

Resistance and Resolution: Attentional Dynamics in Discourse

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Abstract: This paper centers on discourses where instead of accepting or rejecting an assertion, a hearer uses an epistemic possibility claim to bring a new subject matter to the original speaker’s attention and consequently leads this speaker to change her mind and retract the initial claim. To analyze such *resistance moves*, we develop a new theory of attention-shift-induced belief change in which attention is modeled using granularity-levels or *resolutions* of logical space and refining a speaker’s attention can allow her to combine more of her resolution-sensitive information and potentially change her beliefs. We integrate this theory into pre-existing machinery from the literature on formal models of discourse to account for both the informational and attentional dynamics in epistemic resistance discourses, and to lay out some of the formal prerequisites for a more comprehensive theory of resistance moves in general. Along the way, we introduce the new concept of a *subject matter under public attention* (SUP) and compare this with the more familiar concept of a *question under discussion* (QUD).

1 Resistance Moves

Cases of agreement and disagreement like (1)-(3) have been taken to motivate a variety of contextualist, expressivist, and relativist accounts

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of predicates of personal taste (*tasty, fun*), modal operators (*might, must, should, ought*), and epistemic attitude verbs (*knows*) (see MacFarlane 2005a, 2007, 2011, 2014; Yalcin 2011, 2012; von Stechow & Gillies 2011, among many others):

- (1) X: Black licorice is tasty.
Y: Yeah. / Sure. / I agree.
Y': No, it tastes horrible.
- (2) X: Carnegie Deli might have reopened.
Y: Yes, it might have.
Y': No, it's still closed.
- (3) X: Carlos knows that the 3 Seventh Ave Express is running on its regular schedule.
Y: Yes, he just rode the 3 train.
Y': No. For all Carlos knows, the 3 train is making local stops.

Cross-linguistic confirmation and denial data has also led to revisions of standard accounts of speaker commitment, and to a rethinking of the role of *polarity particles* (English: *yes, no, yeah*; German: *ja, nein, doch*; Romanian: *da, nu, ba*; and so on) in compositional semantics and pragmatics (Farkas & Bruce 2010; Kramer & Rawlins 2009, 2010; Krifka 2013; Roelofsen & Farkas 2015; Goodhue & Wagner 2018, among others). But, of course, a lot can happen in the aftermath of an assertion. Besides acceptance or rejection, there is a broad landscape where in particular the class of non-agreeing response moves includes much more than just corrections and other kinds of denials.¹

In the opening exchanges (1)-(3), Y flat-out accepts or rejects X's proposal to update the discourse context. But what if Y isn't yet ready to make a call on acceptance or rejection because she thinks that X might not be attending to some subject matter relevant to their discussion? In the face of such uncertainty, Y can *resist* X's assertion and try to stimulate further discussion by bringing up the subject matter she thinks X might be overlooking. Rather than simply agreeing or disagreeing with X, Y can instead try to open some room for negotiation and potentially lead X to reevaluate his commitments.

¹One can, of course, reject a speech act without correcting it (or even uttering a declarative sentence):

- (i) X: We would be better off if the Visigoths had won the war.
Y: That's a very stupid thing to say.
Y': Stop being silly. / Shut up!

We call such hearer responses “resistance moves”.² Here are some examples of resistance with epistemic and circumstantial modals:

- (4) Context: It is right before the 1963 Academy Awards at the height of the famous Hollywood rivalry between Bette Davis and Joan Crawford.
 X: Bette is coming to the Oscars party.
 Y: Joan might be there. (So are you sure Bette is coming?)
 Y’: Might Joan be coming?
- (5) Context: We have just heard a radio report of subway delays and heavy traffic on the Brooklyn Bridge.
 X: Lucas is going to be late for dinner.
 Y: He could take the Manhattan Bridge.

In both of these examples, Y challenges the exhaustiveness of X’s claim. In example (4), for instance, Y resists X’s assertion because she thinks that he might be failing to attend to whether Joan will be at the party, and Y thinks that Joan’s presence could deter Bette from coming. Though Y resists by expressing her modal belief that Joan might be at the party, our proposal is that the point of the resistance isn’t to coordinate on this belief about Joan but rather to bring to X’s attention the matter of whether Joan will attend, as Y thinks that how things stand with respect to this matter might bear on whether Bette will attend. As we will see, this can lead X to conditionalize or even fully retract his claim.

In fact, the primary aim of this paper is to analyze a version of the party example with a level of detail sufficient to explain its coherence and correctly predict various things about what the interlocutors believe and are attending to—both publicly and privately—as the conversation proceeds. Doing this will require developing a new combined theory of attention and belief change and integrating it into a broader formal model of discourse with both informational and attentional dimensions. Before getting started, though, let us first establish resistance moves as a natural class of hearer responses; there are a wide variety of forms one can use to resist, and such moves are productive in discourse. The common character across all of the following examples is that after the resistance move, the original speaker must reconsider her initial move.

Besides the modal responses in (4) and (5), for instance, various kinds of conditional-ish questions are also well-suited for attention-targeted resistance (Rawlins 2010; Bledin & Rawlins 2019):

- (6) X: I’m not going to eat anything at the diner.

²Previously, Rawlins (2010) dubbed the phenomenon “conversational backoff”.

- Y: If they have peach cobbler, will you eat some?
 Y': {What/Even} if they have peach cobbler?
 Y'': What about some peach cobbler?

High negative polar interrogatives and rising reverse tag interrogatives also work well, as do questions with minimizers and NPIs:

- (7) Y: Do you want to go see a movie?
 X: No.
 Y: Isn't there a romcom that you wanted to see?
 Y': *The Lobster* is still playing, isn't it?
 Y'': Not even the new Thor movie?

In fact, one can resist using even run-of-the-mill positive polar questions and plain non-modalized assertions (though some readers report that these responses sound slightly less natural):

- (8) X: Bette is coming to the party.
 Y: Is Joan coming? They can't stand one another.
 Y': But Joan will be there. So are you sure Bette's coming?³
 (9) X: Either the butler or the maid did it.
 Y: The chauffeur was also working on the day of the murder.

Even if Y knows that X knows that the chauffeur was at work, Y might still assert that the chauffeur was also working to ensure that X takes him into account.

While we focus here on attention-directed resistance moves following assertions, it is also worth noting that speakers can resist imperatives used to command, request, invite, and so forth:⁴

- (10) X: Eat your vegetables!
 Y: Or what? (Biezma & Rawlins 2016, ex. 1)
 (11) X: Please pass the salt.
 Y: But what if there's salt in your food already?
 (12) X: Come over later.
 Y: Even if I'll be distracted by work?

Speakers can also challenge biased and some non-rhetorical questions in this manner:

- (13) X: Isn't Urkel the biggest dork ever?

³Thanks to Yasutada Sudo (p.c.) for suggesting this variant of our party example.

⁴Thanks to Cleo Condoravdi (p.c.) for pointing out this data.

Y: Have you met Screech? He's a contender.

(14) X: How can we get to the party?

Y: What if there's a cover charge? You sure you want to go?

In these examples, too, Y pushes back on X's attempt to update the discourse context in various ways by bringing up subject matters that she thinks X should be considering.

Furthermore, resistance moves can target other aspects of speakers' mental states or external circumstances besides what they are attending to. For instance, Y can challenge X's *epistemic credentials*:

(15) X: Alfonso bought a new Ferrari.

Y: {How do you know?/Really?} Did you see it? (Williamson 1996, 2000)

She can also challenge his *presuppositions*:

(16) X: The Golden State Warriors have won every game this season.

Y: They've started playing already?

And so forth. In calling Y's replies in (4)-(16) "resistance moves", we mean to identify a broad natural class of hearer responses that should be distinguished from both the agreeing and disagreeing responses in (1)-(3). Unlike "agreement moves", they disrupt what would be the smoothest and simplest result of X's initial speech act understood as a proposal to update the context in some way—namely, an unquestioned acceptance of this proposal. On the other hand, resistance moves differ from "rejection moves" like corrections in that they do not, at least not necessarily, put the conversation into "crisis" (Farkas & Bruce 2010) or signal an informationally "defective context" (in the sense of Stalnaker 1978) where any issues under discussion can be settled only after the original speaker or the rejector retracts a commitment, or they agree to disagree.⁵

⁵This is not to deny that many of the modal/interrogative constructions used by Y can appear in rejective responses when preceded by complex negative phrases such as *No, not necessarily* (a notable exception is *even if* questions, which seem especially anaphoric on the assertion to which they respond):

(i) X: Lucas is going to be late for dinner.

Y: No, not necessarily; he might take the Manhattan Bridge.

We take (i) to be an actual disagreement, rather than resistance. In particular, *not necessarily* in (i) is a full sentence that involves what has been termed "Σ-licensed TP ellipsis" (Merchant 2003, 2006; Kramer & Rawlins 2009, 2010), similar to the species of ellipsis seen in phrases such as *perhaps not, maybe not, if not ..., why not?*, and *I expect not*. In such examples, a full TP has been elided with negation (and

Following Y's resistance move in our party example (4), X *might* retract her claim that Bette is coming to the Oscars party in light of the possibility that Joan will be there. However, X might also stand by his earlier assertion after considering Joan's possible attendance or respond to Y's challenge by indicating that Joan was already in mind:

- (17) Continuations of (4):
 Y: Joan might be there.
 X: Oh, damn. I forgot about her. Joan told me she's coming.
 So Bette {might/will} not show up after all.
 X': I forgot about Joan. But she won't keep Bette away.
 X'': I know. But Bette promised she'd come either way.

In the first instance, X no longer accepts that Bette is coming after Y raises the possibility of Joan's attendance. In the second and third instances, X stands his ground and the conversation can move forward without anybody having to retract anything.

In speaking of resistance, we mean also to distinguish Y's responses in our examples from Ginzburg-style (1998; 2012) *clarification requests* (CRs) at the comprehension level:

- (18) X: Maggie is coming to the pub.
 Y: Maggie who?

Whereas in (18) it is the requester's comprehension of the prior move (and not his acceptance/rejection *per se*) that is contingent on the issue raised by the CR, resistance moves instead postpone a final word on the uptake or refusal of a mutually understood prior proposal while triggering further discussion about a relevant subject matter. In (18), Y would of course still have to make a call on acceptance/rejection, but comprehension is prior to that. Admittedly, the class of CRs and the class of resistance moves might overlap. At least some discourse processing theorists, like Schlöder and Fernández (2015), would classify

in several of these cases, a modifier) left as a remnant. This means that (*No,*) *not necessarily* itself is acting as a correction. The role of the modal continuation is not to resist but rather to indicate the grounds for making this correction. See also Khoo's (2015) cases of "Type-2 disagreement", where a possibility claim can be used to directly reject a universal or unmodalized assertion.

It is also worth noting that some of the expressions uttered by Y can appear even in cases of agreement:

- (ii) X: Bette isn't coming to the party.
 Y: Joan might be there. So, yeah, there's no way Bette will be there.

We do not mean to suggest that epistemic *might* is used only to resist or reject.

many of Y’s replies in the above examples as CRs at the “uptake level”. Since CRs are a fairly loose category—we do not know of any diagnostic for the class of CRs as a whole—we are happy to allow that some of Y’s questions in (4)-(16) might count as both CRs and resistance moves. Still, even if the classes of resistance moves and CRs overlap, they differ in important ways. Not all resistance moves are requests—they simply invite clarification. And many CRs, like the one in (18), are not intended as resistance.

While we will not attempt to offer a precise definition of resistance moves here, let us summarize some general features of the surveyed data:

(19) **Resistance moves, informal characterization**

- a. A resistance move postpones the resister’s acceptance or rejection of a prior proposal, raising some new subject matter that bears in some way on this proposal.
- b. A resistance move signals that the resister’s decision between acceptance/rejection (or something in between) is contingent on what the resister has to say about this subject matter.
- c. The subject matter might be raised indirectly (i.e., not via a question).
- d. The resistance move might be used to probe and/or influence the resister’s current attention state, epistemic credentials, presuppositions, or goals (this is not an exhaustive list).

We leave it to future work to characterize resistance more precisely and to more carefully situate resistance moves within the broader typology of non-agreeing moves.

As noted, our goal in this paper is more theoretical: to show how existing analyses of attention, belief revision, and discourse structure need to be extended and integrated in order to systematically account for the dynamics of attention-directed resistance. In the process we also aim to provide further motivation for these pre-existing ingredients, and to motivate a specific notion of attention as a component of linguistic context. Though attention-directed resistance can take many forms, it isn’t feasible to discuss all of the above examples in this paper. To focus our discussion, we develop an in-depth analysis of our party example (4) involving resistance with an epistemic modal declarative, which we call “Feud”. To narrow things down even further, we discuss mostly the variant in (17) where Y’s resistance move leads X to acknowledge that Bette might not come to the party (though we briefly discuss other variations as well):

- (20) X: Bette is coming to the Oscars party.

Y: Joan might be there.

X: Oh, damn. Bette might not show up after all.

We orient our analysis around Feud because epistemic *might* claims are one of the most effective and readily available means for a speaker to draw attention to new subject matters. While Y's resistance in (8) using the non-modal declarative *Joan will be there* is felicitous only if she believes that Joan will attend the party, Y's modal resistance in Feud can be felicitous even if she doesn't know whether Joan is coming. The attention-drawing function of *might* claims has been highlighted in the literature on modality (Swanson 2006; Franke & de Jager 2007; de Jager 2009; Brumwell 2009; Ciardelli, Groenendijk & Roelofsen 2011, 2014; Roelofsen 2011, 2013; Willer 2013), with some linguists going so far as to build this function directly into their semantics for *might* (see for instance Ciardelli et al.'s 2014 "attentive semantics"). It must be emphasized, however, that while we are looking to contribute to the literature on modals by clarifying the attentive potential of epistemic *might*, our treatment of *might* is to a certain extent detachable from our core proposal. The theory we develop is applied to Feud but can also accommodate the non-modal resistance in (8)—we take ourselves to be laying out some of the formal prerequisites for a more comprehensive theory of attention-directed resistance in general.

