

# Sequence of Tense as Abstraction over Topic Time

*Seth Cable*

*University of Massachusetts, Amherst*

December 11, 2008

## 1. Introduction

### Central Claim:

‘Sequence of Tense’ (SOT) phenomena in English can be captured by a simple Reichenbachian semantics for tense *just so long as we permit lambda abstraction over topic times*.

### (1) Outline

- a. Section 1: Introduction  
Provides a basic description of the data of interest, within the framework of certain ontological and semantic assumptions.
- b. Section 2: A Basic Reichenbachian Semantics for Tense  
Presents a simple Reichenbachian semantics for tense, and shows that it is unable to capture the data of interest.
- c. Section 3: Capturing the Simultaneous Reading: Abstraction Over Topic Time  
Presents and motivates the central claim above.
  - (i) Argues that the ‘agreement analysis’ of SOT (Stowell 1995, Kusumoto 2005) is insufficient to account for the full range of facts.
  - (ii) Presents an augmentation of the basic Reichenbachian semantics from Section 2, whereby subordinate *topic times* can be abstracted over.
  - (iii) Demonstrates that the amended system can capture various basic facts regarding SOT phenomena.
- d. Section 4: Further Predictions of the Analysis  
Discusses a number of more complex facts regarding SOT phenomena, and argues that they too follow from the proposed account.

*In particular, discusses the dependency of SOT phenomena upon the aspect of the subordinate clause.*
- e. Section 5: Groping Towards an Understanding of Embedded Present in English  
Presents some speculative thoughts on how the proposed system can be extended to account for a key puzzle regarding embedded present tense in English.

(2) **The Phenomenon of Interest: ‘Sequence of Tense’**

Sentence (2a) is ambiguous. Besides the reading paraphrased via the ‘direct discourse’ in (2ai), it also allows a reading paraphrased via the ‘direct discourse’ in (2aii).

- a. Dave thought that Mary was dancing.
  - (i) *‘Past in Past’ Reading:*  
Dave thought the following: “Mary **was** dancing”
  - (ii) *‘Simultaneous’ Reading:*  
Dave thought the following: “Mary **is** dancing.”

*Issue:*

The ‘paraphrases’ in (2ai) and (2aii) are rather crude, and don’t *truly* capture the truth conditions of the targeted readings...

... In order to do a better job, we’re going to need to introduce certain semantic and ontological assumptions...

(3) **Towards a More Precise Characterization of the Ambiguity: Doxastic Alternatives**

Throughout this discussion, I will assume that the semantics of ‘think’ and ‘believe’ make reference to a given entity’s ‘doxastic alternatives’, defined as below.

a. Doxastic Alternatives

The *doxastic alternatives* for an entity  $x$  at a world  $w$  and a time  $t$ , are all those world-time pairs  $\langle w', t' \rangle$  with the following property: as far as  $x$  knows at  $w$  and  $t$ , he could actually be at  $\langle w', t' \rangle$ .

(The *doxastic alternatives* for an entity  $x$  at a world  $w$  and a time  $t$ , are all those world-time pairs  $\langle w', t' \rangle$  which  $x$ ’s knowledge at  $\langle w, t \rangle$  does not distinguish from  $\langle w, t \rangle$ .)

b. Notation

Dox-Alt( $x, w, t$ ) = the doxastic alternatives for  $x$  at  $w$  and  $t$

(4) **Towards a More Precise Characterization of the Ambiguity: Semantics of ‘Think’**

$[[ \text{think} ]]^w, t = \lambda p_{\langle si, t \rangle} . \lambda x . [ \forall \langle w', t' \rangle \in \text{Dox-Alt}(x, w, t) : p(w', t') ]$



(6) **Some Additional Preliminaries Regarding Doxastic Alternatives**

Certain aspects of our proposed account (as it is currently developed) will depend upon assumptions regarding the time component  $t$  of a given ‘doxastic alternative’  $\langle w, t \rangle$ .  
(I will explicitly note when these assumptions come into play in the argumentation.)

a. Simultaneity Requirement<sup>1</sup>

If  $\langle w', t' \rangle \in \text{Dox-Alt}(x, w, t)$ , then  $t' = t$ . That is, all of an entity’s ‘doxastic alternatives’ at a given time  $t$  are co-temporaneous with  $t$ .

In essence, entities are assumed to know the *time* they are in, but not to know the ‘facts of the world’ they are in.

*Note that this assumption is already implicit in our characterization of the simultaneous reading in (5a):*

That characterization assumes an equivalence between “Dave thinks at  $t$  that Mary is dancing” and “Mary is dancing at all of Dave’s doxastic alternatives at  $t$ .”

b. The Evaluation Time (Utterance Time) is a Point<sup>2</sup>

Following a ‘useful assumption’ in the literature on tense, the evaluation time (utterance time / ‘psychological now’) will be assumed to be a simple, dimension-less temporal point, rather than a temporal interval.

Ultimately, this assumption will be used (as it often is) to derive the inability for perfective eventive predicates to be in present tense (i.e. ‘no present perfectives’)

c. Doxastic Alternatives are Points

If  $\langle w', t' \rangle \in \text{Dox-Alt}(x, w, t)$ , then  $t'$  is a simple, dimension-less temporal point rather than a temporal interval.

Ultimately, this assumption will be used (in conjunction with (6a) above) to derive the absence of ‘simultaneous readings’ in certain environments...

*Conceptual Motivation for the Assumption:*

The doxastic alternatives for  $x$  at a given time  $t$  are those world-time pairs that  $x$  thinks that they could *currently* be in. Thus, the temporal component of the doxastic-alternative represents the ‘psychological now’ of the agent, and (following the assumption in (6a)) will be assumed to be a point.

---

<sup>1</sup> Section 5 argues that dropping this assumption may extend the empirical reach of the theory in interesting ways. Thus, I don’t wish to commit too deeply to this potentially controversial assumption.

<sup>2</sup> Section 4.3.1 argues that assumptions (6b) and (6c) are actually eliminable from the theory. Thus, as with (6a), I don’t wish to commit too deeply to these potentially controversial assumptions.

