

Adverbs of Change and Dynamicity

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Abstract

This paper makes two contributions, one empirical and one theoretical. The empirical focus is ‘adverbs of change’—modifiers such as *quickly*, *slowly*, and *immediately*, which characterize the change described by the modified predicate as fast or slow (Cresswell 1978; Rawlins 2013; a.o.). The paper develops a semantic account that is uniform both across and within such adverbs. That is, I argue that adverbs of change share a common semantic core which selects for dynamic predicates and measures out event duration. I also argue that individual adverbs are not lexically ambiguous, despite their ability to take on different readings—namely rate, extent, narrative, or illocutionary. Rather, these different readings arise through interaction with aspectual and discourse structure, and are further restricted by idiosyncratic attachment possibilities. The proposed account of adverbs of change has theoretical implications for the aspectual notion of dynamicity, claiming that dynamicity is built directly into the mereological structure of events. More concretely, dynamic predicates are claimed to refer to ‘transitions’, a kind of complex event which labels the change that has occurred (cf. von Wright 1963; Szabolcsi 1982; Landman 1991; Pustejovsky 1991; Beavers 2013; Krifka 2014). Overall, the paper aims to lay the groundwork for a general theory of verbal change that can do justice to the richness of the linguistic data.

Keywords: adverbs of change, dynamicity, lexical aspect, event mereology, event measurement

1 Introduction

Change is a fundamental part of the human experience and, unsurprisingly, it is abundantly represented in natural language. The most direct way of representing change in language is through ‘dynamic’ predicates (Vendler 1957; Comrie 1976: ch.2; Dowty 1979; Smith 1997; Kearns 2000: ch.9; Rothstein 2004; a.m.o.). Essentially, these are verbal predicates that are drawn from the aspectual classes of activities (like *run* or *push a cart*), accomplishments (like *paint a picture* or *deliver a sermon*), and achievements (like *spot the plane* or *reach the summit*). Notably, dynamic predicates exclude states (like *believe* or *love*), which—as their name suggests—are static and do not convey change.

There is a class of verbal modifiers that characterize the change described by dynamic predicates as fast (e.g., *quickly*, *rapidly*, *swiftly*, *immediately*, *instantly*) or slow (e.g., *slowly*, *sluggishly*, *glacially*). I dub such modifiers ‘adverbs of change’, partially falling in line with prior labels such as ‘motion adverbs’ (Cresswell 1978), ‘celerative adverb’ (Cinque 1999), ‘rate adverbs’ (Tenny 2000; Kearns 2007), ‘aspect-manner adverbs’ (Ernst 2004), or ‘adverbs of time and change’ (Rawlins 2013). In this paper, I will focus on *quickly* and explicitly compare its interpretational properties to those of *slowly* and *immediately*. These three modifiers were chosen deliberately to establish key commonalities and differences that exist across adverbs of change, particularly concerning their interaction with the aspectual notion of dynamicity.

The starting observation is that adverbs of change presuppose dynamicity. This is most evident with *quickly*, the most versatile exemplar of such adverbs. The basic pattern is that *quickly* is incompatible with stative predicates but may co-occur with predicates from all other major aspectual classes (activities, accomplishments, achievements), arguably because it selects for dynamic predicates. This is illustrated in (1).

- (1)
- | | | |
|----|------------------------------------|------------------|
| a. | ?Justin loved Selena quickly. | (state) |
| b. | Selena ran quickly. | (activity) |
| c. | Selena ran to the park quickly. | (accomplishment) |
| d. | The boy quickly spotted the plane. | (achievement) |

Note that while (1a) is marked as degraded, there are cases where *quickly* can felicitously combine with stative predicates. However, in such combinations the stative predicate is coerced into conveying an inchoative reading (e.g., *Justin went to bed and quickly was asleep* \approx ‘Justin went to bed and soon fell asleep’). That is, in such combinations the modified predicate is no longer a state because it is bounded by a starting point. The mechanism at work which coerces atelic predicates (states or activities) into conveying an inchoative meaning will be made explicit in section 4.5.

Since adverbs of change may characterize rates, they have often been classified as a kind of manner adverbs (e.g., Jackendoff 1972: ch.3; Parsons 1990: ch.4; Ernst 2004: ch.2; Maienborn and Schäfer 2011; Morzycki 2016: ch.5). However, such adverbs display a wide variety of seemingly unrelated readings and should be better viewed as constituting a class in their own right. For example, *quickly* can measure the rate of change, the duration of the entire described event, the narrative time between the current event and some prior event, or the illocutionary time between asking and answering a question. This is demonstrated in (2).

- (2)
- | | | |
|----|--|-----------------|
| a. | Selena ran quickly. | (rate) |
| b. | Harry read the book quickly. | (extent) |
| c. | The professor walked in and the student quickly noticed her. | (narrative) |
| d. | Quickly, what is the capital of Uganda? | (illocutionary) |

In spite of this apparent polysemy, I will claim that adverbs of change are generally not lexically ambiguous. Instead, such adverbs consistently measure event duration, and the various readings hinge on the kind of event being targeted.

As a benchmark for all other adverbs of change, I will propose the semantics for *quickly* in (3), here stated somewhat informally (see section 4.2 for details). According to it, *quickly* composes with dynamic predicates and distributes over event structure, stating that every minimal event that falls under the modified predicate is of a relatively short duration (cf. Cresswell 1978; Rawlins 2013).

- (3) QUICKLY (informal)
- i. $\llbracket \text{quickly} \rrbracket(P)$ is defined only if P is a dynamic predicate.
 - ii. If defined, $\llbracket \text{quickly} \rrbracket(P)$ is the set of all events e in P with the following property: for all minimal subevents e' of e which fall under P , the temporal duration of e' meets the relevant standard for short events of P -ness.

Given the proposal in (3), here is a preliminary sketch of how the four readings in (2) will be derived (section 4 spells out the details). The extent reading in (2b) constitutes the most straightforward case. A common assumption in the aspectual literature is that telic predicates (accomplishments and achievements) denote events which lack proper parts that fall under the same predicate (Krifka 1989). Because of this property, only maximal events will fall under the predicate, and so *quickly* ends up characterizing as short the entire described event. Deriving the readings in (2c) and (2d) requires an extrapolation of this same idea to covert predicates that refer to abstract events. That is, in (2c) *quickly* characterizes as short a narrative event, one that spans the time between a previously mentioned event and the described event (Rawlins 2013). In turn, (2d) has *quickly* modifying an illocutionary event that spans the time between the speech event itself and the event of the addressee reacting to the question. Example (2a) is the only case where the distribution over event structure does some real semantic work. A crucial assumption in the literature is that the denotation of activities contains not just maximal events but also subevents of a certain size, making the denotation ‘divisible’ down to minimal parts (cf. Bennett and Partee 1972; Dowty 1979; Bach 1981; Krifka 1989; Landman and Rothstein 2012a, 2012b; Champollion 2017). This assumption forces *quickly* to distribute over the minimal meaningful parts of the described process, implying that all such parts are of a relatively short duration and giving rise to the intuition of a fast rate.

The explicit semantic analysis of *quickly* in (3) allows us to characterize the entire class of adverbs of change as selecting dynamic predicates and measuring out event duration. At the same time, this analysis provides initial insights into the dimensions along which other adverbs in this class are expected to vary (see section 5). First, notice that *quickly* and *slowly* are grammatically gradable whereas *immediately* seems to lack this property (cf. *more quickly/slowly than* vs. *?more immediately than*, *very quickly/slowly* vs. *?very immediately*). While grammatically gradable, *quickly* and *slowly* additionally differ in scale direction, requiring that the measured event meet the standard for short or long events of the relevant kind (respectively). These differences will be claimed to result from the presence or absence of a degree argument, as well as the type of measure lexicalized by a given adverb. Second, not all readings are available for all adverbs: *slowly* turns out to be able to convey rate or extent readings only, and *immediately* is always read narratively. A lacking rate reading could, in principle, be due to the absence of a quantificational component and the resulting distribution over minimal events. More generally, since the (in)accessibility of certain readings seems arbitrary, such semantic gaps are likely due to idiosyncratic restrictions on syntactic attachment.

The proposed semantics for adverbs of change presupposes a fine-grained understanding of the aspectual notion of dynamicity, as well as its interaction with other fundamental aspectual notions, like telicity and durativity. To formally articulate this notion, I will propose that dynamicity is built directly into the mereological structure of events, where the term ‘event’ is used for an eventuality of any kind (Bach 1986). More concretely, I will assume that dynamic predicates refer to ‘transitions’, i.e., complex events labeled by a description of the change that has occurred (cf. von Wright 1963: ch.2; Szabolcsi 1982; Landman 1991: ch.5; Pustejovsky 1991; Beavers 2013; Krifka 2014). The technical innovation that I introduce to represent transition events is the ‘arrow’ operator \rightarrow . This operator takes a prior event e , a successor event e' and an event description Q , and creates the transition $e \xrightarrow{Q} e'$. Intuitively, transitions like these capture the idea that Q —and no other unrelated change—comes about between e and e' . This is enforced by the three conditions listed in (4) (see section 2.1 for details).

(4) ARROW (informal)

A transition event $e \xrightarrow{Q} e'$ is defined only if

- i. Q does not hold of e but Q holds of e' ,
- ii. e and e' differ only with respect to Q and anything entailed by Q , and
- iii. e' follows immediately upon e .

For example, if s is the state of Jill being outside the room, s' is the state of Jill being inside the room, and Q is the property of Jill being in the room, then the transition $s \xrightarrow{Q} s'$ may represent the event of Jill entering the room.

The arrow constructor is specifically designed for mereologies of events and enriches standard mereologies, which may include entities of any kind (Leonard and Goodman 1940; Link 1983, 1991; Simons 1987; Krifka 1989, 1998; Casati and Varzi 1999; Hovda 2009; Champollion and Krifka 2016; Varzi 2016; Champollion 2017: ch.2; a.o.). Standard mereologies employ the ‘sum’ operator \oplus (sometimes called ‘fusion’ or ‘join’) as their primary tool for constructing wholes from parts. That is, if e and e' are events, $e \oplus e'$ is their sum, or the minimal event that contains e and e' . Against this background, the additional expressive power conferred by the arrow constructor is necessary for at least two reasons. First, proper parts of transition events may be targeted by covert aspectual operators, such as inchoative operators (see section 4.5). This means that without explicitly representing the structure of transitions, defining the meaning of such operators becomes challenging. Second, spelling out transition events broadens our understanding of the relationships between dynamicity and the aspectual notions of telicity and durativity. That is, as discussed in section 2.2, dynamic predicates can be telic or atelic (in fact, telicity is a subcase of dynamicity), and durative or punctual (in fact, punctuality is a subcase of dynamicity).

The rest of the paper is structured as follows. Section 2 introduces an enriched mereology that includes transition events and also spells out the aspectual notion of dynamicity and its links to telicity and durativity. Section 3 discusses the semantic distribution of *quickly*, emphasizing the important role of the aspectual profile of the modified predicate. Section 4 presents the main proposal about *quickly*, making a crucial use of our explicit assumptions regarding event type and aspectual class. Section 5 is devoted to variation within the class of adverbs of change, briefly comparing *quickly* to *slowly* and *immediately*. Section 6 discusses two previous accounts of adverbs of change (i.e., these of Cresswell 1978 and Rawlins 2013), and section 7 is the conclusion.

2 Dynamicity and lexical aspect

This section serves as a theoretical background for the proper semantic analysis of adverbs of change. It proposes to revise standard event mereologies so that dynamicity is directly built into the structure of events. Extending prior work, the section provides explicit representations for different event types and formally defines three key distinguishing features of aspectual class: dynamicity, telicity, and durativity. The proposed definitions of these features not only play a crucial role in the semantics of adverbs of change but also predict the correct entailment patterns between major aspectual classes.

