

Underspecified (Embedded) Tense Semantics

Abstract

Past tense morphemes embedded under a past tense matrix clause can systematically express both backward-shifted and simultaneous propositions. Traditionally, this Sequence of Tense (SoT) phenomenon has been explained through ambiguity at the level of the logical form. In this paper, we provide a novel, compositional account of tense, which does not assume ambiguity but rather underspecification of past tense semantics. We propose that tense morphemes trigger the existence of covert tense operators through upward agreement (Zeijlstra, 2012) and that both of these components are semantically active. For past tense, the triggered operator uniformly introduces indexical past tense semantics and the past tense morpheme uniformly establishes weak precedence relations between the past-tense marked events and their local evaluation times. We show that this underspecification account fares at least equally well as other existing SoT analyses in terms of the range of data it can account for, and that it has additional advantages over them as well. We move on to demonstrate that the proposed underspecification account is straightforwardly extendable to present tense embeddings and explains the empirical phenomena here as well. For present tense, the triggered operator uniformly introduces inclusion of the utterance time, while the present tense morpheme uniformly establishes inclusion relations between the present-tense marked events and their local evaluation times. Furthermore, the account introduces a number of free parameters which open up space for cross-linguistic differences attested with respect to SoT.

Word count (without references and test items): 16,120.

1 Introduction

Typically, past tense morphology systematically marks that the event expressed by the verb or predicate of a sentence is located prior to the time of utterance (1), whereas present tense morphology denotes that an event is ongoing at the time of utterance (2):

- (1) Mary *was* ill (*now/last year/*next year).
- (2) Mary *is* ill (now/*last year/*next year).

Nevertheless, it is well-established in the literature that for either of the two tenses this is not always the case. Across different matrix embeddings, the meaning of their tense morphemes seems to vary: In past-under-past embeddings, the contribution of embedded

past tense morphology may appear to be vacuous (see Section 1.1); The semantic contribution of present tense morphology sometimes appears to anchor an event to a certain evaluation time rather than just anchoring it to the utterance time (see Section 1.2). In this article, we propose a novel syntactic-semantic account for past and present tense that can explain the full range of their behavior while retaining a one-to-one mapping between tense form and meaning. Before outlining the structure of the argument, let us briefly recapitulate why embedded tenses pose such an interesting and important puzzle to solve.

1.1 The embedded past tense puzzle

It has long been known that sentences in which a past tense is embedded under a matrix past have two usages: a simultaneous [sim] and a backward-shifted [b-s] one, with the former being the most salient usage.¹

- (3) John said Mary was ill.
- a. John, at some $t' < \text{utterance time}, t_u$: “Mary is ill.” [sim]
 - b. John, at some $t' < t_u$: “Mary was ill.” [b-s]

The availability of the simultaneous usage for past-under-past constructions is commonly referred to as Sequence of Tense (SoT) and has been a prevalent topic of research for an extensive period of time (e.g., Curme, 1931; Jespersen, 1931). One reason for the continuing interest is that, intuitively, there are two ways to think about past tense, and each of them fails to predict the two-fold meaning distinction observed in (3). Leaving the various implementation variants on the market aside for now, the puzzle boils down to the following:

Under an *absolute* view on past tense, each instance of past tense is taken to place the event time of the predicate it scopes over prior to the sentence’s utterance time (see, e.g., Reichenbach, 1947; Prior, 1967; Comrie, 1985; Declerck, 1995, 2015).

$$(4) \quad \llbracket \text{PAST}_{\text{absol.}} \rrbracket = \lambda P. \exists t' < t_u \ \& \ P(t')$$

In clauses in which a past tense morpheme is embedded under a matrix past, two such prior-to- t_u relations are established, but their internal order is not further specified.

$$(5) \quad \text{John} \quad \underbrace{\text{say-PAST}}_{\exists t_1 < t_u \ \& \ \text{say}(t_1)} \quad \text{Mary} \quad \underbrace{\text{be-PAST}}_{\exists t_2 < t_u \ \& \ \text{be-ill}(t_2)} \quad \text{ill.}$$

Such a view correctly predicts the availability of the simultaneous and the backward-shifted usages for past-under-past sentences (i.e., the temporal orderings $t^2 < t^1 < t_u$ and $t^2 = t^1 < t_u$, respectively). At the same time, however, it also, incorrectly, predicts a forward-shifted [f-s] usage to be available, falsely supporting the paraphrase in (6) for (3). As a result, a purely absolute theory of past tense cannot provide a final answer to the puzzle.

- (6) John, at some $t < t_u$: “Mary will be ill.” [f-s]
 (temporal ordering: $t^1 < t^2 < t_u$)

¹A more standard term for *usage* would be *reading*, but as we will argue in this article that SoT constructions are not ambiguous between different readings, we cannot stick to that term, therefore employing the term *usage*, even though that may not be the ideal term.

The second intuitive way to look at past tense is to regard it as a *relative* tense. Under such a view, each instance of past tense is assumed to place the event time of the predicate it scopes over prior to the predicate’s evaluation time, which is provided by its closest c-commanding tense, or, in the absence of such a tense, the utterance time (see, e.g., [Prior, 1967](#)).

- (7) a. $\llbracket \text{PAST}_{\text{rel.}} \rrbracket = \lambda P. \lambda t^*. \exists t' < t^* \ \& \ P(t')$
 b. John $\underbrace{\text{say-PAST}}_{\exists t_1 < t_u \ \& \ \text{say}(t_1)}$ Mary $\underbrace{\text{be-PAST}}_{\exists t_2 < t_1 \ \& \ \text{be-ill}(t_2)}$ ill.

In contrast to an absolute view on past tense, adopting a relative view correctly rules out a forward-shifted usage of (3), since the matrix tense provides the evaluation time of the embedded tense. At the same time, however, such a proposal fails to predict the availability of the simultaneous usage. The only usage it predicts is the backward-shifted one. Hence, neither of the two intuitive views on past tense explains the systematic two-fold meaning distinction of English past-under-past constructions.

To solve this problem, it has become received wisdom in most SoT literature that there exists some mechanism by means of which the embedded past tense may lose its semantic contribution in SoT contexts. Implementations of this insight vary, among others, from the assumption of a void tense in SoT-languages ([Partee, 1973](#); [Heim, 1994](#); [Kratzer, 1998](#)), to a past tense which is, in fact, a present-in-disguise ([Ross, 1989](#); [Abusch, 1988, 1997](#); [Klecha, 2016](#)), an optional tense deletion mechanism constrained by syntax ([Ogihara, 1995](#); [Stowell, 1995, 2007](#)), and hybrid approaches ([Kusumoto, 1999](#); [von Stechow, 2009](#)). Irrespective of the different manners of implementation, however, an assumption shared by all of these proposals is Logical Form (LF)-ambiguity between the simultaneous and backward-shifted usages. A notable exception to this assumption is provided by pragmatic approaches (e.g., [Altshuler, 2016](#); [Altshuler & Schwarzschild, 2012](#)). These approaches deny the existence of true simultaneous readings of past-embedded past tense and attribute the perceived simultaneity to the absence of a cessation implicature in SoT configurations, i.e., to a canonical past tense that does not stand in competition with its present-tensed alternative (discussed more extensively in [Section 2.4.2](#)).

The assumption that past-under-past embeddings are ambiguous is also what we challenge in this paper. Nevertheless, instead of providing a pragmatic solution to the SoT problem, we argue that past tense is semantically *underspecified* and therefore compatible with both simultaneous and backward-shifted usages, though crucially not with forward-shifted usages.

1.2 The embedded present tense puzzle

A similar puzzle to the one presented for embedded past tense morphology can be observed for embedded present tense morphology: Present tense, too, can be interpreted in one of two different ways, depending on the matrix environment (8).

- (8) a. John will say Mary is ill. [sim]
 b. John said Mary is ill. [d-a]

In (8a), an instance of present-tense morphology is embedded under a future-shifted matrix tense. This setting leads to a simultaneous [sim] usage of the present-tensed complement clause; i.e., one in which the time of Mary’s illness is understood to include the time of John’s saying event—which lies in the strict future of t_u —but not necessarily the utterance time t_u itself. The example in (8a) can therefore be feasibly paraphrased as follows: *John, at some t later than t_u : “Mary is ill (now).”* In (8b), by contrast, in which present tense morphology is embedded under a past-tensed matrix verb, the present tense is interpreted as fulfilling a different, dual role: It anchors the time of Mary’s illness to both the utterance time and the time of John’s saying, i.e., its evaluation time. Such a usage of embedded present tense morphology is commonly referred to as double-access [d-a]. Traditionally, double-access usages of present-tense morphology had been characterized as expressing simultaneity with respect to the evaluation time and the time of utterance. As a result, (8b) was argued to be true if John said at at some t prior t t_u : *“Mary is ill (now).”* and (according to the speaker) Mary is ill at t_u (Smith, 1978). However, since then this characterization has been refuted (e.g., Ogihara, 1995; Klecha, 2018), and it has instead been suggested that the relevant speech-time inference is that anybody (including the speaker) who takes the content of the attitude to be true, also believes that the prejacent still holds at t_u (Klecha, 2018).

As with past tense, the established two-way meaning distinction of present tense in different environments poses a puzzle to traditional relative/absolute views on tense. A *relative* view on present tense predicts that each instance of present tense morphology includes its respective evaluation time; an *absolute* view on present tense tense proposes that present tense morphology always establishes an inclusion relation with respect to t_u (Prior, 1967; Comrie, 1985; Declerck, 1995, 2015). The above data show that neither view can capture the full meaning of present tense: Whereas (8a) provides evidence for a relative and not an absolute view on present tense—as no reference to t_u is made by the present tense morpheme—the example in (8b) refutes such a view: When embedded under a past matrix verb, present tense *always* makes reference to t_u in addition to its evaluation time. Hence, neither a relative nor an absolute view of present tense readily explains the attested usages, proving that present tense meaning should be more complex. Again, the leading intuition in the literature is that the respective embedded present tense meanings should be derived on the basis of different LF structures; one in which the tense contribution is deleted, leading to a simultaneous interpretation, and one where it is not, yielding a double-access reading.

Even though the ambiguity of past tense morphology has received a lot of attention in the literature, the present tense morphology-counterpart of the puzzle seems to have been discussed less extensively so far. This might be due to the fact that, *prima facie*, the cases of past- and present tense morphology-ambiguity do not seem directly related, as the two-way meaning distinction of the former reveals itself within a sentence, whereas the two-way meaning distinction of the latter only reveals itself across different embedding contexts. Nevertheless, a closer inspection shows that they can be analyzed in a parallel manner. Such a unified treatment should be able to capture the meaning distribution of both past and present tense and, thus, incorporate an absolute as well as a relative meaning component. That is indeed what we will provide in this paper.

1.3 Outline of the paper

The paper is structured as follows: In Section 2, we propose a past tense semantics that is underspecified between a simple past tense and past perfect meaning. To do so, we disentangle the different meaning components of past tense via outsourcing its absolute past meaning into a structurally high, covert past operator (*Op-PAST*) while encoding a relative non-future meaning into the past tense morpheme (*-ed*), which is syntactically dependent on the aforementioned operator. After introducing the basic idea of the proposal, we apply it to standard SoT cases, as well as more complex cases of past temporal embeddings. In Section 3, we provide a purely compositional implementation of our proposal in terms of presuppositional tense semantics. Section 4 is devoted to demonstrating that the same mechanism can also be straightforwardly extended to present tense; An underspecified present tense proposal akin to the one proposed for past tense, i.e., containing an absolute and a relative meaning component, yields the correct semantics both for matrix and embedded tenses, including challenging embeddings. Section 5 concludes.

2 Past tense proposal

2.1 Introducing the components

We start our analysis with the well-established observation that past tense takes higher scope than its surface position on the finite verb (Klein, 1994; Ogihara, 1996; Abusch, 1997; Kusumoto, 1999, 2005; von Stechow, 2002; Stowell, 1995, 1996, 2007; Zeijlstra, 2012). Evidence for such a scopal ordering of past tense comes, for instance, from examples like the following:

- (9) Wolfgang played tennis on every Sunday. (von Stechow, 2006)

The intended interpretation of (9) is one where past tense outscopes the distributive quantifier *every Sunday*, which in turn outscopes the lexical verb *play*, yielding the paraphrase in (10a). The scopal order where past tense would take scope at its surface position, i.e., under *every Sunday*, amounts to the reading in (10b), which is absent (von Stechow, 2002, 2005; Zeijlstra, 2012).

- (10) a. There exists a past interval t such that for every Sunday in t , Wolfgang plays tennis.
b. *For every Sunday, there exists a time before it such that Wolfgang plays tennis at that time.

That there exists a covert past tense operator outscoping the distributive quantifier in (9) can furthermore be shown by expressing the operator explicitly. Crucially, the resulting sentence is truth-conditionally equivalent to (9):²

²We thank Jacopo Romoli and Manfred Krifka (p.c.) for independently pointing out that there exist scenarios in which the fact that past tense usually takes highest scope over such distributives does not always hold true. Consider the following utterance, addressing a person who keeps re-telling the same story,

(12) In the past, Wolfgang played tennis on every Sunday.

From the correct reading in (10a) it becomes evident that the distributive quantifier takes scope from an intermediate position between the lexical verb and the past operator, clearly revealing the dichotomy between the locus of semantic interpretation and the locus of morphological instantiation of past tense. Therefore, we assume—again in line with many others (e.g., Kusumoto, 1999, 2005; von Stechow, 2003; Stowell, 1995, 1996, 2007; Zeijlstra, 2012)—that the past tense morpheme does not carry canonical past tense semantics. Instead, we propose alongside them that ‘real’ past tense meaning, i.e., anteriority, is contributed by a structurally higher, covert past tense operator *Op-PAST*, whose presence is triggered when past tense morphology is used. One important role of past tense morphology is then to indicate the existence of a structurally high past tense operator. Syntactically, such a relation is commonly implemented by assuming past tense morphology to carry an uninterpretable feature, [uPAST], which is checked by a matching interpretable feature, [iPAST], carried by *Op-PAST*. We assume this covert past tense operator to carry the following semantic content³:

$$(13) \quad \llbracket \textit{Op-PAST} \rrbracket = \lambda P. \lambda t^*. \exists t < t^* \ \& \ P(t)$$

Op-PAST places the predicate P at a time t prior to some evaluation time t^* . At the matrix level, t^* by default applies to t_u and for the sake of simplicity we will take *Op-PAST* to denote $[\lambda P. \exists t < t_u \ \& \ P(t)]$ in these cases. Later in this paper we will discuss examples in which the value deviates from the default, though, providing evidence for the necessity of the more complex definition of *Op-PAST* given in (13).

We crucially depart from other approaches by proposing that even though the locus of past tense is different from its overt instantiation—i.e., the tense marker *-ed*—, this does not entail that the past tense morpheme is semantically vacuous. Just as in syntactic dependencies like binding of an anaphor by an antecedent, or when movement leaves a trace, where both participants in the dependency are semantically active (see also Kusumoto, 2005), we assume that both the covert past tense operator and the past tense morpheme are semantically active. Concretely, we take the meaning of a past tense morpheme, like *-ed*, to be comprised of two components: a syntactic feature [uPAST], which encodes a syntactic dependency with a higher past tense operator (as discussed above), and a semantic element, which contributes a relative non-future meaning with respect to its closest c-commanding tense node (informally: ‘not later than’). This assumption will ultimately lead to the underspecified interpretation of past-under-past embeddings we propose:

$$(14) \quad \llbracket \textit{-ed} \rrbracket = \lambda P. \lambda t. \exists t' \leq t \ \& \ P(t')$$

The expression $t' \leq t$ indicates that the lower boundary of the time interval t' is not later than the lower boundary of the time interval t . Hence, either the two events started at the same time, or the event with run time t' began strictly prior to the event with run time t .

but reliably changes their role in it. In such a context, we understand the distributive quantifiers in (11) to raise across the past tense:

(11) You were a hero every Sunday, but you were a coward every Monday.

