

***By now*: Change of State, Epistemic Modality and Evidential Inference**

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Abstract

We examine the constellation of factors—lexical, aspectual, temporal and conversational—that give rise to evidential implications from assertions. We target intensional and inferential meanings associated with a certain class of present-tense state sentences: those containing a temporal adverb headed by *by*, e.g., *The American traveling public is pretty mature by now*. We ask why sentences containing *by* temporal adverbs (BTAs) are improved by and sometimes appear to require an epistemic modal, e.g., *They ??(must) live in a mansion by now*. Key to our analysis is the idea that BTA sentences require the onset of a resultant state to overlap a time that precedes the time described by the adverb. Our proposed analysis allows us to identify the pragmatic factors that lead interpreters to construe present-tense BTA reports as conjectures, guesses or suppositions. Moreover, we build on an analysis of epistemic modals by von Stechow & Gillies (2010) and Mandelkern (2016) to hypothesize the manner in which the BTA change schema is instantiated in intensional contexts and discuss the relationship between intensional and evidential contexts. We see the merging of aspectual and epistemic features in BTA sentences, and in particular present-tense sentences, as the result of a semantic reconciliation procedure: the use of an epistemic modal in a BTA predication evokes an observation or act of reasoning, prior to speech time, that permits the speaker to make her assertion, and this inference trigger is identified with the ‘onset event’ in the BTA schema.

1 Introduction

In asserting ϕ , a speaker may reveal how she came to know ϕ . This observation is no more than a truism for typologists: there are languages and language families with grammatical markers that express the evidentiary basis on which the speaker is asserting ϕ (Chafe & Nichols 1986, Aikhenvald 2004, Boye 2012, Matthewson & Glougie 2018). But if construed as a statement about evidential implicatures attached to exponents of temporal expressions (e.g. tense, aspect, adverbs) on particular occasions of use, the observation raises new questions: how do these implicatures arise, and are they calculable based on conversational reasoning? Studies of evidential implications range from those that examine the use of perfect forms to report situations known of through abductive reasoning and hearsay (Slobin & Aksu 1982, Lau & Rooryck 2017) to those that relate the use of future tense in inferential and mirative utterances to canonical functions of future tenses, as in conjectures (Escandell-Vidal 2014). These treatments view evidential inferences as being ‘strengthened’ (in the sense of Traugott 1988, Brinton 1996); they are present where original temporal significations are absent, as when the Turkish past-tense morpheme *-miş* is used in present-tense mirative utterances, or the Spanish inflected future is used to express suppositions about current situations.¹ In this paper, we instead examine evidential

¹ Dahl (1985: 11) describes conventionalized pragmatic inference in the following way: “if some condition happens to be fulfilled frequently when a certain [grammatical] category is used, a stronger association may

inference on the fly, formed from a ‘perfect storm’ of interpretive constraints (lexical, aspectual, temporal and conversational).

We base our study on an English temporal adjunct used in predications that describe resultant states: the *by*-temporal adjunct (BTA), whose combinatoric potential—so far as tense and illocutionary force are concerned—is no different from that of temporal adverbials like *on Friday*. The BTA is a prepositional phrase (PP) headed by *by*, whose complement is a nominal that describes a time *t*; the resulting combination means ‘no later than *t*’ (Thomas & Michaelis 2009). Examples are given in (1)-(5):²

- (1) G.M. Says Its Driverless Car Could Be in Fleets **by Next Year**.
- (2) If he left the box here, **by tomorrow** it would be looted.
- (3) She recalled some mention of a romance being sealed on this porch...and this was enough, in her present mood, to get her fastened in a light pique dress and linen jacket, her valise packed and bulging, in record time. They left **by late morning**.
- (4) The doctor told me we can’t continue to give you the steroid and cortisone shots because you’ll be dead **by the time you’re 40**.
- (5) Thanks, honey. You’re the best. Be home **by five** so you have time to get ready.

In line with Thomas & Michaelis (2009), we see the time described by the BTA complement as a time at which a particular state holds, i.e. is in force (Copley 2018): the state that is described by the verb and its arguments. We hypothesize that the state is necessarily a resultant state of some event that has culminated: the BTA describes a time that follows the state’s time of inception. Thus, for example, (1) describes a possible state (use of G.M. driverless cars by ride-hailing services) with an onset prior to the end of next year. This state is understood to result from some event (or a series of events) that can be easily accommodated given our world knowledge, e.g. satisfactory testing of driverless cars. Similarly, (2) describes a possible state (a rifled box) that results from an event (the leaving of the box in a salient location).

Example (3), however, seems to pose a challenge for our hypothesis: the BTA *by late morning* is paired with a patently perfective predicate (*leave*), thereby suggesting that the BTA is not aspectually restricted in the way proposed. In line with Thomas & Michaelis (ibid), we view such combinations as exemplifying pragmatic resolution. In particular, we assume that a preterit predication in (3) expresses a state (of their absence from the house) that began just after the culmination of the event (of departure) described by the verb (Michaelis 2011). This interpretation is comparable to the ‘covert past-perfect’ reading that attaches to *when*-clauses in contexts like (6):

- (6) When the troops **left**, people in the neighborhood learned that four young men were dead. (sc. ‘when the troops **had** left...)

develop between the condition and the category in such a way that the condition comes to be understood as an integral part of the meaning of the category”.

² Except as otherwise noted, all numbered examples that are neither cited from another work nor used to illustrate ungrammaticality were retrieved from the Corpus of Contemporary American English (Davies 2008-) or from Google searches conducted at the time of drafting.

If the BTA expresses a (potential or actual) time of verification of a state *qua* resultant state, then the semantic representation of the BTA obligatorily includes a change component, as reflected in the pattern of variation observed in the constructed examples (7)-(10):

- (7) They (had) arrived by Friday. (achievement)
- (8) She (had) cleaned out her locker by Monday. (accomplishment)
- (9) She (had) walked around at/?by noon. (activity)
- (10) She loved hot toddies in/?by November. (state)

The contrasts in (7)-(10) suggest that Aktionsart is relevant to BTA use conditions: a BTA sentence felicitous only when a transition prior to reference time can be inferred. In this respect, BTAs contrast with most (though not all³) temporal adverbials. An activity predicate like *walk around*, as in (9), is BTA-incompatible because it has no entailed resultant state. On the other hand, (10) suggests that state descriptions that are not readily construed as consequences, intended or unintended, of prior events are also incompatible with BTAs.⁴ Recall that (1), which also contains a state description, is BTA-compatible because one can easily accommodate an event (or a series of events) that result in the use of G.M. driverless cars. Such cannot be said for the state of loving hot toddies; there is no obvious candidate event that would result in such a state.⁵

There is another important respect in which BTAs differ from many temporal adverbials: BTAs are downward compatible with respect to the evoked time scale, while temporal adverbials are not. Thus (11) below is contradictory, but (12) is not:⁶

- (11) #I arrived home at midnight; in fact, I arrived home at 10pm.
- (12) I arrived home by midnight; in fact, I arrived home at 10pm. (constructed⁷)

³ See Altshuler 2014 for a discussion of *currently*, which is aspectually restricted, combining only with stative predicates. See also Carter & Altshuler 2017 for a discussion of subordinate uses of *now* (“Now that I’m in Northampton, I can see Mt. Tom.”), which they claim are aspectually restricted as well.

