

On the Weakness of *Believe*

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Abstract

There is a robust intuition that the attitude verb *believe* imparts some sort of weakness to the attitude holder regarding the prejacent proposition (cf. *I believe that Kim is on vacation* vs. *I know that Kim is on vacation*). This paper pits two alternative views on where in its semantics the weakness of *believe* resides, i.e., in its non-maximal modal force (Hawthorne et al. 2016; Rothschild 2020; see also Moss 2019) or in its subjective modal flavor (cf. Lyons 1977; Kratzer 1981; Nuyts 2001; Papafragou 2006; Portner 2009). Judging by three sets of data that tap directly into the modal strength of *believe* (i.e., occurrence in modal contexts, interaction with other epistemic expressions, and closure under conjunction), the emerging picture suggests that *believe* carries a strong modal force but conveys subjective (and thus ‘weak’) epistemic content.

Keywords: *believe*, modal strength, subjectivity, epistemic modality

1 Introduction

The verb *believe* has played a central role in the development of formal semantics as it sets a benchmark for the analysis of other attitude predicates. This verb also underlies a number of widely studied phenomena, such as opacity, presupposition projection, neg-raising, the norm of assertion, and others. Given its theoretical significance, it is critical to understand its core interpretational properties. Ever since Hintikka (1969), it has become standard to analyze *believe* as involving universal quantification over possibilities. More specifically, a belief attribution is taken to state that the ‘prejacent’ (the clausal complement of *believe*) is true in all of the agent’s doxastic alternatives. This is usually rendered as in (1), where $Dox_{x,w,t}$ stands for the set of x ’s doxastic alternatives in a world w and at a time t , i.e., the set of possibilities compatible with everything x believes in w and at t .

$$(1) \quad \llbracket \text{believe} \rrbracket^{w,t} = \lambda p \lambda x. \forall \langle w', t' \rangle \in Dox_{x,w,t} : p(\langle w', t' \rangle)$$

Although very popular, this Hintikkan orthodoxy fails to address one key semantic property of *believe*, i.e., its felt modal weakness. There is a robust intuition that *believe* expresses some sort of ‘weak’ attitude towards the prejacent proposition, so that e.g. *I believe that Kim is on vacation* conveys a lower degree of certainty or commitment than does *I know that Kim is on vacation*. In spite of this intuition, the standard Hintikkan semantics makes no clear predictions as to whether the belief agent regards the prejacent as true, certain, likely, possible, etc. The reason is that, according to (1), the strength of *believe* hinges on the kind of modal content that the set of doxastic alternatives *Dox* represents. Since *Dox* is defined as the set of possibilities compatible with everything the agent ‘believes’, the modal strength issue is merely pushed into the metalanguage. It is not derived from the semantics and needs to be independently stipulated.

Despite this omission, the structure of the Hintikkan semantics outlines quite clearly the two factors that the modal strength of *believe* depends on, i.e., modal force and modal content. The modal force of *believe* is determined by the force of the quantifier, or more generally by the logical relation that holds between the set of doxastic alternatives *Dox* and the prejacent proposition.¹ In turn, the modal content of *believe* is determined by the domain of the quantifier, i.e., by *Dox* itself. As it happens, the Hintikkan semantics addresses only the force factor, stating that the prejacent is true across all doxastic alternatives, as per the universal force of the quantifier. But this semantics fails to address the content factor, or how committing these doxastic alternatives are, and so it fails to make predictions about the modal strength of *believe* more generally.

Surprisingly, the issue of the modal strength of *believe* has barely been touched upon in the literature, with a few notable exceptions (see Hawthorne et al. 2016; Moss 2019; Rothschild 2020). While work on graded modality has discussed the strength with which epistemic modals imply their prejacent (Karttunen 1972; Kratzer 1991; von Stechow and Gillies 2010, 2021; Lassiter 2016, 2017; Goodhue 2017; Giannakidou and Mari 2018; Del Pinal and Waldon 2019; a.o.), the focus

¹That is, we can sensibly talk about ‘modal force’ in the absence of overt quantification. For example, the entry in (1) can be rephrased as $\llbracket \text{believe} \rrbracket^{w,t} = \lambda p \lambda x. Dox_{x,w,t} \subseteq p$, where the strong modal force is expressed by set-theoretic inclusion.

has been on modal auxiliaries and modal adjectives, which are impersonal and (in unembedded positions) take the perspective of the speaker. Since attitude verbs like *believe* project an external argument, the issue of modal strength here translates into the issue of the certainty or commitment level of the attitude holder regarding the prejacent proposition, and so it requires special attention.

The intuition that *believe* is ‘weak’ begs the question of where in its meaning this weakness resides. As just discussed, there are two analytical choices for pinning this weakness on: its force or its content. The former choice has been defended in Hawthorne et al. (2016) and Rothschild (2020) (see also Moss 2019), who attribute the weakness of *believe* to its non-maximal modal force. Roughly, the claim is that a belief attribution is true just when the agent’s degree of certainty in the prejacent proposition is sufficiently high. I dub this view Weak Force (WF) and render it informally as in (2).

(2) WEAK FORCE (informal)

x believes p is true if and only if the degree of certainty that *x* assigns to *p* exceeds some vague contextual threshold

Alternatively, one could argue that *believe* owes its weakness not to its modal force (which is at a maximum) but to the kind of modal content it conveys. To the best of my knowledge, this view has not been explicitly defended previously. However, it is suggested by a distinction drawn in prior literature between two flavors of epistemic modality, i.e., ‘subjective’ and ‘objective’ (Lyons 1977, ch.17; Kratzer 1981; Nuyts 2001; Papafragou 2006; Portner 2009, 4.2; see also Hamblin 1971; Krifka 2015; Geurts 2019). While this intuitive distinction has been fleshed out theoretically in different ways, I will broadly adopt Kratzer’s (1981) characterization of the contrast in subjectivity as being about what is publicly defensible. That is, while objective certainty entails public commitments and thus requires strong evidence, subjective certainty merely describes the mental state of the agent and may be based on weak evidence. Assuming that *believe* lexicalizes this latter subjective flavor of epistemic modality, we may call this view Subjective Content (SC) and state it informally as in (3).

(3) SUBJECTIVE CONTENT (informal)

x believes p is true if and only if *x* assigns to *p* a maximal degree of subjective certainty

The main contribution of this paper is twofold. First, I will spell out WF and SC in sufficient detail, thus making clear the background assumptions and the general predictions of these two views. Second, I will compare the predictions of WF and SC with respect to three sets of empirical data: (i) the distribution of *believe* in modal contexts, where the agent’s degree of certainty regarding the prejacent proposition is fixed by the prior context; (ii) the interaction of *believe* with other expressions of epistemic modality, such as *know*, *sure*, and *doubt*; (iii) the observation that *believe* is closed under conjunction introduction, i.e., the intuitively correct inference from *believe p* and *believe q* to *believe (p and q)*. While most of these data turn out to be compatible with either view, the emerging picture is that SC makes more specific and better predictions than WF overall.