³Here we only present the intuition in operational terms. A full compositional analysis of the facts, which will be cast in presuppositional terms, will be spelled out in Section 3.

With these assumptions in place, a mono-clausal past-tensed sentence such as *Susan loved her mother* receives the following interpretation:

(15) Susan loved her mother.

LF: $[_{TP_2} Op-PAST]_{[iPAST]} [_{TP_1} -ed]_{[uPAST]} [_{VP} \text{Susan love her mother}]]]$
 $\exists t' < t_u$ $\exists t^2 \leq t'$

- a. $[[VP]] = \lambda t. \text{love}(\text{Susan}, \text{her mother}, t)$
- b. $[[TP_1]] = \lambda t. [\exists t^2 \leq t \ \& \ \text{love}(\text{Susan}, \text{her mother}, t^2)]$
- c. $[[TP_2]] = \lambda t. [\exists t' < t \ \& \ [\exists t^2 \leq t' \ \& \ \text{love}(\text{Susan}, \text{her mother}, t^2)]]$
 When TP_2 is pronounced at the utterance time, t_u , it gets interpreted with respect to t_u :
- d. $[[TP_2]](t_u) = 1$ iff $\exists t' < t_u \ \& \ [\exists t^2 \leq t' \ \& \ \text{love}(\text{Susan}, \text{her mother}, t^2)]$
- e. *There is a time t' strictly before the utterance time t_u and Susan's loving her mother starts at a time no later than t' .*

Note that the proposed analysis makes no hard commitment with respect to whether Susan loves or fails to love her mother at/after t_u ; rather, it restricts the contexts in which (44) can be felicitously uttered to those in which Susan's love for her mother started prior to t_u . The proposal is therefore fully compatible with the well-established fact that even though a past-tensed stative sentence may trigger the inference that the described state has ceased to hold, it never entails that (see [Altshuler, 2016](#), for discussion and overview). Note furthermore that by ascribing the past tense marker a non-vacuous meaning, we propose that past tense overall has a *complex* meaning, but *not* an ambiguous one: The only reading the sentence in (44) has is one where Susan started loving her mother no later than some time that lies strictly before the utterance time.

Our proposal deviates from standard analyses in that it introduces vagueness with respect to the ordering of t' and t^2 in simple past-tensed sentences: They either refer to the same point in time or the latter precedes the former; In this sense, a clause containing a single past tense morpheme should be able to yield both a regular past tense interpretation and an interpretation very close to that of a past perfect (albeit in the case of a past perfect interpretation, the intermediate t' must be a *salient* reference time, whereas this is not required, though possible, for our simple past tense interpretations). At first sight, this seems like a counterintuitive complication of the meaning of past tense. However, empirically, this additional relative non-future semantics of the past tense morpheme actually receives support. There are contexts in which a speaker may choose to use a simple past-tensed sentence even though the interpretation she wants to trigger is actually more comparable to a past perfect one and, thus, t^2 is to be interpreted to precede t' . One such context is the following:

- (16) a. Did Susan go to today's 4pm class?
 b. No, she left for Spain.

The intended interpretation of (16b) is one that places Susan's leaving for Spain *prior to* 4pm today. The intermediate time interval t' here may act as a reference time in the sense of [Reichenbach \(1947\)](#).

We speculate that most likely due to pragmatic blocking effects, this ambiguity of past tense usually remains unnoted in unembedded sentences as the same information can, more transparently, be expressed via a past-perfect construction. Hence, the question arises why single past tense should be able to give rise to such usages in the first place. It could in principle very well be the case that any interpretation where t^2 precedes rather than overlaps t' is pragmatically blocked. Interestingly, however, the preference to use past perfect over simple past tense in contexts like (16) seems to decline with time, as has been shown in literature on language change (e.g., [Bowie, Wallis, & Aarts, 2013](#); [Gorrell, 1995](#); [Michaelis, 1998](#)). For instance, [Bowie et al. \(2013\)](#) reports a significant decline of the past perfect across contexts (−34% per-million-words frequency across two subcorpora⁴), mostly at the expense of present perfect and simple past tense forms. Closer analysis of the relevant contexts lets them conclude that there seems to be an “increasing tendency to choose the past non-perfect [i.e., simple past] in main clauses, relative clauses, and temporal clauses [where, historically, past perfect was used]” ([Bowie et al., 2013](#)). The observation that the simple past tense can convey interpretations that in earlier days were arguably only expressed by past perfects is fully in line with our proposed past tense semantics. In (17) we present some examples from [Bowie et al. \(2013\)](#) where the more transparent past perfect tense traditionally would have been used but now is not.

- (17) a. They sent one to my mother after she *died* or something.
 b. so I just took uh some of the tablets you *gave* me and it cleared up within two days [*Context indicates the giving of the tablets preceded their taking by as much as a year.*]

Contexts such as (16) as well as the examples cited from the literature on language change in (17) lend plausibility to a past tense semantics that explains both usual past tense usages and usages that are closer to a past perfect. Although further work should establish the exact semantic restrictions which enable/prevent the interchangeability between simple past and past perfect forms in a given context, we take this data as tentative support for an underspecification account of past tense.⁵

2.2 Accounting for sequence of tense

In this section, we show that the proposed past-tense semantics renders a mechanism that explains the systematic ambiguity between the simultaneous and the backward-shifted usages

⁴[Bowie et al. \(2013\)](#) investigates the change in usage of the (general) perfect in spoken standard British English based on the *Diachronic Corpus of Present-day Spoken English (DCPSE)*, a spoken, mainly British, English corpus. The corpus is comprised of two subcorpora, the *London–Lund Corpus (LLC)* and the *British Component of the International Corpus of English (ICE-GB)*, collected several decades apart, i.e., 1950s–1970s and 1990s, respectively, which enables the study of language change across this time interval.

⁵It is a known fact that in past perfects, both the topic time and the event time can be targeted by temporal adverbs: In *Yesterday at 5, John had (already) arrived*, the arriving event took place before 5, while in *John had arrived at 5 pm. yesterday* the arriving event took place at 5. One would then expect that the same would hold for our simple past constructions, but *At 5, Mary was at home* can’t be true if Mary left home again before 5. However, we take these adverbials not to target the topic/event times directly, but rather the VPs that contain them. Past perfects have two VPs (one projected by the auxiliary, one by the main verb); simple pasts only contain one VP (projected by the main verb). Therefore, simple pasts can only have the event time modified by temporal adverbials.

of past-under-past embeddings without postulating past-tense meaning deletion. The crucial advantage of this approach over other syntactic-semantic approaches of SoT is then that it does away with the assumption that the two usages are truth-conditionally distinct, an assumption which has recently been called into question by [Altshuler and Schwarzschild \(2012\)](#); [Altshuler \(2016\)](#). In contrast to most of the literature (modulo [Altshuler & Schwarzschild, 2012](#); [Altshuler, 2016](#)), the proposal introduced here thus retains a one-to-one mapping between past tense form and meaning, a feature which makes it desirable from a compositional semantic point of view.

As a starting point for the analysis of sentences that contain more than one instance of past tense morphology, we follow [Zeijlstra \(2012\)](#), who proposes that the number of covert operators is regulated by economy principles: We assume that a covert operator (here *Op-PAST*) may only be included when grammatically necessary. Since a single covert past tense operator can in principle check off all of the uninterpretable past tense features in its syntactic domain via multiple agree—like any other covert operator—, a sentence with a past tense morpheme in both the matrix and an embedded clause requires the presence of only one past tense operator. In (18), Zeijlstra’s economy constraint thus entails that one *Op-PAST* will check all present [uPAST] features and no further *Op-PAST* may be included. Only when two [uPAST] features appear in different syntactic domains is the inclusion of a second *Op-PAST* allowed, and even necessary, as we will see later on.

The fact that only one past operator is required for the analysis of past-under-past constructions, together with the relative non-future semantics we attribute to past tense morphology, explains why every past tense embedded under another past tense is compatible with both a simultaneous and a backward-shifted usage. Such a configuration yields a totally ordered set of tense nodes from the matrix past operator to the most embedded past tense⁶:

(18) John said Mary was ill.

a. [*Op-PAST*_[iPAST] [-ed_[uPAST] [John say [-ed_[uPAST] [Mary be ill.]]]]]
 $\exists t' < t_u$ $\exists t^2 \leq t'$ $\exists t^3 \leq t^2$

b. $\exists t' < t_u$ & [$\exists t^2 \leq t'$ & say(John, t^2 , [$\exists t^3 \leq t^2$ & be-ill(Mary, t^3))]]

c. *John’s saying is strictly before the utterance time t_u and Mary’s being ill starts out no later than at the time of John’s saying.*

As was the case for mono-clausal sentences, the covert past tense operator in (18) places the sentence proposition at some time $t' < t_u$, providing the head of the tense chain. Both instances of past tense morphology semantically express a relative non-future with respect to their closest c-commanding tense node. The time t^2 is interpreted as a relative non-future with respect to t' , and t^3 constitutes a relative non-future with respect to t^2 . The backward-shifted usage of (18) then arises in case that $t^3 < t^2$, while the simultaneous interpretation is yielded for $t^3 = t^2$. The systematic availability of both usages for past-under-past constructions thus receives a principled explanation in terms of semantic underspecification and

⁶Note that for purposes of illustration we take *say* to be extensional here, though we are completely aware that it is actually an intensional predicate (see Section 3, as well as, e.g., [Pearson, 2015](#) and references therein). Nothing in our analysis hinges on that, though.

not in terms of LF-ambiguity in this way. It also immediately follows that a forward-shifted usage—in which t^3 would be temporally located between t^2 and t_u —cannot be derived since our approach only takes every past tense morpheme to refer to a time interval no later than the closest c-commanding evaluation time.

2.3 Evaluating the proposal

2.3.1 Future reference of past tense morphology in other configurations

The previous section has shown that our account yields the correct results for standard SoT sentences: It derives the simultaneous and the backward-shifted, but crucially not the forward-shifted usages of past-under-past embeddings. We have also proven that the proposal still makes correct predictions for mono-clausal past-tensed sentences. Nevertheless, any theory of SoT additionally has to account for more complex cases of temporal embeddings, e.g. special cases in which an embedded past tense morpheme does receive a future-oriented interpretation or an interpretation that seems to be temporally independent from the closest evaluation time. This subsection and the next are devoted to demonstrating how our approach deals with such challenging SoT sentences, starting with the behavior of past tense in complement clausal embeddings, and moving on to the interpretation of past tense in (non-)restrictive relative clauses and certain cases involving ellipsis.

Future reference in past-under-past configurations involving *woll*

We begin with the well-established observation that—seemingly in contrast to what was said above—past-embedded past tense *can* in fact sometimes make reference to a time interval that strictly succeeds the matrix time in English. Examples of such future-reference past tense uses include the following:

- (19) John said he would buy a fish that *was* still alive. (Ogihara, 1989)
- (20) He decided a week ago that in ten days he would say to his mother that they *were* having their last meal together. (Abusch, 1988)

In its most prominent usage, the most embedded past tense forms, i.e., *was* and *were*, express simultaneity with respect to the time of buying and the time of saying, respectively. The challenge such examples pose to SoT accounts stems from the fact that these times have been shifted to a time later than the matrix time by means of *would* (see, e.g., Abusch, 1988, 1997; Ogihara, 1989, 1995). As a result, *was* and *were*, even though carrying past tense morphology, receive a future-reference interpretation with respect to the matrix time.

Importantly, for temporal configurations as in (19) and (20) future-reference interpretations are possible, and are the most prominent ones. Yet, in the absence of temporal modifying adverbs, such as *still* in (19), the order of events is first and foremost underspecified. For example, without the temporal modifier *still*, sentence (19) could be felicitously uttered in case the fish is alive at the time of buying, in case it was alive shortly before the buying event but after the saying event, or arguably even in case it was alive prior to the

- b. $\exists t' < t_u \ \& \ [\ \exists t^2 \leq t' \ \& \ \text{decide}(\text{he}, t^2, [\ \exists t^3 > t^2 \ \& \ \text{say-to-his-mother}(\text{he}, t^3, [\ \exists t^4 \leq t^3 \ \& \ \text{be-having}(\text{they}, \text{last meal together}, t^4)]))]]]]$
- c. *There is a time t^4 which is the time of their last meal, and t^4 starts no later than some time t^3 . The time t^3 is the time of his saying and lies strictly after t^2 , i.e., the time of his deciding. t^2 is prior or equal to t' which, in turn, is a time strictly before the utterance time t_u .*

Even when neglecting the temporal modifiers, which unambiguously place the time of the meal in the future, the formula derived from the tense nodes within the sentence already shows that the time of the meal is not restricted to a past interval. As it is ordered relative to the forward-shifted time of the saying event, the time of the meal can lie strictly after t_u ⁹.

Future reference in past-under-past configurations without *woll*

Another set of challenging data which evoke a future interpretation for a past-embedded past tense in a complement sentence consists of sentences like the following:

- (24) He hoped she *tried* to kill him first. (Klecha, 2016)

The novel challenge posed by these examples is that they have an interpretation akin to that of (19) and (20), even though they do not contain an overt future-shifter, like *woll*. Naturally, if you can still hope, you have not been killed yet, meaning that, temporally, the hoping event expressed in (24) takes place prior to the potential killing event. Klecha (2016) argues that the availability of such an independent future-shifted interpretation of the embedded past tense is restricted to predicates that already have an inherent modal future orientation built into their semantics, like *hope* or *pray*. By contrast, Klecha proposes that predicates like *think* impose an upper limit on the temporal possibilities of their prejacent and therefore the temporal possibilities of their complement clauses (*Upper Limit Constraint* (ULC); Abusch, 1997).

Klecha's (2016) implementation of this insight relies on the observation that future-oriented attitudes like *hope* deviate from other, non-future-oriented attitudes like *think*, in the choice of modal base pronouns they may combine with. Modal bases determine the set of worlds which are accessible from a given point in time (Kratzer, 1981, 1991), and Klecha claims that only two different modal bases exist: a doxastic one, which imposes an upper limit on its prejacent's temporal orientation via quantifying over *actual* histories, and a circumstantial one, which does not impose such a limit and instead maps the prejacent's time and a history to the set of all possible *future* histories departing from that time. Crucially, Klecha argues that attitude verbs like *think* may only combine with a doxastic modal base, whereas *hope* and *pray* may also combine with a circumstantial modal base, explaining the possible forward-shifted interpretations of their complement clauses. For Klecha it is not the case that those predicates introduce a forward shifted reference time; The element responsible

⁹Note that for (20), the backward-shifted relation between the most embedded past tense and its c-commanding tense node (i.e., the time of saying) appears to absent. This is however is due to additional aspectual information, namely imperfective aspect on *having*). Since disambiguation is achieved through aspect and not tense, such blocking does not provide a problem for the proposed analysis but rather shows how underspecification can be resolved in practice.

for the forward-shifted interpretation is the tense marker in the embedded clause, which is underlyingly a present tense that is only morpho-phonologically realized as a past tense. Every present tense then is actually a non-past, and given that *hope* and *pray* are the only predicates whose finite complements are compatible with a forward-shifted interpretation, these are the only predicates under which (underlying) present tenses in their complements do not have to give rise to a simultaneous usage.¹⁰

Our proposal is not in line with Klecha’s (2016) view, as our embedded past tense morpheme is a relative non-future. For this, we need predicates like *hope* and *pray*, as well as other circumstantial modals, to introduce a forward-shifted reference time (as proposed in Abusch, 2004; Condoravdi, 2002). Klecha criticizes such an approach by arguing that it predicts both follow-ups in (25) below to be fine (as there would be a forward shifted reference time to which the embedded tense morphemes can be evaluated), even though only (25b) is.