⁴ Further evidence that Aktionsart is relevant to BTA use conditions comes from the data below, from Sam Carter (p.c.), which shows that BTAs are incompatible with *still*. This is expected, since *still*, as a marker of temporal persistence, prohibits a transition between presupposed and asserted state phases.

- (i) He was (??still) proclaiming his innocence by Friday.
- (ii) Those sandals are (??still) on sale by now.

⁵ As observed by an anonymous reviewer, “it is always possible to ‘coerce’ meaning in such a way that a transition can be inferred regardless of verb class”. We will reflect on this observation in subsequent sections.

⁶ In this way, BTAs are analogous to *before* and *after* clauses (e.g., *I arrived before/after midnight; in fact, I arrived home at 10pm/2am*).

⁷ Here is a naturally occurring example:

- (iii) One of the rules at Red Rocks is that all shows have to be finished by midnight. In fact, most shows are finished around 11-11:30 PM so there is plenty of time for everyone to exit the venue. (Retrieved on March 13, 2018 at: <https://edmmaniac.com/global-dance-festival-announces-2017-lineup>).

Key to the analysis that we propose in this paper is the observation that BTA time reference is *indefinite*. For example, the BTA predication *I arrived home by midnight* effectively means ‘I arrived home *at some point* prior to midnight’. Clearly, a speaker may choose non-specific time reference over specific time reference when the exact time of a state’s inception is irrelevant, so long as it falls within a certain range of times. What is of particular interest to us is the manner in which non-specificity contributes to a particular evidential reading of present-tense reports. One of our major aims in this paper is to describe the constellation of factors that give rise to this reading, illustrated in (14):

- (13) Shira is home now. (constructed)
- (14) Shira is home by now. (constructed)
- (15) Shira was home by now.⁸ (constructed)

While (13) could be spoken by someone at home, who thereby has firsthand knowledge of Shira’s presence at home, (14) could not. The report in (14) is naturally seen as the product of an inference: the speaker is not at home and is merely offering a conjecture about Shira’s whereabouts.⁹ Contrasting (14) with (15), a past-tense report, shows that this inferential reading depends on present-time reference. Sentence (15) conveys nothing about whether or not the speaker directly witnessed Shira’s arrival.¹⁰

Interestingly, some present-tense BTA tokens are redeemed only by the presence of an epistemic-stance indicator, e.g., a modal such as *must* or *probably*:¹¹

- (16) They ??(must) prefer white wine by now.
- (17) They ??(probably) live in Mountain View by now.

Moreover, the infelicitous example noted in (10), repeated below, improves when we add an epistemic-stance indicator, e.g., *will*, as in (18):

- (10) ?She loved hot toddies by November.

⁸ While it is well known that *now* can be used with the past tense (Dry 1979), such a usage is typically embedded within a past narrative. This is how we conceive (15). Below is a naturally occurring example.

That night in Kev’s apartment, we cleared away the coffee table and kicked the empty cans to the side. Toolie was home by now, sitting on the couch, his knees splayed and a roach in his hand.

(<https://erinflanagan.net/its-not-going-to-kill-you/excerpt>)

⁹ An anonymous reviewer argues that (14) does not count as a supposition or conjecture, because while (i) seems fine, (ii) does not:

- (i) I suppose/conjecture that Shira is home, but I don’t know for sure
- (ii) ??Shira is home by now, but I don’t know for sure.

We assume that there is a difference between a conjecture, as in the first clause of (ii), and a statement about one’s conjectures, as in the first clause of (i). A statement about what one supposes can always be used to convey uncertainty, but one can be certain about what one conjectures. In other words, a conjecture is necessarily a conclusion based on inference, but not necessarily a tentative one.

¹⁰ If we assume that the narrative in (iv), footnote 8, is told by a third-person omniscient narrator, then this narrator would (by definition) have knowledge of Toolie’s whereabouts (even if she doesn’t directly witness the event, since omniscient narrators are not characters in the story world).

¹¹ To fully appreciate the contrast, (16) and, to a lesser extent, (17), may require additional context. We come back to this point in section 3.

(18) She will love hot toddies by November. (constructed)

What is the nature of the relationship, if any, between the indirect-evidence implication of present-tense BTA sentences like (14) and the implied epistemic stance of uncertainty or supposition? And why do BTA sentences like (16-17) and (18) appear to require overt indication of epistemic stance when others apparently do not?

In addressing these questions, we illustrate the close relationship between evidentiality, understood as the indication of evidentiary source, or *epistemic justification* (Boye 2012), to epistemic modality, understood as the indication of degree of certainty or commitment (referred to by Boye 2012 as *epistemic support*). A BTA predication contrasts two phases: that in which the expressed state holds and that in which it does not. The only certitude in a BTA sentence is that there was a period in which the state at issue did not or will not hold. Since a BTA sentence does not tell us exactly when that period ended or will end, the denoted state may exist only as a supposition or inference about the evoked reference time. For example, a language user who directs another to *be home by 5*, as in (5), anticipates a period of indeterminate length in which the addressee is absent. Because BTA sentences describe states that come to exist only at the outer margins of the intervals they delimit, they are natural vehicles for the introduction of content for which there is only indirect evidence.

The remainder of this paper is structured as follows. In Section 2, we describe the BTA change schema by appealing to a theory of contextual operators, which we make more precise using a Neo-Davidsonian event semantics. After doing so, we offer a pragmatic account of how the inferential construal of present-tense BTA reports arises. Subsequently, in Section 3, we hypothesize the manner in which the BTA change schema is instantiated with epistemic modals and discuss the relationship between intensional and evidential contexts. Finally, in Section 4, we offer concluding remarks about the interplay of tense, aspect, evidentiality and modality that we observe here.