At least at an informal level, it is reasonably clear what is going on in (20). The exchange begins with X asserting that Bette is coming, but in his limited state of attention where he is overlooking the possibility that Joan will attend. On the other hand, Y is thinking about Joan—there is an attentional mismatch (i.e., the discourse context is *defective*, though not necessarily defective with respect to information, as in Stalnaker 1978)—and Y brings up Joan with her epistemic possibility claim. This resistance has the intended effect: it updates X's attention state with the subject matter of whether Joan is coming and thereby facilitates the retrieval of his information about the ongoing feud between Bette and Joan. As a result of this, X becomes unsure about Bette's attendance—no longer willing to stand by his earlier public commitment, he retracts his initial assertion.

The challenge is to fill in the contours of this rough sketch with a precise formal analysis of how the discourse context (which we take to include X and Y's attention and belief states) evolves as (20) proceeds. We work our way towards our final analysis in stages, adding complexity as required. This effort begins in §2 where we present a simple version of Stalnaker's classic pragmatics in which an assertion automatically adds its propositional content to a pool of public information taken for

granted for the purposes of the conversation—the *common ground*—unless it is rejected (Stalnaker 1978, 2002, 2014). This is meant only to set the stage, as the Stalnakerian account leaves no room for resistance of any kind, attention-directed or otherwise. To open some space for resistance moves in §3, we follow Farkas & Bruce (2010) and extend the Stalnakerian framework with “tables” that keep a short history of asserted propositions waiting for incorporation into the common ground. With this extra discourse structure in place, assertive updates can now be decomposed into a proposal phase and subsequent confirmation step, and resistance can happen in the space between.

The other main ingredients required for the analysis of (20) are a theory of epistemic modality and a theory of attention and attention-shift-induced belief revision. Because we are interested primarily in the attentional effects of epistemic *might* claims and this cross-cuts the many different theories of modality that have been proposed in the literature, we do not try to decide between these theories. Instead, in §4 we adopt an off-the-shelf consistency-checking account of epistemic *might* due in its essentials to Veltman (1996) and Yalcin (2008, 2011). A central reason for working with this account has less to do with epistemic modals per se and more with Yalcin’s general psychological proposal, which is crucial to what follows, that beliefs—modal and otherwise—are essentially *about* various subject matters, where these subject matters can be formally modeled as partitions (or “modal resolutions”) of logical space along the lines of Lewis (1988a,b) (see also Yablo 2014; Yalcin 2018; Hoek 2019). According to Yalcin, Y’s belief that Joan might be at the party amounts to her being in a “resolution-sensitive” state of mind where her beliefs about Joan’s attendance leave open the possibility that she will come; her epistemic modal claim can be conventionally interpreted as a proposal to coordinate on this property of her belief state.

The concept of *aboutness* is at the heart of our theory of attention as well. We propose in §5 that X’s evolving attention state in (20) can also be modeled using Lewisian subject matters (see Hulstijn 2000; Swanson 2006; de Jager 2009; Franke & de Jager 2010; Fritz & Lederman 2015 for related proposals). At the beginning of this example, X is not thinking about whether Joan will come to the party; as we understand the example, X is failing to distinguish between some possibilities in which Joan comes and others in which Joan does not. But after Y resists, X can be formally understood as distinguishing between any possible worlds that lie in distinct cells of the bipartition representing the matter of whether Joan is coming. Crucially, this attentional update leads X to retrieve his latent information about Joan, and this leads him

to weaken his stance regarding Bette.⁶ We model this change using a new formal storage-retrieval mechanism building on the *evidence models* of van Benthem & Pacuit (2011) and van Benthem, Fernández-Duque & Pacuit (2014), which integrates evidence models with the *aboutness* of a speaker’s attentional and epistemic state in the following way: when a speaker thinks about a new subject matter, stored information about it and the other subject matters to which he was already attending can become visible at the more fine-grained resolution determined by his updated attention state, and by putting this retrieved information together the speaker can reshape his views about the world.

We bring everything together in §6 where we show how the theory of epistemic modality in §4 and theory of attention-facilitated belief revision in §5 can be merged with the Farkas & Bruce-style discourse structure from §3 to give a systematic analysis of our target example (20). In the course of doing so, we also introduce the new concept of a *subject matter under public attention* (SUP), which is closely related to but distinct from the more familiar notion of a *question under discussion* (QUD; Roberts 1996; Ginzburg 1996; van Kuppevelt 1996; Büring 2003). But to repeat: while this paper is centered on (20), the machinery in §6 is meant to apply more generally to any construction in natural language that serves to indicate which subject matters a speaker is attending to or thinking about. We conclude in §7 with a discussion of some opportunities to improve the coverage of our model and a comparison to other work on attention in the linguistics literature.

2 Stalnakerian Foothills

Broadly speaking, a formal discourse theory must have two components. First, we need a way to represent time slices of a discourse, or *discourse contexts*, that encode the relevant features of the conversation we are interested in. For purposes of understanding resistance, it will be useful to draw a private-public distinction and take contexts to represent both the individual mental states of the speakers and certain features of the discourse that have been made public among them, which we refer to as the “conversational score”.⁷ We focus here on dialogues involving two

⁶Throughout this paper, we follow van Benthem, Fernández-Duque & Pacuit (2014) in assuming that “evidence” or “information” needn’t be factive, as agents can interact with unreliable sources. Furthermore, the evidence gathered from different sources might be jointly inconsistent.

⁷This terminology is from Lewis (1979), who compares various conversational exchanges to a baseball game.

participants, X and Y, so our contexts look like this:

$$(21) \quad \mathbf{Discourse\ context} = \left\langle \begin{array}{l} \text{conversational score,} \\ \text{representation of X's mental state,} \\ \text{representation of Y's mental state} \end{array} \right\rangle$$

We also need a set of conversational updates or moves that capture the characteristic tendencies of speech acts to effect transitions from one context to the next.

Following much work in formal pragmatics, our point of departure is Stalnaker's classic theory (1978; 2002; 2014) in which a conversation unfolds against a background of shared presuppositions that speakers can exploit when making assertions and that they intend to modify with their informational contributions—the *common ground*. Where \mathcal{W} is a space of possible worlds, the common ground of a (nondefective) context can be modeled as a set of propositions (a set of subsets of \mathcal{W}) or as their intersection (a subset of \mathcal{W}), which Stalnaker calls the “context set”. As a first pass, we equate the score of a discourse context with its context set and likewise take the relevant mental states of X and Y to be their belief states modeled using sets of worlds (Hintikka 1962; Stalnaker 1984 introduces the more general notion of *acceptance* to handle conversations involving assumption, pretense, and so on, but we stick with belief here):

(22) **Stalnakerian contexts**

A *Stalnakerian context* c is a tuple $\langle cs_c, \mathcal{B}_{X_c}, \mathcal{B}_{Y_c} \rangle$ consisting of a context set $cs_c \subseteq \mathcal{W}$ and two additional nonempty sets of worlds $\mathcal{B}_{X_c}, \mathcal{B}_{Y_c} \subseteq \mathcal{W}$ representing the belief states of X and Y respectively, where $\mathcal{B}_{X_c} \subseteq cs_c$ and $\mathcal{B}_{Y_c} \subseteq cs_c$.

In its most recent incarnation in Stalnaker (2014), common ground is spelled out using epistemic logic in terms of what speakers *commonly accept*.⁸ In earlier work (Bledin & Rawlins 2016), we followed suit and also characterized common ground status as supervening on individual mental states. However, we have since become somewhat skeptical that speakers ever have common acceptance, common belief, or some related higher-order “common” attitude—and that this kind of attitude is even required to explain coordination in discourse—in part due to arguments by Lederman (2018a,b). While (22) requires that propositions in the common ground are at least *mutually believed* by the speakers, we want to remain officially neutral in this paper about what else is needed for information to be public in the relevant sense.

Turning to dynamics, Stalnaker famously proposes that the essential effect of an assertion is to add its propositional content to the common

⁸See Fagin et al. (1995) for a good primer on group attitudes in epistemic logic.

ground. For the time being, let us not worry too much about semantics and simply assume that each sentence φ in our main example (20) can be assigned a proposition $\llbracket\varphi\rrbracket \subseteq \mathcal{W}$ as its semantic value (we abandon this assumption in §4). We can then model assertion as follows, where an assertion by X using φ serves to intersectively update both the context set and Y's belief state with its content $\llbracket\varphi\rrbracket$:⁹

(23) **Stalnakerian assertive update**

$$c + \mathbf{S}\text{-Assert}_X(\varphi) = \langle cs_c \cap \llbracket\varphi\rrbracket, \mathcal{B}_{X_c}, \mathcal{B}_{Y_c} \cap \llbracket\varphi\rrbracket \rangle$$

Felicity conditions: appropriate in c only if

- a. $\mathcal{B}_{X_c} \subseteq \llbracket\varphi\rrbracket$ (speaker sincerity)
- b. $\mathcal{B}_{Y_c} \cap \llbracket\varphi\rrbracket \neq \emptyset$ (hearer consistency)

The sincerity condition (Searle 1969) ensures that X believes $\llbracket\varphi\rrbracket$, while the consistency condition requires that Y's beliefs be compatible with $\llbracket\varphi\rrbracket$, because otherwise Y should reject the assertion (assuming here that Y would be unwilling or unable to engage in non-monotonic reasoning to accommodate X's assertion).¹⁰ One might want to impose a stronger epistemic requirement for felicitous assertion like Williamson's (1996; 2000) rule that we assert only what we know.¹¹ Presumably, one would also want to add a requirement that the assertion be *relevant* to the speaker's active *discourse goals* (Roberts 1996, 2012) and/or *real-world domain goals* (van Rooy 2003; Franke & de Jager 2010). While sincerity and consistency are arguably necessary for appropriate assertion, they certainly are not sufficient.

Now, how does (20) play out in this system? We run into difficulties pretty early on. When X asserts that Bette is coming to the party, there are only two options. Either we apply the following assertive update to the discourse-initial context c_0 or we don't:

$$(24) \quad c_0 + \mathbf{S}\text{-Assert}_X(\text{Bette is coming}) = \langle cs_{c_0} \cap \llbracket\text{Bette is coming}\rrbracket, \mathcal{B}_{X_{c_0}}, \mathcal{B}_{Y_{c_0}} \cap \llbracket\text{Bette is coming}\rrbracket \rangle$$

However, neither option accurately captures the effect of X's assertion. Y does not outright reject X's assertion—after all, Y might have ultimately come to accept it if X had successfully met her challenge—so we do not want to just ignore this assertion and move on. On the other hand, Y

⁹The mirror-image update with Y as assertor and X as hearer is obtained by swapping all occurrences of X and Y in the entry below (likewise for other updates in this paper).

¹⁰Note that the sincerity condition combined with the informational update of Y's belief state in (23) ensures that this update preserves the mutual belief condition.

¹¹Though see Weiner (2005); Lackey (2007); Hill & Schechter (2007); Kvanvig (2009) for criticism of this Knowledge Rule and for some alternative proposals.

does not fully accept X’s assertion either—if she did, then the rest of the exchange would make little sense—so we do not want to apply (24) and incorporate \llbracket Bette is coming \rrbracket into the common ground. Instead, what seems to be happening is that this proposition enters a state of limbo while X’s assertion subsequently comes under resistance by Y.

It might be tempting to think that Y *partially* accepts X’s assertion by resisting rather than rejecting it. Indeed, one of the authors of this paper previously argued in Rawlins (2010) that resisters partially accept resisted assertions limited to those possibilities that are not explicitly raised by their resistance moves; in the case at hand, this would amount to Y accepting that Bette is coming in worlds where Joan is not while leaving it open whether Bette is coming in worlds where Joan is (and we might then want to update the common ground with the proposition \llbracket Bette is coming $\rrbracket \cup \llbracket$ Joan is coming \rrbracket). But this line is hard to square with cases of *repeated resistance*. Consider our party example with this alternative ending:

- (25) X: Bette is coming to the Oscars party.
 Y: Joan might be there
 X: No, Joan’s not coming.
 Y: Okay. But what if Miriam Hopkins is there? Will Bette still come then?

If Y believes after her first resistance move that Bette is coming if Joan is not, then her second resistance move is puzzling (since she would believe at this point that Bette is coming). As (25) shows, there does not seem to be even restricted acceptance directly associated with a resistance move. Rather, the asserted proposition \llbracket Bette is coming \rrbracket remains in a kind of temporary purgatory while under challenge from Y, though it might exit into the common ground if Y decides to stop resisting.

3 Decomposing Assertion

We need to take more seriously the idea that an assertion is a *proposal* to update the context.¹² To properly capture the proposal+response sequence of resistance, we now adopt a proposal based on Farkas & Bruce (2010) (who build on earlier work by Hamblin 1971; Ginzburg 1996; Roberts 1996; Gunlogson 2001, 2008; Büring 2003) that many

¹²Stalnaker (1978) himself recognizes the proposal nature of assertion but does not emphasize it, such that many working with a Stalnakerian pragmatics simply employ a system like the one sketched in the previous section where an assertion automatically updates the context unless it is rejected.

conversational moves can be broken down into two phases: a proposal to update the context in some way, and an acceptance or confirmation move from other participants. While Farkas and Bruce are primarily interested in confirming and reversing reactions to assertions and polar questions using polarity particles, the phenomenon of resistance further motivates their proposed factorization of assertion.