- (25) Mary may leave tomorrow, but she hasn’t decided yet. John won’t find out either way until he gets back home the day after.
- a. He’s going to get back home on Tuesday, and *I hope she left when he gets back.
 - b. He’s going to get back home on Tuesday, and I hope she has left when he gets back.

However, the ungrammaticality of (25a) need not be due to the unavailability of a forward-shifted tense. It could also be the result of a conflict between the choice of two different tense markers in the embedded clause (*she left* and *he gets back*) and the simultaneity effect that *when* triggers. If this is the case, then a sentence like (26), which includes a forward-shifted past tense form, but does not contain the simultaneity inference raised by *when*, should be judged significantly better than (25a), and on par with (25b).

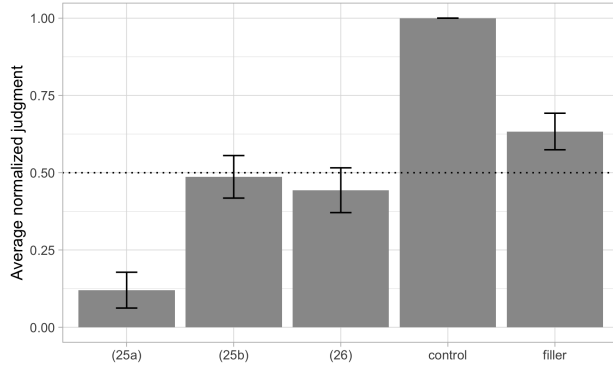
- (26) He’s going to get back home on Tuesday, and I hope she left before he gets back.

To test this hypothesis, we ran a small pilot survey ($n = 25$, after applying exclusion criteria; see Appendix A.1.1 for details) in which we asked participants on Amazon’s Mechanical Turk (MTurk) for the acceptability of the sentences in (25)-(26), as well as for a grammatical control sentence (27a) and a filler sentence (27b):

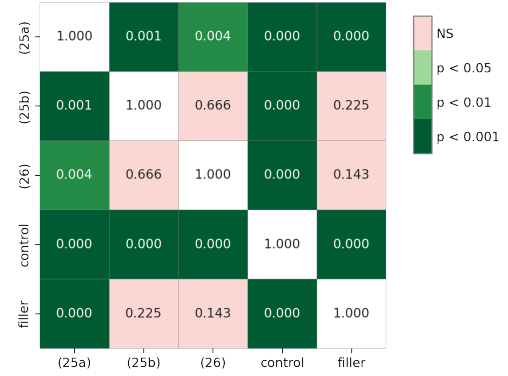
- (27) a. [control] He’s going to get back home on Tuesday, and I hope she leaves before he gets back.
- b. [filler] He’s going to get back home on Tuesday, and I hope she will have left before he gets back.

We find that participants indeed judged (26) to be as good as (25b) ($p > .05$ in posthoc paired t -test; Figure 1b). Furthermore, they rated both these sentences to be significantly

¹⁰Klecha assumes, following Kaufmann (2005), that matrix present tenses are embedded under an epistemic covert modal that gives rise to an ULC effect too, effectively rendering *hope* and *pray* the only modal contexts where present tense morphology may reveal its non-past nature. The latter may trigger a learnability problem as children should converge at the non-past interpretation of present tense morphology on the basis of examples like (24) only.



(a) Average judgments per item (judgments min-max normalized within subjects), error bars show standard error of the mean.



(b) Post-hoc ANOVA pairwise t-tests to test for statistical significance among sentences, Holm-corrected for multiple comparisons.

Figure 1: Results of MTurk pilot survey ($n = 25$). Participants judge sentence (26) to be as acceptable as (25b).

more acceptable than (25a) (both $p < .01$), which participants unanimously judged to be ungrammatical, as is predicted by prior literature.

Based on these pilot survey results, we tentatively argue that the contrast between (25)-(26) seems to not provide an argument against temporal forward-shifters, though we leave a full empirical study to future research. We therefore follow Abusch (2004); Condoravdi (2002) in assuming that circumstantial modals and with them predicates like *hope* and *pray* are able to introduce a forward-shifted time. The past tense morphology on *hope* in (24) then places the time of the matrix sentence prior to the utterance time. and *hope*, by itself, shifts the evaluation time of its complement proposition to a future point in time.

(28) He hoped she tried to kill him first.

- a. [*Op-PAST*_[iPAST] [-ed_[uPAST] [He hope [-ed_[uPAST] [she try to kill him
 $\exists t' < t_u$ $\exists t^2 \leq t'$ $\exists t^3 \geq t^2$ $\exists t^4 \leq t^3$
first]]]]]

As a result of the inherent future shift of predicates like *hope*, our analysis derives the correct meaning of the future-shifted sentences presented by Klecha (2016) similar to that of those in (19) and (20): Since the forward-shifted evaluation time t^3 is introduced in the matrix clause (which can lie strictly after the time of utterance t_u), the past tense morpheme on the verb *tried* orders its event time t^4 to be no later than t^3 , but not relative to t_u . As a result, it can also lie in the strict future of t_u . One caveat of the implementation we choose is that we also predict an unattested usage of (24) to be available, i.e. one in which the killing takes place prior to the hoping (e.g., in the case that $t^4 < t^3 = t^2 = t' < t_u$). Whereas the availability of such a temporal ordering is crucial for us in order to derive the correct semantics for sentences like (28) for the case under discussion we rely on pragmatics, e.g., the addressee’s knowledge that hoping requires not having been killed yet, to independently block such usages.

Future reference in past-under-future configurations

The last instance of embedded past tense morphology that receives a future interpretation which we discuss here pertains to cases where past tense is embedded under a future matrix predicate (29). Such past-under-future constructions can again give rise to different interpretations: It could be interpreted in a way such that the past tense is assigned its canonical ‘prior to time of utterance’-interpretation (29a). Nevertheless, the most prominent usage of (29) is one in which the past-marked action takes place *after* the utterance time (29b)—a usage that poses a challenge to many SoT theories.

- (29) Alan will think everyone hid.
- a. (Tomorrow) Alan will think everyone hid (yesterday).
 - b. (Tomorrow at 3pm) Alan will think everyone hid (tomorrow at 2pm).

An important observation when it comes to analyzing such sentences is that the tense shifter *woll* is instantiated as *will* in this context. This entails that *will* cannot carry a [uPAST] feature. As part of his economy principle, Zeijlstra (2012) proposes that an operator needs to be included in the closest possible position above the highest instance of the uninterpretable feature it checks. Since *will* does not carry a [uPAST] feature that *Op-PAST* could check (but rather a [uPRES] feature, discussed further in Section 4), the past-tense operator is included above the highest instance of [uPAST], i.e., in the complement clause. As a result, the underlying syntactic structure of (29), for now, must be the following (see also Heim, 1994):

- (30) [Alan will think [*Op-PAST*_[iPAST] [-ed_[uPAST] [everyone hide]]]]

Uncontroversially, we take the semantics of *will* to be the same as those for *would* (21), modulo the [uPAST] feature that restricts it to past environments. Hence, *will* shifts the evaluation time of its prejacant to a point in time which succeeds the evaluation time it receives as its input. Sentence (29) does not specify an evaluation time for *woll*’s relative argument *t*, e.g., by means of a modifying clause or an embedding predicate; The variable thus gets valued against its default value t_u . Under these assumptions, the correct interpretation of (29) is yielded in the following way:

- (31) Alan will think everyone hid.
- a. [Alan will think [*Op-PAST*_[iPAST] [-ed_[uPAST] [everyone hide]]]]
 $\exists t' > t_u$ $\exists t^2 < t'$ $\exists t^3 \leq t^2$
 - b. $\exists t' > t_u$ & think(Alan, t' , [$\exists t^2 < t'$ & $\exists t^3 \leq t^2$ & hide(everyone, t^3)])
 - c. *There is a time t' in the strict future of t_u and Alan thinks at t' that there is a time t^2 earlier than t' such that everyone from a contextually salient group hid at a point t^3 no later than t^2 .*

The evaluation-time shifter *will* takes scope over the past tense operator and changes the evaluation time t^* of *Op-PAST* to a time in the future. It is from this future-shifted point in time that the past marker *-ed* introduces a no-later-than relation between the hiding event

and the thinking event; no direct connection between the event time of the past-tensed predicate and t_u is thus established, which is why the hiding can lie in the strict future of t_u .

Note that if the operator *Op-PAST* entailed an absolute past ordering of the tense morphemes that it takes scope over with respect to the utterance time (i.e., if its denotation were $\llbracket \textit{Op-PAST} \rrbracket = \lambda P. \exists t < t_u \ \& \ P(t)$), sentences such as (29) could not be accounted for by our proposal. However, as seen in (13), the relation ‘prior to time of utterance’ is not cooked into the semantics of *Op-PAST*; Instead, the operator is defined as a *relative* past with respect to a time variable t^* , whose value may be t_u , but which can also refer to a time interval later than t_u when introduced by an independent source (such as in (31)).

2.3.2 Relative clauses

A further set of data for which embedded past tense morphology may evoke usages that are not anchored with respect to the evaluation time involves relative clauses. In certain relative clauses, as in example (32), the embedded past can be used for any of the following usages: a backward-shifted [b-s], a simultaneous [sim] and a forward-shifted [f-s] one. Both past tenses thus independently refer to a time interval prior to the time of utterance.

- (32) Mary met a woman who was president.
- a. In 2000, Mary met a woman who was president in 1995. [b-s]
 - b. In 2000, Mary met a woman who was president in 2000. [sim]
 - c. In 2000, Mary met a woman who was president in 2004. [f-s]

Whereas [Enç \(1987\)](#) observed that relative clause tenses differ from complement clause tenses in allowing an independent, or absolute interpretation, [Abusch \(1988\)](#) showed that this only applies to relative clauses in extensional contexts. In intensional contexts, relative clauses can only trigger a forward-shifted usage if they receive a *de re* interpretation (see also [Ogihara, 1989, 1996](#)). Under a *de dicto* construal, relative clauses behave similarly to complements of intensional contexts in only allowing a backward-shifted or simultaneous usage. In (33a – 33b), for example, both a *de re* and a *de dicto* interpretation are available, but in (33c), only a *de re* interpretation is yielded (see also [Heim, 1994](#); [Ogihara, 1995](#); [Stowell, 2007](#)):

- (33) Mary thought that she met a woman who *was* president.
- a. *De re/de dicto*: In 2000, Mary thought that she met a woman who was president in 1995. [b-s]
 - b. *De re/de dicto*: In 2000, Mary thought that she met a woman who was president in 2000. [sim]
 - c. *De re/*de dicto*: In 2000, Mary thought that she met a woman who was president in 2004. [f-s]

To account for the differences in (33), we follow [Stowell \(2007\)](#) who argues that the *de re/de dicto* distinction is structurally encoded in terms of the LF position of the relative clause: outside or inside the CP complement of the intensional verb. Concretely, we entertain the hypothesis that the past tense morpheme inside a relative clause that yields a *de dicto*

(35) Sam will offer a job to a/any candidate [who filled out an application the day before].

Hence, (32) must have two logical forms: one with a raised relative clause that is outside the agree domain of matrix tense *Op-PAST*, and one where the relative clause is present within the agree domain of matrix tense *Op-PAST*. Both (simplified) LFs for (32) are provided below:

(36) Mary met a woman who was president.

- a. [*Op-PAST*_[iPAST] -ed_[uPAST] Mary meet a woman] [who *Op-PAST*_[iPAST] $\exists t' < t_u$ $\exists t^2 \leq t'$ $\exists t'' < t_u$ -ed_[uPAST] be president] $\exists t^3 \leq t''$
- b. $\exists x$ [woman(x) & $\exists t' < t_u$. $\exists t^2 \leq t'$ [meet(Mary, x , t^2) & $\exists t'' < t_u$. $\exists t^3 \leq t''$ [president(x , t^3)]]]
- c. *There is a woman x and at t^2 , prior or equal to t' which, in turn, is a time strictly before the utterance time t_u , Mary met x , and at t^3 , prior or equal to t'' which, in turn, is a time strictly before the utterance time t_u , x is president.*

(37) Mary met a woman who was president.

- a. [*Op-PAST*_[iPAST] -ed_[uPAST] Mary meet a woman [who -ed_[uPAST] $\exists t' < t_u$ $\exists t^2 \leq t'$ $\exists t^3 \leq t^2$ be president]]
- b. $\exists t' < t_u$. $\exists t^2 \leq t'$ [meet(Mary, t^2 , [$\exists t^3 \leq t^2$. $\exists x$ [woman(x) & be-president(x , t^3)]])]
- c. *At t^2 , prior or equal to t' which, in turn, is a time strictly before the utterance time t_u , Mary is meeting a woman x , and at t^3 , prior or equal to t^2 , x is president.*

Thus, under the assumption that the position in which a relative clause needs to appear to receive a *de re* interpretation is a position from which its internal [uPAST] cannot be checked by [iPAST] on matrix *Op-PAST*, it follows directly that relative clauses with a *de re* construal in intensional contexts behave temporally independent from their matrix clauses.¹¹

2.4 Comparison with other sequence of tense approaches

So far in this section we have introduced an alternative account of SoT that relies on under-specified tense semantics instead of ambiguity at the level of LF, and we showed that it fares at least equally well with respect to the different challenges English poses to SoT accounts as existing proposals. Nevertheless, the fact that our account can explain the data does not in itself justify its correctness. Given the impressive canon of SoT literature, an important

¹¹Note that for us, unlike for Stowell (2007), it is not necessarily the DP that contains a relative clause that must move to a higher position at LF; also the relative clause itself can do so. This provides a solution for a problem pointed out by Kusumoto (2005) involving examples like *I tried not to hire anybody who put on a terrible performance* where the head noun of the relative clause must be c-commanded by the matrix verb (evidenced by the fact that it is a Negative Polarity Item), but where the tense of the relative clause is independent from matrix tense. That relative clauses can raise independently is well known and witnessed by cases involving relative clause extraposition (*Someone left a message whom we don't know*). The prediction is that such relative clauses can only be interpreted *de re*, which is indeed the case.

question to answer is how the proposal compares to existing ones and whether it provides new insights or even advantages.

2.4.1 Comparing underspecification- and ambiguity approaches

When comparing our analysis to existing ambiguity SoT approaches, an immediate advantage that emerges on the theoretical side is that we do not have to postulate a difference between a real past and a surface past, which is, underlyingly, a present tense in disguise (e.g., [Abusch, 1988](#); [Ogihara, 1989](#)), a zero tense (e.g., [Kratzer, 1998](#)), or something yet different. In order to account for the simultaneous usage of past-embedded past tense, most ambiguity analyses are forced to allow present tense morphemes to receive the morphological shape of a past tense morpheme under certain conditions (e.g. [Abusch, 1988](#); [Ogihara, 1989](#); [Kusumoto, 1999](#); [Stowell, 2007](#), and references therein), except [Kratzer \(1998\)](#), who embeds the assumption into the bigger picture of binding theory, where anaphors denote bound variables that inherit features of their antecedents at PF.

Via taking past tense morphology to be a relative non-future, the approach proposed in this paper can account for the same cases as the ambiguity proposals while retaining a clear one-to-one mapping between temporal form and temporal meaning. Further conceptual challenges for ambiguity proposals arise in light of questions such as why only past tense exhibits the proposed kind of ambiguity—and not present tense, too—, and why this putative homophony is a systematic, cross-linguistic phenomenon (see [Stowell \(2007\)](#) for further discussion).

