particular as having eventive interpretations that stand in a ‘witness’ relation, of some type, for the stative $\Diamond H(S)$ interpretation. The precise way of formulating this relationship is a task for future work. However, the existence of such a relationship in part accounts for the appearance of two ontological ‘types’ of ability, suggested by Mari and Martin (2007, 2009); this is discussed in Section 7.2

at which Olga suddenly came into the requisite strength, but does not require that she exercised her newfound strength (example 6.40 in Chapter 6 derives this interpretation formally).

(7.11) *Olga a soudain été assez forte pour soulever un frigo, mais elle ne l'a pas fait.*

≡ (6.40)

‘Olga was-PFV suddenly strong enough to lift a fridge, but she did not do it.’

Interpretation: Olga suddenly became strong enough to lift a fridge, but ...

Similarly, a bounding durational modifier like *pendant deux heures* (‘for/during two hours’) favours maximal over instantiative coercion, and consequently also renders the *enough* claim in (6.41) compatible with complement negation.

(6.41) *Pendant deux heures ce matin, Olga a été assez forte pour soulever un frigo.*

‘For two hours this morning, Olga was-PFV strong enough to lift a fridge.’

Interpretation: This morning contained a maximal state of Olga having the necessary strength for lifting a fridge.

We have already seen evidence of the same coercion alternations for perfectly-marked ability attributions. Examples (2.45) and (2.46), due respectively to Homer (2011) and Mari and Martin (2007), were first presented in Chapter 2, as counterexamples to Hacquard’s (2006) account of actuality entailments. Since Hacquard derives actuality entailments from the relative scope of aspect and modality, temporal modification of the sort in (2.45) and (2.46) should not have any effect on the inferential profile of perfectly-marked *pouvoir*. Indeed, since (2.45) and (2.46) involve both ability modals and the perfective aspect, they would seem, at least at first glance, to present a challenge for any account which associates actuality entailments to the overt presence of perfective aspect.

(2.45) *Olga a soudain pu soulever un frigo, mais elle ne l'a pas fait.*

‘Olga could-PFV suddenly lift a fridge, but she did not do it.’

(2.46) *Notre nouveau robot a même pu repasser les chemises à un stade bien précis de son développement. Mais on a supprimé cette fonction (qui n'a jamais été testée) pour*

des raisons de rentabilité.

‘Our new robot could-PFV even iron shirts at a particular stage of its development. But we suppressed this function (which was never tested) for reasons of profitability.’

Following the discussion of aspectual coercion in Chapter 6, these data points are no longer puzzling. In fact, Proposal 7.10, by analogy with the implicative proposal for *enough* constructions, predicts the absence of actuality entailments in (2.45) and (2.46): actuality inferences arise just in case the stative capacity attribution in clause (7.10-ii) is interpreted eventively, as an instantiation of the capacity it describes. *Soudain* (‘suddenly’) in (2.45) as usual favours inchoative coercion, deriving an interpretation on which Olga, at or within the reference time, suddenly develops the capacity for action which will bring it about that she lifts a fridge. (2.46) includes a bounding temporal modification, *à un stade bien précis de son développement* (‘at a particular stage in its development’), which privileges a maximal interpretation: (2.46) describes a now-ended period during which it was possible for the robot to bring it about that it ironed shirts, but does not require that any shirts were ever actually ironed.

Since ABLE establishes the same kind of state as dynamic adjective *enough/too* predicates – that is, a state in which the agent has a particular type of action available – we expect that ABLE will also default to instantiative coercion over inchoative or maximal coercion, thus predicting the default to actualized interpretation, and producing actuality entailments, under perfective marking.

(1.9b) *Marja a pu traverser le lac Nokomis à la nage, #mais elle ne l’a pas traversé.*

‘Marja could-PFV swim across Lake Nokomis, #but she did not cross it.’

It should be noted that Homer (2011) also argues for an aspectual coercion analysis of actuality entailments, but one which differs from the current analysis in a few important ways. To derive actuality entailments, he proposes an operation of *actualistic* coercion, motivated by the same data as Chapter 6’s instantiative coercion, but which is ultimately predicted to be applicable to a wider range of predicates than INST/INST’. Roughly speaking, ACT takes

a stative predicate P and returns a salient, pragmatically-determined (quantized) predicate Q of eventualities that are concurrent with P -eventualities (see 6.33). While ‘actualistic’ aspectual coercion does allow Homer to derive actuality inferences, as well as to explain the acceptability examples like 2.45 and (2.46), I argued in Section 6.2.3 that ACT is too unconstrained, and as a result makes incorrect predictions for *enough/too* constructions involving static adjectives. The basic problem is that ACT misses an important generalization about the type of coercion responsible for actuality entailments: instantiative coercion applies exclusively to ‘capacity’ predicates, that is, to stative predicates assigned to an object or individual x as a proxy for the characterization of potential events in which x is involved. Proposal 7.10 makes good on Homer’s insights about the relevance of aspectual coercion to the actuality entailment phenomenon, but improves on his account by constraining the effects of the relevant type of aspectual coercion. It also improves on Homer’s analysis by introducing the complex causal structure of implicative semantics: this structure allows Proposal 7.10 to account for pure ability as well as for actualized interpretations of ABLE, while Homer, who treats ability modals as pure circumstantial possibility operators, cannot derive the reliability required by pure ability.

Finally, Proposal 7.10 explains the defeasible actuality inferences of English *be able* in the same way as Proposal 5.95 explains the defeasible complement inferences of dynamic adjective *enough* constructions. In Chapters 5 and 6, we saw that the ambiguity between eventive and stative interpretations for dynamic capacity attributions is resolved by durational information in a particular context. A context like (6.44), which provides a reference interval that is significantly longer than the runtime expected for an eventuality matching the complement proposition, favours a stative capacity-attributing interpretation for *be strong enough*, and thus permits any complement inferences to be easily cancelled, if they arise at all.

- (6.44) When she was young, Marja was strong enough to swim across Lake Nokomis, but she always swam in Lake Harriet instead.

On the other hand, a strongly episodic context like (6.43) favours the eventive, instantiated interpretation of *be fast enough*, leading to inferences that the complement, as a guaranteed causal consequence of the causing action, was realized.

- (6.43) At the track meet last week, Juno was fast enough to win the 5K, ?but she didn't win/?but she didn't run.

The negation of the *enough* complement in (6.43) is highly marked. As discussed in Chapter 6, the reason it is not fully contradictory is that English lacks a grammatical means (i.e., overt grammatical aspect) for forcing the eventive interpretation. Consequently, nothing can force the entailment of the *enough* complement, even in examples like (6.43), where its negation is pragmatically odd.

Actuality inferences for *be able* work the same way.² As a capacity attribution, ABLE is assumed to have both stative and eventive interpretations. Durative contexts, like the one in (6.44), will favour the stative interpretation. This is reflected in the discussion of (1.4) in Chapter 1. I observed then that a reference time that is significantly longer than the expected time for realizing the ability (and thus also too long for a single instantiation of its causing action) suggests a pure ability, rather than an actualized interpretation, as in (1.4a). In (1.4b), on the other hand, the short reference interval favours an eventive interpretation, leading to the inference that Marja both attempted (took the causing action) and succeeded in swimming across Lake Nokomis.

- (1.4) Marja was able to swim across Lake Nokomis.

- a. In her twenties, Marja was able to swim across Lake Nokomis.

²In principle, Proposal 7.10 also represents a proposal for the semantics of English abilitative *can*, and thus should predict actuality inferences from past tense *can* (*could*) in the same contexts that favour actualized interpretations of *was able*. This prediction is not supported: an example like (i) seems to favour either a maximal interpretation or even a counterfactual one over an actualized reading (though see Kratzer, 2011, for an alternative view).

- (i) Yesterday morning, Marja could swim across Lake Nokomis.

One possible explanation for this might be that the use of *could* for counterfactual readings, coupled with the availability of *be able* as an alternative ability-attributing predicate, leads to pragmatic blocking effects; I leave a proper investigation of these effects for future investigation.

~ *In her twenties, Marja had the ability to swim across Lake Nokomis.*

- b. Yesterday morning, Marja was able to swim across Lake Nokomis.

~ *Yesterday morning, Marja swam across Lake Nokomis.*

Adopting Proposal 7.10, then, allows us to account for the similarities between ABLE and *enough* constructions as compared to lexical implicatives. The preceding discussion shows that we predict actualized interpretations as a default from perfective ABLE claims, and that this default can only be overridden by specific temporal information which privileges inchoative or maximal coercion over instantiative coercion. We also predict the absence of actuality entailments under imperfective marking as a consequence of the crucial difference between the capacity attribution asserted by ABLE in clause (7.10-ii), and the asserted content of a two-way lexical implicative, which directly realizes its causing action. Since ABLE is at base stative, no complement entailment is predicted in the absence of overt perfective aspect (and its associated coercion effects); by contrast, the shared causal sufficiency presupposition forces eventive implicative assertions to entail the realization of their complements, regardless of aspectual marking. Section 6.3.4 offered a more detailed discussion of the effects of aspectual marking on the entailments of lexical implicatives.

7.1.2 Negated ability, temporal overlap, and causal dependence

The preceding discussion focused on positive ability assertions, showing that an implicative proposal successfully predicts the distribution of actualized and non-actualized readings of English *be able* and ability modals under overt grammatical aspect, and illustrating the semantic parallels between ABLE and dynamic adjective *enough* constructions. It turns out, however, that the inferential profiles of *enough* constructions and ABLE assertions diverge under negation in the matrix clause.