## 2. A Basic Reichenbachian Semantics for Tense

### (7) Review: The Core Insight to the Reichenbachian Theory of Tense

- a. Tensed (finite) sentences include reference to a ‘Topic Time (TT)’.

Yesterday, I bought some staples. (TT = ‘yesterday’)  
 I had run out the night before. (TT = ‘yesterday’)  
 Currently, I have enough staples for a week. (TT = ‘now’)

- b. Tense morphology contributes information about the relation between the TT and the Evaluation Time / Utterance Time (UT)

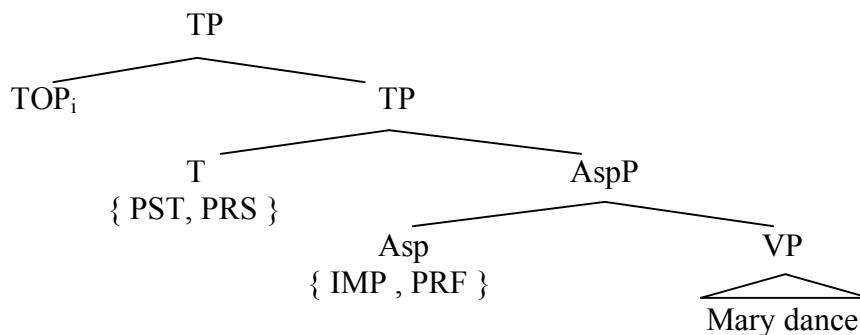
Past Tense = ‘The Topic Time precedes the Utterance Time’  
 Present Tense = ‘The Topic Time *is* (contains) the Utterance Time’<sup>3</sup>

- c. Aspect morphology contributes information about the relation between the TT and the Event Time (ET)

Perfective Aspect = ‘The Topic Time contains the Event Time’  
 Imperfective Aspect - ‘The Event Time contains the Topic Time’

### (8) Formalization: Core Syntactic Assumptions

- The Topic Time of a sentence is contributed by a tense pronoun, notated *TOP*
- There are two tenses: past (PST) and present (PRS).
- There are two aspects: imperfective (IMP) and perfective (PRF)
- At *LF*, the subject is reconstructed into SpecVP (*assumed for simplicity*)



<sup>3</sup> As we will later see, whether ‘present tense’ is understood as asserting that TT *is* UT or merely that TT contains UT can have significant empirical consequences.





### 3. Capturing the Simultaneous Reading: Abstraction over Topic Time

Thus far, we've seen that a basic Reichenbachian semantics for tense, like that in (8) and (9), cannot capture the possibility of the 'Simultaneous Reading' (SR) in (2aii) and (5aii).

#### **Consequence:**

**Something must be *added* to the basic theory in order to capture the possibility of the SR.**

- *Worry:* Isn't such an addition (by definition) *ad-hoc*?
- *Reply:* Well, yes... but:
  - (a) Thus far, 'everybody does it';  
Nobody has a completely principled account of the SR
  - (b) The *ad-hoc* nature of the mechanisms coheres with the fact that the SR is not universal across languages.  
(Thus, the languages lacking the SR may simply lack the mechanisms stipulated to derive it in languages like English)

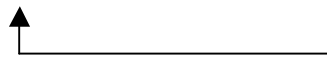
#### (14) A Classic Approach: 'Non-Interpreted Past Tense' (Stowell 1995, Kusumoto 2005)

One 'notion' that theorists have pursued is that, under the SR, the subordinate past tense is (in some sense) 'not really there'. That is, while the subordinate verb in such sentences has past-tense morphology, that morphology is (in some sense) 'semantically inert'. It's a 'dummy tense'; it's 'erased at LF'; etc.

A particular implementation of this proposal occurs in the work of Stowell (1995) and Kusumoto (2005), who develop a system whereby the 'simultaneous reading' simply reflects a kind of *concord* or *agreement* between the (semantically contentful) matrix tense and a semantically empty subordinate tense.

##### a. Simultaneous Reading as 'Tense Concord'

Dave  $T_{\text{PAST}}$  thought that Mary  $T_{\emptyset}$  was dancing.



*Agreement with matrix past tense causes underlyingly tenseless subordinate clause to surface with past-tense morphology.*

Interestingly, however, Andrew McKenzie (p.c.) has noted a difficult problem for such 'agreement theories' of the simultaneous reading:

(15) **Simultaneous Readings with Matrix Present Perfect (McKenzie, p.c.)**

- a. Sentence:  
Dave has thought that Mary was dancing.
- b. Simultaneous Reading (Informal):  
Dave has thought the following: “Mary is dancing.”
- c. Simultaneous Reading (Semi-formal):  
'There is some prior time **t** such that all of Dave's 'doxastic alternatives' at **t** are contained in an event of Mary dancing.'

Side-Note:

Because of the special semantics of the present perfect in English, sentence (15a) is a little bit 'funny' to begin with. The following really draw out the possibility of the targeted reading.

(16) **Further Examples of Simultaneous Readings with Matrix Present Perfect**

- a. I've believed (in the past) that communism was the answer to all our problems.  
*I've believed the following: "communism **is** the answer to all our problems."*
- b. My dad has (sometimes) suspected that my sister was on drugs.  
*My dad has suspected the following: "that girl **is** on drugs."*
- c. The administration has (in the past) contended that salaries were too high.  
*The administration has contended the following: "salaries **are** too high."*

**The Issue Raised by (15) and (16):**

- In the sentences in (15) and (16), the matrix tense is *present*, not *past*.
- Thus, the possibility of the 'simultaneous readings' of the subordinate *past* tense clauses cannot simply be due to the subordinate past tense being a 'dummy tense' that is licensed by concord with a matrix past tense.
- Thus, the 'concord account' of Stowell (1995) and Kusumoto (2005) can't be correct.
- (*Indeed, the very description of the general phenomenon as 'sequence of tense' seems somewhat inapt.*)