2.1 Revising the event mereology

Formal treatments of lexical aspect typically draw a categorical distinction between events proper and states (e.g., Davidson 1967; Bach 1986; Parsons 1990; Kamp and Reyle 1993: ch.5; Rothstein 2004; Wellwood 2019). The guiding intuition behind this distinction is that events proper are dynamic and imply some sort of change, while states are static and do not imply any change. However, this approach obscures the important issue of what exactly aspectual change amounts to and further hampers the linguistic analysis. Since events proper are unanalyzed entities, it becomes challenging to distinguish between different types of change, such as telic vs. atelic or punctual vs. durative (Comrie 1976: ch.2; Dowty 1979: 3.8; Beavers 2013). Moreover, aspectual operators may target the different components of change (see section 4.5), suggesting that these components are explicitly represented in language.

To address the issue of aspectual change, I will reimagine the dualistic event–state picture just described and propose to build change directly into the mereological structure of events. In doing so, I will adopt what Landman calls the ‘filmstrip’ model of change (Landman 1991: 212). This model is based on the metaphor of how moving pictures are created from the fast movement of static frames. In traditional filmmaking, each frame is flashed on a screen for a split second and is immediately replaced by a slightly different frame. Since the persistence of vision blends the frames together, the viewer is left with the illusion of a moving picture. In a similar way, we can conceive of aspectual change as a sequence of shifting states.¹

In order to flesh out the filmstrip model of change, I assume that an event e can be of one of two types: a state s or a transition t . Starting with states, these are the fundamental building blocks of all events and may be put together to form larger states. That is, any sum of prior states is also a state, as stipulated in (5).

(5) STATES

If s and s' are states, then their sum $s \oplus s'$ is also a state.

Transitions, on the other hand, are built from states and the arrow operator as follows. A simple transition is constructed through the arrow operator from two prior states and an event predicate. Moreover, a complex transition is any event that contains a transition as one of its parts. This is formalized in (6), where \sqsubseteq is the ‘parthood’ relation.

(6) TRANSITIONS

- i. If s and s' are states and Q is a predicate, then $s \xrightarrow{Q} s'$ is a transition.
- ii. If t is a transition and $t \sqsubseteq t'$, then t' is also a transition.

To put it plainly, whether an event is a state or a transition depends on the absence or presence of arrows in it, respectively. That is, states contain no arrows and transitions contain at least one arrow. This distinction makes intuitive sense if we keep in mind that only transitions (but not states) are dynamic and dynamicity is encoded by the arrow operator.

The formal properties of the sum operator \oplus are well known from prior work on mereology (e.g., Champollion and Krifka 2016).² But we need to impose certain restrictions on the application

¹Landman complains that the filmstrip model is too static as change itself is removed from it. However, I fail to see why change should be decomposed into notions that are themselves dynamic.

²At a minimum, the sum operator is assumed to be commutative, associative, and idempotent.

of the arrow operator \rightarrow as well. This is done in (7), which follows similar ideas outlined in von Wright (1963: ch.2), Szabolcsi (1982), Landman (1991: ch.5), Pustejovsky (1991), Beavers (2013), and Krifka (2014). Notice that the symbol \prec marks the temporal adjacency or ‘abutment’ relation between two events (Kamp and Reyle 1993: 573).

(7) ARROW (formal)

If e, e' are events and Q is a property of events, the transition $e \xrightarrow{Q} e'$ is defined only if

- i. $\neg Q(e)$ and $Q(e')$,
- ii. for all event properties Q' : if $Q \not\subseteq Q'$ then $Q'(e) = Q'(e')$, and
- iii. $e \prec e'$.

Let me comment on the three definedness conditions in (7). Starting with (7i), this is the central condition on the application of the arrow operator. It enforces the intuition that Q comes about between e and e' , meaning that Q is false of e but true of e' . Moving on to (7ii), this condition imposes a minimality restriction on the expressed change. It says that e and e' are the same, except with respect to Q and anything entailed by it.³ Finally, (7iii) requires not just that e precede e' but also that these two events be temporally adjacent or ‘abut’ each other, meaning that there is no third event that falls in between.⁴ In practical terms, this means that—according to our model—change takes no time. There is no ‘moment of change’ during which the change is partially but not fully in place (for discussion, see Landman 1991: ch.5). While a given change may be preceded or followed by a long and complex process, the change itself occurs instantaneously. Notice also that both (7i) and (7iii) entail that the arrow operator is anticommutative, or that change is always ‘directed’. That is, if $e \xrightarrow{Q} e'$ is defined, it is never the case that $e' \xrightarrow{Q} e$ is defined as well.

In summary, I have reimagined the classical event mereology by introducing two major revisions. Classical event mereology relies on two qualitatively distinct kinds of entities, i.e., events proper vs. states, and employs the sum operator as its sole tool for constructing wholes from parts. In contrast, I proposed that all events are constructed from states by means of not one but two operators: sum and arrow. The distinction in dynamicity between states (which are static) and transitions (which are dynamic) now hinges on the absence or presence of the arrow operator, respectively.

2.2 Event types

With this revised event mereology in place, we can now elucidate well-known differences in event type. Ever since Vendler (1957), the aspectual literature has distinguished between four main event types: states, activities, accomplishments, and achievements (Kenny 1963: ch.8; Comrie 1976: ch.2; Taylor 1977; Mourelatos 1978; Dowty 1979; Bach 1986; Moens and Steedman 1988; Parsons 1990: ch.3; Pustejovsky 1991; Kamp and Reyle 1993: ch.5; Smith 1997; Kearns 2000: ch.9; Rothstein 2004; Beavers 2013; a.o.). Differences in event type have reflexes in linguistic behavior

³While several other contingent changes may have occurred at the moment when Q comes about, these should be represented by events distinct from the transition $e \xrightarrow{Q} e'$. For example, if at the very moment when Jill walks into the room she is overcome by a feeling of happiness, the two changes will be represented by two different transition events, with their labels corresponding to *be inside the room* and *be happy*.

⁴More formally, where $<$ is the (strict) precedence relation, $e \prec e'$ iff $e < e'$ and there is no e'' such that $e < e''$ and $e'' < e'$.

and are assumed to result from differences in internal composition. I will now demonstrate how the shared intuitions about the four main event types can be explicitly represented.

Starting with states, these are the kind of things referred to by predicates like *know*, *love*, *be asleep*, etc. States are assumed to be ‘divisible’, in the sense that they consist of smaller states that are of the same kind (cf. Bach 1981; Krifka 1989; Landman and Rothstein 2012a, 2012b; Champollion and Krifka 2016).⁵ While divisible, states do not express change, so they must be constructed through the sum operator alone. This is schematized in (8).

$$(8) \text{ STATES: } s = s_1 \oplus \cdots \oplus s_n$$

Moving on to achievements, these are the type of events referred to by predicates like *notice the plane* or *reach the top*. Although achievements always involve transitions, Bach (1986) distinguishes between two kinds of achievements: ‘happenings’ and ‘culminations’. Happenings, referred to by predicates like *notice the plane*, constitute simple transitions from a prior state to a follow-up state and thus require no preparation to occur. In contrast, culminations are described by predicates like *reach the top* and constitute complex transitions as they are preceded by a preliminary process. These two structures are schematized in (9), and the details of the preliminary process in (9b) will be further specified in (11b) below.

$$(9) \text{ ACHIEVEMENTS (preliminary)}$$

- a. HAPPENINGS: $t = s \xrightarrow{Q} s'$
- b. CULMINATIONS: $t = t' \xrightarrow{Q} s$

Notice that a transition label, marked as Q in (9), need not coincide with the description of the entire event. In fact, since such labels only apply to (follow-up) states, they are not appropriate descriptions of the entire transition. However, the two predicates are closely linked, as an achievement description will entail the label predicate. For example, the achievement description *notice the plane* entails the label predicate *be aware of the plane*, where the former is dynamic and applies to transitions while the latter is non-dynamic and applies to states. Similar observations can be made about other types of transitions, like activities and accomplishments, which will be discussed below.

Now let us consider activities. Activity events are described by predicates like *walk* or *drive a car*. Similar to states, activities are divisible into smaller parts that are of the same kind. However, unlike states, activities are not sums of smaller states—instead, they are sums of simple achievement-like transitions. Their structure is schematized in (10), which exemplifies a sum of simple transitions from s_0 to s_1 , from s_1 to s_2 , and so on up to s_n .

$$(10) \text{ ACTIVITIES: } t = (s_0 \xrightarrow{Q_1} s_1) \oplus (s_1 \xrightarrow{Q_2} s_2) \oplus \cdots \oplus (s_{n-1} \xrightarrow{Q_n} s_n)$$

It is important to stress that the labels within any specific activity need not be the same. For example, in an activity described by *walk*, appropriate labels could include *have taken one step*, *have taken two steps*, etc. Similar to achievements, these labels will be entailed by the description of the entire activity, i.e., *walk*.

⁵I will set aside the question of whether states are infinitely divisible. This question is linked to the more general issue of whether event mereologies are atomic, atomless, or perhaps have parts that are atomic and parts that are atomless.

Having provided a detailed structure for activities, we can now spell out the structure of culminations, which was left open in (9). I will assume that the preliminary process of this kind of achievement is simply an activity, i.e., a sum of simple transitions. This is made explicit in (11).

(11) ACHIEVEMENTS (final)

a. HAPPENINGS: $t = s \xrightarrow{Q} s'$

b. CULMINATIONS: $t = ((s_0 \xrightarrow{Q_1} s_1) \oplus (s_1 \xrightarrow{Q_2} s_2) \oplus \dots \oplus (s_{n-2} \xrightarrow{Q_{n-1}} s_{n-1})) \xrightarrow{Q_n} s_n$

Finally, accomplishments are typically conceived as activity-like processes that reach a certain point and are followed by a state. Sometimes their initial segment is called a ‘preparatory phase’, their final segment is called a ‘consequent’ (or ‘result’) state, and the change itself is called a ‘culmination point’ (cf. Moens and Steedman 1988; Kamp and Reyle 1993: 5.3.2). In spite of this intuitive complexity, I will assume that accomplishments are just sums of simple transitions. This is shown in (12), where intuitively the preparatory phase corresponds to the chain of transitions from s_0 through s_{n-1} , the consequent state corresponds to s_n , and the culmination point corresponds to the final transition from s_{n-1} to s_n .

(12) ACCOMPLISHMENTS: $t = (s_0 \xrightarrow{Q_1} s_1) \oplus (s_1 \xrightarrow{Q_2} s_2) \oplus \dots \oplus (s_{n-1} \xrightarrow{Q_n} s_n)$

Notice that (12) displays the exact same structure as the one proposed for activities in (10). One sort of general motivation for this assumption is that the very same event can be felicitously described by, say, the activity predicate *run* or the accomplishment predicate *run to the store*. More to the point, in section 3 we will see that when an adverb of change like *quickly* modifies accomplishment predicates, it can describe the rate of the action, just like when *quickly* modifies activity predicates.

In spite of this internal similarity between accomplishments and activities, one salient difference is that accomplishments but not activities are felt to be oriented toward a goal, or to be telic. However, following Krifka (1989) and much subsequent work, I take it that this contrast in telicity is encoded not at the level of individual events but rather in the way the denotations of the corresponding predicates are structured.⁶ That is, the denotation of accomplishment predicates is ‘quantized’, in the sense that no event is a proper part of another event. In contrast, the denotation of activity predicates is ‘cumulative’, i.e., the sum of any two events in the denotation is also included in the denotation. This will be made explicit in section 2.3.