The three sets of data listed above were chosen because they seem to reveal the most immediate effects of the modal strength of *believe*. That said, the finding that SC has an empirical edge over

WF is suggestive rather than conclusive, as more empirical evidence could be adduced for or against either view. One potentially consequential piece of additional evidence is neg-raising, a phenomenon whereby a matrix negation is interpreted as though it takes scope inside an embedded clause (Bartsch 1973; Horn 1989; Gajewski 2007; Romoli 2013; Homer 2015). Since *believe* is a classic neg-raising predicate, so that *x doesn't believe p* typically comes to mean *x believes not p*, one might wonder whether this property is characteristic of predicates of a particular strength. Indeed, Horn (1989) and Hawthorne et al. (2016) hypothesize that neg-raising may be licensed by 'weak' predicates (e.g., *want*, *like*, *advise*) but not by 'strong' predicates (e.g., *need*, *love*, *order*), and conclude from this that *believe* must carry a weak modal force. However, what this reasoning leaves open is whether the felt weakness of neg-raisers stems from their force or their content. In fact, a weakness in content seems to be the more likely option, as some neg-raisers (e.g., *feel*, *plan*, *advise*) presumably lack a force component entirely.² Given that the kind of weakness involved here is unclear, I will leave the detailed study of the link between neg-raising and modal strength for future research.

In order to get the comparison between WF and SC off the ground, I will assume a gradable semantics for *believe* within the standard degree-based approach to gradable predicates (Cresswell 1976; von Stechow 1984; Heim 1985; Kennedy and McNally 2005; Morzycki 2016; and others). According to this semantics, *believe* denotes a relation between individuals, propositions, and degrees, stating that the agent's degree of certainty in the prejacent proposition meets some threshold. This is formalized in (4), where the measure *C* is anchored to an agent (as well as worlds and times) and maps propositions to degrees of certainty.

$$(4) \quad \llbracket \text{believe} \rrbracket^{w,t} = \lambda p \lambda d \lambda x. C_{x,w,t}(p) \geq d$$

The idea that *believe* is grammatically gradable is suggested by both WF and SC, which talk about degrees of certainty (of the relevant kind). It is also supported by the apparent ability of *believe* to interact with degree morphology, cf. *partially believe*, *fully believe*, *believe more strongly than Jill*, etc.³

We have been talking about the modal force and the modal content of *believe*. In the standard Hintikka semantics in (1), these two components are encoded by the universal quantifier (which determines the logical relation between the quantifier domain and the prejacent proposition) and the quantifier domain itself (the set of the agent's doxastic alternatives), respectively. But how are these two components encoded in the gradable semantics in (4)? In this latter case, the modal force of *believe* will depend on the default value of *d*, where a strong force corresponds to *d* being at a maximum (*d* = 1) and a non-strong force corresponds to *d* coming in below the maximum (*d* < 1). In turn, the modal content is encoded by *C*, which assigns degrees of certainty. In short, according to both (1) and (4) the modal strength of *believe* is a child of two parents: it depends on the force

²In addition, Homer (2015) argues that in British English epistemic *must* is a neg-raiser while epistemic *have to* is not, even though the former may feel stronger than the latter. See Horn (1989: 5.2) for more on crosslinguistic variation in neg-raising.

³For more discussion on the gradability of *believe*, see Bolinger (1972, ch.9) and Lassiter (2021). For a general discussion on graded modality, see Kratzer (1991), Portner (2009, ch.3), von Stechow and Gillies (2010; 2021), Yalcin (2010), Klecha (2014), Lassiter (2016; 2017), Santorio and Romoli (2017), a.o.

and the content of this verb. Thus, although very different, we see that at some level of generality the quantificational and the degree-based analyses of *believe* share the same basic ingredients.

Before closing this introductory section, one important caveat is in order. It should be stressed that the current paper analyzes the semantic properties of the English verb *believe* and not the philosophical notion of ‘rational belief’. That is, there is a long-standing debate in the philosophical literature concerning the question of when it is rational to believe a proposition and the related question of whether rational belief should be closed under conjunction or entailment more generally (Kyburg 1961; Hintikka 1962; Makinson 1965; Stalnaker 1984; Harman 1986; Foley 1992; Clarke 2013; Leitgeb 2014; Greco 2015; and others). Importantly though, the notion of rational belief is a normative one, and so this notion need not be identical to the natural meaning of the verb *believe*, which is a purely empirical issue. Thus, one should be careful not to draw conclusions from whatever the norms of rational belief may be assumed to be to what the semantics of *believe* actually is.

The structure of the paper is as follows. Section 2 introduces the distinction between subjective and objective epistemic modality and juxtaposes two views on the weakness of *believe*, i.e., WF and SC. Section 3 presents three sets of empirical data on *believe*, which generally turn out to favor SC over WF. Section 4 concludes and offers a brief outlook on subjectivity and epistemic modality more generally.

2 Two views on the weakness of *believe*

This section spells out two alternative accounts of *believe*, i.e., Weak Force (WF) and Subjective Content (SC). While both accounts entail that *believe* has a ‘weak’ semantics, they disagree on what this weakness amounts to. That is, WF views *believe* as carrying a weak modal force and assumes no special kind of epistemic content. By contrast, SC claims that *believe* carries a strong modal force but conveys a flavor that is subjective in the intended sense.

2.1 Weak Force

An unmodified use of *believe* is felt to convey some sort of ‘weak’ attitude regarding the prejacent proposition. For example, (5a) would typically imply a lower degree of certainty or commitment than does the variant with *know* in (5b).

- (5) a. I believe that Kim is on vacation.
- b. I know that Kim is on vacation.

One natural reaction to this contrast is to say that *believe*, unlike *know*, carries a non-maximal modal force. Hawthorne et al. (2016) and Rothschild (2020) follow this general line in the form of a threshold semantics (possibly, with the gradability of *believe* in mind). More specifically, the claim is that the degree of certainty ascribed to the belief agent must exceed some vague contextual threshold. An informal version of this view was already presented in (2). Plugging in

the gradable semantics for *believe* stated in (4), this view can be rendered more formally as in (6), where C is interpreted as some generic measure of certainty shared among all epistemic modals and θ_{bel} is the relevant belief threshold. Notice that, in the absence of overt degree morphology, the degree argument of *believe* is filled by the null morpheme POS, an idea that follows the gradability literature (Cresswell 1976 and much subsequent work).

(6) WEAK FORCE

$$(\llbracket \text{POS} \rrbracket^{w,t}(\llbracket \text{believe} \rrbracket^{w,t}(p)))(x) \text{ iff } C_{x,w,t}(p) > \theta_{bel}$$

Roughly, WF states that *believe* parallels *likely* in that the threshold value is taken somewhere from the middle of the scale (Yalcin 2010; Lassiter 2017). More abstractly and leaving the modal domain, this view makes *believe* similar to proportional quantifiers like *most* or *more than half* (Barwise and Cooper 1981; Hackl 2009; Solt 2016) in that it requires some sort of a ‘majority’ interpretation.

Hawthorne et al. (2016) actually add to (6) a second truth condition, according to which the prejacent must be significantly more likely than any of its salient alternatives: $C_{x,w,t}(p) \gg C_{x,w,t}(q)$, for all salient alternatives q of p (see also Kahneman and Tversky 1982; Dorst 2019; Dorst and Mandelkern 2021; Holguín 2022). In the case of a binary choice between p and \bar{p} , this condition boils down to $C_{x,w,t}(p) \gg C_{x,w,t}(\bar{p})$, which entails that the likelihood of the prejacent is significantly greater than the midpoint of the scale. However, when several alternatives to the prejacent are salient in the context of utterance, the threshold may drop below the midpoint. Although I will mostly ignore this second condition, it will become relevant in the discussion of the race horse example at the end of Section 3.1.