In Farkas and Bruce’s system, the first step of an assertion involves putting a proposition on the “table”. The table records a short history of the active discourse, serving as the purgatory slot for any discourse items that are still under discussion; Farkas and Bruce represent this directly as a separate component in their model of context. In this framework, both questions (QUDs) and assertions can be under discussion, and the table intuitively characterizes a current shared discourse of evaluating or resolving whatever is on top of the stack. Though Farkas and Bruce’s tables are populated with both propositions and question denotations (along with the sentences used to express them), questioning plays only a peripheral role in our paper, so we delay its introduction until §6. For now, the only adjustment to our previous Stalnakerian contexts is an enrichment of the conversational score with an *assertion stack*. Sitting alongside the context set, this stack is loaded up with propositions that have been asserted and now await either acceptance (i.e., incorporation into the context set) or rejection by the audience.¹³

(26) **F&B contexts**¹⁴

An *F&B context* c is a tuple $\langle cs_c, \mathcal{A}_c, \mathcal{B}_{X_c}, \mathcal{B}_{Y_c} \rangle$ where $cs_c, \mathcal{B}_{X_c}, \mathcal{B}_{Y_c}$ are as before and \mathcal{A}_c is a stack of propositions.

With this structure in place, we can redefine our assertive update so that it simply adds the proposition asserted to the assertion stack:

(27) **F&B assertive update**

$$c + \text{FB-Assert}_X(\varphi) = \langle cs_c, \text{push}(\llbracket \varphi \rrbracket, \mathcal{A}_c), \mathcal{B}_{X_c}, \mathcal{B}_{Y_c} \rangle$$

¹³We assume some familiarity with stacks; in addition to Farkas & Bruce (2010), see Kaufmann (2000) and Isaacs & Rawlins (2008) for similar uses. We adopt the following (standard) notation: $\text{push}(x, s)$ is the stack obtained by adding x to the top of stack s , $\text{pop}(s)$ is the stack obtained by removing the top element of s , and $\text{top}(s)$ is the top element of s . While stacks suffice for present purposes, more complicated data structures are needed for modeling other phenomena. For instance, one of the referees for this journal suggests using priority queues to handle exchanges where an addressee tackles a sequence of questions in the order in which they are asked.

¹⁴We call the new discourse contexts with assertion stacks “F&B contexts”, and prefix the conversational updates in this section with **FB-** because the upgraded formal system is directly inspired by proposals in Farkas & Bruce (2010). But there are significant differences as well, and any errors associated with these are our own.

Felicity condition: appropriate in c only if $\mathcal{B}_{X_c} \subseteq \llbracket \varphi \rrbracket$.¹⁵

Downstream from this, accepting an assertion updates the context set and belief state of the accepter with the top element of the assertion stack, $top(\mathcal{A}_c)$, which is then removed from the stack:

(28) **F&B acceptance**

$$c + \text{FB-Accept}_Y = \langle cs_c \cap top(\mathcal{A}_c), pop(\mathcal{A}_c), \mathcal{B}_{X_c}, \mathcal{B}_{Y_c} \cap top(\mathcal{A}_c) \rangle$$

Defined only if $\mathcal{A}_c \neq \langle \rangle$.

Felicity condition: appropriate in c only if $\mathcal{B}_{Y_c} \cap top(\mathcal{A}_c) \neq \emptyset$.

Since acceptance is the default or unmarked response to assertion (as Farkas & Bruce 2010 put it, assertions “project” their acceptance), the step in (28) often happens silently/implicitly; we do not see it. But sometimes acceptance is signaled with explicit agreement/confirmation moves involving particles or more complex phrases, and with nodding or other physical gestures.

(29) X: Third Rail Coffee is open on weekends.

Y: Yes, it is. / Okay. / Uh huh. / Sure.¹⁶

Note that from our current perspective, the Stalnakerian update (23) can now be regarded as an assertion move where things go as planned:

$$(30) \quad c + \text{S-Assert}_X(\varphi) \approx c + \text{FB-Assert}_X(\varphi) + \text{FB-Accept}_Y$$
¹⁷

By factoring the earlier update into a proposal+acceptance sequence, however, we can allow for a variety of other hearer responses.

Most dramatically, a hearer can *reject* a prior assertion by asserting a new proposition that updates the assertion stack in such a way that it can no longer be emptied through acceptance alone (arguably this is just what it is to *disagree*: to be in a context where the assertion stack cannot be fully popped via acceptance). In this kind of conflict situation, one of the participants might come to *retract* a prior assertion:

(31) **F&B retraction**

$$c + \text{FB-Retract}_Y = \langle cs_c, pop(\mathcal{A}_c), \mathcal{B}_{X_c}, \mathcal{B}_{Y_c} \rangle$$

¹⁵In Farkas and Bruce’s (2010) system, asserting $\llbracket \varphi \rrbracket$ also adds this proposition to the speaker’s (public) *discourse commitment set* (cf. Hamblin 1971; Gunlogson 2001, 2008). One could do something similar here and have X’s assertion update the context set (and Y’s belief state) with the proposition that X believes $\llbracket \varphi \rrbracket$. However, we do not explicitly model such higher-order belief in this paper.

¹⁶There are subtle differences between these reactions. For instance, *Yes* signals that Y has independent reasons for believing what X reports (Gunlogson 2008).

¹⁷We use \approx rather than equality because the S- update and FB- updates operate on different structures. For ease of presentation, we are abusing notation slightly and letting c stand for both Stalnakerian and F&B contexts.

Defined only if $\mathcal{A}_c \neq \langle \rangle$.¹⁸

Felicity condition: appropriate in c only if $\mathcal{B}_{Y_c} \not\subseteq \text{top}(\mathcal{A}_c)$.¹⁹

Alternatively, X and Y can *agree to disagree* by removing their opposing proposals from \mathcal{A}_c while maintaining belief in these propositions (see Farkas & Bruce 2010 for an implementation). Unlike acceptance, which informationally updates the context set and the accepter’s belief state with the proposition at the top of the stack, these other responses pop the assertion stack while leaving the rest of the discourse context unchanged.

As we have emphasized all along, a hearer might also *resist* a prior move by making an assertion or asking a question with the intention of generating further discussion about a relevant matter (and unlike a rejection, a resistance move does not, at least not necessarily, set up a context where retraction or agreement to disagree is needed to empty the stack). Take (20), for instance. More carefully now, we can model this Feud variant using the following sequence:

$$\begin{aligned}
 (32) \quad & c_0 + \text{FB-Assert}_X(\text{Bette is coming}) \\
 & + \text{FB-Assert}_Y(\text{Joan might be there}) \\
 & + \text{FB-Accept}_X + \text{FB-Retract}_X \\
 & + \text{FB-Assert}_X(\text{Bette might not come}) \\
 & + \text{FB-Accept}_Y
 \end{aligned}$$

In our Farkas & Bruce-style system, X’s discourse-initial assertion places $\llbracket \text{Bette is coming} \rrbracket$ onto the assertion stack but Y checks its progress into the common ground by pushing $\llbracket \text{Joan might be there} \rrbracket$ onto the stack above it. At this intermediate point, there are two assertion moves ‘under discussion’, with the possibility claim at the top of the stack and the original move on hold until the possibility claim is resolved. To return to deciding what to do about the original move, the possibility claim itself has to be dealt with (e.g., by accepting or rejecting it). Since each point on the stack is effectively a discourse goal for one or more participants (decide on the element at the top of the stack), a natural conclusion for a hearer to draw in the face of such a move is that the original decision is waiting on a decision about the resistance move in some way. In this example, rather than rejecting or counter-resisting Y’s new proposal, X tacitly accepts it. Though there is no explicit retraction marker in (20) like “I take that back”, X must also have retracted his

¹⁸Because speakers can retract only their own assertions, this move should really be defined only if Y placed $\text{top}(\mathcal{A}_c)$ onto the stack. Formalizing this would require us to keep track of who is responsible for adding particular items to the table, as in Gunlogson (2008).

¹⁹One might want to strengthen this to the *requirement* to retract when a speaker no longer believes what she put forward. See MacFarlane (2005b) for discussion.

initial assertion—as signaled by his final incompatible assertion that pushes \llbracket Bette might not come \rrbracket onto the assertion stack. In the end, Y silently accepts the new proposal and it becomes public belief between X and Y that Joan might come and keep Bette away.

This more fine-grained analysis is clearly a big improvement over how we were doing things back in §2. It nicely captures how Y’s resistance move defers a decision on X’s assertion until her own assertion has been addressed. That said, the analysis in (32) still leaves a lot to be desired. First, there is an attentional gap: we still have no account of how the speakers’ attention states evolve as the dialogue proceeds. As a result, we miss out on one of the most intriguing features of this example—how Y’s resistance move draws X’s attention to whether Joan is coming, and leads X to change his mind about Bette’s attendance. This is no small matter. Without this missing piece, we do not yet have an analysis of (20) as a *rational* discourse (where ‘rational’ should be understood in a sense applicable to agents with limited attentional resources). Note that in the current setup, the felicity conditions for FB-Assert_X (Bette is coming) and FB-Retract_X require that X changes his mind about Bette before he retracts. However, the conversational updates in the F&B-model don’t allow for this to happen. As a result, when we run through (32), X must violate the felicity condition of at least one of these moves.

At this stage, we have also said next to nothing about semantics, and simply assumed that modal and non-modalized sentences alike can be assigned propositions. But the semantics and pragmatics of epistemic modality remains controversial: perhaps Y’s modal claim should not be understood as a proposal to update the context with a proposition but instead as serving some other function. So in addition to clarifying how her resistance move effects a transition between attention states, we need to say more about its informational character. As it turns out, filling in this informational gap can help us address the attentional gap as well. The theory of epistemic modals that we present in §4 will serve as a useful bridge to our theory of attention-driven belief change in §5.

4 Epistemic Modality

How should we understand Y’s possibility claim? It is hard to say. The space of candidate theories for epistemic modality is enormous and growing, including *contextualist* accounts (Hacking 1967; Teller 1972; Kratzer 1981; DeRose 1991; Dowell 2011; von Stechow & Gillies 2011; Dorr & Hawthorne 2013; Yanovich 2014; Silk 2016), *relativist* accounts (Egan 2007; MacFarlane 2011, 2014), and *expressivist* accounts of both

static semantic (Yalcin 2011; Stalnaker 2014; Moss 2015) and dynamic semantic (Veltman 1996; Willer 2013; Yalcin 2015) stripes.

But let us be clear that we are interested less in the fact that Y resists with an epistemic possibility claim, and more in how her claim heightens X’s attention to a new subject matter—an effect that could have also been achieved with a *{what/even} if* or tag question, or one of the other constructions discussed in §1. Because our principal aim is not to argue for a particular theory of epistemic modality but rather to clarify the attentional effect of Y’s modal claim, we adopt a theory of epistemic modals based on work by Veltman (1996) and Yalcin (2008, 2011) without motivating it over its many competitors.

4.1 From Propositions to Mental Properties

At this point, it is useful to assume that the logical forms of the sentences in (20) (as well as those in other examples to come) can be represented at a suitable level of abstraction with the following formal language:

(33) **Basic sentential modal language**

The language \mathcal{L} is generated from a stock of atomic sentences $At_{\mathcal{L}}$ (each written in sans serif), negation ‘ \neg ’, conjunction ‘ \wedge ’, and epistemic possibility ‘ \diamond ’ in the usual way.

Veltman (1996) interprets a modal language like \mathcal{L} using a dynamic *update semantics* (building on Kamp 1981; Heim 1982; Gärdenfors 1984; Groenendijk & Stokhof 1991). Unlike compositional calculi that assign sentences a proposition or truth value relative to a point of evaluation, the semantic value of each sentence in the following semantic system is a program or instruction for updating information states (technically, a function from sets of worlds to sets of worlds):²⁰

(34) **Models for the modal language**

A *model* \mathcal{M} for \mathcal{L} is a pair $\langle \mathcal{W}, \mathcal{V} \rangle$ where \mathcal{W} is a nonempty set of possible worlds and $\mathcal{V} : At_{\mathcal{L}} \rightarrow 2^{\mathcal{W}}$ is a valuation function sending each atomic sentence $\alpha \in At_{\mathcal{L}}$ to a set of worlds $\mathcal{V}(\alpha) \subseteq \mathcal{W}$.