In addition, empirically, potential advantages of our proposal reveal themselves in ellipsis configurations such as (38a), which are known to tease apart ambiguity and underspecification, or in conclusion sentences with coordinated subjects as given in (38b).

- (38) SCENARIO. At breakfast (earlier this morning), John said “Mary was ill a month ago,” and Bill said “Mary is ill now.”
- a. During breakfast, John said that Mary was ill and Bill did so, too.
 - b. Therefore, both John and Bill said that (at some point) Mary was ill.

Given the assumption of structural parallelism in ellipsis contexts, ambiguity approaches predict that (38a) may only be used in scenarios in which John and Bill both uttered the sentence *Mary is ill* or both uttered the sentence *Mary was ill*. This is because the LF of the elided clause must be identical to the LF in the antecedent. Since simultaneous and backward-shifted readings have different LFs in these approaches, the two readings should be the same for both clauses; They should both either yield a simultaneous reading or a backward-shifted reading. As a result, ambiguity approaches predict sentence (38a) to be unacceptable in the given scenario. Similarly, ambiguity approaches rule out the coordinated subject construction in (38b) as an adequate conclusion sentence in the provided context, since there exists a mismatch between the simultaneous report context set up by John’s utterance and the backward-shifted one set up by Bill’s utterance. Our proposal, on the other hand, rules them in principle in as an adequate conclusion. We predict temporally mixed usages to be available for both (38a) and (38b) (of course, in addition to the temporally

parallel ones). Hence, under the approach proposed in this paper, (38a) and (38b) should in principle be acceptable.¹²

We put the acceptability of sentences with coordinated subjects in scenarios such as (38b) to test in three-term reasoning experiment pilot study ($n = 24$, after applying exclusion criteria; see Appendix A.1.2 for experiment details). Our critical stimuli follow a 2-by-2 factorial design, crossing the factors *tense of first utterance* [PRESENT, PAST] and *presence of the temporal modifier “at some point”* [+ASP, -ASP]:

- (39) a. i. At breakfast, Ada said: “Mary was ill a month ago.” [PAST]
 ii. At breakfast, Ada said: “Mary is ill now.” [PRESENT]
 b. And Bea said: “Mary is ill now.”
 c. i. Therefore both Ada and Bea said that Mary was ill. [-ASP]
 ii. Therefore both Ada and Bea said that, at some point, Mary was ill. [+ASP]

Based on our theoretic account we hypothesize, contra ambiguity approaches, that past-tensed conclusion sentences are possible for utterances that talk about the same event using a mix of present and past tense. We also hypothesize that the acceptability of mixed-tensed utterances increases with the supplemental modifier clause “at some point”, as it renders the underspecification evident.

To test this hypothesis, we gathered data via Amazon’s Mechanical Turk for (i) 24 critical items, (ii) 6 control items, which followed the critical items in style but contained a past tense in the first utterance and a future tense in the second utterance; As in the critical items, the conclusion sentence contained a past tense (without the modifier at some point), and (iii) 48 filler items containing three-term reasoning scenarios including a variety of different relations. We then fit an ordinal mixed-effects logistic model with TENSE and MODIFIER as fixed effects and Subject and Item as random effects to our data. The model followed a maximal random-effects structures, i.e. included random intercepts and slopes for participants and items for both factors (Barr, Levy, Scheepers, & Tily, 2013). The model yielded a significant main effect of tense ($p < .01$), no main effect of modifier presence ($p > .05$), and a significant interaction effect ($p < .05$). These results indicate that using an underspecified past tense to conclude from temporally-mixed descriptions of the same event is dispreferred to using an SoT conclusion of the two utterances using a present tense to describe the same event. Nevertheless, the presence of the modifier significantly improves the acceptability of mixed-tensed utterances, rendering the mixed-tensed utterances statistically as acceptable as the uniformly-tensed ones (Two-sided Welch 2-sample t-test: [PRES, +ASP] vs. [PAST, +ASP]: $t = 1.80$; $p > .05$).

Furthermore, when comparing the scores assigned to the mixed-tensed items with those assigned to other conditions, such as control items or various filler items, it becomes evident that—though significantly less acceptable than the present-tense conditions—the mixed-

¹²Note that we do not predict that each and every example like the ones above will always have simultaneous and non-simultaneous usages; if the context is such that one of the usages is strongly dispreferred, only the other usage will emerge; however, unlike ambiguity approaches, our proposal predicts that both usages should become available when the context doesn’t rule out one of those.

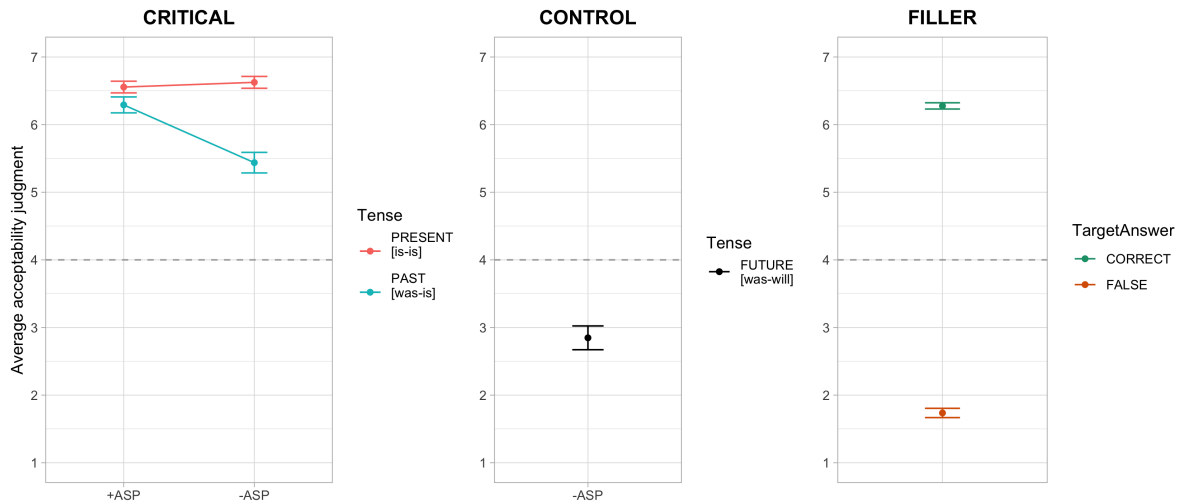


Figure 2: Results of three-term reasoning study ($n = 24$). Past-tensed conclusion sentences for fully present-tensed utterances sentences are significantly better than for past-present tensed ones, regardless of whether the conclusion sentence contains an under-specification modifier *at some point* (CRITICAL). However, past-tensed conclusion sentences without the temporal modifier (target condition) are rated significantly better in the PAST condition than in another temporally-mismatched structure *was-will* which cannot have an underspecified meaning (CONTROL) as well as better than false filler sentences (FILLER FALSE).

tensed critical items receive a high acceptability rating across the board: Our target condition, [PAST, -ASP], receives significantly higher acceptability ratings than a false control condition, which uses a past-tensed conclusion sentence to summarize a past- and a future-tensed description of the same event ([PAST, -ASP] vs. control items: $t = 10.83$; $p \ll .001$), as well as the bad filler items ([PAST, -ASP] vs. bad fillers: $t = 20.69$; $p \ll .001$). Our target condition was rated worse than the correct filler sentences ([PAST, -ASP] vs. good fillers: $t = -3.0$; $p < .01$), but in the presence of the modifier, scores for the mixed tense condition were better than for our good filler items ([PAST, +ASP] vs. good fillers: $t = 2.7$; $p < .01$). The fact that our good filler items did not receive a higher overall rating is likely explained by the greater difficulty in terms of mental load associated with these items, which is reflected in the right-skewed, but not fully polarized score distributions of these filler items (see A.2; A.3). Thus, even though this study showed that an underspecified use of past tense in conclusion sentences is not equally acceptable as its more canonical SoT usage, the results indicate that past-tensed conclusion sentences are rated as fairly acceptable by native speakers of English for utterances that talk about the same event using a mix of present and past tense. The empirical predictions that the underspecification approach makes are thus compatible with this empirical picture.

Given the theoretical and empirical advantages underspecification analyses exhibit over ambiguity approaches, we reject the hypothesis that SoT should best be explained in terms of LF ambiguity. Note that we are not the first ones to take a stand against this well-established ambiguity assumption, though. Altshuler’s (2016) and Altshuler and Schwarzschild’s (2012) pragmatic SoT proposal also assigns only one LF to both usages. As a next step, we shall, therefore, evaluate our analysis against theirs.

2.4.2 Comparison with existing non-ambiguity approaches

Like us, [Altshuler \(2016\)](#) and [Altshuler and Schwarzschild \(2012\)](#) assume that past-under-past embeddings of stative predicates do not give rise to a simultaneous and a backward-shifted usage. Unlike us, however, they propose that such configurations always, unambiguously, receive a backward-shifted interpretation and that a true simultaneous interpretation of past-embedded past tense does not exist. In fact, what is commonly referred to as the simultaneous usage of embedded past tense in the SoT literature for them only constitutes a canonical past usage that does not stand in competition with the present-tensed alternative of the same clause. Thanks to the lack of competition, they argue, such instances of past-tensed statives do not evoke their usual cessation implicature that the described state no longer holds, and therefore the perception of simultaneity arises.

To make the theory's core assumption more explicit, consider the following example.

(40) My heart was racing.

Even though nothing in the semantics of the sentence excludes the possibility that the author's heart is still racing at the time of utterance (under an existential theory of tense, the truth conditions of (40) are met as long as there exists some moment prior to t_u at which the author's heart was racing), we nevertheless understand that the described state no longer holds. According to [Altshuler's \(2016\)](#) and [Altshuler and Schwarzschild's \(2012\)](#) scalar theory of tense, this is the case since the utterance stands in Gricean competition with its present-tensed alternative *My heart is racing* ([Grice, 1975](#)).

Given such assumptions, now the question that arises for the scalar tense theory is why past tense morphology does not evoke cessation implicatures uniformly. For example, they have to explain why no cessation implicature is commonly calculated in the object clause of the following sentence.

(41) The doctor said my heart was racing.

As before, the answer lies in the clause's competition with its present-tensed alternative, i.e., *The doctor said my heart is racing*. As it turns out, this alternative cannot function as a competitor for (41), given the fact that it yields a double-access interpretation, and it is exactly in those cases in which it cannot do so that Gricean reasoning does not advance to the stage at which a cessation implicature is drawn and the sentence, even though backward-shifted in semantic terms, is perceived to convey simultaneity.

A crucial assumption for [Altshuler \(2016\)](#); [Altshuler and Schwarzschild \(2012\)](#) is that whenever a state holds at a point in time, it must necessarily also hold at another point in time, no matter how tiny, preceding it, something they refer to as *The temporal profile of statives and stative-like predicates (TPS)*. Thus, whenever a state holds at the time of utterance, it must also have held at a moment prior to it, meaning that a present-tensed stative always asymmetrically entails its past-tensed counterpart. Even though our proposal makes similar predictions as [Altshuler \(2016\)](#) and [Altshuler and Schwarzschild's \(2012\)](#) with respect to the non-ambiguity of different past-under-past usages, it is also substantially different. For the scalar theory, for example, the TPS is a necessary assumption for the

computation of a cessation implicature, as it places the present- and past-tensed version of stative clauses on a scale. At the same time, the TPS is not uncontroversial. It has been (implicitly) rejected in various existing semantic discussions of tense (see, e.g., the discussion of lifetime effects in Musan, 1997; Magri, 2009, 2011; Thomas, 2012 or the *earliest*-operator in Beaver & Condoravdi, 2003). Relatedly, the causal relation between the absence of cessation and a simultaneous usage has recently been called into question by Sharvit (2018) based on data from Hebrew and Greek, where particular expressions can be conveyed both via an embedded present and via an embedded past tense, i.e., cases where the cessation implicature is predicted to emerge but does not do so. By contrast, our approach does not raise these concerns.

Nevertheless, even if we were to accept the TPS hypothesis, Altshuler (2016) and Altshuler and Schwarzschild’s (2012) proposal would make different predictions from ours. Their proposal predicts that past-under-past embedded eventive predicates are always interpreted in a backward-shifted and not a simultaneous manner (as the TPS does not hold for eventives). Our proposal, by contrast, should allow for simultaneous and backward-shifted usages for both embedded eventive and embedded stative predicates—similar to many versions of the classical ambiguity theory, which also do not have stativity as a prerequisite for simultaneous usages. A possible point of evaluation between the two non-ambiguity proposals is therefore provided by the presence or absence of simultaneous usages of past-embedded eventive predicates. We believe that our proposal is indeed on the right track as the claim that no embedded past eventive may receive a simultaneous interpretation appears to be too strong for English.

That only stative predicates may receive a simultaneous usage has, for example, been refuted by Kusumoto (1999). She argues that examples such as (42) have a simultaneous usage even though they embed a past eventive verb:

(42) Elliott observed/noticed/perceived that Josephine *got* hurt.

(Kusumoto, 1999)

Simultaneous usages generally appear to be possible for verbs of perception (*observe/notice/perceive*), even though for some speakers a backward-shifted usage is still preferred.¹³ We take this to be due to the fact that in English, where there exists a grammaticalized imperfective-perfective distinction, perfective aspect in past-under-past constructions yields a preference for a backward-shifted usage. This is because the imperfective grammatical competitor (*Elliott observed that Josephine was getting hurt* or *Elliott observed Josephine getting hurt*) unambiguously triggers a simultaneous interpretation due to its stativity property, and thus provides a more transparent way to express the desired meaning. The fact that there exist such (aspectual) competitors in English, however, may suggest that the absence of the simultaneous usage in English past-under-past perfectives might be due to pragmatic blocking effects rather than being a property of past itself. The question then is why the simultaneous usage under perception verb is less sensitive to these pragmatic effects

¹³It was pointed out to us that predicates of communication may also have this effect: *The announcer said that John struck out* can mean ‘The announcer said: “John strikes out” next to ‘The announcer said: “John has struck out”’.

than other verbs. We tentatively presume that this has to do with the lexical semantics of perception verbs (in general, you perceive something at the time it is happening). However, irrespective of the question of why certain verbs appear to be more sensitive to these blocking effects than under other verbs, the crucial thing is that since simultaneous usages are possible for eventive predicates, tense semantics must in principle allow for them and not forbid them (as is the case in the system of [Altshuler & Schwarzschild, 2012](#); [Altshuler, 2016](#)).

All in all, this section has shown that the SoT approach proposed here not only explains the relevant data points of embedded tense in English but also has clear advantages over alternative existing SoT analyses.

3 Capturing our proposal in formal terms

Closely related to the question of how to capture the complex past (and present) tense meaning is the question how they should be formally implemented. Historically speaking, there exist two main lines of proposals for tense semantics: *Quantificational* analyses in the spirit of [Prior \(1967\)](#) assume that tense introduces existential quantification over points in time, thereby relating the predicate's (P) event time (t') to its evaluation time (t) in a specific way (e.g., for past tense: $\llbracket [\text{PAST } P] \rrbracket^t = \exists t'. t' < t \ \& \ P(t')$). *Pronominal* approaches in the spirit of [Partee \(1973\)](#), on the other hand, propose that tense is pronominal in nature and imposes presuppositional restrictions on its referents (e.g., for past tense: $\llbracket [\text{PAST}_i P] \rrbracket^{g,t} = P(g(i))$, defined if and only if $g(i) < t$).