2 Semantics of BTAs

2.1 Contextual operators and the transition component

Following Thomas & Michaelis (2009), we identify BTAs with the class of contextual operators, described by Kay (1990, 1997) as “lexical items and grammatical constructions whose semantic value consists, at least in part, of instructions to find in the context a certain kind of information structure and place the information presented by the sentence within that information structure” (Kay 1997:159). Other examples of contextual operators are: (i) *even*, which suggests that the asserted proposition is to be construed as an extreme case along a scale of eventualities (Kay 1990)¹², (ii) *already*, which instructs the hearer to interpret the denoted state as one that holds prior to the inception of a process or procedure that typically effects that state (Michaelis 1996)¹³ and (iii) *let alone*, which conjoins a contextually given proposition, e.g., *They were never convicted*, to one judged to be more

¹² See also Greenberg 2017 and references therein.

¹³ See also Krifka 2000 and references therein.

informative, as in, e.g., *They were never charged, let alone convicted* (Fillmore, Kay & O'Connor 1988).

Along these same lines, Thomas & Michaelis postulate that “BTA-bearing predications require interpreters to retrieve or construct frames containing time series” (p. 140), and that such time series may be understood either as schedules or developmental sequences (p. 133). This analysis seems intuitively valid. For example, BTA sentences commonly express deadlines, as in (19), and points of culmination, as in (20):

- (19) You must submit your application **by midnight CST on December 1**.
- (20) The prime minister’s investment had grown to nearly \$8.7 million **by then**.

We assume that in (19), the hearer imagines a series of permissible submission times, just as the hearer of (20) imagines an incremental increase in the monetary value of the investment.

It happens, however, that a BTA sentence need not describe a state that is ordered with respect to another:

- (21) It took a few hours to retrieve our guys from the valley, and **by that time** it had begun to rain.
- (22) When I was in religious school, we looked at this parashah and said, “Leprosy! How gross! And who cares anyway?” **By then**, we knew that leprosy, also called Hansen’s Disease, was almost obsolete.
- (23) The doctor told me we can’t continue to give you the steroid and cortisone shots because you’ll be dead **by the time you’re 40**. (= (4))

It seems implausible to assume that (21) imposes a construal in which the rain had been in the offing throughout the retrieval operation. It is simply the case that a transition from dry to wet conditions had begun sometime prior to the past reference time (the time at which the retrieval operation had finished). By the same token, (22) could not be said to presuppose a knowledge scale along which knowledge of leprosy was increasing prior to the past reference time. Finally, we could not reasonably suppose that (23), repeated from (4) above, implies that the speaker would be dying throughout his twenties and thirties.

In light of these considerations, we propose that the BTA simply selects for a state that results from a transition *at some time prior* to the reference time of the predication. A BTA sentence asks of the interpreter only that she adduce a transition adjoining the denoted state that renders the state that holds at reference time (i.e. the time indicated by the complement of the BTA) a resultant state. In the next subsection, we make our proposed analysis of BTAs more precise.

2.2 *A toy analysis*

As noted at the outset, we assume that as far as tense and illocutionary force are concerned, BTAs are no different from temporal adverbials like *on Friday*. A toy analysis of *Ava left on Friday* is provided below to illustrate one way that we can model the compositional contribution of *on Friday*. We then go on to show the contribution of BTAs.

- (24) [Ava leave] \hookrightarrow
 $\lambda e.\text{leave}(e) \wedge \text{AGT}(e) = \text{ava}$
- (25) [On Friday] \hookrightarrow
 $\lambda P.\lambda t'.\exists v,t[t' \subseteq \text{FRIDAY}(t) \wedge t' \circ v \wedge P(v)]$
- (26) [[On Friday][Ava leave]] \hookrightarrow
 $\lambda t.\exists e,t'[t' \subseteq \text{FRIDAY}(t) \wedge t' \circ e \wedge \text{leave}(e) \wedge \text{AGT}(e) = \text{ava}]$
- (27) [PAST] \hookrightarrow
 $\lambda Q.\exists t[\text{PAST}(t) \wedge Q(t)]$
- (28) [PAST [[On Friday][Ava leave]]] \hookrightarrow
 $\exists e,t,t'[\text{PAST}(t') \wedge t' \subseteq \text{FRIDAY}(t) \wedge t' \circ e \wedge \text{leave}(e) \wedge \text{AGT}(e) = \text{ava}]$

In (24), we assume that that the extension of a tenseless VP like *Ava leave* is a set of leaving events by Ava, who is the agent. In (25), we assume that *on Friday* is a function from a set of eventualities to a set of times, requiring that there be an eventuality v in the extension of the VP such that: v overlaps some time t' (i.e. $t' \circ v$) and t' is temporally included within a time t , which has the property of being a Friday. Finally, PAST in (27) saturates the time argument in (26) via existential closure, ensuring that this time is in the past. The resulting formula is provided in (28), which characterizes an event e of Ava's leaving at a time t' that is within a past time t , which has the property of being Friday. This correctly characterizes the truth conditions of *Ava left on Friday*.

Below, we show how this toy analysis generalizes to stative descriptions like *Ava was happy on Friday*. We distinguish events from states in our ontology (by means of e vs. s variables ranging over events and states, respectively). Since *on Friday* don't discriminate between eventive and stative descriptions, we use the eventuality variable v in (25)/(30), which ranges over events and states (Bach 1986). We also follow Parsons (1990) in distinguishing the thematic role AGT, which stands for the agent of an event, from IN, which stands for the state that an individual is in (e.g., in *Ava was happy on Friday*, Ava is in the state of being happy).

- (29) [Ava be.happy] \hookrightarrow
 $\lambda s.\text{be.happy}(s) \wedge \text{IN}(s) = \text{ava}$
- (30) [On Friday] \hookrightarrow
 $\lambda P.\lambda t'.\exists v,t[t' \subseteq \text{FRIDAY}(t) \wedge t' \circ v \wedge P(v)]$
- (31) [[On Friday][Ava be.happy]] \hookrightarrow
 $\lambda t.\exists s,t'[t' \subseteq \text{FRIDAY}(t) \wedge t' \circ s \wedge \text{be.happy}(s) \wedge \text{IN}(s) = \text{ava}]$
- (32) [PAST] \hookrightarrow
 $\lambda Q.\exists t[\text{PAST}(t) \wedge Q(t)]$
- (33) [PAST [On Friday][be.happy]] \hookrightarrow
 $\exists e,t,t'[\text{PAST}(t') \wedge t' \subseteq \text{FRIDAY}(t) \wedge t' \circ s \wedge \text{be.happy}(s) \wedge \text{IN}(s) = \text{ava}]$

As noted above, this is just one way in which we can model the compositional contribution of *on Friday*. We will not provide independent motivation for the idea that

temporal adverbials existentially bind the eventuality variable.¹⁴ Moreover, we will not specify the semantics of PAST¹⁵ and FRIDAY¹⁶. What is crucial for us is the idea that the preposition *on* contributes temporal inclusion (\subseteq) and the observation that *on Friday* contributes an *indefinite* statement of the following kind: *there is a time at which the eventuality described by the VP held/was instantiated*.