In Chapter 4, we saw evidence that, just like the complement inferences of positive *enough* claims, the complement inferences of negated *enough* constructions are defeasible, both in English and under imperfective marking in French.

- (4.76) a. Juno was not ??(really/actually) fast enough to win the race, but her competitors were ill that day and ran unusually slowly.
 b. *Juno n'était pas (généralement) assez rapide pour gagner, mais ses concurrents étaient malades cette journée-là et ils ont couru lentement.*
 'Juno was-IMPF not (ordinarily) fast enough to win, but her competitors were ill that day and ran slowly.'
- (4.77) *Juno n'était pas assez rapide pour gagner la course, mais la coureuse en tête a trébuché dans la dernière manche, et donc, Juno a gagné (après tout).*
 'Juno was-IMPF not fast enough to win the race, but the lead runner tripped on the final lap, and so, Juno won (after all).'
- Interpretation:* Juno was not running fast enough to win, but ...

By contrast, negated ABLE claims entail the negation of their complements, as shown by (3.67b).

- (3.67) a. Eman was able to go to the party ... \leadsto *Eman came to the party.*
 \checkmark ... but she decided to stay at home.
 b. Eman was not able to go to the party ... \vdash *Eman did not go to the party.*
 $\#$... but she went in the end.

Data points like (3.67) seem to motivate a one-way implicative analysis of *be able*, since, taken together with the defeasibility of complement inferences under positive matrix polarity, as shown in (3.67a), the negative entailment in (3.67b) gives *be able* the same inferential profile as a one-way polarity-preserving implicative like Finnish *jaksaa* ('have the strength').

- (3.47) a. Hän **jakso-i** noust-a.
 he.NOM have.strength-PST.3SG rise-INF
 'He had the strength to rise.' \leadsto *He rose.*
- b. Hän e-i **jaksa-nut** noust-a.
 he.NOM NEG-3SG have.strength-PP.SG rise-INF
 'He did not have the strength to rise.' \vdash *He did not rise.*

The same entailment data holds for imperfectly-marked ability claims under negation in Hindi and French: both (7.12a) and (7.12b) are judged by my informants to be contradictory.

- (7.12) a. Yusuf havaii-jahaaz nahĩ̃ ũṛaa **sak-taa** thaa, #lekin us-ne
 Yusuf air-ship fly NEG can-IMPF be.PST.MASC, #but 3SG-ERG
 havaii-jahaaz ũṛaa-yii.
 fly-PFV.FEM.
 ‘Yusuf was not able to fly airplanes, #but he flew the airplane.’
- b. *Rebecca ne **pouvait** pas traverser le lac à la nage, #mais elle l’a fait.*
 ‘Rebecca was-IMPF not able to swim across the lake, #but she did it.’

At first glance, the divergence between negated *enough* claims and negated ABLE claims seem to pose a challenge for the implicative account of ABLE in Proposal 7.10, which only differs from Proposal 5.95’s account of *enough* constructions with respect to the specificity of the presupposed causing action.

As it turns out, however, no problem arises. In fact, the non-defeasibility of complement inferences under matrix negation is expected on Proposal 7.10. To see why, we need to examine the data in (4.76)-(4.77) a little more closely.

The negated *enough* claim, *Juno was not fast enough to win the race* asserts that Juno does not have the capacity for taking the causally necessary action for race winning, because she lacks the required degree of speed. Given this assertion, the only way to consistently assert that she did in fact win is by appealing to exceptional circumstances, in which the relationship between her speed and the realization of the complement may differ from the norm. This is what we see in (4.76)-(4.77). (4.77) introduces exceptionality by means of a progressive interpretation (marginal at best for English *be fast enough*), which introduces the potential for imperfective paradox effects: the complement assertion in (4.77) involves the ‘interruption’ of an event in progress.

Examples (4.76a)-(4.76b) introduce exceptional circumstances by means of habituality. In both examples, introduction of the habitual operator (HAB; 6.25) induces an interpretation on which most of the contextually-relevant times (C-rel(*t*)) within the reference interval are

ones at which Juno lacks the necessary race-winning speed. Nothing forces the specific race, mentioned in the complement clause, to be during one of these intervals, however. Crucially, we understand both (4.76a) and (4.76b) to convey that the race time is located in an exceptional interval – that is, outside of a contextually-relevant subinterval of the reference time – and thus that the normal relationship between Juno’s speed and a race win need not obtain at race time.

$$(6.25) \quad \llbracket_{\text{HAB}} \rrbracket := \lambda w \lambda P \lambda e [[\text{MOST}(t) \subset \tau(e) : \text{C-rel}(t) \rightarrow \exists e' : t = \tau(e') \wedge P(w)(e')] \wedge \\ \neg P(w)(e) \wedge \exists t', t'' \subset \tau(e) : \text{C-rel}(t'), \text{C-rel}(t'') \wedge t' \neq t'']$$

Modification by *généralement* (‘generally’) brings out the habitual interpretation in French, while the English examples require a modifier like *really* or *actually* to avoid being contradictory.

We can immediately set aside the possibility of progressive interpretations for ability attributions. English and Hindi both require the use of a dedicated progressive marker for these interpretations, and in both languages the progressive is ungrammatical in combination with ABLE. (7.13a) shows this for English *be able*, and (7.13b) for the Hindi ability modal *saknaa*. My informants confirm that a progressive interpretation is ruled out for French ability modal *pouvoir* under imperfective marking, as suggested by Bhatt (1999).

- (7.13) a. *Eman was not being able to go to the party.
- b. *Yusuf havaii-jahaaz uṛaa **sak** rah-aa thaa.
 Yusuf air-ship fly can PROG-MASC be.PST.MASC.
 Intended: ‘Yusuf was being able to fly airplanes.’
- c. *Ludo pouvait ouvrir la porte.*
 ‘Ludo could-IMPF open the door.’
 Impossible: Ludo was in the process of being able to open the door.

Turning to potential habitual interpretations, we find that adding *actually* to (3.67b) does not have the same effect as the addition of *actually* in (4.76a). (7.14) remains contradictory.

- (7.14) Eman was not actually able to go to the party, #but she went in the end.

Intuitively, this is because the time of Eman's inability and the time of going to the party are the same in both (3.67b) and (7.14); thus, if the semantics of ability, under negation, require that Eman does not have the capacity at reference time for an action which is causally necessary and causally sufficient to bring it about that she goes to the party, then it is simply impossible that she goes to the party.

The reason that habitual interpretations of negative *enough* claims like (4.76a)-(4.76b) are compatible with the assertion that their complements were realized is that, on a habitual interpretation (induced by *actually* in the English example), we can sever the time of the complement from the contextually-relevant times at which the (negative) speed capacity is attributed. ABLE does not allow us to do this: instead, like *manage* and other lexical implicatives, it requires that its complement clause overlaps temporally with the matrix clause.

(7.15) and (7.16) provide evidence for this requirement. (7.15) shows that, like *manage*, *be able* does not allow temporal modifiers in its complement that conflict with the tense of the matrix clause.

(7.15) #Morgan was able to solve the riddle next week.

(5.37a) #Morgan managed to solve the riddle next week.

On an abilitative reading, (7.16a) is interpreted as establishing the speaker's ability to speak French at the utterance time, which is also the reference time for the present tense matrix clause. Crucially, there is no possible abilitative interpretation for (7.16a) on which the time of speaking French is forward-shifted to a point where it does not overlap with the reference time: (7.16a) cannot mean, for instance, that while I am not capable of speaking French right now (perhaps because I do not know how), I will be capable of speaking French next year. Adding an overt temporal modifier to the complement, as in (7.16b) does not make such a reading available: ABLE simply does not allow non-overlapping interpretations of its complement clause.³

³This is a particularly striking constraint in view of the pragmatic plausibility of a situation in which I take some action now (such as signing up for a class which begins in a few weeks) which will result in my developing the capacity to speak French by next year.

- (7.16) a. I {can/am able to} speak French.

Impossible: I have a potential action available to me now such that taking it now will bring it about that I speak French at a non-overlapping time period in the future.

- b. #I {can/am able to} speak French next year.

The temporal overlap requirement is specific to abilitative modality: (7.16b) is acceptable, for instance, on a deontic reading, where the regulations of the world at utterance time are such that I will be permitted to speak French at a non-overlapping future time.

In Section 5.1.4 of Chapter 5, I argued that the temporal overlap requirement of lexical implicatives is a consequence of their underlying causal semantics, and in particular of the tight causal relationship between the matrix condition and the realization of the complement. Similar arguments apply to the temporal overlap requirements of verbs like *begin* and *try*, as discussed in Section 5.1.4. In other words, a temporal overlap requirement is consistent with – and indeed, predicted by – the causal structure assigned to ABLE by Proposal 7.10, and thus supports a view on which abilitative modality is causal in nature.

In contrast with examples like (7.16a) and (7.16b), we saw that dynamic adjective *enough* and *too* constructions can involve temporal separation of the matrix and complement clauses:

- (5.2a-i) When I saw her run last week, Juno was fast enough to win today's race.

- (5.2c-i) *Quand je l'ai vue courir la semaine dernière, Juno a été assez rapide pour gagner la course d'aujourd'hui.*

‘When I saw her run last week, Juno was-PFV fast enough to win today's race.’