Comparing (12) with (11b), one might wonder why the significant structural difference between accomplishments and culminations, given that these event types share some intuitive similarity. That is, both an accomplishment predicate like *run to the store* and a culmination predicate like *win the race* are felt to refer to events that start with a preliminary process, reach a culmination point, and end in a consequent state. However, in spite of this similarity, Bach (1986) points out that culminations are like happenings and unlike accomplishments in that they behave like punctual predicates. For example, only the former allow for modification by temporal point adverbials like *at 3 p.m.* (see section 2.3). It is thus important that the proposed formalism keeps culminations and accomplishments apart.

⁶This means that, strictly speaking, the terms ‘accomplishment’ and ‘achievement’ should only be applied to predicates (or predicate denotations). In spite of that, I will follow common practice and use these terms to refer to individual events as well.

In summary, we have demonstrated how our revised event mereology can represent different event types. According to this mereology, all events are constructed from the same basic building blocks. Event types only differ in the way they are constructed, i.e., in how the sum and the arrow operators combine simple states to form complex structures. This implies that event types are hierarchically structured, with more complex event types built from simpler event types. More specifically, states are composed of smaller states, happenings are transitions from one state to another, activities and accomplishments are sums of happening-like transitions, and culminations are complex transitions from activities to states.

Before closing this section, let me emphasize that the event typology developed here is not intended to be exhaustive. One event type not mentioned is represented by predicates like *tap*, *knock*, or *flap*. On their ‘semelfactive’ reading these predicates denote achievement-like events, while on their ‘iterative’ reading their denotation is similar to that of activities (Comrie 1976: ch.2; Smith 1997; Rothstein 2008). Also absent from the above typology are ‘degree achievements’, i.e., events described by deadjectival verbs like *widen* or *darken* (Dowty 1979: 2.3.5; Hay et al. 1999; Kennedy and Levin 2008; Piñón 2008; Rothstein 2008; Kennedy 2012). These two event types are challenging because they are ambivalent regarding their telicity and durativity (see the literature just cited). However, their aspectual properties are not crucial for the main task at hand, i.e., the semantic analysis of adverbs of change. This is why I will set aside these event types, hypothesizing that the proposed formalism can be extended to represent these more complex event types as well.

2.3 Dynamicity, telicity, durativity

The internal structure of each event type projects certain properties that only partially determine its membership in a given aspectual class. The mapping from internal event structure to aspectual class is partial because sometimes the very same event may be viewed as belonging to two different aspectual classes. For example, as mentioned in the previous subsection, a given running event may be conceptualized as an activity or an accomplishment (cf. *run* vs. *run to the store*). This brings up the question of what properties event predicates may have that are not encoded in single events. More generally, we might wonder what properties carve out the logical space in which aspectual classes reside.

Work on lexical aspect has traditionally relied on a small number of distinctive features that generalize attested commonalities and differences across aspectual classes. One very popular triad of features is that of dynamicity, telicity, and durativity (e.g., Comrie 1976: ch.2; Mourelatos 1978; Smith 1997; Kearns 2000: ch.9; Rothstein 2008; Beavers 2013). I will adopt this triad as a basis for aspectual classification. I will first rehearse the established empirical picture on how these three features describe the main aspectual classes, and then will go on to formally define dynamicity, telicity, and durativity. The proposed definitions are partially based on the event typology spelled out in the previous subsection and will play a crucial role in the analysis of adverbs of change in sections 4 and 5.

I start with the dynamicity feature. Dynamicity is about the intuition that certain verbal predicates convey change. However, to the best of my knowledge, this intuition has not been supported by a systematic empirical diagnostic. Typically, a host of diagnostics are employed to distinguish between stative predicates, on the one hand, and activity/accomplishment/achievement predicates, on the other hand, and then the latter class of predicates are simply called ‘dynamic’. Here I will

take felicitous modification by adverbs of change as the prime diagnostic for dynamicity.⁷ That is, among the four major aspectual classes, only stative predicates reject modification by adverbs of change (barring the possibility of a repair reading through aspectual coercion). The data in (13) involves *quickly* and is repeated from (1) above.

- (13) a. ?Justin loved Selena quickly. (state)
 b. Selena ran quickly. (activity)
 c. Selena ran to the park quickly. (accomplishment)
 d. The boy quickly spotted the plane. (achievement)

The reason why adverbs of change select for dynamic predicates is simple and will be discussed in detail in sections 4 and 5. Foreshadowing, the lexical semantics of such adverbs presupposes that the modified predicate is dynamic and imposes further restrictions on the duration of the targeted events.

As for telicity, this feature captures the intuition that accomplishments and achievements are naturally bounded and cannot progress beyond a given point. This contrasts with states and activities, which lack natural boundaries. The standard test employed in the literature for diagnosing telicity involves the contrast between temporal *in*- and *for*-adverbials, where telic predicates take *in*-adverbials and atelic predicates take *for*-adverbials. This is shown in (14).

- (14) a. John liked Mary $\left\{ \begin{array}{l} \text{*in a year} \\ \text{for a year} \end{array} \right\}$. (state)
 b. Pedro walked $\left\{ \begin{array}{l} \text{?in an hour} \\ \text{for an hour} \end{array} \right\}$. (activity)
 c. Bertha painted a picture $\left\{ \begin{array}{l} \text{in an hour} \\ \text{?for an hour} \end{array} \right\}$. (accomplishment)
 d. Kim noticed the painting $\left\{ \begin{array}{l} \text{in a few minutes} \\ \text{?for a few minutes} \end{array} \right\}$. (achievement)

Why do *in*-adverbials go with telic predicates and *for*-adverbials go with atelic predicates? The usual explanation given is that *for*-adverbials distribute over event structure while *in*-adverbials modify maximal events (cf. Dowty 1979: ch.7; Landman and Rothstein 2012a, 2012b; Champollion 2017: ch.5). If only atelic predicates are assumed to make available event parts, the pattern in (14) falls out.

Finally, the durativity feature has to do with the intuition that states, activities and accomplishments are presented as taking time, while achievements are presented as being punctual. This feature can be diagnosed by temporal *at*-adverbials, which single out achievements, as demonstrated in (15).⁸

- (15) a. *John hated Mary at 3 p.m. (state)

⁷Notice, though, that not all possible combinations are felicitous, due to idiosyncratic restrictions on syntactic attachment for different adverbs (see section 5).

⁸Another common diagnostic includes inceptive and terminative operators, like *begin/start* or *finish/stop*. Barring the possibility of a habitual interpretation, these operators reject punctual predicates and are only acceptable with durative predicates (Dowty 1979: 2.2; Smith 1997: ch.3).

- b. ?The man walked in the park at 3 p.m. (activity)
- c. ?Pat cleaned the house at 3 p.m. (accomplishment)
- d. The gas main exploded at 3 p.m. (happening)
- e. We reached the summit at 3 p.m. (culmination)

A natural explanation for the pattern observed in (15) is that *at*-adverbials refer to instants rather than temporal intervals (cf. Vendler 1957; Bennett and Partee 1972). If durative predicates are assumed to refer to events that stretch over intervals, such predicates are expected to be incompatible with *at*-adverbials.

We have arrived at the commonly cited aspectual classification summarized in Table 1. The fact that not all possible combinations are represented suggests that there are interactions between the different features, such that certain specifications of a given feature entail certain specifications of another feature. Specifically, two important generalizations can be gleaned regarding how dynamicity is linked to telicity and durativity. The first generalization is that, while dynamic predicates can be telic or atelic, all telic predicates are dynamic (cf. Rothstein 2008). The second generalization is that a punctual predicate (i.e., an achievement) is always telic, and thus—by our first generalization—also dynamic (see Comrie 1976: 50). These two generalizations are something that any theory of lexical aspect should be able to capture. And indeed, they will be accounted for by the analysis of dynamicity, telicity, and durativity presented at the end of this subsection.

aspectual class	dynamic	telic	durative
states	—	—	+
activities	+	—	+
achievements	+	+	—
accomplishments	+	+	+

Table 1: Classification of aspectual classes in terms of dynamicity, telicity, and durativity.

Our final and most important task in this background section is to provide model-theoretic definitions for the three aspectual features of dynamicity, telicity, and durativity. Dynamicity is the most crucial feature for our purposes because it is directly selected by adverbs of change. Dynamicity is typically analyzed in terms of heterogeneity (cf. Vendler 1957; a.m.o.), i.e., events referred to by dynamic predicates are viewed as having parts that no longer fall under the same predicate. For example, an event described by the activity predicate *waltz* may have parts—say, single steps—that are too small to still count as waltzing. In contrast, non-dynamic predicates (e.g., *believe*) are assumed to refer to homogenous events, meaning that all event parts fall under the same predicate. The relevant formal property that specifies homogeneity and contrasts it with heterogeneity is that of ‘divisibility’ (Bennett and Partee 1972; Taylor 1977; Dowty 1979; Bach 1981; Krifka 1989; Landman and Rothstein 2012a, 2012b; Champollion and Krifka 2016). It is defined in (16).

(16) DIVISIBILITY

P is *divisible* iff for every two events *e* and *e'* such that $P(e)$ and $e' \sqsubseteq e$, it holds that $P(e')$.

However, characterizing non-dynamic predicates as divisible and dynamic predicates as non-divisible faces at least two challenges, particularly when working with traditional event mereologies where the sum operator is the only way to construct wholes from parts. Empirically, we predict

that static activities like *watch TV*, *sleep*, or *wait*—call them ‘stativities’—are divisible, while dynamic activities like *drive a car* or *glide* are non-divisible.⁹ This seems dubious since these two types of activities appear to be about equally divisible, in the sense that any (salient) proper part would count as an event of the same kind.¹⁰ Theoretically, the divisibility property requires strong ontological commitments regarding the way certain event types are structured. For example, we need to stipulate that achievement events, while instantaneous, have proper parts that do not fall under the given predicate. Without this stipulation, achievement predicates will vacuously satisfy the divisibility property in (16) and will be incorrectly classified as non-dynamic.

In contrast to these challenges, the event typology proposed in section 2.2 is tailor-made to characterize dynamicity. We can just say that dynamic predicates are those that apply to transitions as defined in (6) above, i.e., events that contain the arrow operator. This concept is stated in (17) and encompasses activities, accomplishments, and achievements.

(17) DYNAMICITY

P is *dynamic* iff *P* only applies to transition events.

Note that non-divisibility falls out from dynamicity. That is, since transition events are fundamentally built from states, a dynamic predicate will always refer to events which have parts (i.e., states) that do not fall under said predicate.

Moving on to telicity, one straightforward way to characterize this feature is through the quantization property, which is about how a predicate denotation is structured (Krifka 1989, 1992). A predicate counts as quantized when its denotation is exclusively comprised of complete events, i.e., it does not include any two events where one is a proper part of the other. This property is stated in (18).

(18) QUANTIZATION

P is *quantized* iff there are no events *e* and *e'* such that $P(e)$, $P(e')$, and $e \sqsubset e'$.

The characterization of telicity in terms of quantization has been relaxed in later work, typically due to concerns about how the intuition of a culmination point arises and the role of verbal objects in it (Krifka 1998; Kratzer 2004; Filip and Rothstein 2006; Beavers 2012; a.o.). Here I will set aside these concerns and accept that quantization is a key part of the notion of telicity, pointing out that even this stricter characterization does not link telicity with dynamicity tightly enough. That is, recalling the first generalization from Table 1, the quantization property provides no clue as to why telic predicates are dynamic. It allows for the possibility of telic predicates that are static, which would be at odds with the basic intuition that telic predicates are oriented towards a goal and inherently convey change.¹¹ To address this issue, I will simply assume that telicity requires

⁹Stativities have been previously discussed in Dowty (1979: 3.8), Bach (1986), and Fábregas and Marín (2017).