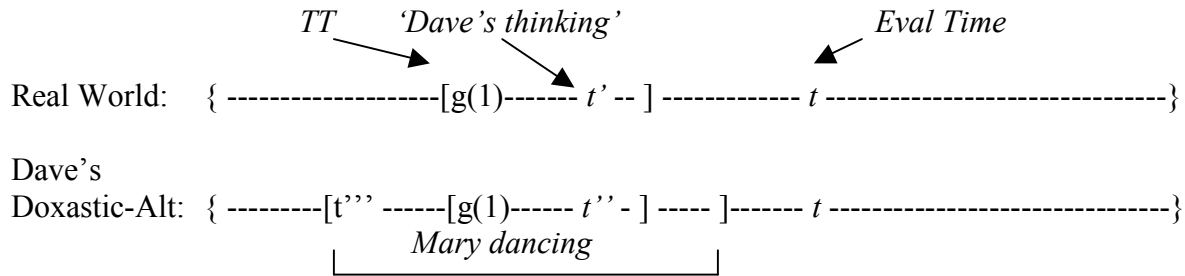
The main goal of the remainder of this presentation is to put forth and pursue an alternative to the general line of thought in (14) ... **one where subordinate tense is *always* semantically interpreted...**



(20) **Informal Reading of the Predicted Semantics**

The Topic Time ( $g(1)$ ) precedes  $t$  and contains a time  $t'$  with the following property:

All of Dave's doxastic alternatives  $\langle w', t'' \rangle$  at  $t'$  satisfy the following property:  
 $t''$  precedes the evaluation time  $t$  and is contained in a temporal interval where 'Mary dances' holds.



(21) **Brief Sketch of How the Semantics is Predicted**

Following the syncategorematic rule in (17), the subordinate CP can be interpreted as in (21a). Following the other semantic rules in (9), this computes out to (21b):

- a.  $\lambda w'. \lambda t' [ [ \text{TOP}_2 [ \text{PST} [ \text{IMP} [ \text{Mary dance } ] \dots ] ] ] ]^{w', t, g(2 \rightarrow t')}$  =
- b.  $\lambda w'. \lambda t' [ ( t' < t ) \ \& \ \exists t''' [ t''' \supseteq t' \ \& \ \text{Mary dances at } t''' \text{ in } w' ] ]$

(22) **Central Observation**

Recall our earlier characterization of the 'Simultaneous' readings:

*The 'Simultaneous Reading'*

'There is some prior time  $t$  such that all of Dave's 'doxastic alternatives' at  $t$  are contained in an event of Mary dancing.'

**It follows that our augmented Reichenbachian system above (with Rule (17)) is now able to predict the possibility of the 'Simultaneous Reading'**

### 3.2 Some Further Discussion of the Predicted Readings

Question:

*How, exactly, does the rule in (17) predict the possibility of the ‘simultaneous reading’?  
How does abstraction over the topic time yield this reading?*

(23) **Redundancy of Subordinate Past Tense**

- When the rule in (17) is employed, we abstract over the subordinate topic time, *rather the subordinate evaluation time*.
- As a consequence, the *evaluation time* of the subordinate clause *doesn’t shift!*
- Moreover, given the meaning for past-tense in (9b), the semantics predicts that, when we apply rule (17), the subordinate past tense states only that the *doxastic alternatives* precede the *evaluation time*.  
***But this information is already entailed by the matrix past tense! (given (6a))***
- **Thus, the subordinate past tense in such sentences ends up being semantically redundant; it contributes no additional information to the sentence.**

(24) **Relationship Between Doxastic Alternatives and Subordinate ‘Event Time’**

- When we abstract over the subordinate topic time (via rule (17)), the logical role played by a (separate) subordinate topic time is played by the temporal component of the doxastic alternatives.
- Thus, the subordinate imperfective aspect states that the *doxastic alternatives* (rather than a separate subordinate topic time) is contained inside an event of Mary dancing, **which yields the desired ‘simultaneous interpretation’.**

(25) **The ‘Unmarked’ Nature of the ‘Past-in-Past’ Reading**

Our system is still able to generate the ‘past-in-past’ reading, simply by employing the original syncategorematic rule in (9g).

*Note that the original rule in (9g) is ‘more natural’ than rule (17) in several respects:*

- First, in (9g), both the evaluation *world* and evaluation *time* are abstracted over. Thus (9g) has a greater ‘internal unity’ than (17) [where the evaluation world, and topic time are abstracted over].
- Abstraction over *evaluation indices* is something of the status-quo in intentional semantics.

Thus, since the rule in (9g) is somewhat simpler and more natural than (17), we might conclude that it is *less marked* than (17), and so:

- **No language will have (17) but not have (9g)**  
(*i.e.*, No language will have ‘simultaneous reading’ but not the ‘past-in-past’ reading)
- **Some languages will lack (17) [but not (9g)]**  
(*i.e.*, Some languages will allow only the ‘past-in-past’ reading)

**These typological predictions appear to be born out. As is often mentioned in the literature on SOT, there are languages which disallow the ‘simultaneous reading’ (e.g. Russian).**

---

### 3.3 A Potential Issue: Long-Distance Binding of Topic Times

As illustrated in (18) & (19), our system generates the observed ‘simultaneous reading’ when the verb ‘believe’ is co-indexed with the Topic Time pronoun of the immediately subordinate clause.

*Thus far, nothing in our system rules out the verb ‘believe’ being co-indexed with Topic Times in still lower clauses. That is, nothing thus far rules out the structure in (26b).*

#### (26) A Possible Syntactic Structure

- a. Dave thought that Bill thought that Mary was dancing.
- b. [ TOP<sub>1</sub> [ PST [ PERF [ Dave [ **think**<sub>2</sub>  
[ TOP<sub>3</sub> [ PST [ PERF [ Bill think  
[ **TOP**<sub>2</sub> [ PST [ IMP [ Mary dance ] .... ]

#### **PROBLEM:**

Our semantics assigns to (26b) a (very weird) meaning that is (intuitively) not a possible interpretation of (26a).