This possibility follows from the variability of modal flavour of *enough* and *too* constructions. In particular, while the backgrounded relationship between a speed instantiation and a race win is still one of causal necessity and causal sufficiency in examples like (5.2a-i) and (5.2c-i), the relationship between the specific speed instantiation described by the matrix clause and winning the race in the complement cannot be causal. In these examples, the matrix instantiation instead provides evidence for Juno's (latent) capacity to perform the

causally necessary and causally sufficient instantiation of speed at race time: the eventualities described by the matrix and complement clauses in (5.2a-i) and (5.2c-i) are related epistemically, rather than causally.

In other words, a temporal overlap requirement is predicted for ABLE, on Proposal 7.10, by the causal dependence semantics it shares with lexical implicatives. Evidence that modal claims must involve temporal overlap in order to have an abilitative interpretation, then, provides support for the implicative analysis of ABLE, and argues for a causal account of ability, more generally. As this discussion showed, the non-defeasibility of ABLE's complement inferences under negation is a consequence of this requirement; thus, what at first appears to be a problematic split between the implicative inferential profiles of dynamic adjective *enough* constructions and ABLE claims in fact provides evidence in support of Proposal 7.10.

7.2 Actuality, ability, and genericity

The previous section set out the implicative proposal for ability attributing predicates, and illustrated its success in deriving the existence and distribution of actualized interpretations under both positive and negative matrix polarity. In this section, I go beyond actuality inferences, and show that an implicative analysis along the lines of Proposal 7.10 can, in addition, explain the effort inferences noted by Bhatt, predict an apparent divergence in the logical behaviour of ABLE under actualized versus pure ability interpretations, and, finally, offers a potential account of the apparent 'genericity' of pure ability interpretations (Maier, 2018b).

7.2.1 Non-triviality of the ABLE complement

Bhatt's two-way implicative proposal for ABLE derives the effort inferences associated with examples like (7.4)-(7.5) from the Karttunen and Peters (1979) 'direct assertion' implicative semantics, on which both *manage* and ABLE simply assert the realization of their complements, and presuppose that this realization required effort from the sentential subject. In Chapter 3, we saw that the specific presuppositions associated with *manage* in fact vary from

one context to another, with *manage* sometimes seeming to presuppose an effort requirement, sometimes a requirement for intentional action, and in others to simply presuppose that the implicative complement was unlikely to occur (cf. Coleman 1975). The examples in (7.17) replace *manage* with *be able* in the naturally-occurring examples (3.32a)-(3.32c) from Chapter 3; (7.17a)-(7.17c) show that the same presuppositional variability associated with *manage* also applies to ABLE.

(7.17) *Compare:* (3.32)

- a. Without intending to, Ms. Streisand actually was able to synthesize the problem of diversity mania.

\nrightarrow intention, \nrightarrow difficulty, \sim unlikely

- b. By 1998, four years after a federal ban on assault weapons took effect, gun manufacturers were easily able to bypass the laws by making small alterations to their weapons.

\sim intention, \nrightarrow difficulty, ? \sim unlikely

- c. The social democrats (Socialdemokratiet) were able to strengthen their position as Denmark's strongest political force as expected during local elections.

\sim intention, ? \sim difficulty, \nrightarrow unlikely

On the ‘prerequisite’ account of implicative semantics (Proposal 3.50), I explained these malleable presuppositions in terms of the causal dependence structure invoked by a lexical implicative (see also Baglini and Francez, 2016). Proposal 3.50 ties the realization of an implicative’s complement proposition to the realization of a causally necessary and causally sufficient prerequisite, taken to be unresolved in the discourse context, and which thus presents a potential obstacle for the realization of the complement. Effort, unlikely, intention, and so on, are context-dependent reflexes of the existence of a causal prerequisite; broadly, the non-triviality of realizing an implicative complement can be attributed to its contingent status in the implicative semantic structure.

Although on Proposal 7.10, ABLE and *manage* are no longer semantically equivalent, as

per Bhatt, we maintain the basic idea behind his proposal, to the effect that the shared ‘effort’ (non-triviality) presupposition follows from shared semantic structure. Unlike *manage* and other lexical implicatives, ABLE does not (necessarily) resolve the status of the prerequisite as part of its at-issue content. However, non-triviality is associated with the shared causal dependence structure, and in particular with the requirement that the complement proposition $A(S)$ is, for both *manage* and ABLE, contingent on a causally necessary causing action. The causal necessity of $H(S)$ for $A(S)$ introduces the potential for $A(S)$ to be causally precluded, if $H(S)$ does not occur; thus, the unresolved status of $H(S)$ represents a potential obstacle for $A(S)$, resulting in an inference that $A(S)$ is non-trivial. Causal necessity is central to deriving this inference: absent the necessity presupposition, introduced by implicative semantics, in clause (7.10-i) of Proposal 7.10, a hypothetical guarantee analysis of ABLE cannot fully account for Bhatt’s observations.

7.2.2 Asymmetric abilities

The sufficiency condition is also an essential component of the implicative analysis of ABLE. The causal sufficiency presupposition in clause (7.10-iii) is not only instrumental in deriving actuality entailments for perfectly-marked ability claims under positive matrix polarity, but also, in combination with the stative capacity attribution in clause (7.10-ii), captures the ‘reliability’ requirement that motivated a hypothetical guarantee account of ability in the first place. The possibility of the ABLE complement, in Proposal 7.10, is established contingently, in view of $A(S)$ ’s status as a guaranteed causal consequence of $H(S)$ in all causally optimal developments of the reference context. If clause (7.10-ii) forced the realization of $H(S)$, an ABLE assertion would directly guarantee $A(S)$ as a causal consequence; since we only require that $H(S)$ is available as a possible action for S , we instead derive both that its causal consequences are possible, rather than inevitable, as well as the inference that the agent S has a reliable strategy which effectively allows her to (causally) control the realization of $A(S)$.

To recall the discussion in Chapter 2, it is the hypothetical guarantee structure that explains our reluctance to attribute ability to an agent like Tara, in Maier’s (2018b)’s golfing

example (2.48), even given a witness for her success at making a hole in one.

- (2.48) *Context:* Suppose Tara is a beginning golfer. She misses most of her shots. On this occasion, however, she strikes the ball from the tee and it happens to go into the hole, so on this occasion she makes a hole in one. (Maier, 2018b, p.412)
- a. ?Tara can make a hole in one.

The judgement in (7.17a) distinguishes ABLE from pure circumstantial possibility, which is verified by the existence of a single witness, or a single accessible world in which Tara makes a hole in one. Thus, while the context in (2.48) supports the claim that it is circumstantially possible for Tara to make a hole in one, it does not support the claim that Tara is able to (or abilitatively can) make a hole in one. Even once we observe a successful hole in one, the background information in (2.48), including in particular Tara's poor track record as a golfer, effectively precludes an ability assertion because it does not support the presuppositional requirements for ABLE. Specifically, the background information does not support the existence of a 'choice point' for Tara, at which she can exert full control over her hole in one, by deciding whether or not to take a particular causally necessary and causally sufficient action for making a hole in one. The core of the abilitative interpretation of *can* and *be able* lies in the existence of such a choice point for an agent. It is in view of the choice point requirement that abilitative possibility crucially fails to verify the axioms of alethic modality discussed in Chapter 2, including Axiom 2.9, which leads from the truth of a proposition p to the conclusion that $\Diamond p$. It is not generally true that $A(S)$ licenses the conclusion that S ABLE A (that is, $A(S) \not\vdash S$ ABLE A).

One of the puzzles associated with the dual ability and actuality interpretations for ABLE, however, is that, on an actualized interpretation, ABLE does seem to verify $A(S) \rightarrow S$ ABLE A . Thalberg's (1972) erratic marksman example, repeated in (1.2), seems to illustrate just this principle: that the observation of Brown's single successful triple bull's-eye licenses the claim in (1.2b), even while it fails to license the periphrastic ability attribution in (1.2a).

- (1.2) *Context:* "Before he hit [...] three bull's-eyes, [Brown] fired 600 rounds, without

coming close to the bull's-eye, and his subsequent tries were equally wild.”

- a. #Brown had the ability to hit the bull's-eye three times in a row.
- b. Brown was able to hit the bull's-eye three times in a row.

The logical contrast, at least at first glance, suggests that while ABLE may have a pure ability interpretation that overlaps with *had the ability*, it also seems to have a second, independent meaning, which corresponds to actualized interpretations and diverges in its logical properties from (pure) abilitative modality.

Building on this apparent split, Mari and Martin (2007, 2009) argue for an ontological distinction between the abilities referenced by pure ability ABLE and periphrastic constructions like *had the ability*, and those referenced by actualized ABLE. On their view, there are (at least) two kinds of objects in the category of *ability*: the ‘canonical’ pure ability, called a *generic ability* (GA), which we would neither attribute to Tara in (2.48) nor to Brown in (1.2), and a second type, which can be picked out by *be able* and by ability modals, but not by *had the ability* or other periphrastic ability constructions. The second type of ability, which Mari and Martin call *action-dependent abilities* (ADAs), are those attributed to Tara and Brown, and are responsible for actuality inferences. Mari and Martin argue that ADAs “ontologically depend” on the actions with which they are associated (2009, p.8); consequently, they are non-persistent, exist in view of, and only in view of, particular actions, and are thus temporally bounded by the bounds of the verifying actions themselves.