With these assumptions in mind, let us now consider how BTAs can be incorporated into the toy analysis outlined above. Below, we provide a semantics for the sentence *Ava left by Friday*, where the only difference between (24)-(28), on the one hand, and (34)-(38), on the other, is the contribution of *on Friday* in (25) as against *by Friday* in (35). The key difference is that *by* ensures that the time interval that has the property of being a Friday precedes or is equal to the time that overlaps the time of the eventuality in the extension of the VP that the *by* phrase attaches to.¹⁷

$$(34) \text{ [Ava leave]} \rightsquigarrow \lambda e.\text{leave}(e) \wedge \text{AGT}(e) = \text{ava}$$

$$(35) \text{ [By Friday]} \rightsquigarrow \lambda R.\lambda t.\exists e,t'[t' \leq \text{FRIDAY}(t) \wedge t' \circ \text{ONS}(s_i) \wedge \text{RES}(e) = s_i \wedge R(e)]$$

$$(36) \text{ [[By Friday][Ava leave]]} \rightsquigarrow \lambda t.\exists e,t'[t' \leq \text{FRIDAY}(t) \wedge t' \circ e \wedge \text{leave}(e) \wedge \text{AGT}(e) = \text{ava}]$$

$$(37) \text{ [PAST]} \rightsquigarrow \lambda Q.\exists t[\text{PAST}(t) \wedge Q(t)]$$

$$(38) \text{ [PAST [By Friday][Ava leave]]} \rightsquigarrow \exists e,t,t'[\text{PAST}(t) \wedge t' \leq \text{FRIDAY}(t) \wedge t' \circ \text{ONS}(s_i) \wedge \text{RES}(e) = s_i \wedge \text{leave}(e) \wedge \text{AGT}(e) = \text{ava}]$$

Like *on Friday*, *by Friday* is a function from a set of eventualities to a set of times. When the input to the function is a set of events, as above, then the onset (ONS) of a prominent

¹⁴ While this assumption will do for the purposes here, see section 3 of this paper, which challenges this assumption, suggesting that epistemic modals operate on this eventuality variable.

¹⁵ There are two leading ideas about the semantics of tense. The first is to say that tense is a temporal pronoun (Partee 1973, Kratzer 1998) or a quantifier with a domain restriction variable over reference times (Roberts 1995, Musan 1995, 1997, von Stechow 2009). For a recent overview of various approaches to the semantics of tense, see Grønn & von Stechow 2016.

¹⁶ The semantics of *on Friday* is complicated by the fact that it has both a deictic and an anaphoric usage. Altshuler (2014) provides the following discourse to illustrate this point with *on Sunday*:

- (iv) a. Three weeks ago on a Friday, Sue gave Fido a bath and cleaned our house.
- b. On Sunday, my wife hired her and gave her a check for one month in advance.

Here we understand that the hiring event took place either on the closest Sunday after the house cleaning or on the closest Sunday prior to the speech time. For a proposal for how to capture these two readings, see Chapter 5 of Kamp & Reyle 1993.

¹⁷ As noted by an anonymous reviewer, if I tell you the paper is due by Friday and you hand it in on Friday, we would normally accept the paper as being on time. Intuitions do seem to diverge in some other cases. For example, if I bet you that Ava will leave by Friday, and we find on Friday afternoon that she has not yet left, have I lost my bet? If it proves to be the case that *by* phrases require precedence, the extension in (35) could be changed accordingly.

state s_i that is the resultant state (RES) of an event e must overlap a time t' , which is prior or equal to a time t that has the property of being a Friday. As shown in (38), this amounts to the following. The onset of the resultant state of Ava's past leaving (i.e. the onset of Ava having left) must precede Friday. That is, *Ava left by Friday* is true iff Ava had left at some point before Friday. As noted in the introduction, we assume that there is a prominent resultant state associated with an achievement like *left*. We further assume that this resultant state comes from the discourse context (as suggested by the formula above), although we do not rule out the possibility that it is entailed by the verb's Aktionsart representation, as in the case of achievement and accomplishment VPs (e.g., *She had fixed the situation by Friday*). What is crucial is that we rule out an activity description like *??Ava walked around by Friday*, because resultant states are typically not associated with such descriptions.¹⁸

Now, if the input to the extension of *by Friday* a set of states, as in (39)¹⁹, then the requirement is that the onset of a state s in the set results from some prominent event e_i . Moreover, as before, s must overlap a time t' that is prior to a time t that has the property of being the Friday under discussion (see (40)²⁰).

$$(39) \text{ [Ava be home]} \rightsquigarrow \lambda s.\text{be.home}(s) \wedge \text{IN}(s) = \text{Ava}$$

$$(40) \text{ [By Friday]}^i \rightsquigarrow \lambda S.\lambda t.\exists s,t'[t' \leq \text{FRIDAY}(t) \wedge t' \circ \text{ONS}(s) \wedge \text{RES}(e_i) = s \wedge S(s)]$$

$$(41) \text{ [[By Friday][Ava be home]]} \rightsquigarrow \lambda t.\exists e,t'[t' \leq \text{FRIDAY}(t) \wedge t' \circ \text{ONS}(s) \wedge \text{RES}(e_i) = s \wedge \text{be.home}(s) \wedge \text{IN}(s) = \text{Ava}]$$

$$(42) \text{ [PAST]} \rightsquigarrow \lambda Q.\exists t[\text{PAST}(t) \wedge Q(t)]$$

$$(43) \text{ [PAST [By Friday][Ava be home]]} \rightsquigarrow \exists e,t,t'[\text{PAST}(t) \wedge t' \leq \text{FRIDAY}(t) \wedge t' \circ \text{ONS}(s) \wedge \text{RES}(e_i) = s \wedge \text{be.home}(s) \wedge \text{IN}(s) = \text{Ava}]$$

For a sentence like *Ava was home by Friday*, we assume that there is a prominent event that can be accommodated from the discourse context—Ava's arriving—that results in the state of Ava being at home. The onset of this state would, then, be correctly predicted to

¹⁸ We do, however, predict that this sentence would be improved when embedded within a discourse which makes a resultant state prominent. For example, if we are tracking stages in Ava's recovery from surgery, we might say: *She had the surgery on Wednesday, on Thursday she sat up in bed and by Friday she walked around.*

¹⁹ Here IN is borrowed from Parsons (1990) as a thematic role whose extension is a function from states to individuals in those states. See Altshuler et al 2019 for more discussion.