(35) **Update semantics**

For model \mathcal{M} , the *update function* $[\cdot]_{\mathcal{M}} : \mathcal{L} \rightarrow (2^{\mathcal{W}})^{2^{\mathcal{W}}}$ maps each sentence $\varphi \in \mathcal{L}$ to a function from any information state $s \subseteq \mathcal{W}$ to an information state, defined recursively as follows:

²⁰This is often called a “context change potential” (CCP), but we refrain from using this terminology here because information states are only components of our discourse contexts, and not contexts themselves.

$$\begin{aligned}
s[\alpha] &= \{w \in s : w \in \mathcal{V}(\alpha)\} \\
s[\neg\varphi] &= s \setminus s[\varphi] \\
s[\varphi \wedge \psi] &= s[\varphi] \cap s[\psi]^{21} \\
s[\diamond\varphi] &= \{w \in s : s[\varphi] \neq \emptyset\}^{22}
\end{aligned}
\tag{Heim 1983}$$

The non-modal clauses are straightforward. As for the final clause for epistemic *might*, updating s with $\diamond\varphi$ imposes a *test* on this state to check whether we can consistently update it with the *prejacent* sentence φ . If so, the test passes and the posterior state $s[\diamond\varphi]$ is just s itself; otherwise, the output is \emptyset .²³

Informally, Veltman speaks of an assertion using $\diamond\varphi$ as an “invitation to perform a test”: if a hearer’s information state is compatible with the prejacent φ (in the sense that it can be updated with φ without crashing), then the assertion should be accepted; otherwise, it should be rejected. Note that each sentence $\varphi \in \mathcal{L}$ determines a property of information states instantiated by those that are fixed points under update with $[\varphi]$ (i.e., running this program leaves the state unchanged):

(36) **Support** (Veltman 1996)

$$s \text{ supports } \varphi \text{ (notation: } s \models \varphi \text{) iff } s[\varphi] = s.$$

Though Veltman does not explicitly frame his pragmatics in such terms, we can now think of a sincere assertor who utters φ as proposing to coordinate on the property $\models \varphi$ instantiated by her belief state (as in Yalcin 2011).²⁴ Often, this effort can still be regarded as an attempt to share belief in a particular proposition $\llbracket\varphi\rrbracket \subseteq \mathcal{W}$.²⁵ When X asserts in

²¹This alternative clause from Heim (1982) is more common in the recent dynamic semantics literature: $s[\varphi \wedge \psi] = s[\varphi][\psi]$. Unlike the clause in (35), which Beaver (2001) calls “static conjunction”, Heim’s clause is non-commutative—if s includes A -worlds and not- A -worlds, for instance, then $s[\diamond A][\neg A] \neq \emptyset$ but $s[\neg A][\diamond A] = \emptyset$. While the difference between the two clauses doesn’t matter for present purposes, we stick with Veltman’s version for consistency with the rest of his proposal.

²²As Yalcin reports in some of his work, the basic idea behind this clause for ‘ \diamond ’ is articulated by Stalnaker (1970).

²³Veltman’s semantics for the non-modal fragment of \mathcal{L} without ‘ \diamond ’ can be recovered by associating each sentence φ in this fragment with a proposition $\llbracket\varphi\rrbracket \subseteq \mathcal{W}$ in the usual way, then defining dynamic meanings in terms of intersective update with these propositions: $s[\varphi] := s \cap \llbracket\varphi\rrbracket$. However, the consistency check contributed by ‘ \diamond ’ introduces something genuinely new that cannot be fit into the classical propositional mold (see van Benthem 1986; Veltman 1996; Rothschild & Yalcin 2016, 2017 for general results in this area).

²⁴A crucial feature of Veltman’s semantics is its *idempotency*: for each sentence $\varphi \in \mathcal{L}$ and information state $s \subseteq \mathcal{W}$, $s[\varphi] \models \varphi$. This ensures that after accepting an invitation to update with $[\varphi]$, a hearer’s belief state will have the property $\models \varphi$.

²⁵Notational clarification: we use the single-bracketed expression $[\varphi]$ to refer to an update function of type $\langle\langle s, t \rangle, \langle s, t \rangle\rangle$ while the double-bracketed expression $\llbracket\varphi\rrbracket$ refers

(20) that Bette is coming (using the sentence **Bette attends**), he is thereby proposing that Y change her belief state in such a way that it comes to instantiate the property \models **Bette attends** of including only Bette-is-coming-worlds, and this can be characterized as a proposal to believe \llbracket **Bette attends** \rrbracket . However, with epistemic modals in play, not everything can be characterized in this manner. When Y resists by asserting that Joan might be at the party (using \diamond **Joan attends**), she is proposing to coordinate on the property \models \diamond **Joan attends** instantiated by her belief state of being compatible with \llbracket **Joan attends** \rrbracket . This property of believing that Joan might come cannot be reduced to belief in a proposition.

4.2 A Puzzle About Epistemic Modal Belief

We might try to recast Veltman’s theory using the Farkas & Bruce-style system in §3 with some adjustments: let the assertion stack be populated with programs to update rather than with propositions, let an assertion using φ push the program $[\varphi]$ onto the stack, let acceptance involve running the topmost program on the accepter’s belief state (among other things), and so forth.²⁶

But we should hold off before developing this further. As it stands, the account just sketched cannot be quite right—at least, not the part about epistemic modal *belief*. We have assumed the following belief principle, which is basically what you get by combining Veltman’s (1996) semantics for epistemic modals with Heim’s (1992) dynamic semantics for belief reports:

$$(37) \quad \text{S believes in } c \text{ that } \diamond\varphi \text{ iff } \mathcal{B}_{S_c} \models \diamond\varphi$$

So in particular, we have

$$(38) \quad \text{Y believes in } c \text{ that Joan might come iff } \mathcal{B}_{Y_c} \cap \llbracket \text{Joan attends} \rrbracket \neq \emptyset.$$

However, believing that Joan might be at the party cannot simply be a matter of maintaining a doxastic state that fails to rule out the possibility that she will come. Consider Z, who once saw a movie starring Joan Crawford but hasn’t thought about her for years. Although Z’s beliefs do not exclude the possibility that Joan will be at the party—the question of who is coming hasn’t even occurred to him—it is nonetheless very odd to describe him as also believing that Joan might be there. (This is a variant of Yalcin’s 2011 Topeka problem.)

to a proposition of type $\langle s, t \rangle$. We assume that propositions can still be assigned to the non-modal sentences in \mathcal{L} , as discussed above in n. 23.

²⁶For a formal pragmatics built atop Veltman’s update semantics that is closer to the basic Stalnakerian picture in §2, see for example Beaver (2001).

Y’s modal belief must involve more than mere compatibility between her belief state and the proposition that Joan is coming. But what else is needed? To patch up our working theory of epistemic modality, we now develop the following answer from Yalcin (2011): Y, unlike Z, has beliefs *about Joan’s attendance at the party* and her beliefs about this matter leave open the possibility that Joan is coming. In fact, Yalcin’s general proposal that our beliefs are essentially directed at the subject matters they are *about* is one of our main reasons for working with the Veltman-Yalcin theory of modality in the first place. Much of the work ahead to prepare for our full analysis of Feud in §6 will consist in making the *aboutness* of our cognitive lives more precise.

4.3 Beliefs About Subject Matters

The proposal is that belief is a *subject-matter-sensitive* state: one might believe about the number of stars that there are more than a billion, believe about the number of mountain gorillas left in the wild that there are fewer than a thousand, and believe many other things about many other subject matters (this might sound platitudinous, but see Yalcin 2008, 2011, 2018 for deeper philosophical discussion). We can formulate this *doxastic aboutness* using the formal theory of subject matters in Lewis (1988a,b), where subject matters like *the 17th century*, *styrofoam*, and *how many stars there are*—to use some of Lewis’s own examples—partition \mathcal{W} into mutually exclusive and jointly exhaustive sets of worlds (see Humberstone 2000; Yablo 2014 for further development):

(39) **Subject matters**

A *subject matter* $M \subseteq \mathcal{W} \times \mathcal{W}$ is a total equivalence relation over \mathcal{W} . Let \mathfrak{M} be the set of subject matters over \mathcal{W} .²⁷

For example, the matter $M_{\#stars}$ of *how many stars there are* groups together worlds that agree on the number of stars. This subject matter determines the following *quotient set* (i.e., set of its equivalence classes), which Yalcin calls a “modal resolution” of the space \mathcal{W} :

$$(40) \quad \mathcal{W}/M_{\#stars} = \{ \llbracket \text{no stars} \rrbracket, \llbracket (\text{exactly}) \text{ one star} \rrbracket, \dots \}$$

Informally, a proposition P *about* a subject matter M is a way things might be like with respect to this matter. As Lewis puts it, the truth value of the proposition “supervenes” on the subject matter. Formally, this amounts to the following condition:

²⁷That is, a subject matter in \mathfrak{M} is a reflexive, symmetric, and transitive relation over \mathcal{W} . We depart slightly from Lewis in counting the universal relation $\mathcal{W} \times \mathcal{W}$ as a genuine (albeit degenerate) subject matter.

(41) **Aboutness**

P is (wholly) about $M \equiv_{df}$ if Mwv then ($w \in P$ iff $v \in P$).

Equivalently, P is about M just in case P is a union of cells from \mathcal{W}/M —or P is “visible” at this modal resolution, in Yalcin’s terminology (cf. Groenendijk & Stokhof’s 1984 “partial answerhood”).

To implement Yalcin’s fix, we can now use this Lewisian machinery to lift the Hintikka (1962)-style model of belief from §2 and §3 to one in which a speaker S ’s belief state is represented using a distinct set of worlds relative to each subject matter that S has beliefs about:

(42) **Subject-matter-sensitive belief states**

A speaker S ’s *belief state* in c is a partial function $\mathcal{B}_{S_c} : \mathfrak{M} \rightarrow 2^{\mathcal{W}}$ which yields for a subject matter M a nonempty proposition (set of worlds) $\mathcal{B}_{S_c}(M)$ about this matter.

Yalcin calls $\mathcal{B}_{S_c}(M)$ the speaker S ’s “view” about M . So a belief state is now a function from subject matters to S ’s views about these matters. Crucially, belief states needn’t be total functions. While you presumably have beliefs about the number of stars in the sky and mountain gorillas in the wild, your belief state is undefined over the great many matters about which you have no coherent views. We say “coherent” here because representing S ’s view about a matter using a single nonempty set of worlds effectively ensures that S ’s beliefs about this matter—which we can identify with the propositions about this matter entailed by S ’s view about it—are consistent and closed under entailment. Like Yalcin, however, we do not officially introduce any constraints between S ’s beliefs about *different* subject matters. This is not to say that such inter-matter constraints aren’t important—even if one is fine with the idea that a speaker’s beliefs across subject matters needn’t be logically coherent, one might reasonably worry that (42) leaves things far too unconstrained, allowing for overly compartmentalized or fragmented belief states. It’s just that inter-matter constraints aren’t needed for the analysis of Feud.

Now, how does the move to (42) help with the puzzle about epistemic modal belief in §4.2? With subject matters in play, we can replace the problematic belief principle (37) with this M -relativized upgrade:

(43) S believes in c about M that $\diamond\varphi$ iff $\mathcal{B}_{S_c}(M) \models \diamond\varphi$.

The extra subject matter argument in (43) gives us a way to distinguish between the beliefs of Y and Z . Letting M_J be the matter of whether Joan is coming (i.e., M_Jwv iff either w and v are both worlds in which Joan attends the party, or neither w nor v is such a world), we can model Z ’s belief state using a function \mathcal{B}_{Z_c} undefined on M_J , so Z doesn’t count as

believing that Joan might come—at least, he doesn’t count as believing this about M_J . In contrast, if $\mathcal{B}_{Y_c}(M_J)$ is defined and compatible with $\llbracket \text{Joan attends} \rrbracket$, then Y has this modal belief.

4.4 Interim Summary

We now have the main components of our working theory of epistemic modality in place. From Veltman, we take the idea that a sincere speaker who makes an epistemic *might* claim can be understood as proposing to coordinate on the property, instantiated by her belief state, of being compatible with its prejacent. From Yalcin, we take the idea that this property is of a resolution-sensitive state of mind. We need an account of epistemic possibility to feed into our analysis of Feud, but it’s really the idea that speakers’ cognitive states are directed at subject matters that is crucial to what follows.

The puzzle in §4.2 provided one source of motivation for the model of belief in (42), and allowed us to introduce subject-matter-sensitivity while getting our account of epistemic *might* on the table. It is worth noting, however, that there is much to say in favor of relativizing belief to subject matters, independently of whether this is ultimately needed to address the puzzle about epistemic modal belief.

First and foremost, the underlying idea that beliefs are about subject matters is just very intuitive, and (42) gives us a way to start formally theorizing about this. Hoek (2019) also shows how this model can be grounded in a decision-theoretic theory of mental representation. Yalcin (2018) argues that relativizing beliefs to subject matters can help with some aspects of the problem of logical omniscience. In the next section, we also show how the model in (42) connects in interesting ways with an independently plausible subject-matter-based account of attention, and we then show in §6 how the resulting attentional-epistemic theory can be integrated into the formal model of discourse from §3 to account for the resistance in cases like Feud.

5 Bringing in Attention

5.1 Two Models of Attention

It is time to add an attentional layer to our theory. Before Y resists in (20), X isn’t thinking about Joan (who is completely off his radar). After Y resists, Joan is squarely in mind. How exactly should we think about this change in X’s attention state? One kind of answer appeals to

tacit assumptions.²⁸ It is tempting to say that pre-resistance X tacitly excludes the possibility that Joan is coming to the party while post-resistance X no longer tacitly assumes her absence. More generally (Lewis 1979; Stalnaker 1984; de Jager 2009; Franke & de Jager 2010; Rawlins 2010; Klecha 2014; Crone 2017, 2018):

(44) **Tacit-assumption account of (in)attention**

Inattention is a matter of, or at least necessarily involves, tacitly ruling out maximally-specific possibilities. Heightening attention consists of abandoning tacit or implicit assumptions and thereby expanding the domain of possibilities under consideration.

In a possible-worlds framework, we might model X’s attention state in a context c with a distinguished set $\mathcal{RA}_{X_c} \subseteq \mathcal{W}$ of *relevant alternatives* that are firmly in view, or with a structure that determines such a set of alternatives (see Franke & de Jager 2010 for a nice implementation). On this proposal, X’s discourse-initial attention state $\mathcal{RA}_{X_{c_0}}$ excludes worlds in which Joan is coming: $\mathcal{RA}_{X_{c_0}} \cap \llbracket \text{Joan attends} \rrbracket = \emptyset$. But after the resistance, X’s attention state expands outward to include some of these worlds previously shrouded in darkness.