¹⁰For example, if Lisa watched TV from 3 to 4 p.m., she must have also watched TV from 3:20 to 3:40 p.m. Similarly, if Lisa drove her car from 3 to 4 p.m., she must have also driven her car from 3:20 to 3:40 p.m.

¹¹A reviewer brings up the interesting case of non-dynamic predicates bounded by *for*-measure phrases, such as *believe something for 20 years* or *sleep for five hours*, suggesting that these predicates are telic. However, standard tests for telicity (compatibility with *for/in* temporal adverbials, modification by *almost*, modification by conjoined temporal location adverbials, entailments of the progressive form; see Verkuyl 1972; Dowty 1979; a.m.o.) either prove difficult to apply for independent reasons or do not paint a clear picture (I omit the relevant data for reasons of space). A more detailed study of such predicates is left to future work.

both quantization and dynamicity. This assumption is codified in (19).¹²

(19) TELICITY

P is *telic* iff *P* is both quantized and dynamic.

Assuming that the denotations of accomplishments and achievements are quantized but those of states and activities are not, this definition correctly singles out the former group of predicates as telic.

Finally, we address the durativity feature. One way to define durativity—as well as its opposite, punctuality—is in terms of temporal instantaneity or event atomicity. However, starting with the first idea, if events were punctual because they only last for a short moment, then the question of punctuality is merely shifted from the realm of events to the realm of time (cf. Freed 1979: 3.1; Engelberg 2000). And if events were perceived as punctual because they are mereological atoms, it would be unclear why achievements (the only punctual event type in our event typology) can convey change at all (but see Piñón 1997).

Here I will take a different approach, following the filmstrip model of change presented in subsection 2.1. Building on the intuition that minimal change happens instantaneously, I will assume that punctual predicates are those that refer to ‘direct’ transitions, i.e., events whose main connector is the arrow operator and thus are of the form $e \xrightarrow{Q} e'$. Recalling the structure of different event types laid out in subsection 2.2, this correctly singles out achievements as the only type of punctual predicates. In turn, durative predicates are defined as being non-punctual, i.e., those that apply to events that do not have the arrow operator as a main connector (these include states and activities/accomplishments). The formal definitions are stated in (20).¹³

(20) PUNCTUALITY / DURATIVITY

- i. *P* is *punctual* iff for every event *e* in *P* there are events *e'*, *e''* and an event property *Q* such that $e = e' \xrightarrow{Q} e''$.
- ii. *P* is *durative* iff *P* is not punctual.

According to this definition, punctual predicates are necessarily dynamic, as they refer to transition events. By making the standard assumption that the denotation of punctual predicates is quantized, we predict more specifically that such predicates are also telic. This derives the second generalization from Table 1, i.e., that punctuality entails telicity.

With the formal analysis of dynamicity, telicity and durativity in place, we can now explore adverbs of change and their semantics, thus illustrating the advantages of our more explicit model of lexical aspect.

¹²Eventually, we might seek a definition of telicity that entails dynamicity not through stipulation but by offering additional explanatory value.

¹³Beavers (2008, 2012, 2013) is one place in the literature where the notions of punctuality/durativity are directly linked to the mereological complexity of events. For him, a punctual event consists of just two atoms (including a beginning and an end), while a durative event consists of more than two atoms (including a beginning, a middle part, and an end).

3 Data on *quickly*

This section presents the main data on *quickly*, examining its compatibility with predicates from different aspectual classes and cataloging the resulting interpretations.

The empirical properties of *quickly* have been previously discussed in Cresswell (1978), Pustejovsky (1991), Tenny (2000), Thompson (2006), Kearns (2007), Rawlins (2013), and Wellwood (2019: 6.3.3), a.o. *Quickly* turns out to be the most flexible of all adverbs of change, combining with various dynamic predicates (activities, accomplishments, achievements) and yielding four different interpretations, i.e., ‘rate’, ‘extent’, ‘narrative’, and ‘illocutionary’.¹⁴ These interpretations are typically linked to the aspectual properties of the modified expression, as demonstrated below.

A rate reading for *quickly* arises with activities and entails that the described action progresses fast. For example, (21) entails that Selena moved through space at a faster rate than the standard rate for a running event of this kind.

- (21) Selena ran quickly.

The rate reading of *quickly* is sometimes characterized as—or even contrasted with—a ‘manner’ reading (e.g., Cresswell 1978; Pustejovsky 1991; Tenny 2000; Thompson 2006). In (21), a manner reading would presumably describe as fast not the speed with which Selena traversed space but the way Selena moved her body parts. However, it is important to note that the two presumed readings are causally related, making it difficult to keep them apart. Furthermore, a distinct manner reading cannot be consistently identified for all activity predicates (e.g., *drive his car quickly* or *move through space quickly*). Therefore, I will set aside the possibility of an independent manner reading for *quickly*.

The extent reading of *quickly* arises with accomplishment predicates and measures the temporal extent of the entire described event. For example, (22a) describes the temporal extent of the book-reading event as being short relative to some appropriate standard. The same kind of reading seems to arise with achievement predicates, specifically with culminations.¹⁵ This is illustrated by the web-inspired example in (22b), where what is described as relatively short is the event of winning the race.

- (22) a. Elaine read the book quickly.
b. Southerland won the race against Perez quickly and decisively.

Note that while achievement predicates are punctual in aspectual terms, an extent reading of *quickly* with such predicates is unsurprising. This is because, on the current account, all events have temporal extent, irrespective of whether they are denoted by durative or punctual predicates. In other words, a punctual predicate refers to events that constitute a direct transition (have the form $e \xrightarrow{Q} e'$), not events that lack temporal extent.

Cresswell (1978) (followed by Pustejovsky 1991, Shaer 1998, Thompson 2006, and Rawlins 2013) claims that when modifying accomplishments, *quickly* is actually ambiguous between an extent and a rate reading. As just mentioned, the extent reading in such cases describes the duration

¹⁴While these labels are largely my own, they align conceptually with existing descriptions of these readings in the literature.

¹⁵I leave it open whether an extent reading for *quickly* is also possible or salient with happenings, merely noting that this reading is clearly available for its antonym *slowly* (cf. *slowly hit the ground* or *slowly notice the sound*).

of the whole event. In turn, a rate reading would modify the intensity of the underlying process. For example, in Cresswell's own words, the extent reading of (23) says that John's walking was a quick walking to the station, while the rate reading of (23) says that John walked quickly and his walking was to the station.

- (23) John walked quickly to the station. (Cresswell 1978: 181)

Rawlins (2013: 154) additionally argues that the extent vs. rate readings of *quickly* with accomplishments can be distinguished by the distribution of measure phrases inside comparative forms. As empirical support, he cites the examples in (24).

- (24) a. Alfonso ran to the park 2 minutes more quickly than Joanna. (extent)
b. Alfonso ran to the park 2 miles per hour more quickly than Joanna. (rate)

According to Rawlins, in (24a) *2 minutes* measures the difference in temporal extent between the two running events, whereas in (24b) *2 miles per hour* measures the difference in rate between these two events. However, while (24a) is uncontroversial, some of the English speakers I consulted find (24b) unacceptable, perhaps due to the rather technical nature of the notion 'miles per hour'. Notice also that when the extent reading is explicitly denied in a follow-up clause, as in (25), the rate reading is not easily accessible, although it does not seem to be completely ruled out either.

- (25) a. ?Alfonso ran to the park quickly, but it took him a long time to get there (he picked the longer path).
b. ?The plane fell to the ground quickly, but it took a long time before it crashed (the plane was flying very high).

What is important here is that the semantic proposal in section 4 is compatible, though it does not mandate, a rate reading for *quickly* with accomplishment predicates. That is, whether or not *quickly* has this reading will be a matter of attachment site. Here I will tentatively assume that—at least for some speakers—such a reading is accessible.

The rate and extent readings of *quickly* are purely semantic, in the sense that both comment on the event denoted by the modified expression. In this aspect, they differ from the narrative and illocutionary readings, which are in some sense pragmatic. Intuitively, what is measured in the latter two readings is the temporal distance between two different events, such as two narrative events or two utterance events. Starting with the narrative reading, it most obviously arises with achievements. As illustrated below, *quickly* appears to measure the distance between the prior walking-in event and the ensuing noticing event in (26a), and the distance between the event of taking a lead and the event of winning the race in (26b).

- (26) a. The professor walked in and the student quickly noticed her.
b. Harry took an early lead and quickly won the race.

The same kind of reading seems possible with other telic predicates, i.e., accomplishments. Two examples are cited in (27) (the second example is from COCA; Davies 2008).

- (27) a. A low sound came from the direction of the bed, and Kazuko quickly moved to the window.

- b. When war broke out, they quickly built a false wall in one of their barns and hid the truck.

In both (26) and (27), it may be difficult to single out the claimed narrative reading from a more regular extent reading. Although I will not offer an empirical diagnostic to distinguish between these two readings of *quickly* with telic predicates, it is worth noting that the possibility of a narrative reading is in line with the common assumption in the literature on narrative discourse (e.g., [Kamp and Rohrer 1983](#)) that telic predicates move the ‘reference time’ forward and thus create some temporal distance, which can be modified by adverbs of change (see section 4.5 for analytical details).

Finally, the illocutionary reading of *quickly* is special because it is not sensitive to the aspectual properties of the modified form. For example, it also arises with stative predicates, which are generally incompatible with adverbs of change (see (1)/(13)). One place where the illocutionary reading pops up is in questions, where intuitively *quickly* modifies the time between the speaker’s utterance event and the projected reaction to that utterance, i.e., the anticipated event of the hearer answering the question. An example of this is given in (28a). Another context for the illocutionary reading is in imperatives, where *quickly* measures the time between the utterance event and the projected event of complying with the command. This is shown in (28b).

- (28) a. Quickly, what were the main causes of the Russian Revolution? ([Shaer 1998: 13](#))
- b. Quickly, talk to Alfonso. ([Rawlins 2013: 174](#))

More generally, the illocutionary reading seems to be restricted to sentences with a non-assertive force, including questions and imperatives.

Before closing, notice that *quickly* is generally unacceptable with non-dynamic predicates, at least out of the blue, see (29a). However, in the right context, such combinations can be coerced into an inchoative achievement-like reading, as demonstrated in (29b). This coercion amounts to a narrative reading, where *quickly* measures the temporal distance between the beginning of the described event (the realization that something is wrong) and a previous salient event (the client’s calling back).

- (29) a. #Justin slept quickly.
- b. The client called back and the operator quickly knew something was wrong.

In summary, *quickly* proves to be compatible with all kinds of dynamic predicates, generating a set of readings largely determined by the aspectual properties of the modified expression. It is thus important to keep track of which reading is compatible with which aspectual class and to explore the implications for the selectional restrictions of adverbs of change concerning the features of dynamicity, telicity, and durativity. Table 2 lists the available combinations of readings for *quickly* with different aspectual classes. Specifically, a rate reading requires predicates that are dynamic and durative, an extent reading requires predicates that are telic (and thus dynamic; see subsection 2.3), a narrative reading requires telic predicates, and an illocutionary reading imposes no aspectual restrictions. In section 4, I will argue that some of these aspectual restrictions emerge naturally from the semantics of adverbs of change and need not be explicitly encoded, while at the same time more restrictions are introduced through covert aspectual or discourse operators.

reading	aspectual class	features
rate	activity, accomplishment	dynamic + durative
extent	accomplishment, achievement	telic
narrative	accomplishment, achievement, inchoative state/activity	telic
illocutionary	(any)	(none)

Table 2: Compatibility of different readings for *quickly* with different aspectual classes and features.