²⁰ One may be concerned that there appear to be two different extensions (in (35) and (40) for *by Friday*. However, one could easily generalize the two entries as below ((35) and (40) are separated for convenience).

(i) $\text{[By Friday]}^i \rightsquigarrow \lambda V.\lambda t.\exists v,t'[t' < \text{FRIDAY}(t) \wedge t' \circ \text{ONS}(s) \wedge \text{RES}(e) = s \wedge V(v)]$, where (a) or (b) holds:
a. if v is in the set of states, then v results from some prominent event e_i .
b. if v is in the set of events, then there is a prominent state s_i that results from v .

overlap a time that precedes Friday. By contrast, *Ava loved hot toddies by Friday* (a variant of (10)) is odd simply because its successful interpretation requires the addressee to construct a peculiar, or at least highly particularized, scenario in which Ava's love of hot toddies is the result of some earlier event. Like an indexical expression, the BTA has minimal semantic constraints, requiring the interpreter to search the conversational common ground for the appropriate specifications (Kay 1997), including abductive reasoning to whatever causal event could yield the denoted state. In what follows, we will further consider the hearer's contribution, which includes inferences about speakers' evidentiary bases for assertions conveyed by present-tense BTA sentences. This is especially clear with BTA sentences containing the temporal adverb, *now*, already mentioned in previous sections.

There is a rich literature on *now*, going back to influential work by Kamp (1971). More recently, Altshuler & Stojnic 2015, Altshuler 2016, and Stojnic & Altshuler 2019 have argued that *now* can be treated as a prominence-sensitive indexical, which (among other things) selects for a state in the discourse that results from a prominent event. They show that this is an essential component of *now*'s meaning by analyzing a wide range of uses, including deictic, bound and discourse-bound uses. While exploring the meaning of *now* would take us too far afield, we end this section by noting that it should not be surprising that *now* has an affinity with *by*: their semantics both require prominent events and their resultant states.

2.3 Evidential implications of BTA predications

In the introduction we considered the minimal triple (13)-(15), repeated here as (44)-(46):

- (44) Shira is home now. (constructed)
- (45) Shira is home by now. (constructed)
- (46) Shira was home by now. (constructed)

Recall that while (44) could be spoken by someone at home, who thereby has firsthand knowledge of Shira's presence at home, (45) could not. The report in (46) is a supposition: the speaker is not at home and is merely reporting what she believes ought to be the case. Like (44), and unlike (45), the past-tense report in (46) conveys nothing about whether or not the speaker directly witnessed Shira's arrival.²¹

To see that this contrast is not particular to the data above consider the pair of sentences in (47) and (48). While (47) implicates that the speaker never tried the soup, (48) lacks this implicature.

- (47) The soup is cool by now. (constructed)
- (48) The soup was cool by now. (constructed)

²¹ As noted in footnote 6, *now* is often used with the past tense in narrative discourse. This is how we conceive (41) – see footnote 6 for a naturally occurring example.

Why should this be the case and what is the nature of the relationship, if any, between the indirect-evidence implication of present-tense BTA sentences like (44) and (46), and the implied epistemic stance of uncertainty or supposition?

To answer this question, recall that according to our proposed analysis, (45) would be analyzed as follows:

$$(49) \text{ [PRESENT [By now][Shira be.home]]} \rightsquigarrow \\ \exists e, t, t' [\text{PRESENT}(t) \wedge t' \leq \text{NOW}(t) \wedge t' \circ \text{ONS}(s) \wedge \text{RES}(e_i) = s \wedge \text{be.home}(s)] \\ \wedge \text{IN}(s) = \text{shira}]$$

According to (49), there was a prominent event that culminated in Shira being home at some time t' prior to the speech time. Interpreting this assertion involves a cascade of conversational inferences. One can reasonably infer that if the speaker had directly witnessed Shira's coming home at t' (e.g., by being in Shira's home), then the speaker would know when Shira had gotten home. But if this were the case, the speaker would presumably have used the present-tense report (44) above, or an event report like *Shira got home a little while ago*. The speaker's failure to employ either of these two more straightforward options triggers two distinct but combinable conversational implicatures. Their combination is an interpretive compromise, inasmuch as it simultaneously satisfies the lower bound of informational sufficiency, on the one hand, and the upper bound of informational necessity, on the other—a dialectic described by Horn (1984). The first of these implicatures is R(elevance)-based, arising from the informational upper bound—the hearer's belief that the speaker is being maximally succinct. The second is Q(uality)-based, arising from the hearer's assumption that the speaker is respecting informational sufficiency in making her report as precise as possible. From the speaker's assumed adherence to the R-principle, the interpreter of (45) infers that the state described (Shira's presence at home) is a resultant state. If it were not, the interpreter's reasoning goes, the present-tense report in (44) would be the preferred report form. When reasoning according to the Q-principle, the interpreter of (45) infers that the speaker lacks knowledge of Shira's exact arrival time; otherwise, a past-tense event report like *Shira came home at 5* would be the most appropriate (i.e. most cooperative) choice. The simplest explanation for the speaker's knowledge gap is that she was at a different location from Shira's location at t' . What is remarkable about sentences like (45) is that they carry an evidential-source implication that cannot be traced to evidential 'marking' of any kind, but is rather the product of an interpretive optimization procedure based on conversational reasoning.

An analogous analysis applies to (47), which has the representation below.

$$(50) \text{ [PRESENT [By now][the soup be.cool]]} \rightsquigarrow \\ \exists e, t, t' [\text{PRESENT}(t) \wedge t' \leq \text{NOW}(t) \wedge t' \circ \text{ONS}(s) \wedge \text{RES}(e_i) = s \wedge \text{be.cool}(s)] \\ \wedge \text{IN}(s) = \text{the soup}]$$

If the speaker had tried the soup at t' , she would, we presume, have been able to say something about the circumstances that obtain at encoding time, e.g., *The soup is cool now* or at a time immediately prior, e.g., *The soup was cool (just now)*. The fact that she did not say either of these things leads to the inference that she has not directly experienced the temperature of the soup. The natural explanation is that the speaker has not (yet) tried the

soup. The lesson here yet again appears to be that evidential-source information is calculable as well as conventional (in those cases where it is encoded by a marker of evidential source).