(27) **Reading Predicted for Structure (26b)**

*As before, I leave the calculation implicit. The reader is invited to confirm.*

- a.  $[[ (26b) ]]^w, t, g =$
- b.  $(g(1) < t) \ \& \ \exists t' [ t' \subseteq g(1) \ \& \ [ \forall \langle w', t' \rangle \in \text{Dox-Alt}(\text{Dave}, w, t') : (g(3) < t) \ \& \ \exists t''' [ t''' \subseteq g(3) \ \& \ \forall \langle w'', t''' \rangle \in \text{Dox-Alt}(\text{Bill}, w'', t''') : (t'' < t''') \ \& \ \exists t'''' [ t'''' \supseteq t'' \ \& \ \text{Mary dances at } t'''' \text{ in } w'' ] ] ] ]$

(28) **Informal Paraphrase of the Reading in (27b), First Pass**

‘Dave thought (at time  $t$ ) that Bill *would later think* (at time  $t' > t$ ) that Mary was earlier dancing (at time  $t$ )’

(29) **Informal Paraphrase of the Reading in (27b), in Greater Detail**

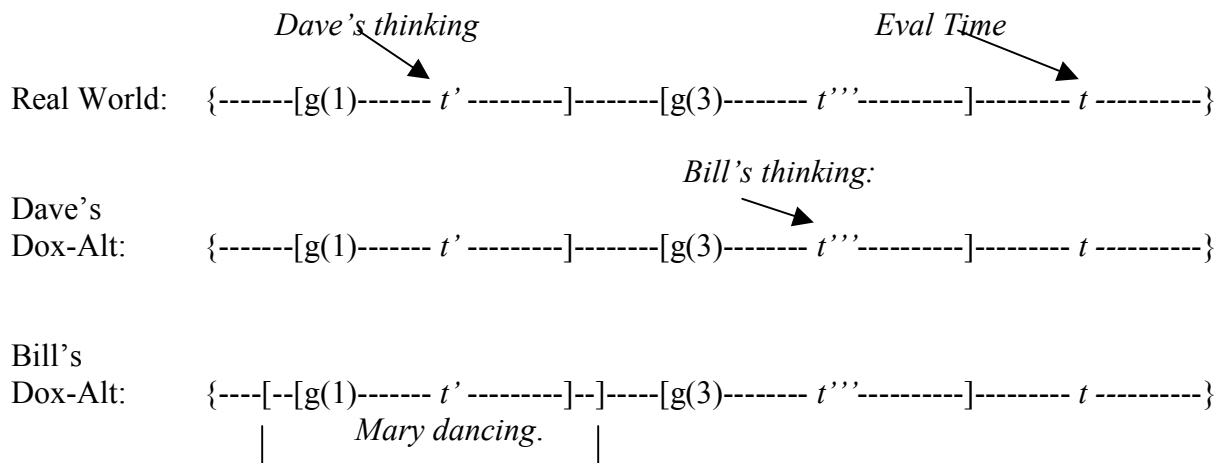
- a. The Formula  
 $(g(1) < t) \ \& \ \exists t' [ t' \subseteq g(1) \ \& \ [ \forall \langle w', t' \rangle \in \text{Dox-Alt}(\text{Dave}, w, t') : (g(3) < t) \ \& \ \exists t''' [ t''' \subseteq g(3) \ \& \ \forall \langle w'', t''' \rangle \in \text{Dox-Alt}(\text{Bill}, w'', t''') : (t'' < t''') \ \& \ \exists t'''' [ t'''' \supseteq t'' \ \& \ \text{Mary dances at } t'''' \text{ in } w'' ] ] ] ]$

- b. The Informal Paraphrae  
 The topic-time  $g(1)$  precedes the evaluation/utterance time, and contains a time  $t'$ , at which which all of Dave’s doxastic alternatives  $\langle w', t' \rangle$  make the following true:

There is some other topic time  $g(3)$  which precedes the *matrix evaluation time*  $t$ , and which contains a time  $t'''$  at which all of Bill’s doxastic alternatives  $\langle w'', t''' \rangle$  make the following true:

The time  $t''$  (of Dave’s doxastic alternatives) *precede*  $t''''$  and are contained in an event of Mary dancing.

- c. Picture:





#### 4. Further Predictions of the Analysis

##### 4.1 Equivalence Between Simultaneous Reading and Embedded Present Tense

In languages lacking ‘sequence of tense’ phenomena (e.g. Russian), the proposition expressed via the ‘simultaneous reading’ of an embedded past tense (in English) is instead expressed via an embedded present tense.

That is, the simultaneous reading of (31a) – which is assumed to reflect the structure in (31b) – is equivalent to the meaning assigned to the (Russian) correlate of (32a), which may be assumed to possess the simple structure in (32b).

##### (31) Embedded Past Tense, with ‘Simultaneous Reading’

- a. Dave thought that Mary was dancing.
- b. [ TOP<sub>1</sub> [ PAST [ PERF [ Dave [ **think**<sub>2</sub>  
[ TOP<sub>2</sub> [ PAST [ IMP [ Mary dance ] ... ] ] ] ] ] ] ] ]

##### (32) Semantically Equivalent Embedded Present Tense Structure

- a. Dave thought that Mary is dancing.
- b. [ TOP<sub>1</sub> [ PAST [ PERF [ Dave [ think  
[ TOP<sub>2</sub> [ **PRES** [ IMP [ Mary dance ] ... ] ] ] ] ] ] ] ]

##### Side-Note:

As is well-known, the *English* sentence in (32a) doesn’t actually allow for a reading that is equivalent to the ‘simultaneous reading’ of (31a).

As we will later see in Section 5, this might follow from a theory where the English sentence in (32a) – unlike it’s Russian correlate – actually *doesn’t* possess the simple structure in (32b).