4 Formal account: *quickly*

This section develops a formal account for *quickly*, beginning with its gradability. It then demonstrates how the proposed semantics interacts with the aspectual properties of the modified predicate to derive the four readings of *quickly* discussed in section 3.

4.1 Gradability

Several linguistic analyses treat *quickly* as grammatically gradable (e.g., Heim 2006; Rawlins 2013; Wellwood 2019: 6.3.3). This is motivated by the observation that this adverb occurs in the comparative and accepts degree modifiers like *very*, as illustrated in (30).

- (30) a. Jill ran to the park more quickly than Jack (did).
b. Jill ran to the park very quickly.

Within the degree-based approach to gradability (Cresswell 1976; a.m.o.), such data can be captured by the assumption that gradable expressions encode measure functions whose value is compared to some appropriate standard. Here I will adopt this approach, assuming more specifically that *quickly* measures event duration. A preliminary lexical entry is given in (31).

$$(31) \llbracket \text{quickly} \rrbracket = \lambda d \lambda P \lambda e . P(e) \wedge d \preceq \mathbf{short}(e) \quad (\text{preliminary})$$

According to this entry, *quickly* carries over the meaning of the modified predicate (first conjunct) and compares the duration of the described event to some degree of length (second conjunct). More formally, *quickly* encodes the measure **short**, which maps events to degrees of temporal duration such that higher degrees on the scale correspond to shorter events.¹⁶ This is evident from the examples in (30), where in comparative sentences the main clause contains the shorter event and degree intensification by *very* additionally reduces the duration of the event.

The degree argument made available by gradable expressions is manipulated by degree constructions or degree adverbs. In the case of *quickly*, this argument is manipulated by comparative morphemes like *more*, intensifiers like *very*, or—in the absence of overt degree morphology—by a covert POS modifier. Existing literature provides semantic accounts of adjectival versions of these elements (Cresswell 1976; Klein 1980; von Stechow 1984; Heim 1985; Kennedy 1999; Kennedy

¹⁶The measure **short** can be composed from Krifka’s (1989) ‘temporal trace’/‘run time’ function, which maps events to the intervals they occupy, plus the ‘temporal extent’ function, which maps intervals to their temporal extent (see Rawlins 2013).

and McNally 2005; Morzycki 2016; Wellwood 2019; a.o.). Here I extend these accounts to include adverbial counterparts to the adjectival prototypes.

Kennedy and McNally (2005) define adjectival POS as in (32). According to this entry, (32) takes a gradable adjective (like *tall*) and states that the degree to which the denoted property P (say, ‘tallness’) applies to the relevant object x exceeds some standard value. This value is selected by the standard function **std** on the basis of P (which determines the scale dimension) and a contextually supplied comparison class C^c of objects of the same kind as x .

$$(32) \quad \llbracket \text{POS} \rrbracket^c = \lambda P \lambda x. \exists d [P(d)(x) \wedge \mathbf{std}(P, C^c) \prec d]$$

An adverbial counterpart POS_{Adv} is presented in (33a).¹⁷ This entry differs from (32) mainly in that it introduces an extra argument A for the modified gradable adverb. This argument restricts the events that fall under the verbal property P (first conjunct) and also determines the dimension along which the events in the comparison class P^c are measured (second conjunct). The result of composing POS_{Adv} with *quickly* is shown in (33b). This meaning applies to verbal properties whose events are of a shorter duration than the standard duration for events of this kind.

$$(33) \quad \begin{aligned} \text{a. } & \llbracket \text{POS}_{Adv} \rrbracket^c = \lambda A \lambda P \lambda e. \exists d [A(d)(P)(e) \wedge \mathbf{std}(A, P^c) \prec d] \\ \text{b. } & \llbracket \text{POS}_{Adv} \text{ quickly} \rrbracket^c \\ & = \lambda P \lambda e. \exists d [P(e) \wedge d \preceq \mathbf{short}(e) \wedge \mathbf{std}(\llbracket \text{quickly} \rrbracket, P^c) \prec d] \\ & = \lambda P \lambda e. P(e) \wedge \mathbf{std}(\llbracket \text{quickly} \rrbracket, P^c) \prec \mathbf{short}(e) \end{aligned}$$

Adverbial versions of *very* and *more* can be defined analogously.¹⁸ For example, very_{Adv} intuitively says that the modified adverbial applies to a degree that not just exceeds the standard but does so by a significant amount. This intuition is formalized in (34), where $d \prec^c d'$ is taken to mean that d' exceeds d by some amount that counts as significantly large in the relevant context. Notice that this is the same meaning as the one for POS_{Adv} in (33a), except for the intensification component enforced in the second conjunct.

$$(34) \quad \llbracket \text{very}_{Adv} \rrbracket^c = \lambda A \lambda P \lambda e. \exists d [A(d)(P)(e) \wedge \mathbf{std}(A, P^c) \prec^c d]$$

In turn, more_{Adv} compares two degrees, stating that the modified adverbial applies to the event described by the matrix clause to a higher degree than it applies to the event described by the comparative clause, see (30b). This is formalized in (35), where it is assumed that comparative clauses denote the maximal degree to which the contained gradable predicate applies (Heim 1985).

$$(35) \quad \llbracket \text{more}_{Adv} \rrbracket = \lambda A \lambda d' \lambda P \lambda e. \exists d [A(d)(P)(e) \wedge d' \prec d]$$

In sum, the gradability properties of *quickly* naturally emerge from a conservative extension of a standard degree semantics originally developed for gradable adjectives. Following this tack provides the first step towards a realistic semantics for *quickly* as well as other gradable adverbs of change (see section 5).

¹⁷Notice that both versions of POS only apply to ‘relative’ gradable predicates, which come with vague standards taken from the middle of the relevant scale, as opposed to ‘absolute’ gradable predicates, which take as standards the scale minimum or the scale maximum (Rotstein and Winter 2004; Kennedy and McNally 2005; Burnett 2017). Since *quickly* is clearly a relative adverb, I will put absolute predicates aside.

¹⁸Their adjectival counterparts are not discussed for reasons of space.

4.2 A semantics for *quickly*

Section 4.1 outlined a semantics for *quickly* that captures its core gradability properties. However, this semantics is lacking in two important respects. First, as discussed in section 3, *quickly* imposes selectional restrictions on the aspectual profile of the modified predicate. Yet nothing said so far prevents this adverb from composing with predicates of any aspectual class. Second, according to our preliminary semantics, *quickly* measures event duration (along a shortness scale). While this analysis directly captures the extent reading, it remains unclear how the rate, narrative, and illocutionary readings are to be derived. The current subsection presents the final entry for *quickly*, addressing the first issue and providing the necessary background for addressing the second issue.

I propose to enrich the preliminary entry for *quickly* in (31) in two respects, i.e., by imposing restrictions on the aspectual profile of the modified predicate and by letting the underlying measure distribute over event structure. Starting with the former enrichment, section 3 has established that *quickly* selects for dynamic predicates.¹⁹ I will thus impose dynamicity as a definedness condition on the lexical entry for *quickly*. The latter enrichment is needed to derive the rate reading of *quickly* (see the next subsection). Following Cresswell (1978) and Rawlins (2013), I will assume that the measure encoded by *quickly* distributes over event structure, targeting the minimal event parts that still fall under the modified predicate.

The final entry for *quickly* is stated in (36). Recall from (17) that dynamic predicates only apply to transitions, i.e., events that contain the arrow operator, the bearer of aspectual change. Moreover, the set of *P*-atoms of an event *e* contains all minimal parts of *e* that fall under *P*. This set is defined in (37).²⁰

$$(36) \quad \llbracket \text{quickly} \rrbracket = \lambda d \lambda P \lambda e : \mathbf{DYN}(P) . P(e) \wedge \forall e' \in \mathbf{atom}(e, P) [d \preceq \mathbf{short}(e')] \quad (\text{final})$$

$$(37) \quad \mathbf{atom}(e, P) = \{e' \in P \mid e' \sqsubseteq e \wedge \neg \exists e'' \in P [e'' \sqsubset e']\}$$

I will now demonstrate how this semantics for *quickly* derives the attested readings (rate, extent, narrative, illocutionary). The basic idea behind the analysis is that all readings involve measuring event duration and the differences in interpretation arise from the kind of events being measured.

4.3 The rate reading

The rate reading of *quickly* may arise with activity predicates and implies that the described action evolves rapidly. This reading is derived in (38), where the bracketed part of (38a) results in the meaning in (38b).

- (38) Selena ran quickly.
- a. Selena [run [POS_{Adv} quickly]]
 - b. $\lambda e . \text{run}(e) \wedge \forall e' \in \mathbf{atom}(e, \text{run}) [\mathbf{std}(\llbracket \text{quickly} \rrbracket, \text{run}^c) \prec \mathbf{short}(e')]$

¹⁹While the illocutionary reading of *quickly* may seem like an exception as it does not appear to restrict the aspect of the underlying lexical predicate, I will propose in subsection 4.6 that this reading involves a covert discourse operator which provides the required dynamicity.

²⁰Notice that if *P* is quantized, none of the events it applies to will be proper parts of each other. In this case, the set of *P*-atoms of *e* will be the singleton {*e*}.

The resulting meaning states that the minimal parts of the relevant running event that still count as runnings are of a shorter duration than the standard duration for running events of this kind. Depending on the context, these atoms may correspond to short stretches of running, individual steps, or perhaps even smaller motions, giving rise to the intuition of a fast rate.

It is worth pausing to comment on the nature of the atomic events measured by *quickly* when deriving the rate reading. Typically, bringing in atomic events into the analysis would introduce the ‘minimal-parts problem’, i.e., the issue of when event parts become too small to satisfy an atelic predicate (see Taylor 1977; Dowty 1979: 7.3; Moltmann 1991; Vlach 1993; Landman and Rothstein 2012a, 2012b; Champollion 2017: ch.5; a.o.). However, since my account incorporates dynamicity directly into event structure, the minimal-parts problem does not really arise, at least not for activities. That is, recalling subsection 2.2, activity predicates denote simple transitions of the form $s \xrightarrow{Q} s'$ and their sums. This means that the minimal parts are explicitly represented as simple transitions and distribution over them can readily apply. Moreover, although such simple transitions count as punctual in aspectual terms (as defined in subsection 2.3), assigning to them temporal duration is quite unproblematic. This is because, on the current account, the temporal notion of duration and the aspectual notion of durativity are kept separate, allowing all events—punctual ones including—to have a positive temporal duration.

4.4 The extent reading

The extent reading of *quickly* is found with telic predicates and targets the temporal duration of the described event. To derive it, we need to ensure that *quickly* composes with the entire verb phrase. Given that the property represented by telic verb phrases is quantized (it contains no two events such that one is a proper part of the other), the distribution over event structure becomes trivial and *quickly* ends up measuring the duration of the entire described event. This is illustrated in (39).

- (39) Selena quickly ran to the park.
- a. Selena $[[\text{POS}_{Adv} \text{ quickly}] [\text{run to park}]]$
 - b. $\lambda e. \text{run}(e) \wedge \text{goal}(e) = \text{park} \wedge$
 $\forall e' \in \mathbf{atom}(e, \llbracket \text{run to park} \rrbracket) [\mathbf{std}(\llbracket \text{quickly} \rrbracket, \llbracket \text{run to park} \rrbracket^c) \prec \mathbf{short}(e')]$
 $= \lambda e. \text{run}(e) \wedge \text{goal}(e) = \text{park} \wedge \mathbf{std}(\llbracket \text{quickly} \rrbracket, \llbracket \text{run to park} \rrbracket^c) \prec \mathbf{short}(e)$

Quickly with accomplishment predicates can also characterize the rate of the underlying process. In this case, it is essential to assume that *quickly* composes with the activity verb first, and then the resulting complex is composed with the object phrase. This is illustrated in (40), where the rate reading arises from distribution over the minimal running events of the underlying process, just as in (38).