Moss (2019) is a kindred account. Like WF, it assumes that *believe* conveys generic epistemic content. However, the proposed mechanism that derives the weakness of *believe* differs. While, according to WF, the degree of certainty associated with *believe* must meet some lower contextual threshold, for Moss *believe* conveys full certainty but allows for some amount of imprecision or ‘loose speech’ (Laserson 1999; Sauerland and Stateva 2011; Solt 2014; Klecha 2018). Notably, this entails that *believe* has the same strict content as e.g. *sure*, both requiring full certainty. Thus, in order to explain the observation that *believe* feels weaker than *sure* (cf. *I believe it’s raining, but I’m not sure* vs. *#I’m sure it’s raining, but I don’t believe it*), Moss proposes that these two modals convey different loose contents, where generally *believe* is interpreted to a lower standard of precision than *sure*. But this means that we need to make lexical stipulations about how much imprecision each given modal expression can tolerate, and so this account ends up looking very similar to the threshold-based account of Hawthorne et al. (2016) and Rothschild (2020). That is, one can regard Moss (2019) as broadly favoring the WF view.

2.2 Subjective vs. objective epistemic modality

Carrying a weak force is not the only way for an epistemic modal to be lacking in strength. Another possibility is that it encodes non-subscribable modal content, i.e., modal content that does not make the relevant agent responsible for the prejacent proposition. Following this general line,

Lyons (1977, ch.17) points out that epistemic modality comes in two flavors, i.e., ‘subjective’ or ‘objective’. In (7), this is illustrated for epistemic *must*, which can take on a subjective or an objective reading. I have preserved the original paraphrases of the two readings.⁴

- (7) Alfred must be unmarried. (Lyons 1977: 791–792)
- a. SUBJECTIVE: I confidently infer that Alfred is unmarried.
 - b. OBJECTIVE: In the light of what is known, it is necessarily the case that Alfred is unmarried.

According to these paraphrases, both readings of *must* involve an inference from some body of evidence, a fact that presumably goes back to the strong force of *must* (cf. Palmer 2001: 2.1.7). But the quality of the evidence differs. While the subjective reading is based on less reliable evidence and merely voices an opinion, the objective reading is based on knowledge and entails commitment to truth. For example, the subjective reading would arise if we learn that Alfred is dating someone, and from this we draw the somewhat risky conclusion that Alfred is unmarried. In turn, the objective reading would come about if we know that exactly one faculty member (whoever that might be) is not married and have already established that every faculty member, except for Alfred, is married. In this latter case, it is a matter of logical deduction to conclude that Alfred is unmarried.⁵

There have been two main attempts to render the subjective–objective distinction in more theoretical terms. Kratzer (1981), for one, proposes to flesh out this distinction not so much in terms of the available evidence but in terms of what we make of it. That is, the proposal is that the two readings share the same ‘modal base’ (the available and agreed-upon evidence) but they differ in ‘ordering source’ (the stereotypical assumptions one makes in order to draw inferences from the available evidence). While subjective modal claims involve risky assumptions that may not be defensible, objective modal claims are based on established regularities and are defensible. The example in (8) provides an illustration (original example in German; see Kratzer 1981: 307).

- (8) *Lenz, who often has bad luck, is going to leave the Old World by boat today, on Friday 13th. On hearing about this, someone utters:*
- a. Probably, the boat will sink.
 - b. It is probable that the boat will sink.

According to Kratzer, the claim in (8a) is subjective. It is based on superstitions about their being unlucky days and cannot be defended on objective grounds. Hence, it requires a subjective background as an ordering source. By contrast, the claim in (8b) is objective. It is based on established facts about the boat, the technical equipment, or the weather, and can be defended on objective grounds. It thus requires an objective background as an ordering source.⁶

⁴Here the term ‘reading’ is used informally and is not meant to imply that epistemic modals are lexically ambiguous. See the Conclusion for more discussion.

⁵A similar contrast arises with weak epistemic modals, like *might*, although in this latter case the issue is whether the prejacent proposition is compatible with the available evidence (cf. Lyons 1977: 797–798).

⁶Presumably, this contrast has something to do with the fact that *probably* is a speaker-oriented adverb while *probable* is a modal adjective. Whatever the correct analysis, the important point is the felt contrast in subjectivity.

Nuyts (2001) and Papafragou (2006) put a different spin on the above distinction. For them, the distinction in subjectivity is about the accessibility of the evidence, i.e., whether it is shared or not among speech participants. Subjective modality involves evidence that is only known to the speaker, while objective (or ‘intersubjective’) modality involves evidence that is shared among all speech participants. This distinction in accessibility does not seem to always cut the pie in the right way, though. For example, in (7) the evidence is shared on both the ‘dating’ and the ‘unmarried faculty member’ scenarios, and yet the intuitive distinction in subjectivity persists. This suggests that the Kratzer and the Nuyts–Papafragou accounts may be tracking two slightly different distinctions. Indeed, Portner (2009: 4.2) demonstrates how these two accounts can coexist within a single formal model.

I will broadly adopt Kratzer’s characterization of the contrast in subjectivity as being about what is publicly defensible. That is, I will view subjective modality as merely describing the mental state of the relevant agent. Since the contents of that state need not be backed by strong evidence, the agent is not held responsible for them. In contrast, objective modality is about contributing information to the public forum. It entails commitments for the agent and thus must be rooted in strong evidence. More formally, I will assume that in the epistemic domain subjective and objective certainty are encoded by two different measure functions, which further specify the generic certainty measure C familiar from Section 1. That is, C^s maps propositions to degrees of subjective certainty in the intended sense. As its counterpart, I introduce the measure C^o , which maps propositions to degrees of objective certainty.

Notice that this use of the terms ‘subjective’ and ‘objective’ is reminiscent but does not quite line up with philosophical parlance about probability (Hájek 2019 for an overview). In this latter literature, Bayesians analyze probabilities in terms of betting behavior and view them as representing the subjective beliefs of individual agents, while frequentists locate probabilities in the world and view them as representing objective proportions. Notably, C^s and C^o are both subjective in this philosophical sense as anchored to an agent. Closer to home, there is a suggestive parallel within the former, Bayesian interpretation. That is, according to subjective Bayesians it is up to the agent which degrees of certainty to adopt as long as these are coherent, i.e., they comply with the axioms of probability theory (e.g., de Finetti 1964; Savage 1972; Jeffrey 1990). By contrast, objective Bayesians require that degrees of certainty be additionally calibrated with the available evidence (e.g., Jaynes 1968; Rosenkrantz 1981; Williamson 2010). Despite the obvious similarities to the intended subjective–objective distinction, some differences remain, of which I mention three. First, the notion of public commitments is key to the intended distinction (see also Hamblin 1971; Krifka 2015; Geurts 2019) but it does not seem to play a prominent role in Bayesian epistemology. Second, while subjective Bayesians disregard evidence entirely, it is dubious that subjective modals like *believe* require no evidence whatsoever. Third, Bayesian epistemology is centered on probabilities, while it is unclear that epistemic expressions at large encode probability measures (e.g., *believe* is generally incompatible with proportional and percentage modifiers, like *two thirds* or *37 percent*). In sum, while there are intriguing parallel links between the semantic subjective–objective distinction and different versions of Bayesian epistemology, one should not push the parallels too far.