For the moment, however, we will put aside any issues surrounding the *actual* interpretation of English (32a), as we are using it merely as a proxy for the equivalent Russian sentence, *which (crucially) is assumed to have the structure in (32b)...*

**Our account predicts the semantic equivalence between the structures in (31b) and (32b)!**

(33) Interpretation Assigned to (32b) [cf. (9c) & (9g)]

a. Meaning Assigned

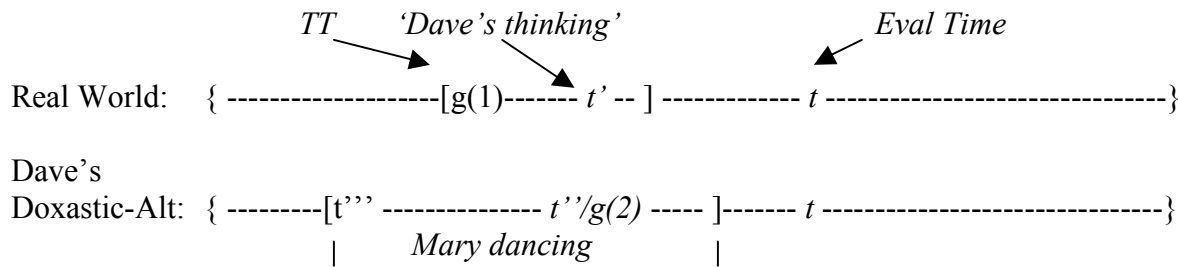
$(g(1) < t) \ \& \ \exists t' [ t' \subseteq g(1) \ \& \ [ \forall \langle w', t' \rangle \in \text{Dox-Alt}(\text{Dave}, w, t') : (g(2) = t'') \ \& \ \exists t''' [ t''' \supseteq g(2) \ \& \ \text{Mary dances at } t''' \text{ in } w' ] ] ]$

b. Informal Reading:

The Topic Time (g(1)) precedes *t* and contains a time *t'* such that:

All of Dave's doxastic alternatives  $\langle w', t' \rangle$  at *t'* are such that:

The (second) topic time (g(2)) equals *t''* and is contained in a temporal interval where 'Mary dances' holds.



**Thus, following our semantic rules in (9c) and (9g), the structure in (32b) is assigned a reading wherein all of Dave's 'doxastic alternatives' are contained in an event of Mary dancing... which is just equivalent to the simultaneous reading!!!**

#### 4.2 Possibility of Simultaneous Reading with Matrix Present Perfect

We earlier noted that it is possible for subordinate past-tense sentences to receive 'simultaneous readings' when the matrix clause is in the *present perfect*.

(34) Simultaneous Reading with Matrix Present Perfect (Andrew McKenzie, p.c.)

a. Sentence

Dave has thought that Mary was dancing.

b. Targeted Reading (Informal):

Dave has thought the following: "Mary **is** dancing."

c. Targeted Reading (Formal):

'There is some prior time **t** such that all of Dave's 'doxastic alternatives' at **t** are contained in an event of Mary dancing.'

**As shown below, given certain natural assumptions regarding the meaning of the perfect, the rule in (17) correctly predicts the 'simultaneous' reading in (34b,c).**

(35) **Background Assumption Regarding the Meaning of the Perfect**

The perfect is an aspect (head of AspP), and asserts that the topic time is in the ‘end state’ or ‘resultant state’ of the event described by the VP.

a. Meaning of ‘Perfect’

$$[[ \text{PRT} ] ]^{w, t, g} = \lambda P_{\langle it \rangle} . \lambda t' [ \exists t'' . (t'' < t') \ \& \ P(t'') ]$$

b. Illustration

(i) *Illustrative Sentence:*

Mary has danced.

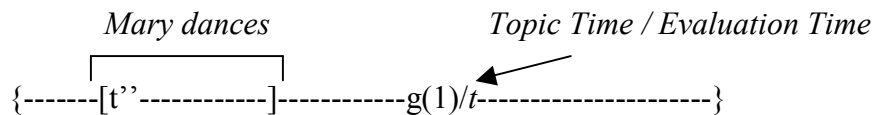
(ii) *Putative Structure:*

[ TOP<sub>1</sub> [ PRES [ PRT [ Mary dance ] ] ] ]

(iii) *Predicted Meaning (cf. (9a), (9c) & (35a) )*

( g(1) = t ) &  $\exists t'$  [ ( t' < g(1) ) & Mary dances at t' in w ]

‘The topic time (g(1)) is equal to the utterance time, and is preceded by a time t' at which Mary dances.’



*The following illustrates how our system (augmented with (35)) can predict the availability of the simultaneous reading in (34b,c)...*

(36) **Deriving the Simultaneous Reading of (34a)**

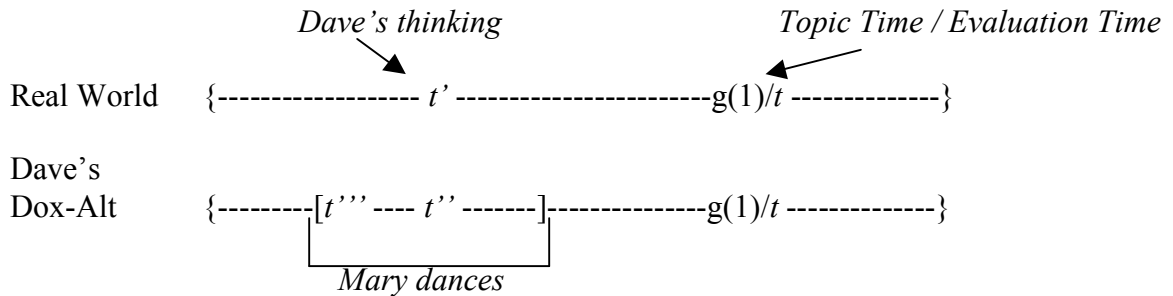
a. Assumed Structure

[ TOP<sub>1</sub> [ PRES[ PRT [ Dave [ **think**<sub>2</sub>  
[ TOP<sub>2</sub> [ PAST [ IMP [ Mary dance ] ... ] ] ] ] ] ] ] ]

b. Predicted Meaning

$$(g(1) = t) \ \& \ \exists t' [ t' < g(1) \ \& \ [ \forall \langle w', t' \rangle \in \text{Dox-Alt}(\text{Dave}, w, t') : \\ (t'' < t) \ \& \ \exists t''' [ t''' \supseteq t'' \ \& \ \text{Mary dances at } t''' \text{ in } w' ] ] ]$$

‘The topic time (g(1)) is equal to the utterance time, and is preceded by a time  $t'$  at which all of Dave’s doxastic alternatives  $\langle w', t' \rangle$  are such that:  $t''$  precedes the utterance time, and is contained inside a time  $t'''$  at which Mary dances.