Mari and Martin recruit the distinction between the aspectual class features of homogeneous, persistent GAs versus bounded ADAs to offer an account of actuality inferences that, like the coercion analysis, relies on particular requirements of the perfective aspect. For Mari and Martin, however, the restriction of perfective aspect to bounded (quantized) predicates does not result in the coercion of an underlyingly stative ABLE. Instead, the selectional restriction of the perfective aspect forces perfectly-marked ABLE claims to select for the type of ability which is inherently bounded, thus picking out an ADA instead of a GA. ADAs, however, only exist in tandem with their associated actions, so the actuality entailment follows directly.

(7.18) **Hypothesis.** (paraphrased from Mari and Martin, 2007, 2009)

Actuality entailments are triggered when the eventuality described by the infinitive is the only one which can satisfy the “Boundedness Constraint” associated to the perfective. If another eventuality can satisfy it, the entailment is not compulsory.

(7.18) also provides an explanation of data like (2.46): in this example, the overtly bounded opportunity for exercise of the attributed ability is sufficient to satisfy the ‘boundedness constraint’.

(2.46) *Notre nouveau robot a même pu repasser les chemises à un stade bien précis de son développement. Mais on a supprimé cette fonction (qui n’a jamais été testée) pour des raisons de rentabilité.*

‘Our new robot could-PFV even iron shirts at a particular stage of its development. But we suppressed this function (which was never tested) for reasons of profitability.’

Consequently, the ability itself need not be interpreted as bounded, and perfectly-marked *pouvoir* can, in this case, refer to a GA. Absent this or similar temporal modification, only an ADA interpretation is compatible, on Mari and Martin’s view, with the bounding requirements of the perfective.⁴

There are several puzzling points in Mari and Martin’s proposal. First, while Mari and Martin argue that the two-ability account is not a polysemy analysis, since both ADAs and GAs belong to the class of ‘abilities’, it seems at least to be an ambiguity-based, insofar as ABLE can refer to two distinct types of object. Second, it is not clear what part of an ability modal, for Mari and Martin, can be taken to refer to an ontological entity.⁵ Finally, in the absence of an account which links GAs and ADAs and explains in what sense they are both abilities, the existence of a class of ADAs seems stipulative; as noted by Piñón (2009), it is

⁴It is worth observing that the particular formulation of (7.18), which takes the eventuality described by the modal preagent to be the satisfying eventuality, is in effect equivalent to Homer’s (2011) aspectual coercion analysis, but offers a less robust theory of aspectually-driven reinterpretation.

⁵For *had the ability* and its French equivalent *avoir la capacité*, the nominal element plausibly performs this function – but since these periphrastic constructions can only refer to GAs, this is ultimately a reason to be suspicious of the ontological reality of ADAs as a type of ability.

not clear what differentiates ADAs, *qua* abilities, from actions.

Indeed, from this perspective, Mari and Martin's account amounts to the claim that ability, as an ontological object, necessarily represents a 'generic', persistent property of an individual, but that ABLE is ambiguous between a predicate that refers to this ontological object and one which simply instantiates the modal prejacent (meaning 'did', as per Thalberg 1972). Even if we accept the basic ambiguity, this account offers no explanation for the non-triviality inferences associated with actualized interpretations of ABLE. On the ontologically-driven account, we simply have to stipulate that certain types of actions – for instance, breathing, in example (7.4a) – do not have corresponding ADAs, and are thus infelicitous independently of the effort condition. If we do this, however, it is difficult to see how we might explain why (7.4) improves in contexts where the ABLE complement is backgrounded as non-trivial.

(7.4a) #Timmy was able to breathe.

(7.5) *Context:* Timmy had a bad car accident as a result of which he lost control over most of his muscles for several hours.

a. Thankfully, Timmy was able to breathe.

The causal implicative structure of Proposal 7.10 allows us to make sense of the apparent logical split between abilitative and actualized uses of ABLE with respect to Axiom 2.9 ($p \rightarrow \Diamond p$) and, at the same time, explain both GAs and ADAs as realizations of a single underlying structure for ability.

I take Proposal 7.10, as a whole, to represent the ontological entity 'ability'. Thus, an ability can be attributed to an agent in view of – and only in view of – the validity or felicity of the entire complex causal structure. The requirement that the context meet these conditions does not vary according to the abilitative or actualized interpretation of ABLE. This means that, in an example like (1.2), it is not a single witness for the modal prejacent (i.e., Brown's single triple bull's-eye) which licenses *was able*, but instead a causal dynamics leading up to and including the single triple bull's-eye which supports the requirements of Proposal 7.10.

We already have some evidence that the triple bull's-eye alone cannot be what licenses (1.2b): past-tense ABLE claims, as shown by (7.4), require a context which supports non-triviality of the modal complement. This requirement, as argued above, is a reflection of the causal necessity requirement. Taking the witness for the prejacent and the non-triviality requirement together, the only remaining licensing condition for a *was able* claim is the causal sufficiency of the necessary condition responsible for the non-triviality of the prejacent.

As we saw in Chapter 5, causal sufficiency of $H(S)$ for $A(S)$ in a context c requires that all of the causally optimal worlds which lead from c to $H(S)$ are worlds in which $A(S)$ occurs as a consequence of $H(S)$. In a context where $H(S)$ has been realized, this requires that all normal causal developments have $A(S)$. But, again as seen in Chapter 5, causally optimal worlds will be indistinguishable from one another with respect to the causal consequences of settled propositions; thus, in a context where $H(S)$ is realized, a causal sufficiency claim is licensed by the observation that $A(S)$ followed $H(S)$, in the course of normal causal developments – practically speaking, that $A(S)$ occurred no earlier than $H(S)$, and plausibly as a consequence of $H(S)$. Looking at the past, then, causal sufficiency of $H(S)$ for $A(S)$ can be verified by the truth of $A(S)$ just as long as $H(S)$, and the (plausibly causal) path from $H(S)$ to $A(S)$ have also been observed. In other words, what licenses *was able* in a context like (1.2) is not just the triple bull's-eye, but also the observation of Brown's actions prior to the triple bull's-eye, including perhaps things like loading the gun, adjusting his stance, and aiming. These actions are clearly causally necessary for Brown to make a triple bull's-eye, and the observation that he both took them, and that a triple bull's-eye followed, licenses the inference that all other causally necessary conditions were settled in the positive direction, and thus that Brown's actions were causally sufficient for the triple bull's-eye: thus, Brown *was able* to hit the bull's-eye three times in a row.

The past observation of Brown's preparatory actions and the consequent triple bull's-eye, however, are not adequate licensing conditions for an attribution of ability in a context where $H(S)$ has not been settled. In this type of context, not all of the causally optimal worlds will be ones in which $H(S)$ is realized, and we need stronger evidence than a single observation to establish a dynamics in which all of the $H(S)$ worlds will be $A(S)$ worlds.

Our assumptions about the structure of the dynamics, in this type of context, cannot simply draw on observed events, but must involve our expectations about how events in the world will develop, and can be affected, for instance, by our assumptions about Brown's properties as an agent, including in particular his intentions and his skills as a marksman, as well as, to a certain extent, independent beliefs about the difficulty associated with achieving a triple bull's-eye, in the general way of things. Thus, in a context where neither $H(S)$ nor $A(S)$ is settled, we need in effect more and stronger evidence to support the causal dependence presuppositions of an ability attribution than we do in a context where $H(S)$ is settled.

What this discussion shows is that the surface-level appearance of two different kinds of ability, which are apparently licensed by different kinds of information, subject to different logical properties, and which themselves license different inferences, in fact does not reflect an ambiguity in the meaning of *ability*, but instead follows from the requirements imposed by the causal structure in Proposal 7.10, and in particular by the presupposition of causal sufficiency between the agent's action $H(S)$ and the ability complement $A(S)$. Actualized interpretations for ABLE appear to be more easily licensed – as in the case of Brown – than pure ability interpretations not due to a difference in their ontological structure, but rather because actualized interpretations arise only in contexts where the causing condition, $H(S)$, has been settled. Pure ability interpretations, even though they do not require actualizations of the ability they describe, seem to have stronger truth conditions (or to impose stronger requirements of reliability) because the causal sufficiency relation requires more contextual support and more evidence in a context where $H(S)$ is not settled than it does in a context where $H(S)$ is settled. Both ability and actuality interpretations describe attributions of the whole causal structure in Proposal 7.10 (thus explaining Bhatt's non-triviality presuppositions for actualized interpretations), but their divergence follows from the variation in the requirements imposed by causal sufficiency with respect to two different kinds of utterance contexts.