I conclude this section by addressing two important points. The first point concerns the question of whether the two measures and corresponding flavors of certainty are mutually dependent in some sense. In addressing this question, I suggest the following heuristic for how subjective and objective certainty are expected to stack up: we can think of C^o as a more conservative version of C^s , in the sense that speakers should accompany their public commitments with sufficient belief. That is, assuming that speakers are sincere, a given degree of commitment will be backed up with the same or a higher degree of belief: $C_{x,w,t}^o(p) \leq C_{x,w,t}^s(p)$, for all sincere speakers x (and worlds w and times t).⁷ By contrast, a given degree of belief does not require any specific degree of commitment. For example, an agent may give full credence to a proposition without being willing to publicly commit to it. In fact, expressions of subjective certainty in hedging sentences are often used to spell out exactly this kind of opposition (see Section 3.2).

The second important point is that certain modal expressions may lexicalize a particular flavor of epistemic modality. Thus, mental state predicates like *believe* or *doubt* could be plausibly taken to be inherently subjective, so they convey private opinions and may serve as hedging devices. By contrast, mental state predicates like *know* are inherently objective and commit the agent to the prejacent proposition. That said, most epistemic modals, e.g. *sure*, appear to be neutral and may convey either flavor of modality (see the Conclusion for a brief discussion).⁸

2.3 Subjective Content

In light of the distinction between subjective and objective epistemic modality drawn in the previous section, the intuition that *believe* denotes a ‘weak’ attitude may be fleshed out in terms of subjective content rather than a non-strong modal force. The view that *believe* is strong but subjective is formalized in (9) and spells out the informal statement in (3).

(9) SUBJECTIVE CONTENT

$$(\llbracket \text{POS} \rrbracket^{w,t}(\llbracket \text{believe} \rrbracket^{w,t}(p)))(x) \text{ iff } C_{x,w,t}^s(p) = 1$$

Comparing (6) and (9), we see that WF and SC differ in two respects only. First, the two measure functions are different. According to WF, *believe* denotes a generic measure of certainty, one that is shared with all epistemic modals with a scalar semantics. By contrast, SC views *believe* as measuring subjective certainty, thus conveying a weakness in content which contrasts with the objective certainty encoded by modals like *know*. Second, WF and SC differ in modal force. While WF assigns to *believe* a non-maximal force, requiring that the (generic) certainty associated with

⁷This heuristic is similar to the Sincerity Principle of Geurts (2019), which roughly states that a commitment to p entails a lack of belief to *not* p . See also Lewis’s (1980) Principal Principle, according to which subjective credences ought to match the objective chances.

⁸Nuyts (2001: 390–391) touches on both of these points, as he writes: “The mental state predicates systematically express subjectivity ... Because the mental state predicates are inherently subjective, they are frequently used as mitigating or hedging devices ... In such uses, it is usually quite obvious that speakers are absolutely certain about or convinced of what they are saying, but by using the mental state predicate they suggest that they are voicing a tentative and personal opinion which may be wrong, thus ‘officially’ leaving room for another opinion or for a reaction on the part of the hearer.”

it exceeds some lower threshold value, SC does not weaken the force of *believe*. According to this latter view, the weakness of *believe* is instead rooted in its subjectivity and the threshold value is kept at a maximum.

Overall, we see that the two competing views pin the weakness of *believe* on two different components of the semantics, i.e., modal force vs. flavor of certainty. In the following section, we will see that SC is more on the right track, demonstrating that *believe* exhibits the logical properties of a strong-force modal that can plausibly be assumed to convey subjective content.

3 Data on *believe*

This section looks at three sets of empirical data that appear to favor SC over WF. The first and the second sets, based on the distribution of *believe* in modal contexts and its interaction with other epistemic expressions, suggest that *believe* fails to convey any amount of doubt but may signal a lack of commitment. This is compatible with *believe* encoding a subjective modal flavor. The third set of data is centered on the observation that *believe* is closed under conjunction, which suggests that this verb carries a strong force.

3.1 Distribution in modal contexts

I start by looking at examples in which the certainty level of the belief holder is fixed by the prior context. There are two main cases to consider here. First, when the context assigns a maximal degree of certainty to an agent, so that no doubt remains in their mind, an attribution of belief to said agent is quite natural. This is shown in (10).

- (10) CONTEXT: *We do not know whether the transfer student passed the midterm exam, but Jill has no doubt he did.*

Jill believes that the transfer student passed the midterm exam.

Conversely, it is hard to attribute genuine belief to an agent who doubts the prejacent proposition to some extent. This is illustrated in (11). The degraded status of this utterance becomes quite obvious when contrasted with the fully acceptable variant *Mueller believes the Russians might have hacked the election*, where the prejacent expresses a mere possibility.⁹

⁹Since the judgment in (11) is less categorical, it is worth asking whether negating the utterance flips the judgment. However, there is no straightforward way to negate sentences with *believe* without triggering additional effects. For one, merely negating the target utterance in (11) invites the possibility of neg-raising, which would strengthen the reading to ‘Mueller believes that the Russians didn’t hack the election’ and clash with the prior context. In order to suspend this stronger reading, we may add stress on *believe* (Gajewski 2007; Romoli 2013) and contrast it with *likely*. This is shown in (i-a), which naturally fits the context. A second option is to use matrix negation by prefixing the sentence with *It is not true that...*. While this results in two layers of embedding and may be dispreferred for purely stylistic reasons, (i-b) seems fine once again.

- (i) CONTEXT: *Mueller finds it likely that the Russians hacked the election. But the evidence is inconclusive, so some doubt remains in his mind.*

- (11) CONTEXT: *Mueller finds it likely that the Russians hacked the election. But the evidence is inconclusive, so some doubt remains in his mind.*

? Mueller believes that the Russians hacked the election.

Both of these data-points recommend SC over WF. According to WF, (10) and (11) should give rise to the opposite judgments from what we actually get. That is, if *believe* did not require full certainty, it would be unclear why (10) is fully natural instead of being felt to be underinformative in the presence of a stronger alternative like *Jill is sure that the transfer student passed the midterm exam*. The former sentence should be on a par with, say, *Billy ate most of the cookies* when uttered in a context where it has already been established that, in fact, Billy ate all of the cookies. The relative infelicity of (11) is problematic for WF as well, given that a high (though non-maximal) degree of certainty should be enough to warrant belief. On this view, we would need to conjure up some independent issue with this sentence in order to explain its degraded status. In sum, WF seems to lack the explanatory power to account for examples as simple as (10) and (11).

By contrast, SC predicts the correct judgments in both cases. That is, (10) attributes no doubt to the agent and *believe* is licensed, while (11) attributes some doubt to the agent and *believe* is not licensed. This is exactly as expected.

Data like these have implications beyond their immediate scope because they bear on one type of argument that has been put forward in support of WF. Specifically, Hawthorne et al. (2016: 1400) try to establish the point that the threshold for *believe* may fall below 50% when the prejacent is the most likely alternative among a number of contextually salient alternatives. Their key example (attributed to Jeremy Goodman, p.c.) involves horse races and is cited in (12).

- (12) CONTEXT: *In a three-horse race, the known statistical chances of winning are distributed as follows: horse A = 45%, horse B = 28%, horse C = 27%.*

I believe horse A will win.

The suggestion here is that *believe* cannot possibly require full credence since, in some cases, the threshold value need not even reach 50%. At first blush, this constitutes very strong evidence in favor of WF. However, the above reasoning crucially identifies statistical chances and personal credences. But from examples like (11) (see also (18) and (20) below) we already know that a belief attribution is not natural if the agent has any doubt in the prejacent proposition. So it is dubious that in (12) the lower statistical estimate entails a lack of internal certainty. As additional evidence pointing into the same direction, notice that in the very same context one can equally well utter either of the variants in (13a). Even though holding such beliefs may not be entirely rational, the point is that these are possible.¹⁰ Notice also that, as demonstrated in (13b), in this

a. Mueller doesn't BELIEVE the Russians hacked the election. He only finds it LIKELY.

b. It is not true that Mueller believes the Russians hacked the election. He only finds it likely.