- (40) Selena ran quickly to the park.
- a. Selena $[[\text{run} [\text{POS}_{Adv} \text{ quickly}]] \text{ to park}]$
 - b. $\lambda e. \text{run}(e) \wedge \forall e' \in \mathbf{atom}(e, \llbracket \text{run} \rrbracket) [\mathbf{std}(\llbracket \text{quickly} \rrbracket, \llbracket \text{run} \rrbracket^c) \prec \mathbf{short}(e')] \wedge \text{goal}(e) = \text{park}$

Note that there are diverging claims in the literature regarding how the surface position of *quickly* in accomplishment sentences constraints available interpretations. While these claims are not entirely consistent with each other, the consensus seems to be that a postverbal position conveys

a preference for the rate reading, whereas a preverbal position conveys a preference for the extent reading (e.g., [Pustejovsky 1991](#); [Thompson 2006](#); [Kearns 2007](#)). Here I will refrain from specifying concrete surface restrictions for *quickly*, the key point being that rate and extent readings are both possible with accomplishments and result from different scope relations.

Finally, recall from section 3 that a rate reading arises with dynamic predicates that are durative. That is, it arises with activities or accomplishments but not with achievements, which are punctual. We now have an explanation for why that is. The reason is that only activities and accomplishments make available the atomic structure of the underlying process—although in the case of accomplishments the object phrase eventually filters out non-maximal events, resulting in a quantized denotation. In contrast, achievement predicates refer to direct transitions and their denotations remain quantized throughout the semantic composition. What this means is that the restriction of the rate reading to durative predicates need not be explicitly stated. It already follows from the distributivity of *quickly* and the way the denotation of achievement predicates is structured.

4.5 The narrative reading

The narrative reading of *quickly* arises with telic predicates (i.e., accomplishments or achievements). Intuitively, this reading regulates the temporal distance between the described event and some prior salient event. To capture this intuition, I will assume with [Rawlins \(2013\)](#) that what is being measured here is the duration of a ‘narrative event’, an eventive counterpart to ‘reference time’ ([Reichenbach 1947](#): §51). Reference time is a theoretical construct whose main role is to fix the temporal relations between the events introduced in narrative discourse ([Kamp and Rohrer 1983](#); [Partee 1984](#); [Dowty 1986](#); [Hinrichs 1986](#); [Kamp and Reyle 1993](#): ch.5; [Parsons 2002](#); [Bary and Haug 2011](#); [Altshuler 2012](#); a.o.). Rawlins offers a novel implementation of this same idea, proposing instead that narrative discourse is chunked into narrative events, which enter into analogous relations with described events as do reference times on the standard view.²¹

More specifically, I assume that narrative events are introduced by a covert NARR operator. This operator does two things. It selects for telic predicates, as only such predicates are felt to advance the narration time. This operator also states that the narrative event it introduces contains the described event as a final segment. An entry for NARR is provided in (41), where e is a narrative event, e' is a described event, $<$ is the relation of strict temporal precedence over events, and $\mathbf{FIN}(e', e)$ states that e' is a final segment of e .

- (41) a. $\llbracket \text{NARR} \rrbracket = \lambda P \lambda e : \mathbf{TEL}(P) . \exists e' [P(e') \wedge \mathbf{FIN}(e', e)]$
 b. $\mathbf{FIN}(e', e)$ iff $e' \sqsubseteq e \wedge \neg \exists e'' [e'' \sqsubseteq e \wedge e' < e'']$

²¹A reviewer wonders if narrative events can be singled out in discourse, for example by anaphoric processes, thus independently confirming their existence. Although I cannot provide conclusive evidence on this matter, I present one suggestive example with *immediately*, a specialized narrative adverb of change (see section 5 for details). In (i), after A’s initial utterance, B challenges the existence of the described event, while C may be taken to dispute the short duration of the presumed narrative event.

- (i) A: We sat down and the door opened immediately.
 B: It didn’t happen—the door didn’t open.
 C: It didn’t go like that—we waited for a while before the door opened.

An illustration of the narrative reading of *quickly* is provided in (42). To derive it, two additional assumptions are necessary. The first assumption is that the property produced by application of NARR is quantized. If so, distribution over it becomes trivial and *quickly* ends up characterizing as short the entire narrative event. The second assumption is that narrative events are closely aligned with each other, following a similar assumption about reference times made in the literature on narrative discourse. Overall then, (42) entails that the narrative event—which contains the described event as a final segment and immediately follows upon a prior narrative event—has a shorter duration than the standard duration for quick narrative events of this kind. This derives the intuition that the event of Mark opening the door occurs shortly after the previously described event, whatever that might be.

- (42) ... Mark quickly opened the door.
- a. $[[\text{POS}_{Adv} \text{ quickly}] [\text{NARR} [\text{Mark open door}]]]$
 - b. $\lambda e. \exists e' [\text{mark.open.door}(e') \wedge \mathbf{FIN}(e', e)] \wedge$
 $\mathbf{std}([\text{quickly}], [\text{NARR} [\text{Mark open door}]]^c) \prec \mathbf{short}(e)$

Recall from section 3 that, in the right context, a narrative reading may also arise with underlyingly atelic predicates (i.e., states or activities). Such instances are plausibly analyzed as involving aspectual coercion, indicating a shift triggered by a covert operator necessary to resolve an aspectual conflict (e.g., De Swart 1998). For the case at hand, I assume that the narrative reading is facilitated by a covert inchoative operator INC. This operator transforms an atelic predicate into an achievement-like predicate by endowing the events in its denotation with a prior state, thus building change into its structure. A preliminary semantics for this operator is provided in (43).²²

- (43) $[[\text{INC}]] = \lambda P \lambda e : \neg \mathbf{TEL}(P) . \exists s, e', Q [P(e') \wedge e = s \xrightarrow{Q} e']$ (preliminary)

Given the possibility of coercing atelic predicates into telic ones in this manner, the narrative operator may apply as usual, resulting into a narrative interpretation. The structure in (44) provides an illustration and the semantic analysis mirrors that in (42).

- (44) ... Quickly, Jill was asleep.
- a. $[[\text{POS}_{Adv} \text{ quickly}] [\text{NARR} [\text{INC} [\text{Jill asleep}]]]]]$
 - b. $\lambda e. \exists e', e'', s, Q [\text{jill.asleep}(e'') \wedge e' = s \xrightarrow{Q} e'' \wedge \mathbf{FIN}(e', e)] \wedge$
 $\mathbf{std}([\text{quickly}], [\text{NARR} [\text{INC} [\text{Jill asleep}]]]^c) \prec \mathbf{short}(e)$

When composing NARR and INC, as in (44), there are two additional facets that require further attention. The first one is that, while NARR selects for telic predicates (i.e., predicates that are both dynamic and quantized), INC as defined in (43) only ensures dynamicity (it builds change into the underlying atelic predicate). To guarantee quantization as well, the coerced denotation should be based on the maximal events inside the underlying atelic denotation. For example, when coercing *be asleep* into meaning ‘start to sleep’, we want to transform into direct transitions only complete sleeping events, excluding any of their proper parts. This is accomplished in (45) through the maximality operator MAX.

²²The inchoative predicate that results from application of INC may appropriately be called a ‘reverse culmination’ (cf. Mourelatos 1978; Piñón 1997). That is, while both regular and reverse culmination predicates refer to events of the form $e \xrightarrow{Q} e'$, the intuition about the former kind of events is that the moment of change completes the action, whereas the intuition about the latter kind of events is that the moment of change starts the action.

- (45) a. $\llbracket \text{INC} \rrbracket = \lambda P \lambda e : \neg \text{TEL}(P) . \exists s, e', Q[\text{MAX}(e', P) \wedge e = s \xrightarrow{Q} e']$ (improved)
 b. $\text{MAX}(e', P)$ iff $P(e') \wedge \neg \exists e'' [e' \sqsubseteq e'' \wedge P(e'')]$

The second facet concerns the extent to which the described event should be included in the narrative event. The entry for **NARR** in (41) specifies that the entire described event must be included in the narrative event, serving as its final segment. This accords well with intuition when it comes to accomplishments and regular achievements (happenings or culminations), where the narrative reading of *quickly* seems to characterize as short the distance between the end of the described event and some prior event (cf. *They moved next door and quickly built a mill to grind corn*). However, when it comes to inchoative predicates, the intuition changes. What seems to be measured by the narrative reading of *quickly* in this case is the distance between the beginning of the underlying event and some prior event. For example, in (44) the state of Jill's being asleep may span over a longer period, and it would be sufficient for *quickly* to target only some initial segment of that state. To accommodate this intuition, I will modify the semantics for **INC** even further, now requiring that only an initial segment of the described event makes up the inchoative event. The final version is stated in (46), where **INI**(e'', e') states that e'' is an initial segment of e' .

- (46) a. $\llbracket \text{INC} \rrbracket = \lambda P \lambda e : \neg \text{TEL}(P) . \exists s, e', e'', Q[\text{MAX}(e', P) \wedge \text{INI}(e'', e') \wedge e = s \xrightarrow{Q} e'']$ (final)
 b. $\text{INI}(e'', e')$ iff $e'' \sqsubseteq e' \wedge \neg \exists e''' [e''' \sqsubseteq e' \wedge e''' < e'']$

Overt inchoative operators, like *begin* or *start*, yield similar coercion effects as **INC** and may be analyzed along similar lines.

4.6 The illocutionary reading

Finally, I discuss the illocutionary reading of *quickly*, which arises in non-declarative sentences and imposes no restrictions on the aspectual properties of the underlying predicate. In questions, this reading pertains to the metalinguistic component of the question–answer dynamic and intuitively measures the time between two utterance events. To derive this reading, I adopt a similar approach as in the analysis of the narrative reading. Specifically, I assume that discourse interaction is segmented into initiating and reacting events, such as asking and answering questions (cf. van Kuppevelt 1995; Ginzburg 1996, 2012; Buring 2003; Roberts 2012). I implement this idea by proposing that the illocutionary reading involves *quickly* modifying a covert predicate called **REACT**, which characterizes the event of the addressee (**addr**^c) reacting to the current discourse move (**move**^c), see (47a). Making the plausible assumption that this property is telic (i.e., dynamic and quantized), *quickly* can apply, although the distribution over event structure will have no semantic effect. The resulting denotation is shown in (47b).