**Conclusion:**

The combination of the semantics in (35) with our special rule in (17) predicts the availability of ‘simultaneous reading’ in (34b,c).

***Thus, our account correctly predicts the possibility of such a reading, and thus the broader fact (noted by Andrew McKenzie) that a matrix past tense is not required for a ‘simultaneous reading’ to be licensed’!***

*Side-Note 1:*

As with earlier cases, (17) yields the ‘simultaneous reading’ of (34b,c) in the following way: Application of the rule in (17) yields a meaning whereby the subordinate past tense asserts only that the doxastic alternatives precede the *matrix evaluation time*, a fact that is already entailed by the semantics of the matrix present perfect.

*Side-Note 2:*

In Section 4.4, we’ll explore the fact that the sentence in (37a) doesn’t permit the ‘simultaneous reading’ in (37b).

**(37) No Simultaneous Reading if Matrix Clause is in Simple Present**

- a. *Sentence:*  
Dave thinks that Mary was dancing.
- b. *Unavailable Reading:*  
Dave thinks the following: “Mary is dancing”.





## Conclusion:

- Since the reading in (40b) is contradictory, the structure in (40a) cannot be assigned a logically sensible interpretation.
- Thus, only structure (39a) is predicted by our theory to have a sensible, logically consistent interpretation.
- Thus, our system correctly predicts that sentence (38a) *Dave thought that Mary danced* will be perceived by English speakers to only have the reading in (39b).
- **Therefore, our system correctly predicts that (38a) will be judged only to have the ‘past-in-past’ reading.**

### (42) Prediction of the Account

According to the reasoning in (41), the ultimate reason why sentence (38a) cannot have a ‘simultaneous reading’ is that the subordinate VP *Mary dance* cannot hold at a single, dimensionless temporal point.

*Therefore, if a VP could hold at a single dimensionless temporal point – that is, if that VP were stative rather than eventive – then it should be possible to get a simultaneous reading if the VP appears in the simple past (past perfective)*

The prediction in (42) appears to be born out. The sentence in (43a) does seem to admit of the ‘simultaneous reading’ in (43b).

### (43) Accuracy of Prediction (42)

a. Sentence: Dave thought that Mary spoke French.

b. Possible Reading (Simultaneous Reading):

Dave thought the following: “Mary speaks French.”

‘There is some prior time  $t$  at which all of Dave’s doxastic alternatives  $\langle w', t' \rangle$  are such that ‘Mary speaks French’ is true at  $t'$ ’.

As a final step in the argumentation here, we note that our account provides the following analysis of the observed reading in (43b).

That is, if (43a) is assumed to possess the structure in (44a), then our rule (17) predicts that it will have the reading in (44b), which seems to be the intuitive ‘simultaneous reading’ in (43b).



Side-Note:

As argued above, our account predicts that:

an embedded past-tense clause containing a *perfective* (simple past) VP will allow for a simultaneous reading *if the VP is stative*.

Thus, our account also predicts that:

*if a typically eventive VP is coerced into a stative interpretation*, then it should be possible for a subordinate clause containing that VP in the ‘simple-past’ to be given a ‘simultaneous reading’

Thus, our account correctly predicts that:

*if the eventive VP ‘Mary danced’ in (38a) is understood generically (i.e., Mary generally danced), then a simultaneous reading of (38a) should be possible.*

**(46) A Possible Simultaneous Reading of (38a)**

a. Sentence:

Dave thought that Mary danced.

b. Possible Simultaneous Reading:

Dave thought the following: “Mary dances”

**4.3.1 Some More General Points Regarding the Argumentation Above**

The argument in (41) – which attempts to show that the reading in (40b) is contradictory – bears a clear (intended) similarity to a widely-held account of the generalization in (46) below.

**(46) The Inability for Perfective Eventive to be Present Tense**

a. Generalization

Across languages, perfective forms of eventive predicates cannot be in present tense.

b. Illustration (Tlingit)

Mary aawal'éix

Mary PERF-dance

*Mary danced. / \* Mary is dancing.*

Going back to work such as Bennett & Partee (1978), a common explanation for the fact in (46a) is that laid out in (47) below.

(47) **Explanation of Generalization (46a): The Non-Dimensionality of the Present**

- Given our assumptions regarding tense and aspect, a present tense perfective (eventive) predicate would have the structure in (48a) below.
- Given our semantic assumptions in (9), the structure in (48a) would be assigned the meaning in (48b).
- The meaning in (48b) entails that there is a time  $t'$  which is such that (a) it is contained within the evaluation time  $t$ , and (b) the eventive VP *Mary dance* holds at  $t'$
- Given our assumption in (6b), however, the evaluation time  $t$  must be a simple, dimensionless temporal point.
- Thus, given that ( $t' \subseteq t$ ),  $t'$  must also be a simple dimensionless temporal point.
- However, given that the VP *Mary dance* is eventive, it cannot hold at a single temporal point (only over temporal intervals).
- Thus, *Mary dance* couldn't possibly hold at  $t'$ , and so the formula in (48b) is contradictory.
- **Thus, perfective eventives in present tense could never be true at any time, and so are predicted to be non-existent.**

(48) **Structure and Semantics of Present Perfective Eventive**

- a. Structure: [ TOP<sub>1</sub> [ PRES [ PERF [ *Mary dance* ] ] ] ]
- b. Predicted Meaning ((9c), (9e)):  
(  $g(1) = t$  ) &  $\exists t'$  [  $t' \subseteq g(1)$  & *Mary dance* at  $t'$  in  $w$  ]

Side-Note:

Again, the reasoning above crucially relies upon the VP being *eventive*. If the VP were *stative*, and could be true at a single temporal point, then nothing would be 'contradictory' about the formula in (48b)...