However, not all cases of inattention can be understood along the lines of (44); there must be some inattention without tacit assumptions. To see this, suppose that we are discussing where to go on vacation and you are thinking about whether to go to Bali, head to Maui, or do something else—but you don’t have another vacation option specifically in mind. Although you aren’t explicitly considering the option of going to Bora Bora, you also aren’t tacitly ruling out this possibility. If you were tacitly excluding Bora Bora and any such alternative option, then you would be tacitly assuming that we will spend our vacation in either Bali or Maui, and that misdescribes the case.²⁹ This raises a central question: how can someone fail to attend to a possibility (like going to Bora Bora) without ruling it out?

Fortunately, the tacit-assumption account is not the only game in town. A second, rather different approach begins with another seemingly banal thesis about the *aboutness* of our cognitive states—attention, in at least one interesting sense, is a matter of considering or thinking about certain subject matters while overlooking others. This thesis motivates the following alternative picture of attention (see Hulstijn 2000; Swanson

²⁸Tacit assumption is part of the broader class of belief-like “acceptance” attitudes discussed by Stalnaker (1984).

²⁹Assuming here that when $\{P_1, P_2, \dots, P_n\}$ forms a partition of \mathcal{W} and one is tacitly ruling out P_3 through P_n , one is tacitly assuming $P_1 \cup P_2$.

2006; de Jager 2009; Franke & de Jager 2010; Fritz & Lederman 2015; Bledin & Rawlins 2016; Crone 2017, 2018 for related proposals):

(45) **Granularity account of (in)attention**

Inattention is a matter not of tacitly ruling out maximally-specific possibilities but rather of lumping them together. When one is not attending to this or that subject matter, one’s current state of awareness fails to distinguish between alternatives based on whether they agree or disagree with respect to this matter. By attending to new subject matters, one foregrounds distinctions between possibilities and one’s current view of reality becomes increasingly fine-grained.³⁰

Now, the tacit-assumption and granularity accounts aren’t incompatible; a careful reader might have noticed that we reference de Jager (2009) and Franke & de Jager (2010), who offer a hybrid of these two accounts, above both (44) and (45).³¹ However, we model (in)attention in terms of only granularity in this paper for a few reasons. First, as just argued, the tacit-assumption model has its limitations. Second, as we show later in this section, a subject-matter-based account of attention dovetails nicely with a subject-matter-sensitive account of belief. Third, we can now just stipulate that at the beginning of (20), X isn’t tacitly excluding that Joan is coming. So even though tacit assumptions might be needed to analyze closely-related examples, we don’t need them for Feud.

To formally implement the granularity account, we can again use Lewisian subject matters. At this point, it is helpful to introduce some mereology between the subject matters in \mathfrak{M} :

(46) **Mereology of subject matters** (Lewis 1988a)

- a. **Inclusion.** M_1 (mereologically) *includes* M_2 just in case M_1wv only if M_2wv .³² We also say that M_1 *refines* M_2 and M_2 is a *coarsening* of M_1 . (cf. Groenendijk & Stokhof’s 1984 notion of “entailment” between questions)
- b. **Summation.** The *sum* $M_1 + M_2 + \dots$ is the subject matter that includes each of M_1, M_2, \dots and is included in any other

³⁰The accounts in (44) and (45) do not exhaust the space of options. Swanson (2006), for instance, considers modeling the difference between seeing and overlooking possibilities in terms of higher-order belief, though he ultimately goes granular. See Crone (2018) for a recent, comprehensive survey of the currently available options for modeling awareness.

³¹See also Crone (2016, 2017, 2018) who analyzes “impotent” speech acts that raise awareness, such as clarity assertions, in a variant of Franke & de Jager’s system that also involves both tacit assumptions and granularity-based unawareness.

³²Equivalently, each cell of the partition \mathcal{W}/M_2 is the union of cells from \mathcal{W}/M_1 .

subject matter that includes them.³³

For example: *the ages of Earth and Mars* is the sum of the subject matters *the age of Earth* and *the age of Mars*, as the former is the smallest subject matter that includes the latter matters. It is also helpful to assume, following Fritz & Lederman (2015), that the subject matters a speaker is attending to at any given time satisfy the following closure conditions (cf. Stalnaker’s 1984 deductive constraints on acceptance):

- (i) Anybody attending to a subject matter M is also attending to every coarsening of M .
- (ii) Anybody attending to M_1, M_2, \dots is also attending to their sum $M_1 + M_2 + \dots$.
- (iii) A speaker is always attending to at least one subject matter, which can be the universal relation.

Given these three conditions, a speaker’s attention state at any moment in time can be uniquely characterized by a single subject matter—the sum of all the subject matters she is attending to:

(47) **Attention states**

A speaker S ’s *attention state* in c is a subject matter $\Pi_{S_c} \in \mathfrak{M}$, where S is attending to M if Π_{S_c} includes M .³⁴

For instance, we might model your attention state in our tropical island example using a subject matter that includes the matters of whether we will go to Bali and whether we will go to Maui but fails to include the matter of whether we will go to Bora Bora. The subject matter Π which partitions \mathcal{W} as follows would work for this:

$$(48) \quad \mathcal{W}/\Pi = \{[\text{head to Bali}], [\text{head to Maui}], [\text{do something else}]\}$$

Similarly, we might now model X ’s initial attention state in (20) using a subject matter $\Pi_{X_{c_0}}$ that includes the matter M_B of whether Bette is coming to the party but fails to include the matter of M_J of whether Joan is coming—such as the subject matter M_B itself.

What is it exactly to be attending to a subject matter? This question deserves more attention than we can give it here, but attending to M seems to be at least this: being in a state of mind where one’s beliefs

³³Lewis (1988a) suggests that we might want to exclude gerrymandered, unnatural relations from \mathfrak{M} , in which case sums needn’t always exist. However, we assume that \mathfrak{M} ordered by the inclusion relation in (46a) is a complete lattice.

³⁴For various purposes one might want to work with a more fine-grained scheme that allows for *partial* attention. See for instance Rawlins (2013a) who analyzes *thinking about* reports in terms of the Lewisian notion of *non-orthogonality*.

about M are currently steering one’s actions or deliberations. It also seems to be this: being especially open or receptive to new information bearing on M . If one is attending to M , one is poised to reconsider and potentially revise one’s beliefs about M given the relative ease with which information about M can be assimilated into one’s belief state. In a similar vein, attending to M can help facilitate recall of one’s stored information about M . This recall is, of course, at the heart of the Feud variant (20)—after Y draws X ’s attention to whether Joan is coming, X ’s information about Joan and her feud with Bette springs to mind and he infers on its basis that Bette might not come.

Note that while we are focusing on attention to subject matters, one can also talk about attention to *propositions* within the granularity framework. These two varieties of attention are intimately related—an agent’s attention state constrains which propositions she is attending to, in the sense that only propositions about Π_{S_c} are currently available for consideration. Because the proposition $\llbracket \text{head to Bora Bora} \rrbracket$ isn’t visible at the coarse-grained resolution (48), you aren’t entertaining it. Likewise in (20), X comes to attend to stored propositions about Joan only after Y ’s resistance renders them visible (as we discuss in more detail below).

5.2 Attentional Dynamics in Brief

Our proposal is that X ’s belief change in (20) comes about through an interaction between epistemic and attentional *aboutness*: thinking about Joan allows X to retrieve his latent information about Joan and her relationship with Bette from memory and this triggers a reconfiguration of his belief state. The final thing we need in order to prepare ourselves for the full discourse analysis of Feud in §6 is a better account of this attentional update.

Combining the material in §4.3 and §5.1, we can now regard speakers as having both a subject-matter-relative belief state, as defined in (42), and a subject-matter-based attention state, as defined in (47). With these complementary structures in place, we can then define a speaker’s “current view” as the value of her belief state at her attention state:

(49) **Current views**

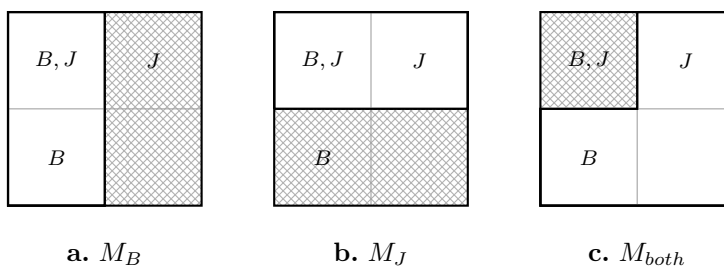
A speaker S ’s *current view* in c is $\Delta_{S_c} = \mathcal{B}_{S_c}(\Pi_{S_c})$.

Intuitively, a speaker’s current view is what she *actively* believes about the subject matters she is busy thinking about. In the discourse theory we are building towards, it is crucially the current views of conversational participants that steer a conversation along; a cooperative speaker will

assert only what is supported by her current view, accept only what is compatible with it, and so forth.

Fleshing out the discourse-initial context c_0 of (20) in more detail, let us now assume that X starts off attending only to whether Bette is coming to the party: $\Pi_{X_{c_0}} = M_B$. Assuming that Bette previously told X that she will attend, his current view about this matter is that she is coming: $\Delta_{X_{c_0}} = \mathcal{B}_{X_{c_0}}(M_B) = \llbracket \text{Bette attends} \rrbracket$ (Fig 1a). For this reason, X's claim that Bette is coming to the party is sincere. Let us also assume that Joan promised she would attend, so X believes about the matter of whether Joan is coming that Joan is: $\mathcal{B}_{X_{c_0}}(M_J) = \llbracket \text{Joan attends} \rrbracket$ (Fig 1b). Furthermore, X believes about the matter of whether *both* Bette and Joan are coming that they will not both attend, given the public feud between these stars: $\mathcal{B}_{X_{c_0}}(M_{both}) = \llbracket \neg(\text{Bette attends} \wedge \text{Joan attends}) \rrbracket$ (Fig 1c). But about the more fine-grained matter of who between Bette and Joan is coming, we assume that X doesn't yet have a coherent view: $\mathcal{B}_{X_{c_0}}(M_B + M_J)$ is undefined.

Fig 1. X's views about various subject matters before Y resists



When Y resists, we take this to shift X's attention state to $M_B + M_J$, after which he is distinguishing between possibilities based on whether Joan is coming to the party.³⁵ In this more fine-grained attention state, X's information about M_B , M_J , and M_{both} is visible and he forms his view about $M_B + M_J$ on its basis. We know from X's follow-up response to Y's resistance move that the attention boost leads him to change his mind about Bette's attendance—his resulting view about $M_B + M_J$ must be compatible with $\llbracket \neg \text{Bette attends} \rrbracket$. But what exactly is X's view

³⁵While the refinement of X's attention state with M_J captures the minimal way in which his attention *must* change as a result of Y's resistance move, this doesn't necessarily characterize the full set of possibilities for how X's attention *can* change. The resistance might bring to mind additional subject matters, such as whether Joan will win an Oscar. But any additional attention-shift will be highly sensitive to fine-grained details of X's cognitive state, so we don't believe it is practical to model it here.

post-resistance? And how does it come about? Unfortunately, we don't have the space here to pursue a comprehensive theory of belief change in a subject-matter-sensitive setting, which can get very complicated very quickly. Our more limited aim in the next subsection is simply to spell out one approach to modeling the cognitive dynamics in (20) that isolates some of the core features of attentional updating in general.

5.3 Retrieving and Combining Evidence

To model the belief change in Feud and related cases, we need to work with some more cognitive structure. In this subsection, we develop a storage-retrieval mechanism that builds on the *evidence models* of van Benthem & Pacuit (2011) and van Benthem et al. (2014) but gives them a resolution-sensitive twist. Roughly, evidence logics aim at modeling how agents might integrate potentially contradictory bits of evidence to form beliefs. The resolution-sensitive version builds on this core idea naturally: agents have various pieces of evidence that may be visible or non-visible, and at any particular resolution they form their belief state by combining whatever the visible pieces of evidence are. 'Evidence' here is used in a slightly technical sense, and shouldn't be taken to presuppose anything about how the agent came across a piece of evidence; in fact, on van Benthem & Pacuit's (2011) account, evidence can be just about any proposition (as long as evidence sets meet certain constraints).