In short, negated variants of (11)—when properly controlled—indeed flip the judgment, as expected.

¹⁰Dorst and Mandelkern (2021: 4) make a similar point about *think* or, more generally, about making guesses, writing: “To be clear, we are not claiming that people never have guesses like these. Our claim is normative: there is something peculiar—something irrational—about guesses like this.”

same context there can be disagreement about which horse will be the winner without a sense of confusion as to what the statistical chances are.¹¹

- (13) a. I believe horse B / horse C will win.
b. Alfonso believes horse A will win, Benita believes horse B will win, and Camila believes horse C will win.

One natural line of explanation is that, in all cases, the agent's subjective certainty is at a maximum and each specific choice is based not on statistical chances alone but also on things like personal preferences, gut feeling, or whatever the belief agent considers appropriate evidence. This might be the reason why such sentences leave the impression that the belief agents may not trust the numbers or may have secret information about the horses, as a reviewer points out. Pursuing this line would allow SC to offer a systematic account for all the horse race data in (12)–(13). By contrast, WF has more work to do in order to explain why non-optimal alternatives as in (13) can naturally serve as personal beliefs. More generally, if agents are free to believe any proposition they wish, then there is no interesting threshold semantics for *believe* to be had.

3.2 Interaction with other epistemic expressions

Probably the most direct way of probing into the strength of *believe* involves interaction with other epistemic expressions. There are several examples that juxtapose *believe* with another epistemic expression and appear to favor WF over SC on grounds of theoretical parsimony. That is, while such examples are compatible with either view, they may be taken to argue for WF as this view need not draw a distinction between different epistemic flavors in order to explain the data. This kind of general consideration notwithstanding, it turns out that in at least some cases SC makes more specific and better empirical predictions.

The first kind of example I will discuss involves modal gradation sequences. One exemplar is based on the old dictum that knowledge is stronger than belief.¹² It is illustrated by the natural gradation in (14).

- (14) Scientists believe that there is water on Mars. In fact, they know it.

This example leaves the impression that the certainty level attributed to the scientists in there being water on Mars goes up as the discourse advances from the first sentence to the second sentence.

¹¹ A reviewer wonders whether we can gauge the strength of belief in (13) by looking at the agent's betting behavior, suggesting that (i) is not ideal. However, there seems to be nothing linguistically wrong with such examples. Even looking at it from a practical or rational perspective, there could be many reasons why a person would act against their own beliefs. (ii) lists a few such reasons and the resulting discourses are quite natural.

- (i) I believe that horse B will win, but I will nonetheless bet on horse A.
(ii) I believe that horse B will win, but I will nonetheless bet on horse A. I just want to support smaller clubs / make my son happy / fool around a bit.

¹² Gettier (1963) is a classic reference.

This suggests that *believe* encodes a lower degree of strength than *know*, although it remains unclear whether we are dealing with a contrast in modal force or in modal content.

While both WF and SC can explain the intuition of strengthening in (14), the nature of the explanation differs in each case. WF offers a straightforward explanation in terms of modal force. All this view has to say is that, since *believe* carries a weak force, it is only natural to strengthen it by using a modal with a strong force, like *know*. This explanation puts (14) on a par with cases in which *likely* is strengthened to *certain* (cf. *It's likely she stole the money. In fact, it's certain*), where presumably these two modals merely differ in force.

In turn, SC states that *believe* lexicalizes a strong force, so it has to resort to a contrast in modal content when tackling (14). In order to make this more explicit, let us posit (15) as a minimal lexical entry for *know*. According to it, *know* differs from *believe* in at least two respects (cf. Percus 2006; Chemla 2008; Sauerland 2008; Schlenker 2012): it has a factive component, so that the prejacent proposition is presupposed, and it lexicalizes objective epistemic certainty, encoded by C^o .¹³

$$(15) \quad \llbracket \text{know} \rrbracket^{w,t} = \lambda p \lambda x : p(\langle w, t \rangle) \cdot C_{x,w,t}^o(p) = 1$$

In the light of this semantics, the intuition of strengthening in (14) can be attributed to a transition from subjective to objective certainty, with everything these two notions entail in terms of degree of commitment, accompanying evidence, etc.

We see that both WF and SC can capture the intuition of strengthening in modal gradation sequences with *believe* and *know*. But unlike WF, which is working with a single notion of certainty, SC needs the additional assumption that *believe* and *know* differ in epistemic flavor. This may be taken as a theoretical point in favor of WF, at least if there are no independent reasons to think that there is a subjective–objective opposition at play in natural language semantics. However, if such reasons do exist (as some of the remaining data suggests), then there is no parsimony argument to be made.

The second kind of example that I will discuss involves hedging sentences. Such sentences consist of a belief attribution accompanied with an explicit disavowal of full certainty (of the relevant kind). One example is cited in (16).¹⁴

(16) I believe it's raining, but I'm not sure it's raining. (Hawthorne et al. 2016: 1395)

Again, both WF and SC can account for hedging sentences like these, although in different ways and by making divergent additional predictions. That is, according to WF, (16) attributes to the speaker high but non-maximal certainty regarding the prejacent proposition. Importantly, there is a single notion of certainty involved here, one that is shared by *believe* and *sure*.

¹³Building on prior literature (Bolinger 1972, ch.9; Partee 2004; Stanley 2004; Wellwood 2019, ch.8; Lassiter 2021), I also tentatively assume that *know* is not grammatically gradable, i.e., it lacks a degree argument. Nothing important depends on this assumption, though.

¹⁴Some English speakers have a slight preference for *think* over *believe* in such examples, presumably due to a contrast in register (this is also noted in Hawthorne et al. 2016, 1400). However, naturally occurring examples of this shape abound on the web. See also the experimental data reported at the end of this section.

SC offers a very different explanation. According to this latter view, (16) establishes a contrast between maximal credence and lower commitment. This contrast can be made formally explicit if we assume that *sure* is a strong gradable predicate that can convey an objective modal flavor. This is spelled out in the preliminary entry in (17), where the default maximum standard associated with *sure* is supplied by the null morpheme POS.¹⁵

- (17) a. $\llbracket \text{sure} \rrbracket^{w,t} = \lambda p \lambda d \lambda x. C_{x,w,t}^o(p) \geq d$ (preliminary)
 b. $\llbracket \text{POS} \rrbracket^{w,t}(\llbracket \text{sure} \rrbracket^{w,t}(p)) = \lambda x. C_{x,w,t}^o(p) = 1$

Although each view takes the hedging data in its stride, WF seems to win out on simplicity once again as it does not have to distinguish between subjective and objective epistemic modality and corresponding measures of certainty. However, there is independent evidence that hedging sentences with *believe* do establish a contrast in modal content rather than a contrast in modal force. This evidence involves (i) expressions of doubt and (ii) manipulation of the agent, world and time parameters.

Starting with the former, sentences with *believe* cannot naturally be hedged with modal expressions that are inherently subjective, such as the dubitative verb *doubt*. This is illustrated in (18).

- (18) # I believe Putin stole the election, but I doubt it.