Let us now reconsider the past-tense examples above, in (46) and (48). The former lacks the implicature that the speaker was absent from Shira's home at the time of her arrival, while the latter lacks the implicature that the speaker has not yet tried the soup. Note, however, that (45) and (47) nonetheless carry a negative implication traceable to the BTA 'onset' schema—that the speaker was not at home/did not try the soup at any time *prior* to the time *t* described by the adverb *now*. Of course, the present-tense reports (45) and (47) share this negative implication with their past-tense counterparts, but unlike their past-tense counterparts, these present-tense reports have no time depth²³, and therefore no time later than encoding time. These present-tense sentences therefore impart that the speaker was *never* at home and *never* tried the soup. By contrast, the past-tense sentences (45) and (47) evoke an interval whose right boundary is earlier than encoding time. As a result, such sentences leave open the possibility that the speaker was at home/did try the soup after the time described by the adverb, but before encoding time. It is for this reason that the indirect-evidence implication is unique to present-tense BTA sentences.

We already know, of course, that the reference time of a state report does not restrict the state itself but only the interval for which the speaker is prepared to vouch for that state (Dowty 1986, Altshuler and Schwarzschild 2012): a sentence like *She was in London yesterday*, if interpreted as an alibi statement, is perfectly compatible with her being in London thereafter. Thus, a tensed state sentence always has what might be called *epistemic import*: it describes the known (or relevant) segment of a state. What is special about sentences like (45) and (47) is that they feature combinations of tense, adverbial meaning and (stative) aspect that reveal not merely what state segment is known to the speaker but also how the speaker knows of it. Indirect evidence is relatively weak evidence. As Karttunen (1972) observes, “indirect knowledge—that is, knowledge based on logical inference—is valued less highly than ‘direct’ knowledge that involves no reasoning” (p. 13). Sentences like (45) and (47) invite paraphrases like *Shira must be home by now* and *The soup is probably cool by now*. In the next section, we offer an account of why such inferential paraphrases are apt and in some cases preferable to their terser counterparts.

3 BTAs in intensional contexts

In section 1, we noted that some present-tense BTA tokens are apparently redeemed only by the presence of an epistemic-stance indicator. The relevant examples are repeated below:

- (51) They ??(must) prefer white wine by now.
- (52) They ??(probably) live in Mountain View by now.

²³ Using Augustine's reasoning we can demonstrate that the 'now' of speech time is a point not merely as a matter of linguistic convention but also as a matter of logic:

“The real or objective present must be durationless for, as Augustine argued, in an interval of any duration, there are earlier and later parts. So if any part of that interval is present, there will be another part that is past or future” (Le Poidevin 2015).

Given the toy analysis of BTAs proposed in the last section, we are now in a position to make sense of the data above. Recall the key idea of the analysis of BTAs presented in section 2.2: BTAs require the onset of a resultant state to overlap a time that precedes the time described by the adverb. On this analysis, the reason that (51)-(52) are odd in the absence of epistemic-stance indicators is that the described states are not naturally interpreted as resultant states of an event—no such event can be deduced in the absence of elaborate context. We are left asking: what caused them to (now) prefer white wine? What caused them to (now) live in Mountain View?

But why should inferences like those required by such contexts be facilitated by the presence of epistemic markers? We are left with two plausible hypotheses about why epistemic-stance indicators alleviate the infelicity above:

- *Hypothesis 1*: epistemic-stance indicators help facilitate the process of accommodating a prominent event that results in the state described.
- *Hypothesis 2*: epistemic-stance indicators alleviate the need to accommodate a prominent event that results in the state described.

In what follows, we will provide some reasons to believe that, depending on the epistemic-stance indicator, either Hypothesis 1 or Hypothesis 2 is valid, leading to outstanding questions about how the toy analysis in section 2.2 should be extended.

According to Kratzer's (1981, 1991) seminal analysis of modals, *must* in (51) requires the described eventuality to hold in all of the most ideal worlds of the modal base. Hence, for (51) to be true, the described wine preference holds in all of the normal worlds (e.g., that in which red wine has become prohibitively expensive). But what about the actual world? What does (51) say about the described wine preference in the world of the speaker? Here, things are more complicated. There are (at least) two well-known answers to this question.

The first comes from von Stechow & Gillies (2010), henceforth F&G, who argue that *must* ϕ is felicitous only if the evidence for ϕ (the prejacent) is indirect. They consider the minimal pairs below²⁴, noting that *must* is felicitous only in the case where the speaker had indirect evidence for the assertion that it is raining.²⁵

(53) a. Context: Billy is looking out of the window at the pouring rain.

#It must be raining.

b. Context: Billy sees someone enter the building holding a wet umbrella, but she cannot see outside herself.

It must be raining.

F&G further claim that the putative indirect-evidence inference is cross-linguistically robust, and while they ultimately conclude that it should be derived as a quantity

²⁴ These data are cited in Goodhue 2017:4, although they go back to Karttunen 1972.

²⁵ This hypothesis has been further explored by Ninan 2014, Ozturk & Papafragou 2015, Matthewson 2015, Lassiter 2016 and Mandelkern 2016.

implicature (Grice 1989, Geurts 2010, Franke 2011, Frank & Goodman 2012), they settle for a lexical stipulation, owing to various challenges faced by a quantity-based-analysis.²⁶

Another proposal, recently defended by Goodhue 2017, comes from Giannakidou & Mari (2016), henceforth G&M, who argue that epistemic modals require the speaker to be ignorant of the prejacent; there is no requirement that the evidence for the prejacent be indirect. The ignorance requirement is formally modeled as a presupposition on top of Kratzer's semantics for epistemic modals, noted above. On this analysis, (53a) does not satisfy the presupposition; it is correctly predicted to be infelicitous because the speaker (Billy) knows that it is raining. By contrast, (53b) does satisfy the presupposition, because the speaker (Billy) is not certain of the ambient conditions—she can only speculate. Hence, (53b) is true if it is raining in all of the most ideal worlds of the modal base.

In what follows, we will consider how and whether these two analyses could be used to support Hypothesis 1 and/or Hypothesis 2 above. We start with an application of G&M's analysis to (51) with the modal *must*. As noted above, for (51) to be true, the described wine preference holds in all of the most ideal worlds of the modal base. Now, let us assume, following G&M, that (51) also presupposes that the speaker does not know whether the described wine preference holds in the actual world. Could the conjunction of the asserted and presupposed content support either Hypothesis 1 or Hypothesis 2?