Causal sufficiency, as an element of ability attributions, thus accounts for the apparent asymmetry between past- and present- or future-oriented ability claims. With the benefit of hindsight, and having witnessed a causal chain of events in the world, we can attribute

to Brown in (1.2) the ‘context-specific’ ability to hit the bull’s-eye three times in a row, because we have evidence that, at the reference time (for the causing action), he did – as it turns out – have an available action that fully determined whether or not he made the triple bull’s-eye. This is true of the reference context regardless of whether or not Brown or anyone else believed that he had such a strategy available to him at the time. His poor track record, and other information about his goals or intentions, becomes irrelevant in view of the observation of the particular causal chain of events in the reference context. Given Brown’s poor track record as a marksman, however, our ‘best guess’ for the causal course of events moving forward does not support the claim that he has a foolproof strategy for hitting three bull’s-eyes in a row – he may not even know how he did it in the past. Thus, the requirements imposed by the causal sufficiency presupposition in effect make past ability claims easier to license than present or future ability claims, even allowing us to attribute (past) abilities to agents who may not have been trying to achieve the goal in question, or perhaps were not even aware that they had done so. This observation suggests a possible connection to the accidental and out-of-control uses for ability predicates in languages like Malagasy, St’át’imcets, and Tagalog (Davis et al., 2009; Paul et al., 2016; Alonso-Ovalle and Hsieh, 2017), motivating an analysis of these phenomena which involves the same type of underlying causal structure as I am proposing here.

The causal structure of ability in Proposal 7.10 does real work in explaining the empirical data here, allowing us to derive not only ability and actuality interpretations, but also to explain the asymmetric behaviour of these interpretations with respect to their logical consequences and licensing conditions, as a consequence of a single, complex structure for ability. The basic distinctions come down to the different requirements for causal sufficiency in different types of context: since the selectional restrictions of perfective aspect, by default, force an eventive interpretation of an agent’s capacity for a causing action $H(S)$, perfective ability claims default to contexts which settle $H(S)$, while imperfective ability claims do not, thus predicting the split in inferential behaviour tracks the aspectual alternation.

7.2.3 Genericity in pure ability

Finally, I want to suggest that fleshing out the hypothetical guarantee structure in terms of causal dependence relations, as in Proposal 7.10, also offers a means of accounting for a particular objection, posed by Maier (2018b), to the hypothetical guarantee/existential-over-universal analyses of ability as a class. Maier (2018b) argues that persistent or generic abilities cannot be explained simply on the layered modal structure, because the embedded universal modal (as in Louie’s proposal, 2.53) imposes too strong of a requirement on the developments of the world. In particular, we are often comfortable attributing ability, using ABLE, to an agent, in cases where we have no reason to expect her to succeed across *all* of the worlds in which she performs a particular preparatory action. Maier illustrates this point with the example (7.19).

- (7.19) *Context:* Gina is an excellent golfer. When she is confronted with a short putt, she almost always – but not quite always – sinks it. She is now confronting a short putt. (Maier, 2018b, p.416)

Maier’s point is that, on a view in which requires that every world in which Gina tries to make the putt, or performs her normal/trusted set of preparatory actions is one in which she sinks the putt, we should be unable to attribute agency (with ABLE), since Gina’s track record shows that she cannot quite guarantee success, and we do not, in fact, always expect her to succeed. In order to account for the potential failures, Maier proposes a ‘hybrid’ view of ability, partially inspired by Bhatt’s appeal to genericity in explaining the non-entailing behaviour of ability modals under imperfective marking, on which the almost-but-not-quite-always requirement is captured by the introduction of a (covert) genericity operator in non-entailing cases. This allows ability to be attributed to an agent just in case the ability complement A is “generally an option” for S (i.e., as long as A is in the set of available actions for S in ‘normal’ conditions or general circumstances; Maier 2018b, p.425).⁶ The generic in effect replaces the universal quantifier of a hypothetical guarantee analysis *à la*

⁶Maier (2018b) offers a more precise definition of what it means to be an ‘option’; this is conceptually the same thing as Brown, Louie, and Mandelkern et al.’s (2017)’s ‘available actions’; pp.423–425.

Brown or Louie with *MOST*, and thus weakens the problematic requirement.

Although a more precise comparison will have to await a more complete theory of causal modality and the causal premise semantics, it seems to me that Proposal 7.10, in view of its causal dependence component, can accommodate Maier's observations without the need to resort to a generic operator. Causal sufficiency requires that, if the world develops (in a causally optimal manner), to the point at which all other necessary conditions for the ability complement are settled in the positive direction, then the realization of the complement is entirely dependent on whether or not the agent does $H(S)$.⁷ In particular, on a causal dependence account, which represents causal relationships in a contextually-developed dynamics, cases where an agent takes a particular action aimed at the ability complement, but fails to achieve complement realization, can be explained as cases where some ambient but potentially unobserved (or unobservable) condition was not satisfied, independently precluding the agent's success – and removing the instance of failure from the set of worlds under consideration for the causal sufficiency relationship. The content of the presupposition is, then, that there are causally optimal ways in which the world can develop where the agent's action is the sole determining factor for the realization of the complement: in general, the complement cannot be achieved without directed action from the agent, but it still may not be achievable unless the right ambient conditions are settled first.

On a causal dependence analysis, moreover, we can go even farther than Maier does, and explain why, depending on the perceived difficulty of an action (that is, the difficulty of getting all of the conditions for success 'lined up' properly), we may even be comfortable attributing abilities of certain types (e.g., making a half-court shot, or landing a triple axel) to individuals who fail in their attempts with high frequency. This reflects the idea that it is unusual or difficult, in the general way, to get to points at which the causing action for these actions is determinable; on a causal dependence analysis, the extent to which frequent actual achievements of the complement are required to license an ability attribution will

⁷This is ultimately quite similar to theories like the one proposed by Cross (1986), which involve reasoning about the consequences of an agent's actions or choices in a set of 'ideal' worlds.

depend, in effect, on the frequency with which normal causal developments are believed to actually get us to the choice point in question.

7.3 Ability, action, and possibility

In demonstrating how Proposal 7.10 accounts for both actualized and abilitative interpretations of ABLE, as well as a number of associated puzzles, the previous sections present a strong argument for pursuing a full formal analysis of ability modals that incorporates the basic implicative causal structure. The main challenge for such a theory is to integrate the structure of a proposal like 7.10 with the baseline premise semantics for modals, in a way that accounts for the use of possibility modals like *can*, *pouvoir*, and *saknaa* to refer to a complex, causal ability structure.

The central difficulty has to do with the relationship between the possibility operator involved in an abilitative claim, the modal prejacent, and the presuppositional material that constitutes the real meat of an implicative approach to ability. In Proposal 7.10, as in the hypothetical guarantee accounts of Louie (2014); Mandelkern et al. (2017); Maier (2018b), and others, the proposition that appears directly under the possibility modal is not the prejacent, as it is across other modal flavours, but instead is an element – the ‘hinge’ condition – that is not apparently represented in the sentential structure at all. This feature sharply distinguishes an implicative analysis of ability from the analysis of possibility modals in general, and a key challenge for a full formalization of the implicative account involves reconciling this contrast in a principled way. Some approaches to abilitative modality – most notably, Hackl (1998) – aim to capture the reliability/guarantee requirement in the selection of a particular type of modal base for the possibility modal, but since the asserted content of Proposal 7.10 hinges on the alternation between an eventive and stative interpretation of the agent’s capacity for the causing condition $H(S)$, which is crucially disambiguated by the application of aspectual marking, I do not see a clear way to capture the implicative analysis of ability on this type of approach.

A more promising alternative comes from Belnap (1991), building on earlier work in

Belnap and Perloff (1988). Belnap and Perloff are interested in what makes a claim agentive, and how this is to be represented logically or ‘canonically.’ They point out that, while both (7.20a) and (7.20b) are true statements about the plot of Melville’s *Moby Dick* from an objective standpoint, only (7.20a) describes an agentive event (from the point of view of the sentential subject): Ahab ensured that this sailing was a sailing in search of the whale, while Ishmael did not knowingly set sail in pursuit of this particular goal.

- (7.20) a. Ahab sailed in search of the white whale.
 b. Ishmael sailed in search of the white whale.

Belnap and Perloff introduce the *stit* (‘seeing to it that’) operator, which is intended to capture the basic concept of agentivity by capturing the idea that agentive actions are the result of a choice for, or in favour of, a particular course of action on the part of the sentential subject.⁸ The difference between (7.20a) and (7.20b) can then be captured by comparing each claim to a *stit* claim as follows:

- (7.21) a. (7.20a) \equiv Ahab *stit*: Ahab sailed in search of the white whale.
 b. (7.20b) $\not\equiv$ Ishmael *stit*: Ishmael sailed in search of the white whale.

Since Ishmael’s choice to sail on the *Pequod* was not aimed (on his part) at chasing the white whale, (7.20b), while true, is not equivalent to an agentive *stit* claim, as shown in (7.21b). On the other hand, since Captain Ahab deliberately set out to find the whale, (7.20a) can be construed agentively, and thus at least has a reading on which it is equivalent to the *stit* claim in (7.21a).⁹

⁸See also Chisholm (1964): “There is a state of affairs *A* and a state of affairs *B*, such that [the agent] makes *B* happen with an end to making *A* happen.”

⁹Note that (7.20b) might be construed as agentive for Ahab, since Ishmael’s pursuit of the whale (aboard the *Pequod*) is due to a deliberate choice or action of Ahab’s. This might equally well be expressed by the claim in (i), using the causative *make*, despite the fact that Ishmael came to join the crew of the *Pequod* of his own free will.

- (i) Ahab made Ishmael sail in search of the white whale.