Since WF is working with a single flavor of modality, it is unclear why (16) and (18) should differ in judgment. In order to derive the attested contrast, this view would have to be supplemented with some independent mechanism. One simple thought is that (18) sounds contradictory simply because *doubt* conveys too much uncertainty for it to be compatible with *believe*. Indeed, in upward-entailing contexts *doubt p* typically implies not just that *p* is uncertain but that *p* is unlikely (Anand and Hacquard 2013). However, this strengthened meaning has been attributed to exhaustification arising from the fact that English *doubt* lacks a stronger scalemate whose meaning amounts to ‘likely not’ (Uegaki 2021). The key observation here is that the implication of unlikelihood melts away in downward-entailing contexts. That is, since *not doubt p* entails *certain p*, it follows that *doubt p* must entail *not certain p* rather than the stronger *likely not p*. But this makes (16) and (18) semantically equivalent and leaves the intuitive difference in judgment unexplained.

One could still argue that, since in (18) *doubt* appears in an upward-entailing context, it is obligatorily exhaustified and so it clashes with *believe*. However, even if *doubt* must be strengthened and ends up conveying unlikelihood, WF would still not rule out (18). The reason is that, according to this view, the threshold for *believe* can lie below the midpoint of the scale, making *believe* logically consistent with the exhaustified meaning of *doubt*. That is, (18) would be incorrectly predicted to be acceptable in contexts where, say, the speaker considers the prejacent to be the most likely alternative but still considers it to be unlikely overall. This prediction is at odds with the strong sense of unacceptability conveyed by (18).

¹⁵In the concluding Section 4, I will suggest that *sure*—along with *might*, *must*, *possible*, *likely*, *certain*—is in fact epistemically indeterminate, in the sense of being able to convey either subjective or objective modality.

By contrast, SC derives the unacceptability of (18) quite naturally. That is, if *believe* and *doubt* are assumed to be antonyms which operate on the same subjective scale, then (18) is correctly expected to lead to an epistemic contradiction, the reason being that this sentence ends up simultaneously attributing and denying full credence in the prejacent proposition. More formally, we can assume that *doubt* is a minimality predicate that lexicalizes the reverse scale to that of C^s , call it D^s .¹⁶ This is formalized in (19).

- (19) a. $\llbracket \text{doubt} \rrbracket^{w,t} = \lambda p \lambda d \lambda x . D_{x,w,t}^s(p) \geq d$
 b. $\llbracket \text{POS} \rrbracket^{w,t}(\llbracket \text{doubt} \rrbracket^{w,t}(p)) = \lambda x . D_{x,w,t}^s(p) > 0$
 $= \lambda x . C_{x,w,t}^s(p) < 1$

One important caveat about the theoretical implications of (18) is that not all linguistic forms of expressing doubt are incompatible with *believe* to the same degree. In order to probe the data more systematically, I tested online the minimally different hedging sentences in (20), which employ the verb *doubt*, the adjective *doubtful*, or the noun *doubt*, and otherwise introduce no further complexities. Three variants of each sentence were presented to 12 participants (with English as a first language and IP addresses located in the U.S.), recruited through the Prolific crowdsourcing platform. Participants were asked to rate each variant for naturalness on a seven-point Likert scale, where 1 corresponded to ‘very unnatural’ and 7 corresponded to ‘very natural’. The obtained means are listed below.

- (20) a. # I believe Putin stole the election, but I doubt that he did. (mean = 1.7)
 b. ?? I believe Putin stole the election, but I’m doubtful that he did. (mean = 2.4)
 c. ? I believe Putin stole the election, but I have some doubts that he did. (mean = 3.3)

As can be seen, all three versions received ratings from the lower part of the scale, against a baseline mean of 4.7 for the respective control sentence with *not sure* in the hedge. I will not speculate why this kind of variation in acceptability exists, although it stands to reason that different expressions of doubt engage with the agent’s certainty in slightly different ways. Looking at the theoretical implications of these data, the presence of some variability is a point in favor of WF. At the same time, the fact that none of the above examples is quite natural suggests that there is something inherently incompatible between *believe* and various expressions of doubt, as would be expected under SC.

Additional evidence for analyzing hedging sentences with *believe* as contrasting modal content rather than modal force comes from manipulating the agent, world, and time parameters. Author et al. (2021) show experimentally that hedging sentences with combinations of third person/past tense/embedded features, while logically consistent, are generally judged as less natural than canonical first person/present tense/main clause forms. For example, participants found the sentences in (22) to be (increasingly) less acceptable than the baseline form in (21).¹⁷

- (21) I believe diplomacy is better than war, but I’m not sure.

¹⁶That is, $D_{x,w,t}^s(p) > d$ ends up meaning the same as $C_{x,w,t}^s(p) < 1 - d$, for all degrees d between 0 and 1.

¹⁷For the sake of simplicity, only minimally different sentences from the canonical form are listed here and combinations of differing features are omitted.

- (22) a. Sean believes diplomacy is better than war, but he's not sure.
 b. One year ago I believed diplomacy was better than war, but I was not sure.
 c. Suppose that I believe diplomacy is better than war, but I'm not sure.

Once again, in the absence of some independent mechanism, WF has little to say about what causes such fine contrasts in judgment. This view draws a purely quantitative contrast between *believe* and *not sure*, rooted in a single epistemic measure and comparable to 'likely but not certain'. So we expect such sequences to be natural across the board, contrary to what we find.

SC, which draws a qualitative contrast between subjective and objective certainty, has a better shot at such data. That is, it has been independently argued that human communication is primarily about negotiating commitments rather than about sharing beliefs or other mental states (Hamblin 1971; Krifka 2015; Geurts 2019). In light of this claim, we expect that the subjective–objective contrast can most easily be drawn in the presence of a salient speech context, since in such cases private beliefs and public commitments can most sharply be distinguished. This means that the closer the parameters on the certainty measures are to the utterance context parameters, where hedging sentences with first person/present tense/main clause features constitute the canonical case, the more natural said contrast is expected to be. This is indeed what the data in (21)–(22) suggests.¹⁸

I close this section with a potential puzzle for both views. In (11) we established that an attribution of belief in the presence of doubt is degraded; the example is repeated in (23a). Nonetheless, a reviewer notes that adding a hedge seems to obviate the problem, as shown in (23b).

- (23) CONTEXT: *Mueller finds it likely that the Russians hacked the election. But the evidence is inconclusive, so some doubt remains in his mind.*
 a. ? Mueller believes that the Russians hacked the election.
 b. Mueller believes that the Russians hacked the election, but he is not fully certain.

Both views make uniform and thus wrong predictions about the contrast between (23a) and (23b), with WF predicting that both sentences should be fine and SC predicting that both sentences should

¹⁸The observation that person/world/time parameters may have an effect on the acceptability of 'epistemic contradictions' is not new. Moore (1993) already noticed that while (i) sounds odd, sentences of this shape are not self-defeating and become acceptable when embedded under modals, or rendered in the past tense or the third person, as shown in (ii)–(iv).

- (i) # It's raining, but I don't believe it's raining.
 (ii) Suppose that it's raining but I don't believe it.
 (iii) I didn't believe it was raining, but as a matter of fact it was.
 (iv) Jack doesn't believe it's raining, but it really is.