Thus, nothing would seem to rule out a stative VP appearing in a present perfective form.

And, as we noted above, one example of such 'present perfectives statives' may in fact be the simple present in English (which is only felicitous on states and other I-level predicates).

The generalization in (46) and the account in (47) raise two important points relevant to our theory of ‘sequence of tense’...

(49) **The Necessity of the Assumption in (6c)**

- Recall our argument in (41) that reading (40b) is contradictory (and hence the English sentence *Dave thought Mary danced* allows only the ‘past-in-past’ reading)
- That argument rested on the assumption in (6c) that the ‘temporal component’ of a doxastic alternative is a *point*.
- While this assumption might seem rather strange at first, *it is actually necessitated by the general account in (47)*.

a. The Account in (47) of the Generalization in (46) Necessitates Assumption (6c)

- As predicted by generalization (46), it is also impossible for perfective (eventive) predicates to appear in present tense *subordinate clauses*
- Thus, the account in (47) should be generalized to subordinate clauses.
- In order to generalize the account in (47) to subordinate clauses, it must be assumed that the evaluation time of subordinate clauses is *also always* a temporal point.
- But, following the standard semantic rule in (9g), the evaluation time of the subordinate complement clause is (ultimately) the temporal component  $t$  of the matrix agent’s doxastic alternatives  $\langle w, t \rangle$
- **Thus, if we truly adopt the account in (47) for the generalization in (46), we must also hold to the generalization in (6c): the temporal component of a doxastic alternative is a dimensionless temporal point.**

(50) **The Dispensability of Assumption (6b) and (6c)**

The pure empirical generalization in (46) alone predicts the ‘semantic ill-formedness’ of reading (40b) [and thus the univocality of *Dave thought Mary danced*.]

Thus, we needn’t necessarily adopt a particular account of (46) – such as the controversial assumptions in (6b) and (6c) – in order to predict the targeted facts in (38).

*In order to see the truth of (50), let us first consider the generalization in (51) below...*

(51) **General Equivalence Between (40a) and a Subordinate Present Perfective**

- We saw in Section 4.1 that the following two clauses were semantically equivalent:
  - (i) a subordinate *past*-tense clause interpreted via rule (17)
  - (ii) a subordinate *present*-tense clause interpreted via rule (9g)
- Consequently, the following two clauses will *also* be semantically equivalent:
  - (i) a subordinate past-tense clause *containing a perfective* VP (interpreted via rule (17))
  - (ii) a subordinate **present**-tense clause *containing a perfective* VP (interpreted via rule (9g))

(52) **Argument for the Dispensability of (6b) and (6c)**

a. Major Point:

While not everyone necessarily accepts the account in (47), it *is* generally accepted that the impossibility of present-tense perfective eventives follows (somehow) from their predicted meaning.

That is, it's generally agreed that there is just something semantically (pragmatically) odd about the meaning assigned to a present-tense perfective eventive VP

b. Consequently:

The general equivalence in (51) predicts that:

*If a subordinate present-tense perfective eventive is 'semantically ill-formed' (as is generally accepted), then*

***The meaning assigned by (17) to a subordinate past-tense perfective eventive must also be semantically ill-formed!***

c. Conclusion:

Even without the specific account in (6b) and (6c), we can conclude on general grounds that the meaning in (40b) is (in some way) 'semantically deviant'.

**Thus, we can be rather confident in our pronouncement that the proposed theory captures the fact that (38a) has only the past-in-past reading in (38b)...**

#### 4.4 Impossibility of Simultaneous Reading when Matrix Clause is Simple Present

In Section 4.2, we noted that our account correctly predicts the phenomenon described below.

##### (53) Simultaneous Reading with Matrix Present Perfect (Andrew McKenzie, p.c.)

- a. Generalization:  
Past-tense subordinate clauses *can* receive a ‘simultaneous reading’ when the matrix clause is *present-tense*, just so long as the matrix clause is also in the perfect aspect.
- b. Evidence:
  - (i) *Sentence:*  
Dave has thought that Mary was dancing.
  - (ii) *Possible Simultaneous Reading:*  
Dave has thought the following: “Mary is dancing.”

*Importantly, as the generalization in (53a) suggests, the following is also true:*

##### (54) No Simultaneous Reading with Matrix Simple Present

- a. Generalization:  
Past-tense subordinate clauses *cannot* receive a ‘simultaneous reading’ when the matrix clause is *present-tense* and not in the perfect aspect (i.e., in the simple present).
- b. Evidence:
  - (i) *Sentence:*  
Dave thinks that Mary was dancing.
  - (ii) *Impossible Simultaneous Reading:*  
Dave thinks the following: “Mary is dancing.”

**Fortunately, our account is able to predict the generalization in (54a).**

*That is our account correctly distinguishes between present perfects and simple presents in terms of their ability to license ‘simultaneous readings’ of subordinate past tense clauses...*



**More importantly, (57) below demonstrates that application of rule (17) in the interpretation of sentence (55a) will not yield a simultaneous reading!**

(57) **The Interpretation of (55) Employing Rule (17): No Sensible Interpretation**

- a.  $[[ (55b) ] ]^{w,t,g} =$
- b.  $[[ [ TOP_1 [ PRES [ PERF [ Dave [ \underline{think}_2$   
 $[ \underline{TOP}_2 [ PST [ IMP [ Mary dance ] \dots ] ] ] ] ] ] ] ] ] ] ]^{w,t,g} = (via (17))$
- c.  $(g(1) = t) \ \& \ \exists t' [ t' \subseteq g(1) \ \& \ [ \forall \langle w', t' \rangle \in Dox\text{-}Alt(Dave, w, t') :$   
 $( t'' < t ) \ \& \ \exists t''' [ t''' \supseteq t'' \ \& \ Mary \text{ dances at } t''' \text{ in } w' ] ] ]$
- d. Informal Reading:  
 Topic time  $g(1)$  is evaluation time  $t$ , and contains a time  $t'$  such that:  
 All of Dave's doxastic alternatives  $\langle w', t' \rangle$  at  $t'$  are such that:  
 $t''$  precedes evaluation time  $t$ , and is contained in an event of  
 Mary dancing.
- e. Impossibility of Reading (57c, d)  
 Given our assumptions in (6a), (6b) and (6c), the interpretation in (57c,d) requires  
 that Dave's doxastic alternatives  $\langle w', t' \rangle$  at  $t'$  all be such that  $t'' = t'$ .