(i) captures the fact that Ahab’s position of authority and his actions in this position are such that Ishmael’s effective preference to join the ship simply produces the outcome that he pursues the whale – that is, Ahab’s actions render Ishmael’s will with respect to the whale irrelevant. If, as proposed in Lauer and Nadathur

Concretely, the *stit* operator is meant to capture the fact that agentive outcomes are the result of a ‘prior choice’ by an agent: that is, the idea that “the present fact that Q is guaranteed by a prior choice of α ” (Belnap, 1991, p.789), where Q is the basic proposition (e.g. *Ahab sail in search of the white whale*, in example 7.20a), and α is the putative agent.

Belnap and Perloff model this within a branching time framework (Thomason, 1984), augmented with a concept of agent choice (following von Neumann and Morgenstern 1944). A branching time model involves a set of worlds W and a set of temporal points, \mathcal{T}_p , such that \prec_i is a linear order on \mathcal{T}_p . In this type of model, a world corresponds to a complete history through times. We add an equivalence relation \simeq_t with the property that, for any two worlds/histories in W , if $w \simeq_t w'$ and $t' \prec_i t$, then it must be the case that $w \simeq_{t'} w'$; thus, \simeq_t relates worlds that are identical up to time t . This ensures that the past is settled, but allows the future to remain ‘open’: worlds that are identical at a point t must be identical prior to t , but can branch apart after t .

At any world-time pair $\langle w, t \rangle$, an agent S has a **choice set**, $C_{S,w,t}$, which represents a partition of all of the histories passing through $\langle w, t \rangle$ subject to the condition that two histories that are identical through a time t' with $t \prec_i t'$ must belong to the same cell of $C_{S,w,t}$. An agent’s choice set, then, can be thought of as a set of actions available to an agent at time t , such that the action taken can determine some, but not necessarily all of the details of the future. Within this framework, given an agent S and a proposition $A(S)$, S *stit* $A(S)$ at $\langle w, t \rangle$ just in case S made a choice H from the set $C_{S,w,t'}$, where $t' \prec_i t$ such that, $\forall w' \in H$, $A(S)$ holds in w' at t . In other words, S took an action H prior to the reference time t such that H ensured $A(S)$ at $\langle w, t \rangle$.

Belnap’s (1991) idea is that ability modals represent simple historical possibilities, but differ from other pure possibility modals in that they necessarily embed *stit* propositions.

$$(7.22) \quad S \text{ ABLE } A := \Diamond_{\text{hist}}[S \text{ stit } A(S)]$$

On this view, S *can/is able to* A in a world w at time t just in case some future verifies the *stit* proposition S *stit* $A(S)$: that is, in case some possible future is such that S took

(2018, 2019), the periphrastic causative *make* predicates causal sufficiency, (i) suggests that *stit* or a similar operator may be analyzable in terms of causal sufficiency as well.

an action prior to $A(S)$ which ensured that $A(S)$ occurs. If we constrain the temporal relationships between utterance time, $A(S)$, and the ‘choice’ in the right way, it is easy to see how this can reduce to the requirement that S has a choice or available action at time t , such that taking that action guarantees that $A(S)$ will occur. In other words, the *stit* theory of ability amounts to a hypothetical guarantee analysis. Moreover, the structure of a choice set (or the parameters of the intermediate action) can easily be constrained in such a way that the choice available to S is necessary as well as sufficient for $A(S)$.

There are, of course, a number of nontrivial issues to be worked out – for instance, what the relationship between historical possibility, causal modality, and agent choice should be, and what is required to integrate a causal dynamics model or causal premise semantics with the branching time structure over which *stit* relations are defined. However, the affinity between a *stit* theory of ability and the implicative proposal for ability is clear. In addition, the *stit* approach offers an immediate solution to the problem posed by Proposal 7.10 on its own, insofar as the implicative proposal apparently embeds presuppositional material under the modal operator, rather than the modal prejacent itself. Since, on Belnap’s proposal, the modal prejacent is itself the *stit* proposition, we can wrap the required presuppositional structure directly into the *stit* (or a similar) operator, without needing to develop a fundamentally different approach to modal semantics. Finally, the *stit* approach suggests a way of extending the implicative account of ability and actuality to the analysis of other modals which license actualized interpretations.

Hacquard (2006) argues that actuality entailments occur across the class of root modals, including ability modals, goal-oriented modals, as in (2.28), and ‘ought-to-do’ deontics, as in (2.29). The entailment patterns are shown below.

(2.28) Actuality entailment contrasts for goal-oriented root modals:

- a. *Jane pouvait prendre le train pour aller à Londres, mais elle a pris l’avion.*
‘Jane could-IMPF take the train to go to London, but she took the plane.’
- b. *Jane a pu prendre le train pour aller à Londres, #mais elle a pris l’avion.*
‘Jane could-PFV take the train to go to London, #but she took the plane.’

(2.29) Actuality entailment contrasts for (goal-oriented) deontic modals:

a. *Lydia pouvait aller chez sa tante (selon les ordres de son père), mais n'y est pas allée.*

‘Lydia could-IMPF go to her aunt’s place (according to her father’s orders), but she did not go there.’

b. *Lydia a pu aller chez sa tante (selon les ordres de son père), #mais n'y est pas allée.*

‘Lydia could-PFV go to her aunt’s place (according to her father’s orders), #but she did not go there.’

I suggested in Chapter 2 that (2.29) is properly analyzed as a goal-oriented modal, indicating that the class of ‘actualizing’ modals may be more restricted than Hacquard claims. Subsequent work has also tried to refine her classifications, and a recent proposal from Mari (2016), argues convincingly that actuality entailments occur exclusively with the class of teleological modals, which deal with possibilities and necessities that exist in view of particular goals, established by a context, speaker, or by the intentions or desires of an agent.

Although ability can be seen as a subcategory of teleological modality,¹⁰ insofar as the ability complement represents a goal for the agent, ability claims differ from ‘strict’ teleological claims like (2.28) in terms of the relationship between the modal prejacent and the goal (and, in particular, what part of the sentential structure is taken to be the goal), and what, ostensibly, is embedded under the modal operator. Crucially, however, both types of modality involve a contingent relationship between some action for the agent and the realization of a particular outcome, and thus seem amenable to similar analyses, particularly if the relevant ordering source for teleological modals can be analyzed in terms of causal developments.¹¹ The structure of a *stit* theory, which links the actions and choices of an

¹⁰Mari (2016) suggests a classification on which the ‘goal-oriented’ modalities include teleological modals, non-generic deontic modals, and abilitative modals, but exclude ‘pure’ circumstantial modals (representing opportunity or pure chance); see Brennan (1993) and Portner (2009), as well as Hacquard (2006), for alternative classifications.

¹¹It is worth pointing out that the analysis of *enough/too* constructions in Chapter 5 involved a similar structure, in which the *enough/too* complement was analyzed as a goal, constraining the set of worlds used to evaluate the necessary condition: in dynamic adjective *enough/too* constructions, moreover, the goal

agent to particular outcomes, offers a good starting point for pursuing a unified account of abilitative and teleological modality, which, in particular, aims at an implicative account of their shared actuality entailments. Given the connections that have emerged throughout the dissertation, between causation, ability, and the telicity/quantization properties of (predicates of) eventualities, a route to the analysis of “implicative”, actualizing modalities which ties together causal dependence, agent choice, and teleological structures seems well worth pursuing.

7.4 Summary

This chapter explored the consequences of a compositional implicative analysis of the actuality inferences of *be able* and ability modals. I first discussed the parallels between *enough/too* constructions, as analyzed over the course of Chapters 4 to 6, and ability attributions, and argued for a ‘square of comparisons’ between dynamic adjective *enough/too* constructions, ABLE claims, and lexically-specific implicatives and bleached implicatives like *manage*, on which the relationship between *be brave enough* and *dare* is comparable to the relationship between *be able* and *manage*, and, similarly, the relationship between *be brave enough* and *be able* is comparable to the relationship between *dare* and *manage*.

(7.8) a. Ana was brave enough to enter the cave.

b. Ana was able to enter the cave.

(7.9) a. Ana dared to enter the cave.

b. Ana managed to enter the cave.

The comparisons between these examples lends weight to a treatment of ABLE as a non-specific version of *enough/too* capacity attributions, or as a ‘hypothetical’ or aspect-sensitive version of *manage*: on the analysis of implicativity and *enough/too* aspect sensitivity developed over the course of the dissertation, these treatments amount to the same thing. I spelled out the requirements of an implicative analysis for ability analysis in Proposal 7.10.

represented by the *enough/too* complement is taken to be a causal consequence of some action by the agent.

I then showed how the key components of Proposal 7.10 – the necessity and sufficiency of some action for the ability complement, a ‘dynamic capacity’ attribution with both stative and eventive interpretations, and a causal interpretation of the necessity/sufficiency presuppositions – each play a role in deriving not just the actuality and pure ability interpretations of ABLE, but also in explicating a number of puzzles that arise from the logical and inferential behaviour of both interpretations. In particular, I showed that the causal implicative structure accounts for an apparent asymmetry in the licensing conditions for past tense uses of ABLE as opposed to its present or future oriented uses. This discussion suggests several ripe areas for future investigation, including the differences between stative and eventive interpretations for ‘action-oriented’ predicates, as they relate to the available interpretations of ABLE versus periphrastic ability constructions like *have the ability*, *be capable*, *avoir le capacité*, *être capable de*, and, following recent work from Castroviejo and Oltra-Massuet (2018), Spanish *ser capaz*. A brief discussion of Maier’s (2018b) ‘generic’ proposal for pure ability interpretations suggested some theoretical connections between genericity and the causal dependence view of normality, which remain to be properly explored.