For the conjunction to support either Hypothesis 1 or Hypothesis 2, we would have to derive a possible change of state by juxtaposing the state in which they do not prefer white wine (in the actual world) to that in which they prefer white wine (in all of the most ideal worlds). Only after deriving this possible change of state can we entertain the question of whether the modal (a) facilitated the accommodation of a prominent event whose resultant state is the state described or (b) merely alleviated the need for this form of accommodation. Unfortunately, such a derivation is not possible.²⁷ To see this, suppose that the modal base $f(w)$ consists of the following set of worlds: $\{w, v\}$. Let σ be the state of them preferring white wine. Now suppose that for all times t , $\langle w, t \rangle \notin \sigma$ and $\langle v, t \rangle \in \sigma$. In other words, suppose that they never prefer white wine in w , and that they have always preferred white wine in v . Finally, suppose that $\{v\}$ is the set of ideal worlds in $f(w)$. Then, for any time in the actual world, $t@$:

- The presuppositional content of *must* is satisfied, since σ does not hold across all ideal worlds in $f(w)$ at $t@$.²⁸
- The assertive content of *must* is satisfied, since σ holds across all ideal worlds in $f(w)$ at $t@$.
- There is no change of state in any world in $f(w)$.

²⁶ As noted by F&G, deriving this inference as a quantity implicature is challenging because there doesn't appear to be an expression that both requires indirect evidence and, when used in a sentence, asymmetrically entails its counterpart sentence with *must*.

²⁷ Thanks to Sam Carter for discussing this option with us.

²⁸ As noted by an anonymous reviewer, what G&M actually require is slightly different: not that $f(w)$ is diverse with respect to the prejacent, but rather that the speaker doesn't know the prejacent. While these two views could come apart, depending on what $f(w)$ represents, our challenge for G&M is independent of this point.

Despite our inability to derive the change of state in this manner, one may still be tempted to conjoin the presupposed and asserted content of *must* and derive the change of state by other (pragmatic) means. As we shall see below, we think this is plausible in the case of F&G's analysis. For G&M's analysis, however, this seems more challenging (at least for us). How, under G&M's analysis would we derive the conclusion that ϕ does not hold *at some prior time* in w ?

With this question in mind, let us now apply F&G's analysis to (51) above.²⁹ Instead of presupposing that the speaker does not know whether the described wine preference holds in the actual world, F&G would say that there is some mechanism that led the speaker to know that the described wine preference holds in the actual world, at her time of utterance. In other words, the speaker came to know that there is a white wine preference in the actual world, prior to encoding time, by some indirect means. And this indirect evidence warranted the use of *must* in (51).

Note that this analysis involves the following change of state: the speaker lacks knowledge of the wine preference at some point prior to speech time and has knowledge of the wine preference at speech time. Note further that this change of state does not guarantee that there was a change of state in the wine preference itself; *the speaker may have come to know something that always held*. However, the speaker came to such knowledge, it was not through witnessing the subjects choosing white wine over other options, or through hearing them declare their preference. This, of course, would be direct evidence. Instead the means by which the speaker gained the knowledge must be some event that enabled the speaker to deduce their preference for white wine, just as Billy's seeing someone enter the building holding a wet umbrella in (53b) led her to deduce that it is raining.

Given this line of reasoning, we hypothesize that (51) implicates that whatever event provided the indirect evidence for the speaker's claim, it is an event that led the speaker to log a new wine preference at speech time, whether or not that wine preference is, in actuality, a new state. Notice in this connection that the speaker can append the following statement to (51) without contradiction: *And perhaps they always did*. Put differently, we hypothesize that the BTA onset schema is satisfied by *must* in (51) because any conjecture about a state of the world can be construed as a new state: if I am now prepared to make a guess about a state of the world, whether based on reasoning or observation, I was not previously prepared to do so.

With this in mind, we can come back to the two hypotheses noted at the outset of this section and ask whether *must* provides information that would facilitate the accommodation of the onset event (Hypothesis 1), or whether *must* alleviates the need to accommodate this event (Hypothesis 2) by identifying the onset event as the evidentiary basis on which the speaker makes her assertion. Everything we have said thus far would suggest the latter hypothesis. However, Mandelkern (2016) provides intriguing data suggesting that *must* differs from other epistemic distancers like *probably* in the following respect: when a speaker uses *must* ϕ , she has to share her evidence for ϕ .³⁰ To see this, consider the following data:

²⁹ Thanks to Matt Mandelkern for discussing this option with us.

³⁰ This proposal builds on work by Stone (1994). In addition to *must*, strong epistemic necessity modals like *have to* and *can't* have this anaphoric feature.

- (54) How are you doing in your classes?
- I'm doing ok.
 - I hope I'm doing ok.
 - {Mrs. Crabtree said/I keep telling myself} that I'm doing ok.
 - I'm probably doing ok.
 - I must be doing ok; my professors all gave me positive midterm reports.
 - ??I must be doing ok.

While (54a)-(54e) are all felicitous responses to the question in (54), (54f) is odd, and crucially odder than (54e), where the speaker shares her evidence for the claim that she is doing ok. Assuming such data are robust, it would suggest that (51), which has *must*, is not as felicitous as (52), which has *probably*, and that (51) is improved when the modal is replaced by *probably*, since no prior context is provided. We share this intuition, which in turn suggests that, on the extended F&G analysis just proposed, *must* supports Hypothesis 1, while other epistemic-stance indicators, like *probably* in (52), support Hypothesis 2.³¹ In other words, the use of *must* ϕ requires the speaker to describe what caused her to know that ϕ , and we claim that this evocation of a prior act of inference facilitates the construction of the BTA state as a resultant state. *Probably* in (52), by contrast, alleviates the need to accommodate the event required by BTA (Hypothesis 2) by identifying that event with the observation or act of reasoning that provided the basis for the speaker's claim.

On this analysis, the use of an epistemic modal like *must* in (51) or *probably* in (52) will always result in a felicitous BTA construction as long as (i) the aspectual restrictions imposed by BTA are respected and (ii) it is plausible that the speaker could gain indirect evidence for her assertion (whether this evidence is shared, as in the case of *must*, or not, as in the case of *probably*). Moreover, on this analysis, if a BTA predication is felicitous in the absence of an epistemic modal (e.g. *They had arrived by Friday*), then adding an epistemic modal (e.g. *They must have arrived by Friday*) leads to the implication that the speaker's assertion is warranted by indirect evidence. If the modal-free BTA predication already has this implication, as in the case of *Shira is home by now* (discussed in section 2.3), then adding the modal will simply strengthen the implication (e.g., *Shira must be home by now*).