Going forward, we assume that a speaker's belief state is determined by a more finely-structured *evidential state*, which encodes the evidence that this speaker currently has at her disposal. While van Benthem & Pacuit model bits of evidence using propositions, we instead use subject matter-proposition pairs of the form $\langle M, P \rangle$ where P is about M (Yablo's 2014 "directed propositions", Hoek's 2019 "quiz-positions") to reflect how evidence is always evidence about a particular matter:

(50) **Evidential bases**

A speaker S 's *evidential basis* in c is a set of directed propositions $\mathcal{E}_{S_c} \subseteq \mathfrak{M} \times 2^{\mathcal{W}}$ such that for any $M \in \mathfrak{M}$ and $P \in 2^{\mathcal{W}}$,

- a. $\langle M, \emptyset \rangle \notin \mathcal{E}_{S_c}$
- b. If $\langle M, P \rangle \in \mathcal{E}_{S_c}$ then $\langle M, \mathcal{W} \rangle \in \mathcal{E}_{S_c}$
- c. $\langle \mathcal{W} \times \mathcal{W}, \mathcal{W} \rangle \in \mathcal{E}_{S_c}$

The first consistency condition ensures that individual pieces of evidence are never contradictory, though combinations of a speaker's evidence might still be inconsistent. The second condition ensures that if the speaker has any evidence at all about a subject matter M , she then has

the tautological evidence \mathcal{W} about this matter—in fact, this might be all the evidence she has about M . The third condition ensures that the speaker accepts \mathcal{W} as evidence about $\mathcal{W} \times \mathcal{W}$. As before, we do not impose any inter-matter constraints on evidence across subject matters because these aren't that important for present purposes.³⁶

Following van Benthem & Pacuit, we assume that a speaker's belief state is completely determined by her underlying evidence.³⁷ In our subject-matter-sensitive framework, this can be implemented as follows. First, define an *M-scenario* in \mathcal{E}_{S_c} to be the (nonempty) intersection of any consistent set of evidence about M in \mathcal{E}_{S_c} that cannot be extended with additional evidence about M in \mathcal{E}_{S_c} while maintaining consistency (cf. Horty's 2007a,b “proper scenarios”; see also Kratzer 1977, 2012 for a related proposal):

(51) ***M-scenarios***

An *M-scenario* based on \mathcal{E}_{S_c} is a set of worlds $\cap \mathcal{X} \subseteq \mathcal{W}$ where \mathcal{X} is a maximal consistent subset of $\{P : \langle M, P \rangle \in \mathcal{E}_{S_c}\}$.

Intuitively, an *M-scenario* is a consistent theory regarding M based on as much of S's evidence about M as possible. We can then define a speaker's belief state in terms of these *M-scenarios*, where S's view about a matter M is that one of the *M-scenarios* based on her evidence (if any) is actual:

$$(52) \quad \mathcal{B}_{S_c}(M) = \begin{cases} \cup \{\mathcal{X} : \mathcal{X} \text{ is an } M\text{-scenario based on } \mathcal{E}_{S_c}\} \\ \text{undefined, if there is no } P \text{ such that } \langle M, P \rangle \in \mathcal{E}_{S_c} \end{cases}$$

As a simple illustration of this, suppose that X has the following evidence at the beginning of Feud:

$$(53) \quad \mathcal{E}_{X_{c_0}} = \left\{ \begin{array}{l} \langle M_B, \llbracket \text{Bette attends} \rrbracket \rangle, \langle M_B, \mathcal{W} \rangle, \\ \langle M_J, \llbracket \text{Joan attends} \rrbracket \rangle, \langle M_J, \mathcal{W} \rangle, \\ \langle M_{\text{both}}, \llbracket \neg(\text{Bette attends} \wedge \text{Joan attends}) \rrbracket \rangle, \langle M_{\text{both}}, \mathcal{W} \rangle \end{array} \right\}$$

There are only three different *M-scenarios* in play: the M_B -scenario $\llbracket \text{Bette attends} \rrbracket$, the M_J -scenario $\llbracket \text{Joan attends} \rrbracket$, and the M_{both} -scenario

³⁶At a minimum it seems reasonable to require that evidential bases be closed under *parthood*, where $\langle M_1, P_1 \rangle$ is part of $\langle M_2, P_2 \rangle$ iff $P_2 \subseteq P_1$ and M_2 includes M_1 (Yablo 2014; “transparent entailment” in Hoek 2019). So, the constraint would be that if $\langle M_2, P_2 \rangle \in \mathcal{E}_{S_c}$ and $\langle M_1, P_1 \rangle$ is part of $\langle M_2, P_2 \rangle$, then $\langle M_1, P_1 \rangle \in \mathcal{E}_{S_c}$. Note that this would render the second condition in (50) redundant. It would also render the third condition redundant when \mathcal{E}_{S_c} is nonempty. Thanks to Sven Lauer for these observations.

³⁷van Benthem et al. (2014) also consider models in which an agent is assigned both a belief and an evidential state that are mutually constrained to ensure that the agent's beliefs are appropriately grounded on the evidence. While these models allow for greater flexibility, we define an agent's beliefs in terms of her evidence because this is simpler and doesn't affect the main points of our analysis.

$\llbracket \neg(\text{Bette attends} \wedge \text{Joan attends}) \rrbracket$. Applying (52) returns the views from §5.2. As before, we can define X’s current view in the discourse-initial context c_0 to be $\Delta_{X_{c_0}} = \mathcal{B}_{X_{c_0}}(M_B) = \llbracket \text{Bette attends} \rrbracket$.

At this point, it is helpful to combine a speaker’s evidential basis and attention state into a single mental representation, which we call a “cognitive state” (terminology adopted most directly from de Jager 2009, though with a different realization here):

(54) **Cognitive states**

S’s *cognitive state* \mathcal{C}_{S_c} in c is a tuple $\langle \mathcal{E}_{S_c}, \Pi_{S_c} \rangle$ consisting of her evidential basis coupled with her attention state. Let \mathfrak{C} be the set of cognitive states.

These structures serve as the inputs and outputs to our attentive update, which can alter both their attentional and evidential parameters.

We assume that the attentional update of a cognitive state \mathcal{C}_{S_c} with the subject matter M can be decomposed into two steps:

(55) **Attentional update**

$$\mathcal{C}_{S_c} \circ M = \mathcal{C}_{S_c} + \text{Refine}(M) + \text{Combine}$$

The first **Refine** step captures the immediate attentional effect of the update with M , which is to refine a speaker’s attention state with this subject matter. In our Lewisian granularity-based framework, refining amounts to summation:

(56) **Refinement**

$$\langle \mathcal{E}_{S_c}, \Pi_{S_c} \rangle + \text{Refine}(M) = \langle \mathcal{E}_{S_c}, \Pi_{S_c} + M \rangle$$

The second **Combine** operation implements the resulting change in the speaker’s evidential basis as stored information becomes visible at her updated attention state and is integrated together.³⁸

A speaker in the cognitive state $\langle \mathcal{E}_{S_c}, \Pi_{S_c} \rangle$ can access any proposition in \mathcal{E}_{S_c} directed at a coarsening of her attention state Π_{S_c} . That is, she can retrieve information in the following “visible kernel”:

(57) **Visible kernel of $\langle \mathcal{E}_{S_c}, \Pi_{S_c} \rangle$**

$$\{P : \langle M, P \rangle \in \mathcal{E}_{S_c} \text{ for some } M \text{ such that } \Pi_{S_c} \text{ includes } M\}$$

We further assume that a speaker puts as much of this accessible evidence together as possible and we model this by intersecting members of the visible kernel. Where

³⁸We assume that attending to a new matter always triggers a reevaluation of the evidence, but one might instead take **Combine** to be an optional component of an attentional update.

- (58) $\mathcal{E}_{\Pi_{S_c}}^*$ is the smallest set closed under nonempty intersections and containing the visible kernel of $\langle \mathcal{E}_{S_c}, \Pi_{S_c} \rangle$

we assume that the speaker S comes to accept each proposition in $\mathcal{E}_{\Pi_{S_c}}^*$ as evidence about Π_{S_c} while S's evidence directed at matters other than Π_{S_c} remains unchanged (cf. van Benthem & Pacuit's 2011 "evidence combination"):

- (59) **Evidence combination** (first pass)
 $\langle \mathcal{E}_{S_c}, \Pi_{S_c} \rangle + \text{Combine} =$
 $\langle \{ \langle \Pi_{S_c}, P \rangle : P \in \mathcal{E}_{\Pi_{S_c}}^* \} \cup \{ \langle M, P \rangle \in \mathcal{E}_{S_c} : M \neq \Pi_{S_c} \}, \Pi_{S_c} \rangle$

To be clear, in our attentive update \odot , this operation is applied to the intermediate state $\langle \mathcal{E}_{S_c}, \Pi_{S_c} + M \rangle$ obtained after refinement.

Putting all this to work in Feud, Y's resistance triggers the following transformation of X's cognitive state:

- (60) $\mathcal{C}_{X_{c_0}} \odot M_J = \langle \mathcal{E}_{X_{c_0}}, M_B \rangle + \text{Refine}(M_J) + \text{Combine}$

The $\text{Refine}(M_J)$ step shifts X's attention state to $M_B + M_J$ as desired. Because M_B , M_J , and M_{both} are all coarsenings of his updated attention state, X can access all his evidence in $\mathcal{E}_{X_{c_0}}$ and running Combine then adds the following directed propositions to this basis:

- (61) $\langle M_B + M_J, \llbracket \text{Bette attends} \wedge \text{Joan attends} \rrbracket \rangle,$
 $\langle M_B + M_J, \llbracket \text{Bette attends} \wedge \neg \text{Joan attends} \rrbracket \rangle,$
 $\langle M_B + M_J, \llbracket \neg \text{Bette attends} \wedge \text{Joan attends} \rrbracket \rangle,$
 $\langle M_B + M_J, \llbracket \text{Bette attends} \rrbracket \rangle, \langle M_B + M_J, \llbracket \text{Joan attends} \rrbracket \rangle,$
 $\langle M_B + M_J, \llbracket \neg(\text{Bette attends} \wedge \text{Joan attends}) \rrbracket \rangle, \langle M_B + M_J, \mathcal{W} \rangle$

These are the raw materials from which X's view about $M_B + M_J$ is formed. The $M_B + M_J$ -scenarios in the updated basis are $\llbracket \text{Bette attends} \wedge \text{Joan attends} \rrbracket$, $\llbracket \text{Bette attends} \wedge \neg \text{Joan attends} \rrbracket$, and $\llbracket \neg \text{Bette attends} \wedge \text{Joan attends} \rrbracket$. Taking their union, X's post-resistance view is $\llbracket \text{Bette attends} \rrbracket \cup \llbracket \text{Joan attends} \rrbracket$ (Fig 2), and so he concedes that Bette might not show up to the party.

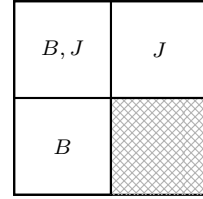


Fig 2. X's view about $M_B + M_J$ after Y's resistance move

Now, this account of attentional update is all we really need for our analysis of Feud—it provides a mechanism by which X's attention shift leads him to incorporate his latent evidence about Joan, including the main piece of evidence corresponding to the backstory of this example, namely, $\langle M_{\text{both}}, \llbracket \neg(\text{Bette attends} \wedge \text{Joan attends}) \rrbracket \rangle$. It is worth noting,

however, that complex as this account might already seem, it is still too simple in at least two respects.

The first respect is that we have been assuming that X regards his different bits of evidence to be of relatively equal strength. Things could have otherwise turned out quite differently. If X prioritized the directed proposition $\langle M_{both}, \llbracket \neg(\text{Bette attends} \wedge \text{Joan attends}) \rrbracket \rangle$ over the rest of his evidence, then his resulting view about $M_B + M_J$ would exclude the possibility that both Bette and Joan are coming to the party. In the alternative continuations of Feud presented in (17), we also saw that X could do something stronger than just conclude that his original claim was unwarranted—he can fully disagree with this claim. That is, he could back off to either the belief that Bette might not attend, as the above derivation gets us, or he could decide that he was wrong altogether and fully switch to believing that Bette will not attend. Intuitively, X’s evidential basis as we have described it above isn’t enough for this, because changing one’s mind requires discounting one piece of evidence entirely (the one that presumably led to the original claim in the first place). Nothing in the present set of assumptions will lead to a piece of evidence being fully defeated, and to handle this kind of reasoning we will need something more, namely, some kind of prioritization of a speaker’s evidence (cf. the explicit prioritization of *default rules* in Brewka 1994; Goldszmidt & Pearl 1996; Horty 2007a,b, 2012). We will not spell this out in detail here, as it would add yet another layer of technical complexity and the intuitive idea serves to make clear how at least toy examples might work.

The second respect in which our account in this paper is too simple is that the update \odot using **Combine** in (59) tells us only how attending to a new subject matter changes an agent’s evidence (and so his view) about the matters he is attending to after the update. So long as this is all one is interested in, one can stop here. However, when X attends to M_J , this can impact not only his view about $M_B + M_J$ but also his view about related subject matters. Suppose for instance that as a result of Y’s resistance, X comes to believe about $M_B + M_J$ that Joan will come to the party and keep Bette away (via evidence prioritization as sketched above). Presumably, X must come to believe about M_B that Bette isn’t coming. If X initially believed about the matter $M_B + M_M$ of who between Bette and Miriam Hopkins is coming that only Bette is, then he also comes to believe about this matter that neither Bette nor Miriam is coming. And so forth. A more comprehensive account of X’s cognitive change needs to tell us how the modification of his evidence about $M_B + M_J$ percolates through the rest of his evidential basis.

One option would be to have the **Combine** operation push an agent’s

newly integrated evidence about Π_{S_c} down to the smaller subject matters included in Π_{S_c} , forcing the agent to accept parts of his evidence about Π_{S_c} as evidence about these smaller subject matters (cf. the closure under parthood condition mentioned in note 36). Letting

$$(62) \quad P \searrow M = \{w : M w v \text{ for some } v \text{ s.t. } v \in P\}$$

the proposal is to replace (59) with this entry:

$$(63) \quad \mathbf{Evidence\ combination} \text{ (second pass)} \\ \langle \mathcal{E}_{S_c}, \Pi_{S_c} \rangle + \mathbf{Combine} = \\ \langle \{ \langle M, P \searrow M \rangle : P \in \mathcal{E}_{\Pi_{S_c}}^* \text{ and } M \text{ is included in } \Pi_{S_c} \} \cup \\ \{ \langle M, P \rangle \in \mathcal{E}_{S_c} : M \text{ isn't included in } \Pi_{S_c} \}, \Pi_{S_c} \rangle$$

Note that this new **Combine** operation coincides with the original entry for evidence about Π_{S_c} , as $P \searrow M = P$ when P is about M , and every subject matter is trivially included in itself. But, to its credit, the new **Combine** ensures that a speaker's evidence displays a nice coherence across the subject matters included in Π_{S_c} —for example, if we push X's evidence about $M_B + M_J$ down in (20), then he comes to accept $\llbracket \text{Bette attends} \rrbracket$, $\llbracket \neg \text{Bette attends} \rrbracket$ and \mathcal{W} as evidence about M_B and so has the view about this matter that Bette might not come. Nevertheless, because the new **Combine** doesn't affect evidence about subject matters that aren't included in Π_{S_c} , it can still sow inter-subject-matter discord. We must leave the development of an even more far-reaching attentional update for the future.