The penultimate section of the chapter contributed to the set of directions for future investigation by setting out the key challenges for reconciling a causal implicative analysis of ability with the premise semantics approach to modality. I suggested that a particularly promising route involves pursuing the connections between agency, causation, and historical possibility that emerge from the *stit* proposal of Belnap (1991) (drawing on Belnap and Perloff 1988). This route also offers a connection to the analysis of goal oriented modality with respect to actualized interpretations, and, more broadly, in terms of the connections between causation, telicity, agency, and ability that have emerged over the course of the dissertation.

In the final chapter, I review the structure of the investigation in the dissertation. I summarize the key findings, offer answers to the three core questions set out in the introduction, and offer some comments on the role of the novel causal dependence component, in particular as it pertains to the direction of future research into the linguistic expressions of ability, action, and agency.

Chapter 8

Conclusion

I began this dissertation with a metaphysical question: what is it to have an ability? Philosophical investigations of ability are primarily concerned with the relationship between ability and performance, a focus which can quickly be traced back to a simple, but puzzling, linguistic observation: across languages, expressions of ability in some contexts convey information about the abilities and potential actions of an agent, and in others simply indicate that the agent performed a particular action. As (1.4) shows, these interpretations can be disambiguated on the basis of temporal information.

(1.4) Marja was able to swim across Lake Nokomis.

a. In her twenties, Marja was able to swim across Lake Nokomis.

~ *In her twenties, Marja had the ability to swim across Lake Nokomis.*

b. Yesterday morning, Marja was able to swim across Lake Nokomis.

~ *Yesterday morning, Marja swam across Lake Nokomis.*

In languages that overtly indicate temporal viewpoint with overt grammatical aspect, the ability/actuality alternation extends to abilitative uses of the possibility modal and, as Bhatt (1999) shows, is fully governed by aspectual marking. Under the ‘internal’ or ‘ongoing’ view of an eventuality supplied by imperfective marking, ability modals are compatible with pure ability interpretations, which crucially do not require that the modal complement occurred,

as shown in (1.9a). Under perfective marking, however, which supplies an ‘external’ or ‘completed’ view of an eventuality, only the actualized interpretation is possible, and (1.9b) entails that the modal complement was realized.

(1.9) The French ability modal *pouvoir* under imperfective and perfective marking:

- a. *Marja pouvait traverser le lac Nokomis à la nage, mais elle ne l’a pas traversé.*
 ‘Marja could-IMPF swim across Lake Nokomis, but she did not cross it.’
- b. *Marja a pu traverser le lac Nokomis à la nage, #mais elle ne l’a pas traversé.*
 ‘Marja could-PFV swim across Lake Nokomis, #but she did not cross it.’

From a linguistic standpoint, then, the investigation of ability and its relationship to both performance and possibility comes down to three core questions, repeated here from Chapter 2:

(I) **What is the semantic content of an ability ascription?**

What do expressions of ability necessarily encode, in view of which they are compatible with both actualized and potentially unrealized ability interpretations?

(II) **What is the connection between ability, actuality, and possibility?**

What, semantically speaking, accounts for the cross-linguistic use of possibility modals to ascribe abilities? How is the ability meaning associated with possibility, and how can this connection be maintained in the context of actualized interpretations?

(III) **What is the role of aspect in actuality and ability interpretations?**

What does aspect contribute to an ability meaning in order to ‘erase’ its modality? Why does this occur only with perfective aspect, and not with imperfective marking?

After showing that an ‘off the shelf’ combination of circumstantial possibility and the perfective aspect cannot explain the emergence of actualized interpretations for ability predicates, I began my investigation with Question I, and attempted to establish what is required for the truth of an ability ascription. This discussion, in Chapter 2, suggested that, while the linguistic encoding of ability does involve a possibility component, it is crucially stronger

than a pure circumstantial possibility, requiring some assurance of reliability in an agent's performance of an ability complement, i.e., a hypothetical guarantee.

In order to see how a strong hypothetical guarantee account of ability might connect to actualized interpretation, and provide a fuller answer to Question I, I then took up a line of investigation suggested by Bhatt's (1999) original comparison between actualized ability attributions and the complement-entailing interpretations of the implicative verb *manage*. Bhatt's idea was to treat ABLE directly as a lexical implicative, but his proposal suggested a more nuanced line of investigation, on which actualized interpretations are to be analyzed as implicative entailments at the compositional, rather than at the lexical level. To pursue this thesis, I first established an account of 'implicativity' as a semantic property, developing an account of the characteristic complement entailment patterns of implicative verbs that relies crucially on relations of causal sufficiency and causal necessity embedded in the lexical semantics. Although the most obvious connection between this account and a proposal for the semantics of ability (the one-way implicative analysis offered at the end of Chapter 3) did not provide an immediate connection to the hypothetical guarantee structure of pure ability, the relevance of a causal sufficiency relation to both actualized and pure ability interpretations suggested that the compositional approach to Bhatt's thesis is on the right track.

Aiming to bridge the gap between implicative lexical semantics and the ability/actuality alternation associated with ABLE, I turned to an investigation of the 'variably implicative' behaviour of *enough* and *too* constructions like *Juri was clever enough to leave early*. In some cases, *enough* and *too* claims simply indicate the possibility of their complement events – based on some measured attribute of the subject – but in others indicate that the measured attribute of the agent actually brought about the complement event, thus showing the full range of ability, actuality, and possibility interpretations associated with Question II. As the investigation in Chapters 4 and 5 showed, implicative behaviour in *enough/too* attributions is tied to the relationship between the matrix adjective and the complement proposition, and in particular arises when the *enough/too* complement is presupposed to be causally dependent on the matrix predicate in some way. Chapter 5 showed that, in

the crucial cases, the alternation between an ‘abilitative’ (latent capacity) interpretation for an *enough/too* attribution and an actualized (complement-entailing) interpretation comes down to an alternation between an eventive and a stative interpretation of the core dynamic predicate attribution. In connecting ability and actuality by means of this alternation, the implicative analysis of *enough* and *too* constructions led to Question III, an examination of the role of viewpoint aspect in driving the interpretive alternation.

Chapter 6 addressed Question III, establishing the features that distinguish predicates in the stative and eventive aspectual classes, and setting out a theory of aspectual interpretation and aspectual coercion, inspired by Moens (1987), Moens and Steedman (1988), de Swart (1998), and Bary (2009), which explains the effects of perfective or imperfective viewpoint aspect on the relationship between the aspectual class features of an underlying predicate of eventualities, and the temporal/durational properties of the eventuality returned at the sentential level. On this theory of aspect, the actualized interpretations for *enough* and *too* constructions arise because of the selectional restrictions on perfective aspect. Under perfective marking, stative predicates of eventualities are reinterpreted as quantized (telic) predicates compatible with the ‘completed’ perspective imposed by the temporal viewpoint semantics of perfective aspect. The perfective’s selectional restrictions account for the emergence of inchoative and maximal interpretations for underlyingly stative predicates; crucially, for the investigation of ability and actuality, however, perfective marking can also trigger a type of coercion that applies exclusively to predicates like *Juno be fast*, which are stative insofar as they attribute a latent capacity for particular kinds of action to an individual, and are thus inherently action-oriented. I proposed a formal representation for the crucial instantiative coercion operator, and showed that, taken together with the implicative and causal semantics for *enough* and *too* constructions developed in Chapters 4 and 5, instantiative coercion, triggered by perfective marking, predicts the distribution of actualized and ability interpretations for ‘implicative’ *enough/too* predicates.

Chapter 7 focused on the consequences of the analytical approach to Bhatt’s implicative ability thesis, bringing the analyses of lexical implicatives, *enough/too* constructions, and instantiative coercion to bear on the answers to Questions I-III. I argued that linguistic

expressions of ability necessarily encode an implicative semantic structure, in particular assigning an ability to perform some action A to an agent S just in case there is some ‘hinge’ condition H available to S , such that $H(S)$ is presupposed to be both causally necessary and causally sufficient for $A(S)$, thus giving the agent S control, in a particular sense, over the possible realization of $A(S)$. This structure links ability with possibility, in answer to Question II, in terms of the circumstantial possibility of the action H for S , in view of which the ability complement $A(S)$ is (contingently) possible. The implicative structure links ability and actuality in the interaction of a stative, dynamic capacity attribution ($\Diamond H(S)$), subject to coercion effects under perfective marking, and the requirements and consequences of the causal relationship between $H(S)$ and $A(S)$.

With a few exceptions, past approaches to actuality inferences have aimed to derive them in the composition of modality and aspect. On the line of analysis pursued in this dissertation, the alternation between ability and actuality does not result from a straightforward combination of these two elements, but instead reflects the interaction of aspect with the causal possibility structure of an ability, and in particular with the presuppositional requirements of causal necessity and causal sufficiency embedded in abilitative predicates. The content of these causal dependence relations – and the strength of their felicity conditions – depends, as seen in Chapter 5’s preliminary exposition of a causal premise semantics, on the immediacy of the causing action $H(S)$ in the reference context. On eventive readings, which force $H(S)$ to be instantiated, causal dependence must be immediately in effect; on stative readings, the dependencies must hold (or be believed to hold) over a wider range of developments of the world, thus imposing a stronger ability meaning while simultaneously avoiding an actualization requirement.