A detailed analysis of this paradigm is beyond the scope of this paper. The important thing to notice, though, is that only the infelicitous example in (i) combines a full commitment (due to the unqualified assertion in the first part of the sentence) and lower credence (due to the negated belief attribution in the second part of the sentence) with the same person/world/time specifications. And, as discussed in Section 2.2, such a combination conveys a lack of sincerity and is expected to be pragmatically odd. (iii) does something similar, but here the belief is anchored to the past while the assertion is anchored to the present, so no oddness arises. In (iv), the agents of the belief and the assertion differ, and (ii) lacks an assertion of rain entirely, owing to the embedded position of the first conjunct.

be degraded. That is, as argued in Section 3.1, WF would be hard-pressed to justify the degraded status of (23a), given that the agent ascribes a high degree of certainty to the prejacant and so *believe* should be licensed. In turn, SC needs to explain why the belief attribution in (23b) seems fine despite the presence of doubt stipulated in the context. One idea would be that the presence of a negated approximator like *fully* introduces imprecision and improves acceptability.¹⁹ However, it is unclear that removing *fully* from the sentence really changes the judgment. I leave the detailed analysis of this puzzle for future research.

To recap, the interaction of *believe* with other expressions of epistemic modality points at its subjective flavor. That is, while some of the data can be folded under either WF or SC and the former view happens to be theoretically more parsimonious, there are certain empirical contrasts that seem compatible only with the latter view (and there are challenges for both views as well).

3.3 Closure under conjunction

The force of any given epistemic modal is expected to be reflected in the logical properties that said modal does or does not possess. One such property that can be used as a diagnostic for modal force is conjunction closure. A modal *M* is said to be ‘closed under conjunction’ just when it licenses the entailment pattern in (24).

(24) CONJUNCTION CLOSURE FOR MODALS

$$M(p), M(q) \models M(p \text{ and } q)$$

How do epistemic modals behave with respect to this property? It is easy to observe that modals that uncontroversially carry a strong force are closed under conjunction. This is illustrated for *certain* in (25).

(25) It’s certain that Sean is in Rome and it’s certain that he is catholic.

\models It’s certain that Sean is in Rome and that he is catholic.

By contrast, modals that uncontroversially carry a non-strong force, like *probably* or *possible*, do not possess this property, as shown in (26)–(27).

(26) CONTEXT: *Each week Jack spends (in no particular order) 3 nights at the local pub and gets drunk, 2 nights at the same pub but stays sober, and 2 nights at home where he also gets drunk. On a given night, I say:*

- | | |
|---------------------------------------|----------------------|
| a. Jack is probably at the pub. | True (chance = 5/7) |
| b. Jack is probably drunk. | True (chance = 5/7) |
| c. Jack is probably at the pub drunk. | False (chance = 3/7) |

(27) It’s possible Jane is in Italy and it’s also possible Jane is in France.

$\not\models$ It’s possible Jane is in Italy and in France.

¹⁹Indeed, expressions like *exactly*, *perfectly*, *approximately*, etc. have been claimed to perform this kinds of function (Lasnik 1999; Sauerland and Stateva 2011; Solt 2014; Klecha 2018).

Crucially, *believe* aligns with strong-force modals in this respect (Hawthorne et al. 2016; Rothschild 2020). It licenses the entailment pattern in (24), as (28) and (29) demonstrate.

- (28) Ron believes Mia is pretty and he also believes she is going to marry him.
 \models Ron believes that Mia is pretty and that she is going to marry him.
- (29) ? John believes it will rain today and he believes it will rain tomorrow, but he doesn't believe it will rain today and tomorrow. (Rothschild 2020: 1357)

Let us now work out the predictions that SC and WF make about the interaction of *believe* with conjunction. The finding that *believe* is closed under conjunction is good news for SC, the reason being that the closure property falls out directly from the assumption that *believe* carries a strong force. Here is an intuitive understanding of why this is the case. Suppose that x believes p and x believes q are both true in a world w and at a time t . On SC, it follows that $C_{x,w,t}^s(p) = 1$ and $C_{x,w,t}^s(q) = 1$. These say that, according to x , the entire certainty weight falls within p and the entire certainty weight also falls within q . That is, all possibilities outside $p \cap q$ are discarded. We may conclude that $C_{x,w,t}^s(p \cap q) = 1$, or that x believes (p and q) is true as well.²⁰

By contrast, the empirical observation that *believe* is closed under conjunction is compatible with WF but it does not follow from this view. The intuitive reason is that if any amount of uncertainty is compatible with any given belief, the uncertainty of individual beliefs will multiply in a combined belief, and the latter may fail to rise above the contextual threshold. That is, we could be in a situation where x believes p and x believes q are both true but x believes (p and q) is false.²¹ What this means is that WF does not guarantee that *believe* is closed under conjunction, contrary to intuition.

Before moving on, I make two important points that should help us better appreciate the implications of conjunction closure for the semantics of *believe*. The first point is that the tight link between a strong modal force and conjunction closure does not depend on the specific technical implementation, e.g., on whether *believe* is given a threshold-based semantics or a standard quantificational semantics. To see why, recall the Hintikkan proposal stated in (1). This proposal encodes strong force via universal quantification over possibilities but still derives the closure property. This is so because, if all of x 's doxastic alternatives are p -possibilities and all of x 's doxastic alternatives are also q -possibilities, then necessarily all of x 's doxastic alternatives are $p \cap q$ -possibilities. Despite this virtue, as discussed in Section 1, the Hintikkan semantics does not

²⁰ Assuming that the measure of *believe* is probabilistic, we can give the following rigorous proof of conjunction closure (world and time parameters are omitted). Let $C_x^s(p) = 1$ and $C_x^s(q) = 1$, so x believes p and x believes q are both true. Since probabilities sum up to 1, we get $C_x^s(\bar{p}) = 0$ and $C_x^s(\bar{q}) = 0$, respectively. Now assume, for contradiction, that $C_x^s(p \cap q) < 1$. For the same reason as above, we get $C_x^s(\bar{p} \cap \bar{q}) > 0$, i.e., $C_x^s(\bar{p} \cup \bar{q}) > 0$. Since probability measures are additive, the latter can be true only if $C_x^s(\bar{p}) > 0$ or $C_x^s(\bar{q}) > 0$, a contradiction. Our assumption is false, hence $C_x^s(p \cap q) = 1$, which means that x believes (p and q) must be true.

²¹ Here is a counterexample to the closure property within WF, fleshed out in probabilistic terms (once again, world and time parameters are omitted). Consider a context in which the threshold for *believe* is 0.5, and let p and q be probabilistically independent. If $C_x(p) = 0.6$ and $C_x(q) = 0.7$, then x believes p and x believes q are true, as they both exceed the threshold of 0.5. However, x believes (p and q) turns out to be false, given that $C_x(p \cap q) = C_x(p) \times C_x(q) = 0.6 \times 0.7 = 0.42$ falls below the threshold of 0.5.

tell us whether the universal force of *believe* translates into full certainty absent some additional stipulations about the modal content of *believe*. What this shows is that conjunction closure is a diagnostic for modal force and as such is insensitive to what kind of modal content we are dealing with.

Another important point is that a weak-force semantics for *believe* may be able to derive conjunction closure if the choice of prejacent is appropriately restricted. One such account is suggested in Holguín (2022, 19–21). Roughly, this account states that the prejacent of *believe* is an optimal disjunction of complete answers to the current Question Under Discussion (QUD) in the sense that, if a given complete answer is included, all more likely complete answers are included as well.²² This is illustrated in (30) for the race horse example from Section 3.1.

(30) CONTEXT: *In a three-horse race, the statistical chances of winning are distributed as follows: horse A = 45%, horse B = 28%, horse C = 27%.*

QUD: Which horse will win?

- a. OPTIMAL ANSWERS: Horse A. / Horse A or B. / Horse A or B or C.
- b. NON-OPTIMAL ANSWERS: Horse B. / Horse C. / Horse B or C. / Horse A or C.