So far we provided semi-formal analyses of the relevant examples in quantificational terms. Below, we show what the full-fledged formal analyses of such examples should look like (for the sentence *John said Mary was ill*). We do so for a simple past and a past-under-past construction, the two core examples we discussed in the previous section. The other examples can be analysed in much the same vein, and we will therefore not show these in detail here.

(43) Mary was ill.

LF: $[\text{TP}_{3<s,it>} \lambda w_0 [\text{TP}_{2<i,t>} \text{Op-PAST}_{[\text{iPAST}]<it,it>} [\text{TP}_{1<i,t>} \text{-ed}_{[\text{uPAST}]<it,it>} [\text{VP}_{<i,t>} \text{Mary be ill-}w_1]]]]$

a. $\llbracket \text{VP} \rrbracket^g = [\lambda t. \text{Mary be ill in } g(1) \text{ at } t]$

b. $\llbracket \text{TP}_1 \rrbracket^g = [\lambda t. \exists t'(t' \leq t \ \& \ \text{Mary be ill in } g(1) \text{ at } t')]$

c. $\llbracket \text{TP}_2 \rrbracket^g = [\lambda t. \exists t''(t'' < t \ \& \ \exists t'(t' \leq t'' \ \& \ \text{Mary be ill in in } g(1) \text{ at } t'')]$

d. $\llbracket \text{TP}_3 \rrbracket^g = [\lambda w. \lambda t. \exists t''(t'' < t \ \& \ \exists t'(t' \leq t'' \ \& \ \text{Mary be ill in in } w \text{ at } t'')]$

And so, in world w_0 and at time t_u :

e. $\llbracket \text{TP}_3 \rrbracket (w_0)(t_u) = 1 \text{ iff } \exists t''(t'' < t_u \ \& \ \exists t'(t' \leq t'' \ \& \ \text{Mary be ill in } w_0 \text{ at } t'')$

(44) John said Mary was ill.

LF: $[\text{TP}_{5<s,it>} \lambda w_0 [\text{TP}_{4<i,t>} \text{Op-PAST}_{[\text{iPAST}]<it,it>} [\text{TP}_{3<i,t>} \text{-ed}_{[\text{uPAST}]<it,it>} [\text{VP}_{3<i,t>} \text{John} [\text{VP}_{2<e,it>} \text{say-}w_0 [\text{TP}_{2<s,it>} \lambda w_1 [\text{TP}_{1<i,t>} \text{-ed}_{[\text{uPAST}]<it,it>} [\text{VP}_{1<i,t>} \text{Mary be ill-}w_1]]]]]]]]]]]]$

a. $\llbracket \text{VP}_1 \rrbracket^g = [\lambda t. \text{Mary be ill in } g(1) \text{ at } t]$

- b. $\llbracket \text{TP}_1 \rrbracket^g = [\lambda t. \exists t'(t' \leq t \ \& \ \text{Mary be ill in } g(1) \text{ at } t')]$
 - c. $\llbracket \text{TP}_2 \rrbracket^g = [\lambda w. \lambda t. \exists t'(t' \leq t \ \& \ \text{Mary be ill in } w \text{ at } t')]$
 - d. $\llbracket \text{VP}_2 \rrbracket^g = [\lambda x. \lambda t. \forall \langle w'', t'' \rangle \in \text{Dox}(x)(t)(g(0)) : \exists t'(t' \leq t'' \ \& \ \text{Mary be ill in } w'' \text{ at } t')]$
 - e. $\llbracket \text{VP}_3 \rrbracket^g = [\lambda t. \forall \langle w'', t'' \rangle \in \text{Dox}(\text{John})(t)(g(0)) : \exists t'(t' \leq t'' \ \& \ \text{Mary be ill in } w'' \text{ at } t')]$
 - f. $\llbracket \text{TP}_3 \rrbracket^g = [\lambda t. \exists t'''(t''' \leq t \ \& \ \forall \langle w'', t'' \rangle \in \text{Dox}(\text{John})(t''')(g(0)) : \exists t' \leq t'' \ \& \ \text{Mary be ill in } w'' \text{ at } t')]$
 - g. $\llbracket \text{TP}_4 \rrbracket^g = [\lambda t. \exists t''''(t'''' < t \ \& \ \exists t'''(t''' \leq t'''' \ \& \ \forall \langle w'', t'' \rangle \in \text{Dox}(\text{John})(t''''(g(0)) : \exists t' \leq t'' \ \& \ \text{Mary be ill in } w'' \text{ at } t'))]$
 - h. $\llbracket \text{TP}_5 \rrbracket^g = [\lambda w. \lambda t. \exists t''''(t'''' < t \ \& \ \exists t'''(t''' \leq t'''' \ \& \ \forall \langle w'', t'' \rangle \in \text{Dox}(\text{John})(t''''(w) : \exists t' \leq t'' \ \& \ \text{Mary be ill in } w'' \text{ at } t'))]$
- And so, in world w_0 and at time t_u :
- i. $\llbracket \text{TP}_5 \rrbracket (w_0)(t_u) = 1$ iff $\exists t''''(t'''' < t_u \ \& \ \exists t'''(t''' \leq t'''' \ \& \ \forall \langle w'', t'' \rangle \in \text{Dox}(\text{John})(t''''(w_0) : \exists t' \leq t'' \ \& \ \text{Mary be ill in } w'' \text{ at } t'))$

Our pronominal approach is as follows. First, following much of the established pronominal tense literature, we assume that tenses are the temporal analogue of pronouns, referring to times whose reference is presuppositionally constrained (e.g., Heim, 1994; Kratzer, 1998; Sauerland, 2002). The function of *Op-PAST* is to shift the time of a complement clause XP to a time $g(1)$ that is presupposed to be prior to the current context time:¹⁴

$$(46) \quad \llbracket \text{Op-PAST}_i \text{ } XP \rrbracket^{g,t} = \llbracket XP \rrbracket^{g,g(1)}, \text{ defined iff } g(1) < t$$

As stated before, we assume *Op-PAST* to carry the syntactic feature [iPAST], which syntactically licenses the presence of one or more past tense morphemes, *-ed*—carrying [uPAST]—, in its syntactic domain.

We take the past tense morpheme *-ed* to be the spell-out of a complex lower head: It is mother to a partial temporal identity function and a tense pronoun. The temporal identity function, *RNF* (short for Relative Non-Future), which *-ed* invokes contributes a relative non-future presupposition to the semantics (48a).

$$(47) \quad \begin{array}{c} -ed_i \\ \wedge \\ \text{RNF}_{\langle i,i \rangle} \quad 2_i \end{array}$$

Jointly, the terminal nodes of the treelet *-ed* make up the past tense morpheme’s semantics as in (48c):

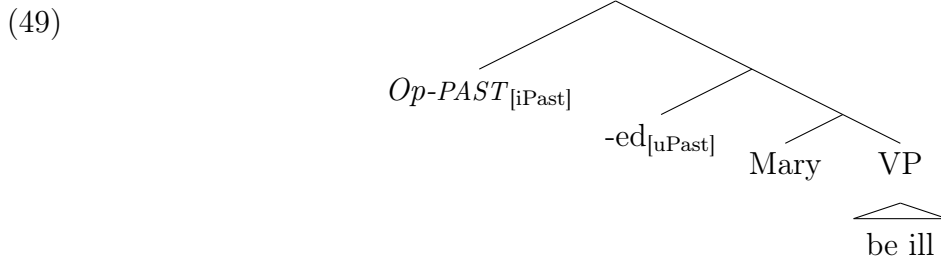
¹⁴Note that the denotation in (46) can be further decomposed into (45) to account for the temporal pronoun. Here, a past pronoun’s reference to past times is presuppositionally realized by *Past*, a partial identity function on the domain of times which combines with a tense pronoun 1 and returns its input time solely in case that it lies strictly prior to the contextually given evaluation time t . Then, we introduce *T-shift* into the denotation of *Op-PAST*, which is responsible for shifting the time:

$$(45) \quad \llbracket \text{Op-PAST } XP \rrbracket^{g,t} = \llbracket [[T\text{-shift } \text{Past}_1] XP] \rrbracket^{g,t} = g(1) < t. \llbracket XP \rrbracket^{g,g(1)}$$

- (48) a. $\llbracket \text{RNF} \rrbracket^{g,t} = \lambda t' : t' \leq t. t'$
 b. $\llbracket 2 \rrbracket^{g,t} = g(2)$
 c. $\llbracket -ed \rrbracket^{g,t} = g(2)$, defined iff $g(2) \leq t$

In a nutshell, we thus propose that *Op-PAST* takes a clause *XP* as its input and shifts its evaluation time *t* to a pronoun *g(2)* that is presupposed to be earlier than *t*, and each past tense morpheme *-ed* is a pronoun of type *i* that comes with a presupposition that it is no later than the *t*.

With these such assumptions, let's approach the previous examples again. A simple past-tensed sentence like *Mary was ill* receives the logical form as in (49) and, as a result, the meaning in (50).

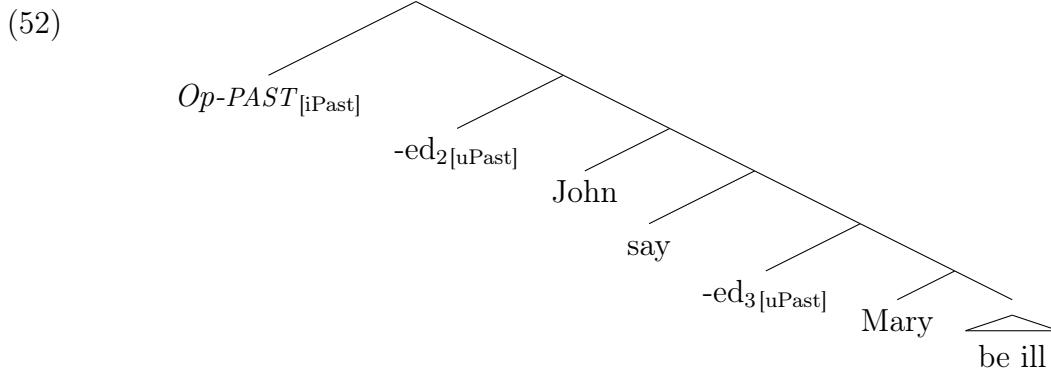


(50) $\llbracket (49) \rrbracket^{g,t} = \lambda w : g(2) \leq g(1) \wedge g(1) < t. \text{be-ill}(\text{Mary}, g(2), w)$

The semantics in (50) say that Mary is ill at a time interval *g(2)* that is presupposed to be earlier than the local context time *t*. This is indeed the meaning that pronominal approaches to tense assign to such a sentence, as well.

Assuming *say* to have the denotation in (51), the semantics spelled out in (46)–(48) yield the LF in (52) and the respective denotation in (53) for an SoT sentence like *John said Mary was ill*.

(51) $\llbracket [\text{say } XP] \rrbracket^g = \lambda x. \lambda t. \lambda w. \forall \langle w'', t'' \rangle \in \text{Dox}(x)(t)(w): \llbracket XP \rrbracket^g(w'')(t'')$



(53) $\llbracket (52) \rrbracket^{g,t} = \lambda w : g(2) \leq g(1) \wedge g(1) < t. \forall \langle w'', t'' \rangle \in \text{Dox}(\text{John})(g(2))(w): g(3) \leq g(2). \text{be-ill}(\text{Mary}, \text{at } g(3) \text{ in } w'')$

'John said prior to t_u that Mary's illness started no later than his saying time.'

Even though our proposal, including *T-shift*, is fully presuppositional, we would like to point out that it could also be implemented without any operational component: Such an alternative implementation of the same idea in pronominal terms may, for example, involve

making use of doubly-indexed pronouns (Ogihara & Sharvit, 2012; Sharvit, 2018; Bar-Lev, 2014).¹⁵

Either way, the proposal thus predicts the meaning of the sentence *John said Mary was ill* to be defined only if the time of John’s saying event is no later than some time interval in the past and Mary’s illness takes place no later than John’s saying. It thus correctly explains that the sentence is true in both a simultaneous and a backward-shifted context. As we have shown before, with these proposed meanings for *Op-PAST* and past tense morphology, all other relevant examples involving past-under-past embeddings follow as well.

In this section, we have argued that these examples can also be cashed out in pronominal terms without further complication. That is, our analysis is fully compatible with both quantification and pronominal approaches. We are, of course, not the first ones to propose a way to successfully analyze embedded tense phenomena in either framework; Ever since the proposal of contextual restrictions coupled with the quantificational force in a quantificational analysis or default existential operators that bind pronominal tenses, the empirical data presented in the literature in favor of a quantificational or pronominal view of tense have been explained under the respective other approach, as well (cf., e.g., Ogihara, 1989, 1995; von Stechow, 2002, 2009; Musan, 1997; Kusumoto, 1999, 2005).

Nevertheless, what we hope to show with this section is that (i) an underspecification approach of past tense does not hinge on the implementational variant chosen and that (ii) doing away with the assumption of LF-ambiguity, which has traditionally blocked the way for embedded tense phenomena to be interpreted straightforwardly in pronominal terms (cf. Abusch, 1997; Heim, 1994; Kratzer, 1998; von Stechow, 2009; Ogihara & Sharvit, 2012; Bar-Lev, 2014), allows for a straightforward pronominal implementation. In particular, pronominal LF-ambiguity theories historically had difficulties with accounting for backward-shifted readings in past-under-past configurations, as well as double-access readings in present-under-past configurations. The reason for this is their assumption that tense heads are referential: While the simultaneous reading of embedded past tense morphology can be derived fairly straightforwardly under such assumptions—by postulating some rule that allows the embedded tense pronoun to be interpreted as a bound variable and to inherit its morphological features from the matrix tense (cf. Heim, 1994; Abusch, 1997; Kratzer, 1998; von Stechow, 2009)—the backward-shifted/double-access reading is not derived as easily, since the embedded tense is assumed to carry referential semantics, as well. These referential semantics, however, can only be licensed in attitude contexts if the tense is interpreted *de re* (cf., e.g., Kratzer, 1998), meaning that there must exist some kind of mechanism

¹⁵According to this tradition, each tense is a pronominal expression that requires two times for its interpretation and, as a consequence, carries two indices. Crucially, the first index, denoting the event time, can be free, whereas the second, denoting the evaluation time, must be λ -bound. Under such assumptions, the following denotations for *Op-PAST* and *-ed* can be provided:

$$(54) \quad \llbracket Op-PAST_{i,j} \rrbracket^g = g(i), \text{ defined if and only if } g(i) < g(j)$$

$$(55) \quad \llbracket -ed_{k,l} \rrbracket^g = g(k), \text{ defined if and only if } g(k) \leq g(l)$$

Self-evidently, *Op-PAST* under such an approach no longer contains an operational component. At the same time, it can be easily verified that this implementation also generates equivalent usages to the one introduced above. Since the two implementations make equivalent predictions, we will keep with the single-indexed pronominal version for the rest of this section, mostly for ease of presentation.

that allows the embedded tense to move outside the scope of the attitude verb.