Perfective aspect contributes to the alternation by requiring as its input an eventive predicate of eventualities. In the case of ability attributions and dynamic adjective attributions, this requirement coerces an instantiation of the capacity attributed to the subject by the matrix clause. Given the presupposed causal structure underlying both ability and *enough/too* constructions, this produces an actuality entailment. In instantiating the causing action, however, the perfective is also restricted in the type of contexts to which it can

apply. A consequence of this is that perfective ability claims are only acceptable in contexts where the causing condition $H(S)$ is realizable; as we saw in Chapters 5 and 7, the licensing requirements for the ‘implicative’ causal structure vary, depending on whether or not $H(S)$ is realizable at the reference time. This not only allows us to make sense of the actualized and abilitative interpretations of ABLE on a single theory of ability, but moreover explains an otherwise puzzling asymmetry in the licensing conditions for ability attributions in the past versus those in the present or with future orientation.

At the end of Chapter 7, I proposed that the causal analysis of ability can be analyzed as a natural extension of the standard theory of modality. In particular, I suggested that abilitative modality belongs to the class of teleological or goal-oriented modalities, all of which participate in the actuality inference phenomenon. This opens up a potential line of investigation into the connections between causal event structure and the analysis of teleological modality, which promises to shed light on the relationship between causal dependencies and the properties of telicity and goal-orientation in the structure of events.

More broadly, the central line of investigation in this dissertation suggests that models of causal dependencies are tightly connected with reasoning about normality and stereotypicality, or the ways in which we expect the world to develop. A causal dynamics, or any other model of causal relationships relies on what we, as language users and intentional agents, know, or think we know, about the actual causal connections between objects and events in the world. In a Humean sense, of course, we can never be certain that our models are accurate; in practice, however, our judgements are made on the basis of probabilistic or statistical tendencies, observations, and/or on assumptions we make about the properties, tendencies (inertial or dispositional) of objects in the world, and the capacities and intentions of other agents, filtered through our own understanding.

One consequence of this is that, while our observations of causal connections between events in the past can be established on an evidential basis, and are necessarily accurate for a particular point and time in the world (in view of having been observed), our assumptions about non-specific causation, or causation moving into the unsettled future, will instead be associated with (our beliefs about) an object’s properties or trajectory, or an agent’s

intentions. In other words, the asymmetry that arises in the licensing requirements for past versus present or future oriented causal claims (abilitative or otherwise) is associated with an alternation between a starting set of assumptions (modal base) that stem from a speaker's observations and informational state and a set of assumptions that have to do with the dispositions and trajectories of objects and (natural) forces (Copley and Harley, 2015), or the capacities and intentions of agents.

There are a number of linguistic phenomena, ranging from the lexical to the sentential level, which exhibit an alternation in licensing and truth conditions based on agentive properties. These include, for instances, the interpretation of lexical causatives and volitive/involitive verb forms (DeLancey, 1984; Inman, 1993; Beavers and Zubair, 2013), accidental and out of control interpretations of ability predicates (Davis et al., 2009; Paul et al., 2016; Alonso-Ovalle and Hsieh, 2017), (non-)culmination inferences for telic accomplishment predicates (Lyutikova and Tatevosov, 2014; Martin, 2015), and a range of complex constructions which exhibit a possibility/actuality alternation that depends on the volitional properties of the individuals involved (e.g., defeasible causatives, Martin and Schäfer 2012, 2014, 2015). The connections opened up in the dissertation suggest a role for causal dependence in exploring and analyzing these phenomena, and argues for a continuing research program in semantics which employs formal models of causation as analytical and explanatory tools.

Appendix A

Sources for naturally-occurring examples

Below, example numbers refer to the number under which the example occurs in the main text.

- (3.21a) Tempting fate, I dared to open an umbrella indoors.
kool1079.com/tempting-fate-i-dared-to-open-an-umbrella-indoors/
Last retrieved on: 2019-02-05
- (3.21b) That is a technical explanation, and it does not throw light on precisely why Mr. Sinha condescended to meet the tainted persons in the first place.
www.dailypioneer.com/2014/columnists/director-in-deep-trouble.html
Last retrieved on: 2019-03-05
- (3.32a) Without intending to, Ms. Streisand actually managed to synthesize the problem of diversity mania.
www.baltimoresun.com/news/opinion/oped/bs-ed-op-0814-goldberg-20170813-story.html
Last retrieved on: 2018-12-04
- (3.32b) By 1998, four years after a federal ban on assault weapons took effect, gun manufacturers had easily managed to bypass the law by making small alterations to their weapons.
www.motherjones.com/politics/2008/07/semiautomatic-people/
Last retrieved on: 2019-01-05
- (3.32c) The social democrats (Socialdemokratiet) managed to strengthen their position as Denmark's strongest political force as expected during local elections.
www.kas.de/nordische/en/
Last retrieved on: 2018-12-04

- (3.60a) Climate change made me do it: activists press the ‘Necessity Defense’.
www.forbes.com/sites/legalnewsline/2018/01/10/climate-change-made-me-do-it-activists-press-the-necessity-defense/#721ecb0553e0
Last retrieved on: 2018-01-25
- (3.72a) [John Boehner] was smart enough to leave once he saw the direction his party was going.
twitter.com/i/web/status/868633857926582273
Last retrieved on: 2018-04-03
- (3.72b) When I played soccer as a chubby little ten-year-old, I was too slow to score any goals, so my dad (who was the coach) had me play defense.
www.theladders.com/career-advice/measure-the-process-not-the-results
Last retrieved on: 2019-04-09
- (4.36) The baby’s mother carried him home and took care of him. And when he was old enough, she took him to the king’s daughter, who adopted him.
onlineministries.creighton.edu/CollaborativeMinistry/r-13-exodus2.html
Last retrieved on: 2019-04-10
- (4.37) “Pesireron’s punch was powerful, but he was too slow,” Park said later in a nationally televised interview in Chonju, about 125 miles south of Seoul.
www.apnews.com/3c3729d21726fa0f685bf48712bdcf6c
Last retrieved on: 2019-04-10
- (4.68a) My daughter was tall enough to ride 7DMT but was too scared.
forum.touringplans.com/t/rider-swap-if-tall-enough-but-scared-to-ride/41287
Last retrieved on: 2019-03-08
- (4.68b) Kavanaugh was old enough to know better – and to suffer the consequences.
www.baltimoresun.com/news/opinion/oped/bs-ed-op-0921-20180920-story.html
Last retrieved on: 2019-04-11
- (4.70a) When I was in JC, I was too light to donate blood.
dear1dear2.wordpress.com/2012/12/
Last retrieved on: 2019-04-01
- (4.70b) The last time we visited, two years ago, he was not tall enough to ride the Amazing Adventures of Spider-Man virtual reality 3D ride.
westpalmbeach.macaronikid.com/articles/59c05679afd5fd5986eddacb/what-we-learned-while-visiting-universal-orlando-resort
Last retrieved on: 2019-04-11

- (4.68c) Though he was too young to vote, Foster looked forward to the 1848 presidential election, where he hoped to “advance a boy’s opinion” in favor of the new antislavery Free Soil Party.
www.theatlantic.com/politics/archive/2016/05/violent-little-partisans/481641/
Last retrieved on: 2019-04-11
- (4.69a) But in Sochi, Hamlin was fast enough to win bronze, the first time ever an American luger reached an Olympic podium.
www.npr.org/2018/02/06/583583419/luger-erin-hamlin-plans-to-have-fun-during-her-4th-olympics
Last retrieved on: 2019-03-06
- (4.69b) A dangerous header off of the free kick bounced to the left of goalkeeper Peter Swinkels but he was nimble enough to scoop it up before the ball crossed the goal line.
sfstategators.com/news/2018/10/19/mens-soccer-msoc-offense-explodes-versus-stanislaus-state.aspx?mobile=skip
Last retrieved on: 2019-03-22
- (4.69c) Air traffic control chiefs withdrew a job offer from a talented graduate because he was too tall to fit his legs under the control room desks.
www.theguardian.com/uk/2005/jul/29/3
Last retrieved on: 2019-03-06
- (4.72a) I mean, I’m sure that I was tired enough to have imagined Santa, but there is no way I could’ve dreamed away all of those Wiffle balls and Game Boys.
tvmegasite.net/prime/shows/smallville/transcripts/season5/5-9.shtml
Last retrieved on: 2019-04-11
- (4.72b) When he died in 1984, the Glasgow Herald argued that he was too nice to have got involved in the grubby business of managing an international team.
www.theblizzard.co.uk/article/euro-76
Last retrieved on: 2019-04-12
- (4.72c) Rather than being concerned about the song or movie, it seems reasonable to have some sensitivity regarding the possible implications of this quote, especially for those women who were too nice to have been harmed, but were.
www.ibrattleboro.com/culture/2018/12/on-banning-baby-its-cold-outside/
Last retrieved on: 2019-04-12
- (5.51a) For those keeping score at home, that’s past the age when the IRS says you’re old enough to be required to take IRA distributions.
www.exchangecapital.com/blog/topic/financial-planning/page/6
Last retrieved on: 2019-04-23

- (5.51b) It's the first year that both of my children were too old to be required to deliver a card to every classmate.

www.westport-news.com/opinion/article/Well-Intended-The-romance-of-pen-paper-and-4315544.php

Last retrieved on: 2019-04-23

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