It is indeed true that any two premises with prejacent pulled from the set of optimal answers will derive the closure property. But the issue is that, due to the optimality requirement, one of the premises will always asymmetrically entail the other, and so the conclusion ends up being logically equivalent to that stronger premise. For example, while *I believe horse A will win* and *I believe horse A or B will win* jointly lead to the conclusion *I believe that horse A will win and that horse A or B will win*, this conclusion means as much as the former and stronger premise, given that $p \wedge (p \vee q)$ is logically equivalent to p . Stated in reverse, on this account we could never derive conjunction closure from belief attributions with logically independent prejacent, like *I believe Jill is in Rome* and *I believe Jack is in Rome*, because at most one of these prejacent (the more likely one) could ever constitute an optimal answer to the QUD. And given the empirical observation in (13) that non-optimal answers can readily serve as prejacent of *believe*, conjunction closure is not derived in the general case.

I close this section with a brief note on conjunction closure and rational belief. There is a lot of discussion in the philosophical literature as to whether the beliefs of a rational agent should be closed under conjunction. While many authors agree that this should be so (e.g., Hintikka 1962; Stalnaker 1984; Harman 1986; Clarke 2013; Leitgeb 2014; Greco 2015; Yalcin 2016; Moss 2019; Holguín 2022), detractors point out that the closure property leads to the ‘lottery paradox’ (Kyburg 1961). A classical version of the lottery paradox goes as follows. Consider a fair lottery with 100 tickets and a single winner. It seems rational to believe the statement *Ticket 1 will not win*, as it has a solid 99% chance of being true. But the same goes for the statements *Ticket 2 will not win*, *Ticket 3 will not win*, and so on down the line up to *Ticket 100 will not win*. By the closure

²²While Holguín’s account is centered on *think* (and what is ‘rationally permitted’ to think more generally) rather than *believe*, for the sake of the argument I will assume that these two verbs are similar in all relevant respects. Also, the account does not actually require that the prejacent of *believe* be optimal in the above sense. It only assumes that, as a matter of some psychological regularity, people tend to form optimal beliefs like these.

property, it should then be rational to believe the statement *No ticket will win*. But this contradicts the assumption that one ticket will win.

The existence of the lottery paradox may be taken as evidence in favor of WF. However, the important point is that the lottery paradox is about the norms of rational belief, not about the semantics of the verb *believe*. If rational belief is understood as reaching some sufficiently high but non-maximal level of confidence, it is indeed reasonable to reject the closure property, or else we would be left with a paradox. However, if what is at issue is the semantics of the verb *believe*, the lottery paradox does not really arise for SC. The reason is that, if the belief agent has any doubt in the prejacent proposition, each of the premises will already be judged false (recall (11), (18) and (20)) and so the conjunction closure inference will end up being vacuously true. To illustrate, take the lottery scenario from the previous paragraph and assume that Jack’s subjective credences exactly match the respective chances. If so, each premise in (31) will be judged false because Jack’s credence—coming in at 99%—will fall short of reaching full subjective certainty, and so the inference cannot be falsified.

- (31) Jack believes that ticket 1 will not win.
 Jack believes that ticket 2 will not win.
 ...
 Jack believes that ticket 100 will not win.

Jack believes that no ticket will win.

To the contrary, if Jack has no doubt whatsoever that each individual ticket will lose, Jack must also have no doubt that no ticket will win. For example, this could happen if a large lottery with a single winning ticket has been split into several sublotteries. Since in a given sublottery there may be no winning ticket, the sequence in (31) would sound quite natural. In this case too SC fails to derive the lottery paradox.²³

4 Conclusion and outlook

The idea that *believe* expresses universal quantification over possibilities hails from a long and venerable tradition in formal semantics. This paper challenged this dictum as non-explanatory, pointing out that it does not predict the intuition that *believe* entails some sort of weakness regarding the prejacent proposition. In order to better understand where this intuition comes from, the paper compared two views on the weakness of *believe*: WF, according to which *believe* conveys regular epistemic content but has a weak force, and SC, according to which *believe* has a strong

²³Notice that SC still derives the related ‘preface paradox’ (Makinson 1965). This paradox is about a prudent scholar who writes in the preface that she believes there are mistakes in her book, even though when she examines the claims individually she believes each of them. The problem is that, since the preface paradox is about the author’s own subjective credences, SC makes both the individual beliefs and the overall statement true. However, the issue here may simply be that such overall statements are not really proxies for the conjunction of all claims in the book and would typically include additional assumptions which the author may fail to believe.

force but conveys content that is subjective in the intended sense. Looking at the occurrence of *believe* in modal contexts, its interaction with other epistemic expressions, and its closure under conjunction, we arrived at the tentative conclusion that the latter view is more on the right track. That is, while much of the data is compatible with both views and WF is theoretically more parsimonious, SC turns out to offer better empirical coverage overall.

Since SC is a serious contender for explaining the semantic properties of *believe*, it is also important to ask what the implications of this view are for the epistemic domain more generally. The core assumption of this view is that epistemic modality comes in two flavors, i.e., subjective and objective, and that certain modals may lexicalize a given modal flavor. But how deeply does the subjective–objective distinction cut into the epistemic domain? Answering this question goes far beyond the scope of this paper, whose modest goal is limited to understanding the intuition that *believe* is weak. The focus on *believe* notwithstanding, one may hypothesize that all epistemic modals are lexically encoded as subjective or objective, or else can be interpreted as either subjective or objective. Indeed, in some cases there is no real choice in how a modal is interpreted. That is, following the line of SC, we have assumed that *believe* and *doubt* are inherently subjective while *know* is inherently objective. In other cases, there seems to be more flexibility. Take *sure* as an illustration. In the face of hedging sentences as in (32a) and the inherent subjectivity of *believe*, SC predicts that *sure* can be read objectively (Section 3.2). In addition, the (marginal) acceptability of (32b) and the inherent objectivity of *know* suggest that *sure* can be read subjectively as well.

- (32) a. I believe she was at the party, but I’m not sure.
 b. (?) I’m sure she was at the party, but I don’t know it.

Building on Lyons (1977) and the discussion in Section 2.2, we could argue that the same holds for modals like *might*, *must*, *possible*, *likely*, and *certain*. How does the ambivalence of such modals come about? It hardly seems plausible that these are lexically ambiguous, in the sense that they are listed twice in the lexicon, once as subjective and once as objective. This would lead to multiplying the range of meanings and would add little explanatory value. Rather, it is more plausible that such modals are not fixed for subjectivity and that the specific interpretation a given use receives depends on the context of utterance. If this is on the right track, we will end up with the basic typology of epistemic modals in (33), with one example given for each case.

- (33) SUBJECTIVITY TYPOLOGY OF EPISTEMIC MODALS
 a. SUBJECTIVE: $\llbracket \text{believe} \rrbracket^{w,t} = \lambda p \lambda d \lambda x. C_{x,w,t}^s(p) \geq d$
 b. OBJECTIVE: $\llbracket \text{know} \rrbracket^{w,t} = \lambda p \lambda x : p(\langle w, t \rangle) . C_{x,w,t}^o(p) = 1$
 c. SUBJECTIVE OR OBJECTIVE: $\llbracket \text{sure} \rrbracket^{w,t} = \lambda p \lambda d \lambda x. C_{x,w,t}^i(p) \geq d$, where $i \in \{s, o\}$

I leave the substantiation of these rather speculative remarks to future work.

Acknowledgments

I am indebted to ... (omitted for reviewing).

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