To the best of our knowledge, two successful implementations of such a mechanism exist, but both of them are not trivial in the sense that they have to assume additional technical machinery. As a standard, pronominal approaches allude to *res-movement* in order to derive the backward-shifted reading (Heim, 1994; Abusch, 1997). The *res* tense is hereby moved outside of the embedding predicate’s scope to an extra argument position of the verb, making it viable to be interpreted with respect to the time of utterance. Even though this rescue strategy is commonly applied, shortcomings of this operation—e.g., *res-movement* is from an A-bar position to an A-position (violating the ban on improper movement), does not leave a trace, and requires you to have a relational meaning for the attitude predicate in addition to the ‘regular’ one—have been long acknowledged in the literature (Heim, 1994) and further discussed since (e.g. Percus & Sauerland, 2003; Cable, 2015), casting doubt on the legitimacy of this operation. An alternative is to introduce *concept generators* into the semantics, i.e., additional technical machinery argued to be independently motivated by the analysis of other directly referential expressions in attitude contexts, such as proper names (e.g. Percus & Sauerland, 2003). In addition to their own technical assumptions, both rescue mechanisms furthermore rely on some implementation of Abusch’s Upper Limit Constraint (ULC) in order to exclude the forward-shifted reading two independently indexical past tenses create. As indicated before, the ULC states that the event time of the matrix clause provides an upper bound for the reference time of the embedded clause (Abusch, 1997; Heim, 1994, a.o.), prohibiting any reading in which the embedded event occurs later than the matrix event.¹⁶

4 Extending the proposal to present tense

Even though the alleged ambiguity of embedded past tense morphology has received a lot of attention in the literature, the present tense morphology puzzle has been discussed less extensively so far. In this section, we argue that both tense morphemes can be analyzed on a par.

We start our discussion of present tense morphology with a reminder of the puzzle it poses across different embedding contexts. For this, reconsider the sentences in (8), repeated for convenience in (57):

(57) a. John will say Mary is ill. [sim]

¹⁶We should note that our approach does not forbid such *de re* interpretations of embedded tense. As (Sharvit, 2018) has shown in recent work that in special circumstances a *de re* reading for embedded tense is still available (albeit not for all speakers). This is the case when the attitude holder assigns himself a false temporal location. Sharvit argues that in a situation where John knows that Mary is self-employed at that time, but where he mistakenly thinks it is January (whereas in reality it is February), for some, though not many speakers it is possible to say *John is saying that Mary was self-employed* when John at that time actually says ‘Mary is self-employed’ In that case, the past tense must feed a *de re* mechanism. Under our approach, the denotation for *say* should then be as in (56):

$$(56) \quad \llbracket \text{say } XP \rrbracket^{g,t} = \lambda x. \lambda t'. \lambda w. \forall \langle w'', t'' \rangle \in \text{Dox}(x)(t)(w): \llbracket XP \rrbracket^{g,t'}(w'')(t'')$$

If the embedded *de re* tense is understood as being accompanied by a time concept generator, the concept generator will need that *t''* argument in order to map the temporal concept it has generated from the temporal *res* to a relevant time in a given *say*-alternative.

b. John said Mary is ill. [d-a]

The crucial observation is that the present tense morphology on *is* has a different semantic effect in the two sentences: In (57a) it evokes a simultaneous (sim) interpretation of the embedded event, expressing that John will state that Mary is ill at the time of John’s saying event, but not necessarily the time of utterance. Sentence (57a) can thus be felicitously paraphrased as follows: *John, at some t later than t_u : “Mary is ill (now).”* In (57b), by contrast, the present tense receives a double-access (d-a) interpretation. This usage of present tense conveys that anyone takes the content of the attitude to be true believes that (i) Mary was ill at the time of his utterance and (ii) she is still ill now (Klecha, 2018). The two embedding environments in (57b) thus reveal that present tense morphology, like past tense morphology, must also be underspecified in meaning, since it can give rise to simultaneity effects and can make reference to the time of utterance.

To explain the observed behavior of present tense morphology, we propose a strategy along the lines of our proposal for past tense. We assume that present tense, too, consists of two ingredients: a covert present tense operator and a semantically active present tense morpheme that agrees with this operator. It was shown in Section 2 that past tense takes scope outside *VP*, evidencing that (past) tense is not interpreted in the base position of the past tense morpheme. As a result we assume also for present tense that, syntactically, each present tense morpheme carries an uninterpretable present feature [uPRES] to be checked by a covert present tense operator (*Op-PRES*) carrying the interpretable feature [iPRES]. Semantically, we make the following assumptions for the two ingredients. First, similar to our proposal for past tense morphology, each instance of present tense morphology (denoted for convenience by *-s* in the following) encodes simultaneity with respect to its respective evaluation time and thus functions as a relative meaning component of present tense. Simultaneity is hereby encoded in terms of time interval inclusion (where $t' \supseteq t$ means that the time interval t is included in or equal to t'):

$$(58) \quad \llbracket -s \rrbracket^{g,t} = g(2) \supseteq t. \quad g(2)$$

Next, the high, covert present tense operator (*Op-PRES*) encodes the ‘real’ present tense meaning and establishes an inclusion relation with respect to the utterance time t_u . Specifically, it introduces the presupposition that its complement clause’s reference time includes t_u :

$$(59) \quad \llbracket [Op-PRES \ XP] \rrbracket^{g,t} = t \supseteq t_u. \quad \llbracket XP \rrbracket^{g,t}$$

With these semantics in place, it can be shown that the proposal makes the correct predictions. Reconsider, for example, the mono-clausal present-tensed sentence *John is running*. With an LF akin to that (49), the following denotation is derived:

(60) John is running.

- a. $\llbracket [_{TP} Op-PRES_{[iPRES]} [_{v^*P} -s_{[uPRES]} [_{VP} \text{John be running}]] \rrbracket$
 - i. $\llbracket [_{VP}] \rrbracket^{g,t} = \lambda t. \lambda w. \text{be-running}(\text{John, at } t \text{ in } w)$
 - ii. $\llbracket [_{v^*P}] \rrbracket^{g,t} = \lambda w : g(2) \supseteq t. \text{be-running}(\text{John, at } g(2) \text{ in } w)$
- b.
 - iii. $\llbracket [_{TP}] \rrbracket^{g,t} = \lambda w : g(2) \supseteq g(1) \wedge g(1) \supseteq t_u . \text{be-running}(\text{John, at } g(2) \text{ in } w)$

Note that the conveyed reading is not that, at some point in the past, John said that Mary is ill at that time as well as at the time of the speaker’s utterance. It would be impossible for John to say such a thing. Rather a speaker conveys via a double-access construction that (i) John said that Mary was ill at the time of his saying and that (ii) if the content of John’s saying was true at that time, it should still be true at the current time of utterance. In our semantics, this is encoded in the presupposition that $g(3)$, the time of Mary’s illness, includes both John’s speech time as well as the time of utterance, according to the speaker. This way, Mary’s illness at the speech time is not an entailment of the double-access utterance. The critical presupposition can be canceled if, for instance, the speaker learns evidence to the contrary as in *John said Mary is ill. Guess he’s wrong.* (Ogihara, 1995).

Crucially, this semantics excludes readings in which reference to two different states of the same kind (e.g., two different illnesses in (63)) are made. This coincides with the well-established fact that double-access present-tense usages require the time of speaking and the time of utterance to be pragmatically close enough for anyone (and in particular the speaker of the utterance) to felicitously believe that the prejacent could hold at both times (Schlenker, 2004):

- (64) a. { Yesterday/?Last month/#2 years ago }, John said that Mary is pregnant.
 b. { A minute ago/#Yesterday }, Mary said that John is in the kitchen.

Our proposal differs from existing approaches that take present tense morphology to be only relative (Abusch, 1997; Ogihara, 1995), as they have trouble explaining the fact that it can receive both an indexical and a relative interpretation: While the simultaneous interpretation is easily accounted for under such approaches, the forward-shifted inference (that whoever believes the prejacent to hold necessarily believes it to still hold at t_u) should be ruled out given the Upper Limit Constraint (ULC). Klecha (2018) for this reason proposes that, strictly speaking, double-access utterances are not grammatical, but can rather be rescued *pragmatically* in case the time of utterance and the time of speaking are ‘close enough’, i.e., in case there is no reason to rationally distinguish between the time of utterance and the time of saying (as argued above). Allowing this level of temporal coarseness makes it possible to conflate the two times and thus pragmatically circumvents violation of the ULC, but it comes at the expense of having pragmatics undo ungrammaticality. However, our approach does not run into these issues in the first place: Because the ULC-effect is encoded directly in the meaning of the past tense morpheme (which we take to be a relative non-future), but not in the meaning of the present tense morpheme there is no such problem for us in deriving the double-access usages.¹⁷

In sum, our approach systematically assigns either a simultaneous or a double-access usage to embedded present tense morphology, while keeping the intuitive meaning of unembedded present tense intact. It provides a simultaneous usage when the matrix clause is headed by an *Op-PRES* operator, i.e., in present or future embeddings, and it provides present tense a double-access usage when it is embedded in an *Op-PAST*-headed clause.

¹⁷Again, just as in the case of past-under-present discussed in Section 3, it is still possible for the embedded present tense indexical to feed a *de re* mechanism to capture cases of false temporal location by the attitude holder. In that case, again the denotation for *say* as in (56) should be adopted.

5 Conclusion

In this paper, we provide a novel syntactic-semantic account for SoT, which does not rely on two truth-conditionally distinct LFs for the derivation of simultaneous and backward-shifted interpretations—a standard assumption in the SoT literature that has been called into question by, e.g., [Altshuler and Schwarzschild \(2012\)](#); [Altshuler \(2016\)](#). At the same time, we explain the systematic availability of both a simultaneous and a backward-shifted usage for past-under-past embeddings. We propose to disentangle the different meaning components of past tense via outsourcing its past meaning into a structurally high, covert past operator (*Op-PAST*) while encoding a relative non-future meaning into the past tense morpheme (*-ed*), which is syntactically dependent on the aforementioned operator. The two usages are thus licensed via the weak precedence relation past tense morphology semantically contributes. We show that this approach can deal with the same challenges as other SoT approaches and has certain additional advantages as well, such as retaining the one-to-one mapping between past tense form and past tense meaning.

We furthermore demonstrate that the proposal is extendable to present tense without further complications. Here, too, we propose, that tense is made up of two semantically active components, i.e., a covert operator which introduces the ‘real’ present tense semantics and a relative component, which establishes inclusion relations between the relevant predicate times and the evaluation times.

Lastly, the account proposed in this paper is built on a number of parameters (e.g. the no-later-than semantics of past tense morphemes, *Op-PAST* being a relative past operator, etc.), which, taken together, yields our analysis of past-under-past embeddings. The existence of such parameters opens up a space for variation, which in principle should account for cross-linguistic differences attested with respect to SoT. A proper investigation of the space of variation in this domain is subject for future research.

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A Appendix

A.1 Methods

A.1.1 Pilot study: Forward-shifters

Subjects. We recruited 50 participants via Amazon’s Mechanical Turk. To ensure data quality, we administered a number of exclusion criteria: Participants were excluded if **(a)** they self-reported that they were non-native speakers of English, **(b)** they failed to complete a given sentence prompt into a grammatical sentence (grammaticality was checked by the experimenters), and **(c)** if they assigned our grammatical control sentence a rating less than 5/5. These exclusion criteria were applied post-hoc, in addition to standard subject-selection criteria provided by Amazon’s Mechanical Turk (e.g., HIT approval rate $> 97\%$). Based on these exclusion criteria, we were able to include 25 subjects in the final analysis.

Materials and procedure. For this pilot study, we asked participants to judge the acceptability of 5 sentences on a Likert scale of 1 (horrible) to 5 (perfect) given a context of utterance.

CONTEXT.

Mary may leave John tomorrow, but she hasn’t decided yet. John won’t find out either way until he gets back home the day after. As I think John treats Mary very badly, I say:

(25a) He’s going to get back home on Tuesday, and I hope she left when he gets back.

(25b) He’s going to get back home on Tuesday, and I hope she has left when he gets back.

(26) He’s going to get back home on Tuesday, and I hope she left before he gets back.

control He’s going to get back home on Tuesday, and I hope she leaves before he gets back.

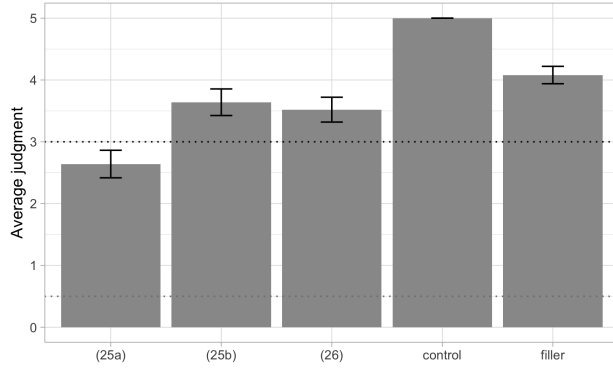
filler He’s going to get back home on Tuesday, and I hope she will have left before he gets back.

Data analysis. To account for variance in the use of scale between subjects, we normalized ratings within subjects using min-max normalization. We then calculate the average rating and errors from the mean from these scores. Note that these results do not alter our main finding, however (see Figure 3).

A.1.2 Experiment 1: Underspecified Past Tense Conclusion

Subjects. We recruited 40 participants via Amazon’s Mechanical Turk. To ensure data quality, we administered a number of exclusion criteria: Participants were excluded if **(a)** they self-reported that they were non-native speakers of English, and **(b)** they failed to assign a score ≤ 2 (out of 7) to at least 80% of the false filler sentences. These exclusion criteria were applied post-hoc, in addition to standard subject-selection criteria provided by Amazon’s Mechanical Turk (e.g., HIT approval rate $> 97\%$). Based on these exclusion criteria, we were able to include 24 subjects in the final analysis.

Design & Procedure. The experiment was designed as a three-term reasoning experiment. Our critical stimuli follow a 2-by-2 factorial design, crossing the factors *tense of first*



(a) Average judgments per item, error bars show standard error of the mean.



(b) Post-hoc ANOVA pairwise t-tests to test for statistical significance among sentences, Holm-corrected for multiple comparisons.

Figure 3: Unnormalized MTurk pilot study results (n=25)

utterance [PRESENT, PAST] and *presence of the temporal modifier “at some point”* [+ASP, -ASP]. All critical items use stative events.

(65) SAMPLE ITEM

- a. i. At breakfast, Ada said: “Mary was ill a month ago.” [PAST]
- ii. At breakfast, Ada said: “Mary is ill now.” [PRESENT]
- b. And Bea said: “Mary is ill now.”
- c. i. Therefore both Ada and Bea said that Mary was ill. [-ASP]
- ii. Therefore both Ada and Bea said that, at some point, Mary was ill. [+ASP]

Each participant saw **(i)** one version for each of the 24 critical items, **(ii)** 6 false control items, which followed the critical items in style but contained a past tense in the first utterance and a future tense in the second utterance; As in the critical items, the conclusion sentence contained a past tense (without the modifier *at some point*), and **(iii)** 48 filler items containing three-term reasoning scenarios including a variety of different relations (see Table 1). For each of the items in the study, participants were asked to rate the acceptability of the conclusion sentence (c. in the sample item) on a scale of 1 (totally unacceptable) to 7 (totally acceptable). To remind subjects of the task, conclusion sentences were highlighted in bold for each of the study items. At the beginning of the study, the task was explained via two examples (one in which the conclusion sentence was unacceptable and one in which the conclusion sentence was acceptable). To ensure that each critical item was only seen in one condition by each subject, we created 4 versions of the experiment, and tested each on 10 subjects. Randomized item lists were created using the Latin Square Design functionality from the `turktools` toolbox (Erlewine & Kotek, 2016). Lists were created such that all critical items were separated by at least 2 filler or control items.

Data analysis. Answer distributions for the critical items were analyzed in an ordinal logistic regression mixed-effects model using TENSE and MODIFIER as fixed effects, and Participant and Item as random effects, with a maximal random-effects structures (Barr

#items	relation	false:correct
6	above/below	1:1
6	in front of/behind	1:1
4	left/right	1:1
4	universal quantification	1:1
4	modus ponens	1:1
6	modus tollens	1:1
4	same city	1:1
4	same favorite color	1:1
6	close to	N.A.
6	neighbor of	N.A.