6 Full Analysis of Feud

Recall from §3 that an analysis of Feud takes the following form:

$$(64) \quad c_0 + \mathbf{Assert}_X(\text{Bette attends}) + \mathbf{Assert}_Y(\diamond \text{Joan attends}) \\ + \mathbf{Accept}_X + \mathbf{Retract}_X + \mathbf{Assert}_X(\diamond \neg \text{Bette attends}) \\ + \mathbf{Accept}_Y$$

However, a problem with the earlier F&B-style analysis was that we didn't yet have an account of epistemic modality on the table, nor did we have any representation of the speakers' attention states and X's attention-shift-induced belief change. With these missing pieces in place, we are now in a position to do better.

6.1 Discourse Contexts

We take the updates in (64) to operate on the following structures:

(65) **Discourse contexts**

A *discourse context* c is a tuple $\langle \mathcal{CS}_c, \mathcal{A}_c, \mathcal{Q}_c, \mathcal{C}_{X_c}, \mathcal{C}_{Y_c} \rangle$ consisting of a set of cognitive states $\mathcal{CS}_c \subseteq \mathfrak{C}$, a stack \mathcal{A}_c of dynamic update programs, a stack \mathcal{Q}_c of subject matters, and two cognitive states $\mathcal{C}_{X_c}, \mathcal{C}_{Y_c} \in \mathfrak{C}$, where $\mathcal{C}_{X_c} \in \mathcal{CS}_c$ and $\mathcal{C}_{Y_c} \in \mathcal{CS}_c$.

Going through this in reverse order, the first difference to note between the contexts in (65) and our earlier F&B-contexts from (26) is that we are now representing the private mental states of X and Y using cognitive states from (54) rather than Hintikka-style belief states. This will allow our discourse moves to interface with the formal epistemology from §5.

Moving on to the public conversational scoreboard, the next thing to note is that our contexts now encode both a short history of assertions awaiting confirmation or rejection and a history of questions that are under discussion (QUDs). While the *assertion stack* \mathcal{A}_c was previously populated with propositions, we now load it up with update programs from Veltman’s theory of epistemic modals in §4.1 (i.e., with functions from sets of worlds to sets of worlds). As for the *question stack* \mathcal{Q}_c , we take it to be populated with question meanings. The top element of this stack, $top(\mathcal{Q}_c)$, is the question under immediate discussion—the “current QUD”—and it is often part of a larger strategy of inquiry for addressing QUDs lower down in the stack (Roberts 2012). Because questions play only a bit role in this paper and we have already worked extensively with Lewisian subject matters, we take question meanings to be subject matters of this kind, as in the classic *partition semantics* of Groenendijk & Stokhof (1984), though see Hamblin (1973), Karttunen (1977), Krifka (2001), and Ciardelli et al. (2013) for influential alternative treatments.

The remaining component of a context is the set \mathcal{CS}_c of cognitive states, which we still refer to as the “context set”. This keeps track of *properties* of cognitive states that have acquired “common ground status” in the discourse—we might now say that a property of cognitive states is “common ground” in c iff every member of \mathcal{CS}_c instantiates it. The conditions $\mathcal{C}_{X_c} \in \mathcal{CS}_c$ and $\mathcal{C}_{Y_c} \in \mathcal{CS}_c$ ensure that a property with this public status is at least mutually shared by the mental states of X and Y, but we again want to remain neutral about what else is needed.

In the basic Stalnakerian theory in §2, we might also take the true members of the common ground in c to be not the propositions entailed by the context set cs_c but rather the doxastic properties of believing these contextually entailed propositions, which the speakers have successfully coordinated on. From this perspective, what we are doing with \mathcal{CS}_c can be regarded as a straightforward generalization of the Stalnakerian theory; we are just allowing a wider class of mental properties to count

as common ground. First, we now attribute this status to properties of an agent’s belief state that are not on the present framework reducible to belief in a proposition—like believing about M_J that Joan might be coming to the party. Second, it is not just properties of belief that can acquire common ground status but attentional properties as well.

In particular, we can now talk about speakers coordinating their attention with respect to a particular subject matter:

(66) **Subject matters under public attention**

X and Y are *publicly attending* to M in c iff the attentional parameter Π of each $\mathcal{C} \in \mathcal{CS}_c$ includes M . In this case, we say that M is a *subject matter under public attention*.³⁹

The concept of a subject matter under public attention—let us call this a “SUP” for short—must be distinguished from the more familiar concept of a QUD, which applies to those matters on the question stack \mathcal{Q}_c . On one hand, many QUDs will not be under public attention because speakers are not making all the relevant distinctions. Assume that the discourse-initial QUD in Feud is the matter M_{party} of who is coming to the party, which partitions \mathcal{W} into cells of worlds that agree on the guest list. Although X and Y are trying to collaboratively answer M_{party} , they aren’t publicly attending to this question, as X isn’t thinking about Joan. Should we at least insist that the current QUD include a subject matter that is also included in each attention state appearing in \mathcal{CS}_c ? Even this is debatable. For an extreme form of potential counterexample, Friedman (2013) argues that an agent can wonder about a question like (67) without having the conceptual resources to entertain any of its answers:

(67) What function do oxyphil cells play in the parathyroid gland?

In such cases of “complete conceptual ignorance”, speakers can arguably face QUDs that they cannot even partially attend to.

On the other hand, not all SUPs are under discussion and those that are not needn’t constrain the flow of future discourse in the manner characteristic of QUDs, which are typically taken to carry a discourse goal of answering them (or otherwise *dispelling* them (Isaacs & Rawlins 2008),

³⁹We can define other collective attention concepts by analogy with standard kinds of group knowledge; for instance:

(i) **Mutual attention**

X and Y are *mutually attending* to M in c iff both Π_{X_c} and Π_{Y_c} include M .

(ii) **Distributed attention**

X and Y are *distributively attending* to M in c iff $\Pi_{X_c} + \Pi_{Y_c}$ includes M .

for example by denying a presupposition or determining that they are practically unanswerable). A good place to look for examples of such *mere* SUPs is exchanges involving *embedded questions*, such as those appearing in knowledge-wh reports (Karttunen 1977; Groenendijk & Stokhof 1984; Heim 1994) and unconditionals (Rawlins 2008a,b, 2013b; Ciardelli 2016):

(68) The doctors know whether it’s a boy or girl, but I want it to be a surprise.

(69) A: Have you picked a name yet?

B: Whether it’s a boy or girl, I’m naming it ‘Lauri’.

Presumably, both (68) and (69) elevate the matter of whether it’s a boy or girl to the level of a SUP. However, this subject matter needn’t be under discussion before or after the utterance of these sentences. In fact, the speaker needn’t even be wondering about the gender of her child, so our notion of public attention must also be distinguished from the related notion of *public wonderment* in Ciardelli & Roelofsen (2015).

6.2 Conversation Moves

We are finally ready for Feud. The analysis begins in a context where the context set is \mathfrak{C} (the default setting), the assertion stack is empty, the question stack contains only the question M_{party} of who is coming to the Oscars party, and X’s discourse-initial cognitive state $\mathcal{C}_{X_{c_0}}$ has the properties mentioned in §5.2 (Y’s mental state is not as important):

$$(70) \quad c_0 = \langle \mathfrak{C}, \langle \rangle, \langle M_{party} \rangle, \mathcal{C}_{X_{c_0}}, \mathcal{C}_{Y_{c_0}} \rangle$$

To move the discourse forward, the first thing we need is an assertive update. This time around, an assertion using φ does three things: (i) it adds the program $[\varphi]$ to the assertion stack, (ii) it attentively updates the hearer’s cognitive state with the subject matter associated with φ , and (iii) it thins the context set by removing any of its members whose attentional component does not include this associated matter. Though we do not explicitly model it here, a polar questioning update with φ ? would also have the attentional effects (ii) and (iii) but instead push new material onto the question stack \mathcal{Q}_c (and it would have different felicity conditions; see Isaacs & Rawlins 2008; Rawlins 2010; Bledin & Rawlins 2019 for examples of questioning updates minus the attention).

What is the “matter associated with φ ”? For any atomic sentence $\alpha \in At_{\mathcal{L}}$, the natural choice is

$$(71) \quad M_{\alpha} wv \text{ iff } (w \in \mathcal{V}(\alpha) \text{ iff } v \in \mathcal{V}(\alpha)).$$

Keeping things simple, we then take the matter M_φ associated with φ to be the sum of all the subject matters determined by the atomic sentences occurring in φ .⁴⁰ Where $At(\varphi)$ is this set of atomic sentences, we have

$$(72) \quad M_\varphi = \sum_{\alpha \in At(\varphi)} M_\alpha.$$

For example, $M_{A \wedge \neg(B \wedge C)} = M_A + M_B + M_C$.⁴¹ We can now define our assertive update as follows:

(73) **Assertive update**

$$c + \text{Assert}_X(\varphi) = \langle \{ \langle \mathcal{E}, \Pi \rangle \in \mathcal{CS}_c : \Pi \text{ includes } M_\varphi \}, \\ \text{push}([\varphi], \mathcal{A}_c), \mathcal{Q}_c, \mathcal{C}_{X_c}, \mathcal{C}_{Y_c} \otimes M_\varphi \rangle$$

Felicity condition: appropriate in c only if

$$\Pi_{X_c} \text{ includes } M_\varphi \text{ and } \Delta_{X_c} \models \varphi. \quad (\text{speaker sincerity})$$

The Searlean sincerity condition now requires X to actively believe that φ , in the sense that X is attending to its associated subject matter M_φ and his current view about this matter supports φ . Presumably, the assertion must also be relevant to the current QUD, $top(\mathcal{Q}_c)$, but we do not formalize this additional licensing requirement because this is a non-trivial task that would take us away from more pressing matters.⁴²

When X asserts that Bette is coming to the party, this shifts the initial context c_0 to

$$(74) \quad c_1 = c_0 + \text{Assert}_X(\text{Bette attends}) = \\ \langle \{ \langle \mathcal{E}, \Pi \rangle \in \mathfrak{C} : \Pi \text{ includes } M_B \}, \\ \langle [\text{Bette attends}] \rangle, \langle M_{\text{party}} \rangle, \mathcal{C}_{X_{c_0}}, \mathcal{C}_{Y_{c_0}} \otimes M_B \rangle$$

The program `[Bette attends]` is added to the assertion stack, encoding X's proposal to coordinate on his view that Bette is coming. Furthermore, the matter M_B of whether Bette is coming becomes a SUP and Y's cognitive state might change as a result. Note that the felicity condition for $\text{Assert}_X(\text{Bette attends})$ is satisfied because we are assuming that $\Pi_{X_{c_0}} = M_B$ and $\Delta_{X_{c_0}} = \llbracket \text{Bette attends} \rrbracket$.

⁴⁰We adopt this idea from Franke & de Jager (2010). However, see Crone (2017) section 2.3.3 for arguments that there must be a non-semantic contextual component to the calculation of M_φ in the most general case. Following Crone, this semantic version of M_φ is really the *minimal* matter associated with any φ .

⁴¹Compare Fagin & Halpern (1988), who suggest that a typical restriction on their syntactic awareness function is that it be closed under subformulae.

⁴²While there is plenty of work on *relevance* in the linguistics literature (see Roberts 1996, 2012; Groenendijk 1999; van Rooij 2003 for some influential accounts), little of it is geared at assertions like Y's epistemic modal claim in Feud that serve only to bring alternatives in $top(\mathcal{Q}_c)$ to a speaker's attention without ruling anything out. A notable exception is Franke & de Jager (2010), who analyze the relevance of awareness-raising discourse in a decision-theoretic framework.

Next comes the resistance step. Instead of accepting X’s proposal to run the program [Bette attends] on her view, Y pushes [◊Joan attends] onto the assertion stack above it, temporarily deferring acceptance or rejection of X’s claim while the context reaches an equilibrium with respect to attention states:

$$(75) \quad c_2 = c_1 + \text{Assert}_Y(\diamond\text{Joan attends}) = \\ \langle \{ \langle \mathcal{E}, \Pi \rangle \in \mathcal{CS}_{c_1} : \Pi \text{ includes } M_{\diamond J} \}, \\ \langle [\diamond\text{Joan attends}], [\text{Bette attends}], \langle M_{\text{party}} \rangle, \mathcal{C}_{X_{c_1}} \circ M_{\diamond J}, \mathcal{C}_{Y_{c_1}} \rangle \rangle$$

At this point, [Bette attends] is still on the table and so under discussion, but this program is no longer at the top of the assertion stack—Y has deferred its consideration until [◊Joan attends] is dealt with. X will draw the inference that this new element on the stack is relevant to the discourse goal associated with the lower stack element, and a primary explanation of its relevance is that the explicit shift in SUPs bears on the program lower on the stack. In particular, Y’s resistance move draws X’s attention to the matter $M_{\diamond J}$ ($=M_J$), so the speakers’ attention is now tightly coordinated on $M_B + M_J$. Furthermore, in his updated attention state, X changes his mind about Bette’s attendance—as discussed in §5.3, he comes to believe $\llbracket \text{Bette attends} \rrbracket \cup \llbracket \text{Joan attends} \rrbracket$ about the more fine-grained SUP.