- (47) a. $\llbracket \text{REACT} \rrbracket^c = \lambda e . \text{react}(e, \text{addr}^c, \text{move}^c)$
 b. $\llbracket \text{REACT} [\text{POS}_{Adv} \text{ quickly}] \rrbracket^c$
 $= \lambda e . \text{react}(e, \text{addr}^c, \text{move}^c) \wedge \text{std}(\llbracket \text{quickly} \rrbracket, \llbracket \text{REACT} \rrbracket^c) \prec \text{short}(e)$

A final hurdle to the analysis is how to incorporate this illocutionary component into the usual question partition (Hamblin 1973 and much subsequent work). I propose that this is mediated by

ILLOC, as defined in (48).²³ What this covert element does is place the illocutionary component in the presuppositional part and the partition component in the at-issue part of the question meaning.²⁴

$$(48) \quad \llbracket \text{ILLOC} \rrbracket = \lambda Q \lambda P \lambda p \lambda e : P(e) \cdot Q(p)$$

The compositional analysis of a question with *quickly* is illustrated in (49). According to it, *quickly* measures the answering event, indicating that this event is of a shorter duration than usual.

$$(49) \quad \begin{aligned} &\text{Quickly, is it raining?} \\ &\text{a. } \llbracket [\text{REACT} [\text{POS}_{Adv} \text{ quickly}]] [\text{ILLOC} [\text{Q raining}]] \rrbracket \\ &\text{b. } \lambda p \lambda e : \text{react}(e, \mathbf{addr}^c, \mathbf{move}^c) \wedge \mathbf{std}(\llbracket \text{quickly} \rrbracket, \llbracket \text{REACT} \rrbracket^c) \prec \mathbf{short}(e). \\ &\quad p = \text{rain} \vee p = \neg \text{rain} \end{aligned}$$

This analysis captures the sense of conversational urgency associated with the illocutionary reading of *quickly*. That is, (49) can be paraphrased as ‘Answer/React quickly, is it raining?’. Furthermore, since *quickly* targets the metalinguistic component rather than the descriptive content of the question, the analysis also captures the empirical observation from section 3 that the illocutionary reading of *quickly* is blind to the aspectual properties of the underlying lexical predicate.

The illocutionary use of *quickly* is also found in imperative sentences. There are different ideas in the literature as to what directive force amounts to semantically: a necessity modal carrying certain presuppositions (Kaufmann 2012), an individual property intended to update the addressee’s To-Do List (Portner 2004), or a speaker’s preference (Condoravdi and Lauer 2012). For ease of comparison and taking a cue from the last of these accounts, I will assume that imperative sentences are of the same semantic type as questions, invoking propositional alternatives. However, unlike questions, imperatives also convey a speaker’s preference towards the uttered alternative. With that much in place, the mechanism proposed for questions can be extended to imperatives as well. For example, (50) intuitively characterizes as short the time between issuing the directive and reacting to it. This intuition is captured by *quickly* appropriately constraining the reaction event introduced by REACT, as illustrated in (50) ($>_{\text{sp}^c}$ conveys the speaker’s current preference).

$$(50) \quad \begin{aligned} &\text{Quickly, open the door!} \\ &\text{a. } \llbracket [\text{REACT} [\text{POS}_{Adv} \text{ quickly}]] [\text{ILLOC} [\text{IMP open door}]] \rrbracket \\ &\text{b. } \lambda p \lambda e : \text{react}(e, \mathbf{addr}^c, \mathbf{move}^c) \wedge \mathbf{std}(\llbracket \text{quickly} \rrbracket, \llbracket \text{REACT} \rrbracket^c) \prec \mathbf{short}(e). \\ &\quad p = \text{open.door}(\mathbf{addr}^c) \wedge p >_{\text{sp}^c} \neg p \end{aligned}$$

4.7 Summary

We have derived the four attested readings (rate, extent, narrative, illocutionary) from the very same semantic content of *quickly*, thus preserving its semantic uniformity. We argued that the apparent divergence in meaning arises from a combination of three external factors: (i) the aspectual properties of the selected lexical predicate, (ii) interaction with covert aspectual and discourse operators, and (iii) the possibility that *quickly* attaches to different positions in the syntactic structure.

²³A REACT operator can be directly composed with a question denotation if ascribed the following higher-type meaning: $\llbracket \text{REACT} \rrbracket^c = \lambda A \lambda Q \lambda p \lambda e : A(\lambda e'. \text{react}(e', \mathbf{ad}^c, Q))(e) \cdot Q(p)$. However, it would be unclear how a meaning as complex as this can identify the class of reaction events necessary to determine the standard of comparison for *quickly*.

²⁴An alternative entry for ILLOC would merely conjoin the two meaning components. However, this would miss the intuition that a slow response to a question with *quickly*, while inappropriate, would still provide an answer.

5 Dimensions of variation: *slowly* and *immediately*

The empirical discussion and the formal analysis thus far have centered on *quickly* as a prime example of an adverb that modifies aspectual change. Yet English has a plethora of adverbs with similar properties. In this section, I will shift the focus to *slowly* and *immediately*, demonstrating how the meaning dimensions of *quickly* can be parameterized to produce the variation displayed by these two adverbs. While establishing a comprehensive semantic typology of adverbs of change is far beyond the scope of this paper, I will also offer a few tentative observations regarding the broader picture.

I begin by examining variation in gradability. As established in section 3, *quickly* is grammatically gradable, allowing occurrence in comparative constructions and intensification by *very*. The same holds for *slowly*. The data in (51) mirrors that in (30).

- (51) a. Jill ran to the park more slowly than Jack (did).
b. Jill ran to the park very slowly.

While gradable, *quickly* and *slowly* are antonymic terms, where the former characterizes the duration of the targeted events as being below standard and the latter characterizes this duration as being above standard.

Immediately shares with *quickly* the direction of comparison, characterizing the targeted events as being of a relatively short duration. However, it differs from both *quickly* and *slowly* in that it does not seem to be grammatically gradable, witness (52).²⁵

- (52) a. *Selena left the room more immediately than Justin (did).
b. *Selena left the room very immediately.

Given the proposed analysis for *quickly* in (36), such points of variation in gradability are not unexpected and require only minor modifications. For *slowly*, I propose that it has a similar semantics to that of *quickly*, except for a difference in measure function. That is, while *quickly* measures event duration on a ‘shortness’ scale, *slowly* measures event duration on a ‘longness’ scale, thus reversing the direction of comparison.²⁶ An entry for *slowly* is presented in (53).

$$(53) \quad \llbracket \text{slowly} \rrbracket = \lambda d \lambda P \lambda e : \text{DYN}(P) \cdot P(e) \wedge \forall e' \in \mathbf{atom}(e, P) [d \preceq \mathbf{long}(e')]$$

As for *immediately*, its non-gradability suggests that this adverb differs from *quickly* in that it lacks a degree argument and incorporates the relevant standard of comparison directly into its

²⁵The picture regarding the gradability of *immediately* is not as clear-cut as it may initially appear. There are occasional naturalistic examples of *immediately* occurring in the comparative or with *very*, as seen in (i) and (ii), both culled from COCA (Davies 2008).

- (i) The greatest challenge to both engineers and managers is that many corporate leaders feel pressure from stockholders and other stakeholders more immediately than they do the urgency of safety or engineering obligations.
(ii) Now, there is also a fair amount of funding being held up in Washington right now that the Egyptians need very immediately.

However, these examples seem to convey a shift in meaning, with (i) amounting to ‘more directly’ (or perhaps ‘more strongly’), and (ii) amounting to ‘very urgently’. This is why, without delving into the precise mechanism behind such meaning shifts, I will tentatively assume that *immediately* lacks a degree argument.

²⁶In other words, $\mathbf{short}(e) \prec \mathbf{short}(e')$ just in case $\mathbf{long}(e') \prec \mathbf{long}(e)$.

lexical meaning. This suggests (54) as one possible analysis (see (62) below for a second, simpler version).

$$(54) \quad \llbracket \text{immediately} \rrbracket = \lambda P \lambda e : \mathbf{DYN}(P) . P(e) \wedge \forall e' \in \mathbf{atom}(e, P) [\mathbf{std}(\text{immediately}, P^c) \preceq \mathbf{short}(e')] \\ \text{(quantificational version)}$$

A second major point of variation across adverbs of change concerns the range of available interpretations. Recall from section 3 that *quickly*—while semantically uniform—has four possible uses, being able to modify rate of change, event duration, narrative time, or illocutionary time. The proposed meaning in (53) makes *slowly* a perfect antonym to *quickly*, so (all other things being equal) it predicts no further variation. However, *slowly* turns out to only partially overlap in available uses with its antonym *quickly*. Just like *quickly*, when modifying an activity, *slowly* gives rise to a rate reading. For example, (55) states that Selena traversed space at a lower rate than the usual rate for a comparable running event.

(55) Selena ran slowly.

Slowly can also acquire an extent reading, for example, when modifying accomplishment predicates. (56) can be taken to mean that it took Tyson a considerable amount of time to climb the hill.²⁷

(56) Tyson slowly climbed the hill.

Despite these similarities, *slowly* is more restricted than *quickly* in that it lacks pragmatic interpretations. Specifically, *slowly* does not give rise to a narrative reading. For example, to the extent that it is interpretable, (57) appears to coerce an inherently punctual event into a durative, slow-motion-like event. Notably, (57) cannot receive a narrative interpretation, whereby the noticing event took just a moment but occurred long after the walking-in event took place.

(57) The professor walked in and Selena slowly noticed him.

Notice also that *slowly* lacks an illocutionary reading. For example, while (58) is acceptable, in it *slowly* may only convey a rate reading. An appropriate context (suggested by a reviewer) could be a geography teacher addressing a pupil who is feeling anxious today and is hastily mumbling wrong responses to questions they otherwise know how to answer correctly.

(58) Slowly, what is the capital of Uganda?

In short, *slowly* is much more restricted in its semantic distribution. It shares with *quickly* a rate and an extent reading, yet it lacks a narrative or an illocutionary reading.

Turning now to *immediately*, the entry in (54) suggests that this adverb differs from *quickly* only in that it lacks a gradability component. However, *immediately* turns out to only give rise to a narrative reading. The examples in (59) illustrated this reading for the case of happenings, culminations and accomplishments, respectively.

²⁷ As discussed in section 3, *quickly* with accomplishments is ambiguous between an extent and a rate reading (Cresswell 1978; Pustejovsky 1991; Shaer 1998; Thompson 2006; Rawlins 2013). This raises the question of whether *slowly* with accomplishments exhibits the same ambiguity. Since the judgments in (24)–(25) for *quickly* seem to work in a similar way for *slowly* (but see Pustejovsky 1991), I will apply analogous reasoning and tentatively assume that *slowly* is ambiguous between an extent and a rate reading in such contexts as well.

- (59) a. I turned on the light and immediately noticed that something was wrong.
 b. Kim took out her gun and the officer immediately exited his patrol car.
 c. When Columbus arrived back in Spain, he immediately wrote a letter announcing his discoveries.

A rate reading for *immediately* with activity predicates is clearly not available. For example, (60a) cannot describe the running event as unfolding at a fast rate. Instead, such combinations are coerced into a narrative reading, whereby *immediately* characterizes as short the narrative time between the (onset of the) underlying event and some previously mentioned event, as illustrated in (60b).

- (60) a. Valentina ran immediately.
 b. I jumped up and Valentina ran immediately toward the fire.

Immediately lacks an extent reading as well. For example, (59c) above does not characterize the letter-writing event itself as short. Rather, it states that, upon returning to Spain, it did not take long for Columbus to write his groundbreaking letter, regardless of the speed of writing. Finally, an illocutionary reading for *immediately* seems to be missing too, as seen in (61).

- (61) ?Immediately, where is the key for the house?

We have established that *immediately* lacks a rate, an extent, or an illocutionary reading, and may give rise to a narrative reading alone.

How to account for the observation that *slowly* and *immediately* display only a subset of the attested readings of *quickly*? One option is to complicate the semantics such that each adverb becomes compatible only with a very specific set of readings. However, a story along these lines would destroy the semantic uniformity not only within but also across adverbs of change. Instead, I suggest that the observed gaps in the semantic paradigm of a given adverb have to do not with its lexical meaning but rather with its attachment possibilities. Recall from section 4 that the rate and extent readings require low attachment (i.e., attachment to the verb or the VP, respectively), while the narrative and illocutionary readings require high attachment (i.e., attachment to high functional projections in the left periphery of the sentence). Now, if *slowly* can attach low but cannot attach high, we can explain its lack of narrative and illocutionary readings without modifying the proposed entry in (53). In the same vein, we can assume that *immediately* has the meaning in (54) but can only attach to the high left-peripheral position designated for the narrative reading. More generally, given the various possibilities for syntactic attachment, such structural restrictions are expected to be idiosyncratic properties of individual adverbs of change.