Table 1: Filler items

et al., 2013), i.e. including random intercepts and slopes for participants and items for both factors. Factors were sum-coded. The analysis was conducted in R, using the Cumulative Link Mixed Models `clmm` from the `ordinal` library (Christensen, 2022) with the formula `clmm(as.factor(Judgment) ~ tense*modifier + (1 + tense*modifier|Subject) + (1 + tense*modifier | Item), data)`. For the comparison of target item answer distributions with the answer distribution of filler items that had the target answer “correct”, we excluded vague items, without a clear right or wrong answer (*closeto* and *neighbor*).

A.2 Score distributions of filler items for Experiment 1

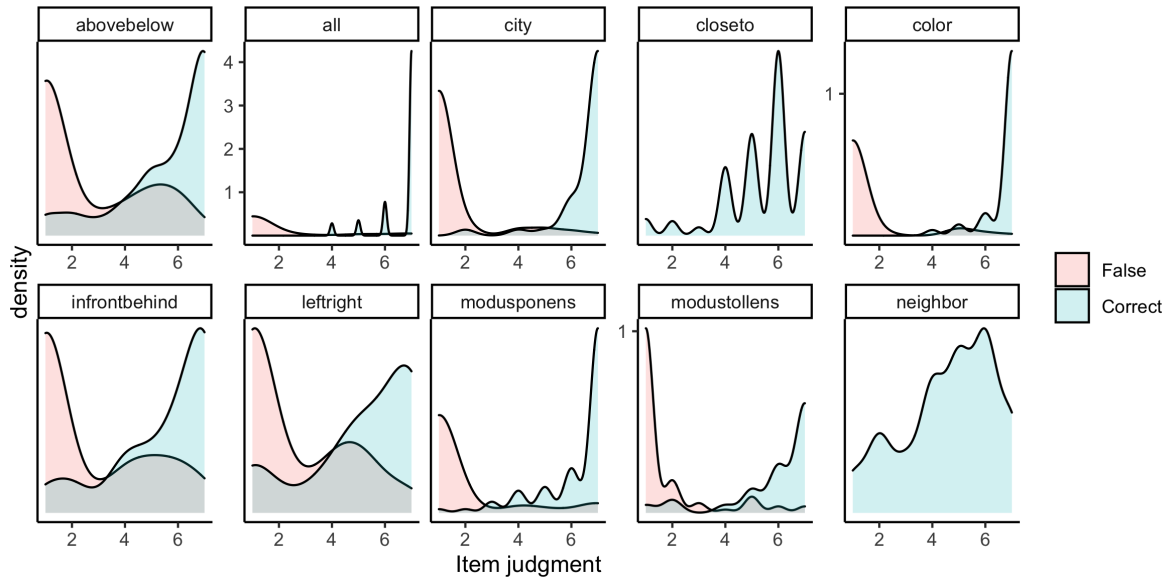


Figure 4: Score distributions of filler items in three-term reasoning study ($n = 24$).

A.3 List of items for Experiment 1

target 1 wasis-noasp

At breakfast, Ada said: "Mary was ill a month ago."

And Bea said: "Mary is ill now."

Therefore both Ada and Bea said that Mary was ill.

target 1 wasis-asp

At breakfast, Ada said: "Mary was ill a month ago."

And Bea said: "Mary is ill now."

Therefore both Ada and Bea said that, at some point, Mary was ill.

target 1 isis-noasp

At breakfast, Ada said: "Mary is ill now."

And Bea said: "Mary is ill now."

Therefore both Ada and Bea said that Mary was ill.

target 1 isis-asp

At breakfast, Ada said: "Mary is ill now."

And Bea said: "Mary is ill now."

Therefore both Ada and Bea said that, at some point, Mary was ill.

target 2 wasis-noasp

At breakfast, Ada said: "Peter was busy two days ago."

And Bea said: "Peter is busy now."

Therefore both Ada and Bea said that Peter was busy.

target 2 wasis-asp

At breakfast, Ada said: "Peter was busy two days ago."

And Bea said: "Peter is busy now."

Therefore both Ada and Bea said that, at some point, Peter was busy.

target 2 isis-noasp

At breakfast, Ada said: "Peter is busy."

And Bea said: "Peter is busy."

Therefore both Ada and Bea said that Peter was busy.

target 2 isis-asp

At breakfast, Ada said: "Peter is busy."

And Bea said: "Peter is busy."

Therefore both Ada and Bea said that, at some point, Peter was busy.

target 3 wasis-noasp

At breakfast, Ada said: "Elisa was pregnant two years ago."
And Bea said: "Elisa is pregnant now."
Therefore both Ada and Bea said that Elisa was pregnant.

target 3 wasis-asp

At breakfast, Ada said: "Elisa was pregnant two years ago."
And Bea said: "Elisa is pregnant now."
Therefore both Ada and Bea said that, at some point, Elisa was pregnant.

target 3 isis-noasp

At breakfast, Ada said: "Elisa is pregnant."
And Bea said: "Elisa is pregnant."
Therefore both Ada and Bea said that Elisa was pregnant.

target 3 isis-asp

At breakfast, Ada said: "Elisa is pregnant."
And Bea said: "Elisa is pregnant."
Therefore both Ada and Bea said that, at some point, Elisa was pregnant.

target 4 wasis-noasp

At breakfast, Ada said: "Nicole was class president two years ago."
And Bea said: "Nicole is class president now."
Therefore both Ada and Bea said that Nicole was class president.

target 4 wasis-asp

At breakfast, Ada said: "Nicole was class president two years ago."
And Bea said: "Nicole is class president now."
Therefore both Ada and Bea said that, at some point, Nicole was class president.

target 4 isis-noasp

At breakfast, Ada said: "Nicole is class president."
And Bea said: "Nicole is class president."
Therefore both Ada and Bea said that Nicole was class president.

target 4 isis-asp

At breakfast, Ada said: "Nicole is class president."
And Bea said: "Nicole is class president."
Therefore both Ada and Bea said that, at some point, Nicole was class president.

target 5 wasis-noasp

At breakfast, Ada said: "Carter was tired yesterday."
And Bea said: "Carter is tired now."
Therefore both Ada and Bea said that Carter was tired.

target 5 wasis-asp

At breakfast, Ada said: "Carter was tired yesterday."

And Bea said: "Carter is tired now."

Therefore both Ada and Bea said that, at some point, Carter was tired.

target 5 isis-noasp

At breakfast, Ada said: "Carter is tired."

And Bea said: "Carter is tired."

Therefore both Ada and Bea said that Carter was tired.

target 5 isis-asp

At breakfast, Ada said: "Carter is tired."

And Bea said: "Carter is tired."

Therefore both Ada and Bea said that, at some point, Carter was tired.

target 6 wasis-noasp

At breakfast, Ada said: "Taylor was hungry two hours ago."

And Bea said: "Taylor is hungry now."

Therefore both Ada and Bea said that Taylor was hungry.

target 6 wasis-asp

At breakfast, Ada said: "Taylor was hungry two hours ago."

And Bea said: "Taylor is hungry now."

Therefore both Ada and Bea said that, at some point, Taylor was hungry.

target 6 isis-noasp

At breakfast, Ada said: "Taylor is hungry."

And Bea said: "Taylor is hungry."

Therefore both Ada and Bea said that Taylor was hungry.

target 6 isis-asp

At breakfast, Ada said: "Taylor is hungry."

And Bea said: "Taylor is hungry."

Therefore both Ada and Bea said that, at some point, Taylor was hungry.

target 7 wasis-noasp

At breakfast, Ada said: "Mary was depressed yesterday."

And Bea said: "Mary is depressed now."

Therefore both Ada and Bea said that Mary was depressed.

target 7 wasis-asp

At breakfast, Ada said: "Mary was depressed yesterday."

And Bea said: "Mary is depressed now."
Therefore both Ada and Bea said that, at some point, Mary was depressed.

target 7 isis-noasp
At breakfast, Ada said: "Mary is depressed."
And Bea said: "Mary is depressed."
Therefore both Ada and Bea said that Mary was depressed.

target 7 isis-asp
At breakfast, Ada said: "Mary is depressed."
And Bea said: "Mary is depressed."
Therefore both Ada and Bea said that, at some point, Mary was depressed.

target 8 wasis-noasp
At breakfast, Ada said: "Paul was drunk two weeks ago."
And Bea said: "Paul is drunk now."
Therefore both Ada and Bea said that Paul was drunk.

target 8 wasis-asp
At breakfast, Ada said: "Paul was drunk two weeks ago."
And Bea said: "Paul is drunk now."
Therefore both Ada and Bea said that, at some point, Paul was drunk.

target 8 isis-noasp
At breakfast, Ada said: "Paul is drunk."
And Bea said: "Paul is drunk."
Therefore both Ada and Bea said that Paul was drunk.

target 8 isis-asp
At breakfast, Ada said: "Paul is drunk."
And Bea said: "Paul is drunk."
Therefore both Ada and Bea said that, at some point, Paul was drunk.

target 9 wasis-noasp
At breakfast, Ada said: "Megan was upset two days ago."
And Bea said: "Megan is upset now."
Therefore both Ada and Bea said that Megan was upset.

target 9 wasis-asp
At breakfast, Ada said: "Megan was upset two days ago."
And Bea said: "Megan is upset now."
Therefore both Ada and Bea said that, at some point, Megan was upset.

target 9 isis-noasp

At breakfast, Ada said: "Megan is upset."

And Bea said: "Megan is upset."

Therefore both Ada and Bea said that Megan was upset.

target 9 isis-asp

At breakfast, Ada said: "Megan is upset."

And Bea said: "Megan is upset."

Therefore both Ada and Bea said that, at some point, Megan was upset.

target 10 wasis-noasp

At breakfast, Ada said: "Rebecca was angry with her boyfriend a week ago."

And Bea said: "Rebecca is angry with her boyfriend now."

Therefore both Ada and Bea said that Rebecca was angry with her boyfriend.

target 10 wasis-asp

At breakfast, Ada said: "Rebecca was angry with her boyfriend a week ago."

And Bea said: "Rebecca is angry with her boyfriend now."

Therefore both Ada and Bea said that, at some point, Rebecca was angry with her boyfriend.

target 10 isis-noasp

At breakfast, Ada said: "Rebecca is angry with her boyfriend."

And Bea said: "Rebecca is angry with her boyfriend."

Therefore both Ada and Bea said that Rebecca was angry with her boyfriend.

target 10 isis-asp

At breakfast, Ada said: "Rebecca is angry with her boyfriend."

And Bea said: "Rebecca is angry with her boyfriend."

Therefore both Ada and Bea said that, at some point, Rebecca was angry with her boyfriend.

target 11 wasis-noasp

At breakfast, Ada said: "Nathan was in the hospital two weeks ago."

And Bea said: "Nathan is in the hospital now."

Therefore both Ada and Bea said that Nathan was in the hospital.

target 11 wasis-asp

At breakfast, Ada said: "Nathan was in the hospital two weeks ago."

And Bea said: "Nathan is in the hospital now."

Therefore both Ada and Bea said that, at some point, Nathan was in the hospital.

target 11 isis-noasp

At breakfast, Ada said: "Nathan is in the hospital."

And Bea said: "Nathan is in the hospital."

Therefore both Ada and Bea said that Nathan was in the hospital.

target 11 isis-asp

At breakfast, Ada said: "Nathan is in the hospital."

And Bea said: "Nathan is in the hospital."

Therefore both Ada and Bea said that, at some point, Nathan was in the hospital.

target 12 wasis-noasp

At breakfast, Ada said: "Ellie was very happy yesterday."

And Bea said: "Ellie is very happy now."

Therefore both Ada and Bea said that Ellie was very happy.

target 12 wasis-asp

At breakfast, Ada said: "Ellie was very happy yesterday."

And Bea said: "Ellie is very happy now."

Therefore both Ada and Bea said that, at some point, Ellie was very happy.

target 12 isis-noasp

At breakfast, Ada said: "Ellie is very happy."

And Bea said: "Ellie is very happy."

Therefore both Ada and Bea said that Ellie was very happy.

target 12 isis-asp

At breakfast, Ada said: "Ellie is very happy."

And Bea said: "Ellie is very happy."

Therefore both Ada and Bea said that, at some point, Ellie was very happy.

target 13 wasis-noasp

At breakfast, Ada said: "Peter was married three years ago."

And Bea said: "Peter is married now."

Therefore both Ada and Bea said that Peter was married.

target 13 wasis-asp

At breakfast, Ada said: "Peter was married three years ago."

And Bea said: "Peter is married now."

Therefore both Ada and Bea said that, at some point, Peter was married.

target 13 isis-noasp

At breakfast, Ada said: "Peter is married."

And Bea said: "Peter is married."

Therefore both Ada and Bea said that Peter was married.

target 13 isis-asp

At breakfast, Ada said: "Peter is married."
And Bea said: "Peter is married."
Therefore both Ada and Bea said that, at some point, Peter was married.

target 14 wasis-noasp
At breakfast, Ada said: "Nicole was in love a year ago."
And Bea said: "Nicole is in love now."
Therefore both Ada and Bea said that Nicole was in love.

target 14 wasis-asp
At breakfast, Ada said: "Nicole was in love a year ago."
And Bea said: "Nicole is in love now."
Therefore both Ada and Bea said that, at some point, Nicole was in love.

target 14 isis-noasp
At breakfast, Ada said: "Nicole is in love."
And Bea said: "Nicole is in love."
Therefore both Ada and Bea said that Nicole was in love.

target 14 isis-asp
At breakfast, Ada said: "Nicole is in love."
And Bea said: "Nicole is in love."
Therefore both Ada and Bea said that, at some point, Nicole was in love.

target 15 wasis-noasp
At breakfast, Ada said: "Carter was mad at his girlfriend yesterday."
And Bea said: "Carter is mad at his girlfriend now."
Therefore both Ada and Bea said that Carter was mad at his girlfriend.

target 15 wasis-asp
At breakfast, Ada said: "Carter was mad at his girlfriend yesterday."
And Bea said: "Carter is mad at his girlfriend now."
Therefore both Ada and Bea said that, at some point, Carter was mad at his girlfriend.

target 15 isis-noasp
At breakfast, Ada said: "Carter is mad at his girlfriend."
And Bea said: "Carter is mad at his girlfriend."
Therefore both Ada and Bea said that Carter was mad at his girlfriend.

target 15 isis-asp
At breakfast, Ada said: "Carter is mad at his girlfriend."
And Bea said: "Carter is mad at his girlfriend."
Therefore both Ada and Bea said that, at some point, Carter was mad at his girlfriend.

target 16 wasis-noasp

At breakfast, Ada said: "John was sick three weeks ago."

And Bea said: "John is sick now."

Therefore both Ada and Bea said that John was sick.

target 16 wasis-asp

At breakfast, Ada said: "John was sick three years ago."

And Bea said: "John is sick now."

Therefore both Ada and Bea said that, at some point, John was sick.

target 16 isis-noasp

At breakfast, Ada said: "John is sick."

And Bea said: "John is sick."

Therefore both Ada and Bea said that John was sick.

target 16 isis-asp

At breakfast, Ada said: "John is sick."

And Bea said: "John is sick."

Therefore both Ada and Bea said that, at some point, John was sick.

target 17 wasis-noasp

At breakfast, Ada said: "Samantha was in jail two months ago."

And Bea said: "Samantha is in jail now."

Therefore both Ada and Bea said that Samantha was in jail.

target 17 wasis-asp

At breakfast, Ada said: "Samantha was in jail two months ago."

And Bea said: "Samantha is in jail now."