Moreover, the interpretation in (57c,d) requires that  $( t = g(1) )$  and  $( g(1) = t' )$ .  
 Thus, the interpretation requires that  $( t = t' )$ .

**However, this is incompatible with the requirement (contributed by the subordinate past-tense) that  $( t'' < t )$ .  
 Thus, application of rule (17) does not yield a sensible interpretation for (55a).**

**Conclusion:**

We find, then, that our system is only able to assign sentence (55a) a single (logically sensible) interpretation: the 'past-in-past' reading in (56).

Thus, our account correctly predicts that sentences of the form in (54bi) do not admit of 'simultaneous readings' like that in (54bii).

## 5. Speculative Groping Towards an Understanding of Embedded Present in English

All the preceding discussion principally concerned the interpretation of subordinate past-tense sentences in English, particularly when they are contained within matrix past-tense clauses.

*As is well-known, however, there are also in English interesting semantic phenomena related to subordinate present tense sentences, particularly when they are contained within matrix past-tense clauses.*

### (58) Interpretation of Subordinate Present Tense in English

#### a. Generalization:

If a subordinate clause in English is present-tense, then its event time must be understood as overlapping the matrix *evaluation* time, ***even if the matrix sentence is past tense.***

#### b. Illustration:

(i) *Sentence:* Dave said that Mary is dancing.

(ii) *Crucial Feature of Interpretation:*

-- Mary's hypothetical dancing is presumed to stretch into the present.

-- If what Dave said is true, then Mary must be dancing *now*.

(ii) *Evidence for This Effect*

i. Dave said just now that Mary is dancing.

ii. \* Dave said last year that Mary is dancing.

#### Observation 1:

As noted earlier in Section 4.1, the generalization in (58a) doesn't hold for embedded present tenses in other languages, like Russian.

In those other languages, sentences of the form in (58bi) are assigned an interpretation akin to the 'simultaneous reading' of sentences like '*Dave said that Mary **was** dancing.*'

We also saw earlier that our account currently predicts that embedded present tense sentences like (58bi) should *uniformly* receive such interpretations...

**Thus, we must augment our theory of English in order to capture generalization (58a).**



### **Observations:**

- As we see in (60), our augmented semantics in (59) *combined with rule (17)* predicts that embedded present tenses in English *should permit* a reading whereby the event time of the embedded VP must overlap the matrix evaluation time.
- Given that such readings seem to be obligatory in English, we might capture this fact by a stipulation/generalization that embedded present tense sentences in English *must* be interpreted via the rule in (17)  
[i.e., rule (9g) might be augmented so that it can only apply to past-tense clauses]

### **BIG PROBLEM:**

- Assumption (6a) – the ‘simultaneity of doxastic alternatives’ – was a key assumption throughout all our argumentation.
- Thus, abandonment of (6a) undermines *nearly all* our earlier semantic results.
- However, abandonment of (6a) is also essential for the provisional result in (60)!  
*Otherwise, it would be impossible for the doxastic alternatives of Dave at time  $t'$  to contain the evaluation time.*

---

## **6. Conclusion**

This handout has defended at some length the following claim:

### **(61) Central Claim:**

‘Sequence of Tense’ (SOT) phenomena in English can be captured by a simple Reichenbachian semantics for tense *just so long as we permit lambda abstraction over topic times.*

That is, we’ve seen that the special semantic rule in (17) – which effectuates lambda abstraction over subordinate topic times – is able to predict the following facts under (62):

(62) **Empirical Coverage of Rule (17)**

- a. Basic possibility of ‘simultaneous readings’ of past-tense imperfective sentences embedded under past-tense matrix sentences.
- b. Equivalence of such ‘simultaneous readings’ to the interpretation of subordinate *present*-tense sentences in languages like Russian.
- c. Possibility of ‘simultaneous readings’ of past-tense sentences embedded under *present perfect* matrix sentences (Andrew McKenzie)
- d. *Impossibility* of ‘simultaneous readings’ of past-tense sentences embedded under *simple present* matrix sentences.
- d. *Impossibility* of ‘simultaneous readings’ of past-tense *perfective eventive* subordinate clauses.
- e. Possibility of ‘simultaneous readings’ of past tense perfective *stative* subordinate clauses.
- f. (Speculative) Subordinate present-tense sentences in English must be interpreted so that the subordinate event time overlaps with the *matrix evaluation time*.

This suggests that so-called ‘sequence of tense’ phenomena in English may be best captured within a system where subordinate past-tenses are *always* semantically interpreted...

---

---

**References**

- Bennett, Michael and Barbara Partee (1978) “Toward the Logic of Tense and Aspect in English.” Manuscript. Indiana University Linguistics Club.
- Kusumoto, Kiyomi (2005) “On the Quantification Over Times in Natural Language.” *Natural Language Semantics* 13. pp. 317 - 357,
- Percus, Orin (2000) “Constraints on Some Other Variables in Syntax.” *Natural Language Semantics* 8. pp. 173 - 229.
- Stowell, Tim (1995) “The Phrase Structure of Tense.” In Rooryck, J. and L. Zaring (eds) *Phrase Structure and the Lexicon*. Kluwer. Dordrecht.