What happens when X tacitly accepts Y’s claim? Before redefining acceptance, we need to introduce a new informative update on cognitive states to work alongside our attentive update \circ from above. This new update is straightforward—when a speaker S in context c updates with $[\varphi]$, we take it that she just runs this program on her current view Δ_{S_c} and intersectively updates each piece of evidence she has about Π_{S_c} with the result $\Delta_{S_c}[\varphi]$ when consistently possible (cf. van Benthem & Pacuit’s 2011 version of “public announcement”):

$$(76) \quad \mathcal{E}_{\Pi_{S_c}}^{**} = \{P : P = P' \cap \Delta_{S_c}[\varphi] \text{ for some } P' \text{ s.t. } \langle \Pi_{S_c}, P' \rangle \in \mathcal{E}_{S_c}\}$$

(77) **Informative update**

$$\langle \mathcal{E}_{S_c}, \Pi_{S_c} \rangle \oplus [\varphi] = \\ \langle \{ \langle \Pi_{S_c}, P \rangle : P \in \mathcal{E}_{\Pi_{S_c}}^{**} \setminus \{\emptyset\} \} \cup \{ \langle M, P \rangle \in \mathcal{E}_{S_c} : M \neq \Pi_{S_c} \}, \Pi_{S_c} \rangle$$

Defined only if $\Delta_{S_c}[\varphi] \neq \emptyset$.⁴³

With \oplus in hand, we can now define our new acceptance move, which pops the assertion stack, informationally updates the acceptor’s mental state with the popped program, and retains only those states in the context

⁴³As with the **Combine** operation (59), the informative update \oplus affects only a speaker S’s evidence about Π_{S_c} , but a more comprehensive update should allow these changes to percolate through S’s evidential basis (as discussed at the end of §5.3).

set whose current views are fixed points under this program (i.e., that incorporate its effect):

(78) **Acceptance**

$$c + \text{Accept}_X = \langle \{ \langle \mathcal{E}, \Pi \rangle \in \mathcal{CS}_c : \mathcal{B}(\Pi) \text{top}(\mathcal{A}_c) = \mathcal{B}(\Pi) \}, \\ \text{pop}(\mathcal{A}_c), \mathcal{Q}_c, \mathcal{C}_{X_c} \oplus \text{top}(\mathcal{A}_c), \mathcal{C}_{Y_c} \rangle$$

Felicity condition: appropriate in c only if

$$\mathcal{C}_{X_c} \oplus \text{top}(\mathcal{A}_c) \text{ is defined.} \quad (\text{hearer consistency})$$

Applying (78) in Feud, X's acceptance of Y's epistemic modal claim removes $[\diamond \text{Joan attends}]$ from the stack and restricts the context set to cognitive states whose current views support $\diamond \text{Joan attends}$ (note that the update of X's mental state with $\oplus[\diamond \text{Joan attends}]$ is inert because his view $[[\text{Bette attends}]] \cup [[\text{Joan attends}]]$ already supports $\diamond \text{Joan attends}$):

$$(79) \quad c_3 = c_2 + \text{Accept}_X = \\ \langle \{ \langle \mathcal{E}, \Pi \rangle \in \mathcal{CS}_{c_2} : \mathcal{B}(\Pi) \models \diamond \text{Joan attends} \}, \\ [[\text{Bette attends}]], \langle M_{\text{party}} \rangle, \mathcal{C}_{X_{c_2}} \oplus [\diamond \text{Joan attends}], \mathcal{C}_{Y_{c_2}} \rangle$$

It is now common ground among X and Y that Joan might be coming to the party.

As discussed in §3, X then retracts his initial assertion. This is accomplished via the following update, which pops the assertion stack while leaving everything else unchanged:

(80) **Retraction**

$$c + \text{Retract}_X = \langle \mathcal{CS}_c, \text{pop}(\mathcal{A}_c), \mathcal{Q}_c, \mathcal{C}_{X_c}, \mathcal{C}_{Y_c} \rangle$$

Felicity condition: appropriate in c only if $\Delta_{X_c} \text{top}(\mathcal{A}_c) \neq \Delta_{X_c}$.

After applying Retract_X to c_3 , the assertion stack is empty:

$$(81) \quad c_4 = c_3 + \text{Retract}_X = \langle \mathcal{CS}_{c_3}, \langle \rangle, \langle M_{\text{party}} \rangle, \mathcal{C}_{X_{c_3}}, \mathcal{C}_{Y_{c_3}} \rangle$$

Note that the felicity condition for this retraction step requires that X's current view no longer supports **Bette attends**: $\Delta_{X_{c_3}} \not\models \text{Bette attends}$. One of the main shortcomings of the earlier F&B-style analysis in §3 was that we did not have an account of how Y's resistance leads X to change his mind about Bette, and so we could not make sense of Feud as a rational discourse. The update $\odot M_{\diamond J}$ in (75) provides this missing piece of the puzzle.

The rest of the analysis is less exciting, and here we can sprint to the finish. X's later assertion is modeled as follows:

$$(82) \quad c_5 = c_4 + \text{Assert}_X(\diamond \neg \text{Bette attends}) = \\ \langle \mathcal{CS}_{c_4}, \langle [\diamond \neg \text{Bette attends}] \rangle, \langle M_{\text{party}} \rangle, \mathcal{C}_{X_{c_4}}, \mathcal{C}_{Y_{c_4}} \odot M_B \rangle$$

This proposal is silently accepted by Y:

$$(83) \quad c_6 = c_5 + \text{Accept}_Y = \\ \langle \{ \langle \mathcal{E}, \Pi \rangle \in \mathcal{CS}_{c_5} : \mathcal{B}(\Pi) \models \diamond \neg \text{Bette attends} \}, \\ \langle \rangle, \langle M_{\text{party}} \rangle, \mathcal{C}_{X_{c_5}}, \mathcal{C}_{Y_{c_5}} \oplus [\diamond \neg \text{Bette attends}] \rangle$$

In the end, the assertion stack is empty, the QUD ‘Who is coming to the party?’ is at least partially answered, and the mental states of X and Y are coordinated in both an epistemic and attentional sense. Because each member of \mathcal{CS}_{c_6} has an attention state that includes the matter $M_B + M_J$ of who between Bette and Joan is coming, this is a SUP. Because each cognitive state in \mathcal{CS}_{c_6} also has a current view supporting $\diamond \neg \text{Bette attends}$, it is now public belief among X and Y that Bette might not come to the party.

7 Conclusion

While our immediate goal has been to account for the attentional and informational flow in our main example (20), we have also introduced some of the formal machinery required for a more comprehensive theory of attention-directed resistance in general. As it stands, the discourse theory developed in this paper can handle both epistemic modalized resistance moves and resistance moves using non-modal declaratives (as in the simpler party variant (8)). More generally, we see our integration of a Farkas & Bruce-style discourse structure with a resolution-based attentional-epistemic theory as providing a foundation for investigating other forms of attention-targeted resistance moves and other kinds of attentional dynamics in discourse. This is not merely of theoretical interest—as demand for human-computer interaction increases, formal models of discourse with attention are expected to play an important role in developing platforms for efficient communication with artificial agents (see for instance Pustejovsky et al. *ms.*, where human users and avatars create shared epistemic models with “co-attention” to facilitate multimodal communication).

There’s still plenty of work to do. On the formal epistemology front, one of the more pressing orders of business is to extend our **Combine** operation (59) to handle more complex epistemic situations involving defeat. Epistemologically-minded logicians might also want to develop logics of subject-matter-sensitive attention and belief along the lines of the *awareness logics* originating in Fagin & Halpern (1988) (see also van Benthem & Velázquez-Quesada 2010 for a dynamic account in this vein) and the various modal logics in the growing field of *dynamic epistemic logic* (Plaza 1989; Gerbrandy & Groeneveld 1997; van Benthem 2007, 2011; Baltag & Smets 2008; and of course van Benthem & Pacuit 2011;

van Benthem, Fernández-Duque & Pacuit 2014).

On the linguistics front, there is room to extend the scope of our formal model in a number of different directions. As discussed in the introduction, speakers commonly resist using a variety of conditional-ish questions:

- (84) X: Bette is coming to the party.
 Y: If Joan shows up, will Bette still come?
 Y': {What/Even} if Joan comes?

To model such responses, questions must play a more prominent role, and extra discourse structure is needed to handle conditional/suppositional phenomena (see Isaacs & Rawlins 2008; Rawlins 2010 for some options). We also mentioned in the introduction how speakers can resist speech acts other than assertions, for instance

- (85) X: Open the window.
 Y: What if it's still raining outside?

It will be interesting to explore how the kind of structure needed to model imperatives—be it “To Do Lists” (Portner 2004, 2007, cf. Roberts 2004, 2015, 2018), a modal semantics (Kaufmann 2012), “effective preferences” (Condoravdi & Lauer 2012), intentions/plans (Charlow 2014a,b), or something else—interacts with the attentional structure developed in this paper.

More generally, one main consequence of our proposal is that we must expand the typology of non-acceptance moves, and we suspect that resistance moves (together with clarification requests; Ginzburg 1998) are just the tip of the iceberg. Our analysis distinguishes the ‘true’ rejection of a proposal, which leaves the discourse in a state that cannot be resolved by acceptance, and mere non-acceptance, where a speaker chooses at least temporarily not to accept something but doesn’t rule out this option going forward. Specifically, the kind of resistance we have been investigating is used to indicate that a speaker isn’t willing to accept some move before ensuring that a certain subject matter (indicated by the resistance move) is under public attention. We don’t regard this as a rejection move because the resister doesn’t rule out the possibility of accepting the resisted move at a later point—though if the resister later accepts this move, it will be under a new SUP. So, in a certain sense, resistance *is* rejection-like: one might construe attention-targeted resistance as the rejection of a proposal to update against an older set of SUPs. We leave for the future a more in-depth exploration of how the incorporation of *aboutness* into discourse contexts changes the landscape of non-acceptance (and acceptance) moves.

It also remains to be seen how our subject-matter-based account of attention in this paper can be integrated with other attention-based approaches in linguistics, and other applications of subject matters in linguistics and philosophy (not to mention a vast psychology literature that is mainly non-linguistic, where attention is oriented towards objects or events in the world, or components of sensory input in general; see for example Driver 2001).⁴⁴ For the most part, linguists have worked with notions of attention directed at things other than subject matters. Close to home, Ciardelli, Groenendijk & Roelofsen (2011, 2014) and Roelofsen (2011, 2013) present an attentive semantics for epistemic *might* where sentences like (86) draw attention to the *possibilities* (sets of possible worlds) determined by their prejacent (see also Brumwell 2009):

(86) Joan might be coming to the party.

Though we haven't explicitly modeled this, we agree that Y's resistance in Feud draws X's attention not only to the subject matter M_J but also to the proposition $\llbracket \text{Joan attends} \rrbracket$, as Y is challenging the exhaustivity of X's assertion in circumstances where Joan is coming.

Roelofsen & van Gool (2010), Starr (2014), and Roelofsen & Farkas (2015) also argue that questions can “highlight” or suggest some of their propositional answers. For example, asking the polar interrogative (87) can draw attention to the proposition $\llbracket \text{window open} \rrbracket$ while asking (88) can draw attention to $\llbracket \text{window closed} \rrbracket$ (see also Caponigro & Sprouse 2007 on rhetorical questions):⁴⁵

(87) Is the window open?

(88) Is the window closed?

Again, we think there is both attention to subject matters and attention to propositions going on in (87) and (88). Both varieties of attention are important and should be included in a more comprehensive account, though—as emphasized in §5—there is a sense in which attention to subject matters is more fundamental because agents can attend only to propositions that are visible at the modal resolutions determined by their attention states.

In the nominal realm, there are also theories of pronouns on which they resolve to prominent individuals to which the discourse participants

⁴⁴For some other applications of Lewisian subject matters, see Cariani (2013) on deontic modals, van Rooij (2014) on knowledge attributions, Carballo (2016) on mathematical thought, and Rawlins (2013b) on (un)conditionals.

⁴⁵Among other things, this highlighting is used to account for the licensing and interpretation of yes/no answers. But see Biezma & Rawlins (2012, 2017) for a different take on “highlighting” in polar interrogatives.

are attending. For example, in the “Attention-Coherence Approach” of Stojnić, Stone & Lepore (2017) (which builds on the earlier “Centering” theories of Grosz, Joshi & Weinstein 1983, 1995; Dekker 1994; Bittner 2014), the semantic value of a pronoun like *she* in (89) is, roughly, a woman lying at the “center of attention” in the context:

(89) She came through the window at nightfall.

The bulk of the theory is then concerned with how quantifiers, pointing and other demonstrative gestures, discourse coherence relations, and so on, manipulate the stack of candidate pronoun resolutions. It’s less clear to us how exactly this kind of nominal attention relates to our own subject-matter-based notion, but we see no reason to think that they cannot co-exist harmoniously. The picture that emerges, then, is one where a variety of different kinds of attention—to subject matters, propositions, individuals—can all play important roles in the explanation of linguistic phenomena.

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