Therefore both Ada and Bea said that, at some point, Samantha was in jail.

target 17 isis-noasp

At breakfast, Ada said: "Samantha is in jail."

And Bea said: "Samantha is in jail."

Therefore both Ada and Bea said that Samantha was in jail.

target 17 isis-asp

At breakfast, Ada said: "Samantha is in jail."

And Bea said: "Samantha is in jail."

Therefore both Ada and Bea said that, at some point, Samantha was in jail.

target 18 wasis-noasp

At breakfast, Ada said: "George was single a month ago."

And Bea said: "George is single now."
Therefore both Ada and Bea said that George was single.

target 18 wasis-asp
At breakfast, Ada said: "George was single a month ago."
And Bea said: "George is single now."
Therefore both Ada and Bea said that, at some point, George was single.

target 18 isis-noasp
At breakfast, Ada said: "George is single."
And Bea said: "George is single."
Therefore both Ada and Bea said that George was single.

target 18 isis-asp
At breakfast, Ada said: "George is single."
And Bea said: "George is single."
Therefore both Ada and Bea said that, at some point, George was single.

target 19 wasis-noasp
At breakfast, Ada said: "Dorothy was under arrest a year ago."
And Bea said: "Dorothy is under arrest now."
Therefore both Ada and Bea said that Dorothy was under arrest.

target 19 wasis-asp
At breakfast, Ada said: "Dorothy was under arrest a year ago."
And Bea said: "Dorothy is under arrest now."
Therefore both Ada and Bea said that, at some point, Dorothy was under arrest.

target 19 isis-noasp
At breakfast, Ada said: "Dorothy is under arrest."
And Bea said: "Dorothy is under arrest."
Therefore both Ada and Bea said that Dorothy was under arrest.

target 19 isis-asp
At breakfast, Ada said: "Dorothy is under arrest."
And Bea said: "Dorothy is under arrest."
Therefore both Ada and Bea said that, at some point, Dorothy was under arrest.

target 20 wasis-noasp
At breakfast, Ada said: "Bill was in rehab two months ago."
And Bea said: "Bill is in rehab now."
Therefore both Ada and Bea said that Bill was in rehab.

target 20 wasis-asp

At breakfast, Ada said: "Bill was in rehab two months ago."

And Bea said: "Bill is in rehab now."

Therefore both Ada and Bea said that, at some point, Bill was in rehab.

target 20 isis-noasp

At breakfast, Ada said: "Bill was is in rehab."

And Bea said: "Bill is in rehab."

Therefore both Ada and Bea said that Bill was in rehab.

target 20 isis-asp

At breakfast, Ada said: "Bill was is in rehab."

And Bea said: "Bill is in rehab."

Therefore both Ada and Bea said that, at some point, Bill was in rehab.

target 21 wasis-noasp

At breakfast, Ada said: "Mary was high two nights ago."

And Bea said: "Mary is high now."

Therefore both Ada and Bea said that Mary was high.

target 21 wasis-asp

At breakfast, Ada said: "Mary was high two nights ago."

And Bea said: "Mary is high now."

Therefore both Ada and Bea said that, at some point, Mary was high.

target 21 isis-noasp

At breakfast, Ada said: "Mary is high."

And Bea said: "Mary is high."

Therefore both Ada and Bea said that Mary was high.

target 21 isis-asp

At breakfast, Ada said: "Mary is high."

And Bea said: "Mary is high."

Therefore both Ada and Bea said that, at some point, Mary was high.

target 22 wasis-noasp

At breakfast, Ada said: "Robert was concerned yesterday."

And Bea said: "Robert is concerned now."

Therefore both Ada and Bea said that Robert was concerned.

target 22 wasis-asp

At breakfast, Ada said: "Robert was concerned yesterday."

And Bea said: "Robert is concerned now."

Therefore both Ada and Bea said that, at some point, Robert was concerned.

target 22 isis-noasp

At breakfast, Ada said: "Robert is concerned."

And Bea said: "Robert is concerned."

Therefore both Ada and Bea said that Robert was concerned.

target 22 isis-asp

At breakfast, Ada said: "Robert is concerned."

And Bea said: "Robert is concerned."

Therefore both Ada and Bea said that, at some point, Robert was concerned.

target 23 wasis-noasp

At breakfast, Ada said: "Nicole was doubtful two days ago."

And Bea said: "Nicole is doubtful now."

Therefore both Ada and Bea said that Nicole was doubtful.

target 23 wasis-asp

At breakfast, Ada said: "Nicole was doubtful two days ago."

And Bea said: "Nicole is doubtful now."

Therefore both Ada and Bea said that, at some point, Nicole was doubtful.

target 23 isis-noasp

At breakfast, Ada said: "Nicole is doubtful."

And Bea said: "Nicole is doubtful."

Therefore both Ada and Bea said that Nicole was doubtful.

target 23 isis-asp

At breakfast, Ada said: "Nicole is doubtful."

And Bea said: "Nicole is doubtful."

Therefore both Ada and Bea said that, at some point, Nicole was doubtful.

target 24 wasis-noasp

At breakfast, Ada said: "Faith was bored yesterday."

And Bea said: "Faith is bored now."

Therefore both Ada and Bea said that Faith was bored.

target 24 wasis-asp

At breakfast, Ada said: "Faith was bored yesterday."

And Bea said: "Faith is bored now."

Therefore both Ada and Bea said that, at some point, Faith was bored.

target 24 isis-noasp

At breakfast, Ada said: "Faith was bored yesterday."
And Bea said: "Faith is bored now."
Therefore both Ada and Bea said that Faith was bored.

target 24 isis-asp

At breakfast, Ada said: "Faith was bored yesterday."
And Bea said: "Faith is bored now."
Therefore both Ada and Bea said that, at some point, Faith was bored.

control 1 falsecontrol

At breakfast, Ada said: "Faith was bored yesterday."
And Bea said: "Faith will be bored tomorrow."
Therefore both Ada and Bea said that Faith was doubtful.

control 2 falsecontrol

At breakfast, Ada said: "Bill was ill two years ago."
And Bea said: "Bill will be ill tomorrow."
Therefore both Ada and Bea said that Bill was ill.

control 3 falsecontrol

At breakfast, Ada said: "Mary was pregnant a year ago."
And Bea said: "Mary will be pregnant in a year."
Therefore both Ada and Bea said that Mary was pregnant.

control 4 falsecontrol

At breakfast, Ada said: "Carter was ill two years ago."
And Bea said: "Carter will be ill tomorrow."
Therefore both Ada and Bea said that Carter was ill.

control 5 falsecontrol

At breakfast, Ada said: "Jim was single a year ago."
And Bea said: "Jim will be single next year."
Therefore both Ada and Bea said that Jim was single.

control 6 falsecontrol

At breakfast, Ada said: "Amelia was drunk last night."
And Bea said: "Amelia will be drunk tonight."
Therefore both Ada and Bea said that Amelia was drunk.

filler 1 fillerabovebelow

The Smiths live above the Taylors.
The Taylors live above the Whites.
Therefore the Smiths live above the Whites.

filler 2 fillerabovebelow

At breakfast, Ada said: "The Andersons live above the Browns."

And Bea said: "The Browns live above the Clarks."

Therefore Ada and Bea combined said that the Andersons live above the Clarks.

filler 3 fillerabovebelowfalse

The Coopers live above the Davis.

The Davis live above the Edwards.

Therefore the Edwards live above the Coopers.

filler 4 fillerabovebelowfalse

At breakfast, Ada said: "The Davidsons live above the Harris."

And Bea said: "The Harris live above the Johnsons."

Therefore Ada and Bea combined said that the Johnsons live above the Davidsons.

filler 5 fillerabovebelow

The Robinsons live above the Smiths.

The Smiths live above the Turners.

Therefore the Robinsons live above the Turners.

filler 6 fillerabovebelowfalse

At breakfast, Ada said: "The Taylors live below the Underwoods."

And Bea said: "The Underwoods live below the Whites."

Therefore Ada and Bea combined said that the Whites live below the Taylors.

filler 7 fillerinfrontbehind

At breakfast, Ada said: "Emma is walking in front of Frank."

And Bea said: "Frank is walking in front of Gwyneth."

Therefore Ada and Bea combined said that Emma is walking in front of Gwyneth.

filler 8 fillerinfrontbehindfalse

Henry is walking in front of Ida.

Ida is walking in front of James.

Therefore James is walking in front of Henry.

filler 9 fillerinfrontbehind

At breakfast, Ada said: "Paige is walking in front of Robert."

And Bea said: "Robert is walking in front of Samantha."

Therefore Ada and Bea combined said that Paige is walking in front of Samantha.

filler 10 fillerinfrontbehindfalse

Amelia is walking behind Bill.

Bill is walking behind Carol.
Therefore Carol is walking behind Amelia.

filler 11 fillerinfrontbehind

At breakfast, Ada said: "Isaac is walking behind Jessica."
And Bea said: "Jessica is walking behind Kevin."
Therefore Ada and Bea combined said that Isaac is walking behind Kevin.

filler 12 fillerinfrontbehindfalse

Liam is walking behind Nicole.
Nicole is walking behind Matthew.
Therefore Matthew is walking behind Liam.

filler 13 fillerleftright

The Smiths live to the left of the Taylors.
The Taylors live to the left of the Underwoods.
Therefore the Smiths live to the left of the Underwoods.

filler 14 fillerleftright

At breakfast, Ada said: "The Andersons live to the left of the Browns."
And Bea said: "The Browns live to the left of the Coopers."
Therefore Ada and Bea combined said that the Andersons live to the left of the Coopers.

filler 15 fillerleftrighfalse

At breakfast, Ada said: "Aaron is walking to the left of Brittany."
And Bea said: "Brittany is walking to the left of Carter."
Therefore Ada and Bea combined said that Carter is walking to the left of Aaron.

filler 16 fillerleftrighfalse

Emma is walking to the left of Frank.
Frank is walking to the left of Gwyneth.
Therefore Gwyneth is walking to the left of Emma.

filler 17 fillerall

All carrots are vegetables.
All vegetables are edible.
Therefore all carrots are edible.

filler 18 fillerall

At breakfast, Ada said: "All cows are mammals."
And Bea said: "All mammals are animals."
Therefore Ada and Bea combined said that all cows are animals.

filler 19 fillerallfalse
All children like apples.
All apples are fruits.
Therefore all fruits are apples.

filler 20 fillerallfalse
At breakfast, Ada said: "All bottles are made from plastic."
And Bea said: "All plastic is bad for the environment."
Therefore Ada and Bea combined said that all bottles are good for the environment.

filler 21 fillercloseto
The Smiths live close to the Taylors.
The Taylors live close to the Underwoods.
Therefore the Smiths live close to the Underwoods.

filler 22 fillercloseto
At breakfast, Ada said: "The Andrews live close to the Browns."
And Bea said: "The Browns live close to the Clarks."
Therefore Ada and Bea combined said that the Andrews live close to the Clarks.

filler 23 fillercloseto
The Millers live close to the Nelsons.
The Nelsons live close to the O'Briens.
Therefore the Millers live close to the O'Briens.

filler 24 fillercloseto
At breakfast, Ada said: "The Jacksons live close to the Logans."
And Bea said: "The Logans live close to the Morgans."
Therefore Ada and Bea combined said that the Jacksons live close to the Morgans.

filler 25 fillercloseto
The Clarks live close to the Davidsons.
The Davidsons live close to the Edwards.
Therefore the Clarks live close to the Edwards.

filler 26 fillercloseto
At breakfast, Ada said: "The Robinsons live close to the Smiths."
And Bea said: "The Smiths live close to the Taylors."
Therefore Ada and Bea combined said that the Robinsons live close to the Taylors.

filler 27 fillerneighbor
Kayla is the neighbor of Lauren.
Lauren is the neighbor of Megan.

Therefore Kayla is the neighbor of Megan.

filler 28 fillerneighbor

At breakfast, Ada said: "Noah is the neighbor of Owen."

And Bea said: "Owen is the neighbor of Peter."

Therefore Ada and Bea combined said that Noah is the neighbor of Peter.

filler 29 fillerneighbor

Carter is the neighbor of Dylan.

Dylan is the neighbor of Ethan.

Therefore Carter is the neighbor of Ethan.

filler 30 fillerneighbor

At breakfast, Ada said: "Amelia is the neighbor of Bill."

And Bea said: "Bill is the neighbor of Carol."

Therefore Ada and Bea combined said that Amelia is the neighbor of Carol.

filler 31 fillerneighbor

Carter is the neighbor of Dianne.

Dianne is the neighbor of Ethan.

Therefore Carter is the neighbor of Ethan.

filler 32 fillerneighbor

At breakfast, Ada said: "Faith is the neighbor of George."

And Bea said: "George is the neighbor of Hannah."

Therefore Ada and Bea combined said that Fatih is the neighbor of Hannah.

filler 33 fillermodusponens

If today is Tuesday, then John will go to work.

Today is Tuesday.

Therefore John will go to work.

filler 34 fillermodusponens

At breakfast, Ada said: "If the sky is blue, then it is not raining."

And Bea said: "The sky is blue."

Therefore Ada and Bea combined said that it is not raining.

filler 35 fillermodusponensfalse

If it is a car, then it has wheels.

It is a car.

Therefore it has no wheels.

filler 36 fillermodusponensfalse

At breakfast, Ada said: "If Beth has a current password, then she can log on to the network."
And Bea said: "Beth has a current password."
Therefore Ada and Bea combined said that Beth cannot log on to the network.

filler 37 fillermodulestollens
If today is Tuesday, then John is working.
John is not working.
Therefore it is not Tuesday.

filler 38 fillermodulestollens
At breakfast, Ada said: "If Paul is the axe murderer, then he can use an axe."
And Bea said: "Paul cannot use an axe."
Therefore Ada and Bea combined said that Paul is not the axe murderer.

filler 39 fillermodulestollensfalse
At breakfast, Ada said: "If Sally has a current password, then she can log on to the network."
And Bea said: "Sally cannot log on to the internet."
Therefore Ada and Bea combined said that Sally has a current password.

filler 40 fillermodulestollensfalse
If Peter lives in Boston, he lives in the USA.
Peter does not live in the USA.
Therefore Peter lives in Boston.

filler 41 fillercityfalse
The Smiths live in Berlin.
The Johnsons live in Munich.
Therefore the Smiths and the Johnsons live in the same city.

filler 42 fillercity
The Smiths live in Berlin.
The Johnsons live in Berlin.
Therefore the Smiths and the Johnsons live in the same city.

filler 43 fillercityfalse
At breakfast, Ada said: "The Browns live in New York."
And Bea said: "The Coopers live in Boston."
Therefore Ada and Bea combined said that the Browns and the Coopers live in the same city.

filler 44 fillercity
At breakfast, Ada said: "The Browns live in Boston."
And Bea said: "The Coopers live in Boston."
Therefore Ada and Bea combined said that the Browns and the Coopers live in the same city.

filler 45 fillercolorfalse

Ethan's favorite color is blue.

Emily's favorite color is red.

Therefore Ethan and Emily have the same favorite color.

filler 46 fillercolor

Ethan's favorite color is blue.

Emily's favorite color is blue.

Therefore Ethan and Emily have the same favorite color.

filler 47 fillercolorfalse

At breakfast, Ada said: "Lauren's favorite color is violet."

And Bea said: "Liam's favorite color is green."

Therefore Ada and Bea combined said that Lauren and Liam have the same favorite color.

filler 48 fillercolor

At breakfast, Ada said: "Lauren's favorite color is violet."

And Bea said: "Liam's favorite color is violet."

Therefore Ada and Bea combined said that Lauren and Liam have the same favorite color.