Notice that this attachment story may appear to block a rate reading for *immediately* for the wrong reason. That is, while this adverb carries a quantificational component and may distribute over event structure, this part of its meaning never comes to light since low attachment is generally unavailable. This suggests the simpler non-quantificational alternative for *immediately* in (62).

- (62) $\llbracket \text{immediately} \rrbracket = \lambda P \lambda e : \mathbf{DYN}(P) . P(e) \wedge \mathbf{std}(\text{immediately}, P^c) \preceq \mathbf{short}(e)$
 (non-quantificational version)

One argument in favor of the quantificational version in (54) is the idea of keeping the semantics of different adverbs of change as similar as possible. This would put the explanatory burden for the missing rate reading of *immediately* on its structural restrictions alone. Conversely, one might

prefer the non-quantificational version in (62) for reasons of language economy. That is, it is difficult to argue for the presence of a quantificational component in the meaning of *immediately* if this component is never going to do any real semantic work for us. I will not make a choice between these two entries, here merely highlighting what the analytical options are.

I close this section with the general observation that adverbs of change seem to fall into several natural classes. One is the ‘quickly’ class, which also includes synonyms like *rapidly*, *swiftly*, *hastily*, *speedily*, etc. All of these adverbs characterize the targeted event (or event parts) as being relatively short and appear to share with *quickly* most of its readings. Another class, perhaps a subclass of the previous one, consists of adverbs like *immediately* and *instantly*, which only receive a narrative reading. These should be distinguished from adverbs like *suddenly* or *abruptly*, which require not just dynamicity but also punctuality (cf. *The door suddenly opened* vs. *#The priest suddenly delivered a sermon*). However, the adverbs in this last group do not produce a narrative interpretation (cf. *We sat down and waited for hours. Suddenly/#Immediately, the door opened*), instead conveying a sense of surprise. Yet another class is that of ‘slowly’, with additional members like *sluggishly* or *glacially*. These adverbs imply a longer-than-usual event duration and seem to overlap with *slowly* in available interpretations. Finally, there is the ‘gradually’ class, including apparent synonyms like *steadily*, *continuously*, *progressively*, *incrementally*, etc. Such adverbs stand out from all other classes in that they predominantly appear with degree achievements (e.g., *The river gradually widened*) and describe an event development which unfolds in stages (Piñón 2000). To sum up, while some of these classes of adverbs display very different properties from the prototypical case of *quickly*, they all appear to interact with aspectual change in various intricate ways. I leave their detailed study and the question of their semantic uniformity to future work.

6 Previous accounts

This section critically evaluates two previous accounts of adverbs of change, i.e., Cresswell (1978) and Rawlins (2013), which anticipate several of the components of my own account. While there are other explicit proposals on the market (e.g., Heim 2006; Morzycki 2016: 5.4.1; Wellwood 2019: 6.3.3), the former two offer the most theoretical depth and make more specific predictions.

Cresswell’s (1978) seminal paper pioneered the idea that adverbs of change distribute over the minimal parts of the described action. Centering his analysis on *quickly*, his main claim is that this adverb modifies motion predicates and compares the distance traveled by the agent during most minimal intervals to some average value. Cresswell thus takes the rate (or ‘manner’) reading of *quickly* as fundamental, writing the following:

The manner sense of *quickly* [when applied to *walk*] involves, I claim, not taking the distance of the whole walk and comparing it with the time taken, but rather taking the minimal subintervals of that interval which are intervals of walking and saying that the ratio of distance to time in most of them is above average for walkings occurring during intervals of that length. (Cresswell 1978: 180)

Cresswell’s formalization of this idea is couched in the language of time intervals rather than event semantics. His proposed meaning for *quickly* is presented in a simplified form in (63). The notion of a ‘minimal subinterval’ is further specified in (64).

- (63) If P is a motion property, a is an individual, and t is a time interval, then $\llbracket \text{quickly} \rrbracket(P)(a)$ is true at t iff
- i. $P(a)$ is true at t , and
 - ii. for most minimal subintervals t^* of t relative to $P(a)$: the distance covered by a during t^* while P -ing exceeds the average distance for P -ing during t^* .
- (64) If a sentence ϕ is true at an interval t , then t^* is a *minimal subinterval* of t relative to ϕ iff
- i. t^* is a subinterval of t ,
 - ii. ϕ is true at t^* , and
 - iii. there is no proper subinterval of t^* at which ϕ is true.

The main merit of Cresswell’s account lies in its ability to derive the rate/extent contrast for *quickly* by considering the aspectual properties of the modified predicate. The rate reading follows directly. For example, the account predicts that *John walked quickly* entails that John walked and that for most minimal subintervals of John’s walking, John covered a longer distance than the average distance covered during walkings of such length. The duration reading is also predicted, as long as the modified predicate is telic. For example, *John walked quickly to the station* entails that, during most minimal subintervals, John covered more distance than the average distance covered by a walking to the station during such intervals. Since this distance is fixed, the only way the above statement can be true is by virtue of the fact that most minimal intervals of John’s walking to the station are shorter than the minimal intervals for an average walking to the station. Crucially, since due to telicity any interval of walking to the station is maximal, this entails that the single interval of John’s walking to the station is of a shorter duration than the relevant average. This is just the extent reading of *quickly*.

In addition to deriving the rate/extent contrast, Cresswell also touches on the narrative reading of *quickly*, suggesting that in this case *quickly* characterizes as short the interval over which the underlying sentence becomes true. Moreover, Cresswell recognizes the gradability of *quickly* and provides a simple extension of his analysis to capture it. His account thus anticipates most major points surrounding the semantics of *quickly*.

Despite its virtues, Cresswell’s account has both empirical and conceptual limitations. It focuses solely on *quickly*, thus leaving out any variation within the broader class of adverbs of change. Furthermore, the account is confined to predicates of physical motion, which is too coarse-grained to capture the rich selectional restrictions of *quickly*. As argued in sections 3 and 4, the relevant notion is ‘dynamicity’, which encompasses a much broader range of cases than just physical motion.

Rawlins (2013) translates Cresswell’s (1978) insights into a modern neo-Davidsonian semantics, while adding several new insights of his own. Rawlins argues that adverbs of change denote degree functions and distribute over event structure, with the resulting semantics for adverbs of change looking very similar to my own proposal. Glossing over technical complexities, the core proposal for e.g. *quickly* is that this adverb denotes a measure function of events on a scale of shortness, as stated in (65a).²⁸ The distribution over event structure is introduced by a covert distributivity operator D (cf. Landman 2000: ch.5), with its semantics as stated in (65b) (C_H is a

²⁸See Kennedy (1999, 2007) for a comprehensive proposal that gradable expressions denote measure functions rather than relations between degrees, entities, and—in the case of adverbs—properties of such entities.

contextually salient property of events that are homogeneous in some respect; see [Rawlins 2013: 7.4.1.2](#) for details). Finally, the standard of comparison is introduced by POS_{Adv} and is based on C_C , a comparison class of events, as shown in (65c). The composition of these elements yields the meaning in (66).

- (65) a. $\llbracket \text{quickly} \rrbracket = \text{short}$
 b. $\llbracket D \rrbracket = \lambda f \lambda P \lambda e. \forall e' \in \text{atom}(e, C_H)[f(P)(e')]$
 c. $\llbracket \text{POS}_{Adv} \rrbracket = \lambda P \lambda e. \text{std}(P, C_C, e) \preceq P(e)$
- (66) $\llbracket [D \text{ POS}_{Adv}] \text{ quickly} \rrbracket = \lambda e. \forall e' \in \text{atom}(e, C_H)[\text{std}(\llbracket \text{quickly} \rrbracket, C_C, e') \preceq \text{short}(e')]$

One difference between this semantics and my own proposal is that here *quickly* ends up denoting a property of events, not a modifier of such a property. This necessitates that said property be composed with the verbal meaning through intersection (or ‘predicate modification’) rather than through function application, as on my proposal. This seemingly minor technical difference has significant consequences for Rawlins’ account. That is, the set of event atoms that the measure of *quickly* distributes over is no longer selected compositionally on the basis of the modified predicate but is determined pragmatically. In other words, the rate/extent reading contrast is not a matter of syntactic scope but a matter of contextual salience. This means that, to derive the rate vs. extent ambiguity of *quickly* with accomplishment predicates, the account requires that either the event as a whole or its atomic parts be contextually salient. Rawlins touts this feature as an improvement over [Cresswell \(1978\)](#) (and, by extension, over my own account), arguing that the occurrence of *quickly* in the same surface position is compatible with both a rate and an extent reading. However, it is unclear how a pragmatic explanation like this could account for reading variation across different adverbs of change. That is, as established in section 5, *slowly* lacks a narrative and an illocutionary reading, *immediately* only allows for a narrative reading, and other adverbs of change display yet different patterns. Thus, without making assumptions about available attachment sites for specific adverbs, it would be a mystery where such idiosyncratic interpretational restrictions come from, given that the contextual salience of events is uniform across adverbs.

The main advantage of Rawlins’ account is that it proposes explanations for large swaths of the interaction between adverbs of change and lexical aspect. For example, the account not only derives the rate vs. extent reading ambiguity but also offers a plausible story about the narrative reading of adverbs of change, one that I have adopted. It also recognizes the illocutionary reading of such adverbs, although without complementing it with an explicit analysis.

The main issue with Rawlins’ account, as I see it, is that it disregards the aspectual notion of dynamicity, which is crucial for correctly stating the selectional restrictions of adverbs of change. Rawlins’ main strategy here is to view adverbs of change as sortally restricted to events proper, thus excluding states. However, a categorical distinction like this is not fine-grained enough and overgenerates. That is, barring cases of inchoative aspectual coercion (see sections 3 and 4.5), adverbs of change are compatible with only a proper subset of eventive predicates. One type of predicate that is ruled out includes stativities like *sleep*, *watch TV*, or *wait*. Such predicates behave like bona fide activities—e.g., in episodic contexts they occur in the progressive and not in the simple present. And yet, they are incompatible with adverbs of change (cf. **Jill slept/watched TV/waited quickly/slowly*). Unlike such difficulties, a restriction like this is fully expected under the current account. All we have to say is that stativity predicates are not dynamic in the relevant sense, i.e., they refer to events that do not express transitions.

7 Conclusion

Adverbs of change select for dynamic predicates and measure out the duration of the events referred to by such predicates. These adverbs give rise to a number of readings, including characterizing the rate of change, the duration of the entire described event, the narrative time between a previously mentioned event and the current event, or the illocutionary time between two utterance events. Despite this apparent semantic diversity, adverbs of change are not lexically ambiguous. Instead, the different readings arise through interaction with aspectual and discourse structure as well as idiosyncratic restrictions on syntactic attachment.

A predictive semantics for adverbs of change necessitates a detailed analysis of the aspectual notion of dynamicity, which is presupposed by such adverbs, as well as a basic understanding of its interaction with telicity and durativity. One simple idea, defended here, is that dynamicity is built directly into the mereological structure of events such that dynamic predicates refer to transitions, a type of complex event that explicitly represents and labels aspectual change.

Acknowledgments and Data Collection

I would like to thank ... (omitted for reviewing). The data in this paper comes from three different sources: prior literature, the web, and traditional data elicitation by the author. The first two sources are cited inside the text. The third source involved five native speakers of American English with academic background (the names have been omitted for reviewing).

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