Let us now reconsider the contrast below. As noted in the introduction, the use of *will* in (55b) alleviates the oddity seen in (55a):

- (55) a. ??She loved hot toddies by November.
 b. She will love hot toddies by November. (= (18))

Unlike the examples previously discussed in this section, (55b) implicates that the speaker believes that the described eventuality does not hold at the speech time, i.e. that she does not currently love hot toddies. Altshuler & Schwarzschild (2012, 2013) call this inference *cessation*, characterized as follows:

³¹ We discuss other epistemic-stance indicators like *hope/say/think* at the end of this section.

- (56) Cessation Implicature: the utterance of a past/future tensed sentence implicates that no state of the kind described currently holds.³²

Combined with the semantic contribution of *will* (there is a time after the speech time when the described eventuality holds), (56) allows us to derive a change of state inference in (55b): the hearer deduces that the individual under discussion does not currently love hot toddies, and that this individual will be in such a state in the future (namely at some point prior to November).³³ As in (52), the event that would lead to this change of state need not be specified in (55b). If we assume that *will* is an epistemic modal on a par with *probably*, then we can apply the leading insight of our F&G-inspired analysis: the use of the modal in a BTA predication evokes an antecedent observation or act of reasoning that permits the speaker to make her assertion, and this inference trigger is identified with the ‘onset event’ in the BTA schema.

In sum, this section has attempted to explain why infelicity in certain types of BTA predications is alleviated by the presence of an epistemic modal. One outstanding issue concerns the means by which we might extend the toy analysis in section 2.2 to incorporate the contribution of intensional operators. Doing so would likely involve revising the idea (which was sufficient for our purposes in section 2.2) that temporal adverbs existentially bind eventuality variables. Given the analysis in this section, it would be worthwhile to explore the hypothesis that it is the epistemic modal/attitude verb that has this task, identifying the event that leads to the change of state with the source of indirect evidence that the speaker relies on in making her assertion. We refer the reader to Hacquard (2009, 2010) for some pioneering ideas about how modals interact with tense and aspect, leaving for future research the question of whether the ideas presented there can be neatly implemented in the compositional semantics proposed in section 2.2.

The other outstanding issue concerns the use of BTAs with other epistemic-stance indicators, such as attitude verbs. The data in (54b,c) may lead one to expect that attitudes can alleviate infelicitous instances of BTAs on a par with the epistemic modal *probably*. Interestingly, while *hope* appears to confirm this expectation,

- (57) Susanna hopes that they prefer white wine by now. (constructed)

say/tell/think do not:

- (58) ??Susanna said that they prefer white wine by now.
(59) ??Susanna told me that they prefer white wine by now.
(60) ??Susanna thinks that they prefer white wine by now.

Why should this be? One relevant observation comes from Simons (2008), who observes that on a parenthetical use of an attitude report, the complement clause carries the main point of the utterance while the matrix clause plays an evidential function, indicating the

³² Altshuler & Schwarzschild argue that this is a scalar implicature: Present ϕ asymmetrically entails Past ϕ and Future ϕ given the semantics of stative predication. See Chapter 4 of Altshuler 2016 for discussion.

³³ As noted by an anonymous reviewer, for those who are hesitant to adopt a future orientation analysis of *will* can choose to assimilate *will* to *must* and the analysis for *must* presented above could be extended straightforwardly.

source of evidence for the proffered content.³⁴ On a parenthetical reading of (58)-(60), this evidence is *indirect*: Susanna is the source of evidence. Of course, the matrix clause of attitude reports does not always convey hearsay evidence. This is especially clear with first-person reports like (61):

(61) I hope they prefer white wine by now. (constructed)

Despite not specifying the source of the evidence that warrants the assertion, (61) still implies that the speaker used some indirect means to reach the conclusion that they have a white wine preference: when someone hopes that a given state is in force at speech time, there is typically a reason for that hope, although (61) tells us more about what the speaker expects or desires than it tells us about the speaker's reasoning. Hence, attitude reports like (58)-(60) more closely resemble (51) [*They ??(must) prefer white wine by now.*] than they do (52) [*They ??(probably) live in Mountain View by now.*], while attitude reports like (61) more closely resemble (52) than they do (51).

Given these observations, we can rephrase the puzzle as follows: what allows us to analyze (57) and (61) on a par with epistemic modals, but not (58)-(60)? In particular, why would *hope* (but not *say/tell/think*) allow for an analysis in which the speaker came to know about the wine preference by indirect means, leading the hearer to deduce that there was a change of state (the wine preference) prior to the point at which the attitude report was uttered? We leave this question open for further research, noting some recent work that may help to solve the puzzle: Anand & Hacquard 2014, which posits various discourse constraints imposed by attitude verbs and Klecha 2016, which motivates a modal semantics for attitudes in which verbs like *hope* are distinguished from *say/think*.

5 Conclusion

We have motivated a change-of-state schema for BTA sentences by appealing to a theory of contextual operators, which we made formally precise, using a Neo-Davidsonian event semantics. Key to the analysis was the idea that BTA sentences require the onset of a resultant state to overlap a time that precedes the time described by the adverb. This analysis allowed us to identify the pragmatic factors that yield the inferential construal of present-tense BTA reports. Subsequently, we built on an analysis of epistemic modals by von Stechow & Gillies (2010) and Mandelkern (2016) to hypothesize the manner in which the BTA change schema is instantiated in intensional contexts and discussed the relationship between intensional and evidential contexts. We assumed that an assertion *must* ϕ requires information that supports the speaker's evidence for ϕ and proposed that the speaker's receipt of this evidence is understood as an event, thereby facilitating the accommodation of the event required by BTA schema. Other epistemic-stance indicators, such as *probably*, differ from *must* in that their interpretive contributions alleviate the need to accommodate an event required by the BTA. They do so by identifying this event with the source of indirect evidence from which the speaker draws her assertion.

³⁴ This observation builds on work by Urmson (1952) and Hooper (1975). See Altshuler et al. (2014) and Chapter 4 of Altshuler (2016) for more discussion.

The analysis offered here differs from prior analyses that view the connection between evidential and modal implications of aspectual constructions through a diachronic lens, as primarily a grammaticalization problem. We treat it as an inferencing problem and a semantic-constraint-satisfaction problem. We see the fusing of aspectual and epistemic implications in BTA sentences, and in particular present-tense sentences, as the product of a reconciliation procedure in which a knowledge state correlates with a resultant state. By highlighting the role of state assertions in triggering acts of pragmatic reasoning, this case study also illustrates the need for an aspectual ontology that includes events, states and times, echoing the view of Parsons 1990, Altshuler 2016 and Altshuler et al. 2019. We found that the BTA could not be analyzed purely in terms of times, and in this respect, the aspectual analysis offered here goes beyond time.

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