A Little Bit on Adverbs and Events

1. **From Adjectives to Adverbs to Events**

We’ve just developed a theory of the semantics of adjectives, under which they denote either functions of type \(<e,t>\) (intersective adjectives) or of type \(<e,e,t>\) (subsective adjectives).

Of course, adjectives aren’t the only kind of modifier in natural language…

<table>
<thead>
<tr>
<th>Adverbial Modifiers</th>
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<tbody>
<tr>
<td>a. [ Dave [ walked quickly ] ]</td>
</tr>
<tr>
<td>b. [ Dave [ walked around South College ] ]</td>
</tr>
<tr>
<td>c. [ Dave [ walked before 3PM ] ]</td>
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(1)

(2) **Initial Observation**

If we assume adverbs to also be of type \(<e,t>\), then we could interpret sentences like those in (2) via Predicate Modification.

\[
S \\
NP e \\
Dave \\
\\
VP <e,t> \\
walked \\
\\
AdyP <e,t> \\
\{ \text{quickly} \\
\{ \text{around South College} \\
\text{before 3PM} \}
\]

(3) **Immediate Question:** What should be the \(<e,t>\) denotation of these adverbs?

<table>
<thead>
<tr>
<th>Immediate Problem</th>
</tr>
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<tbody>
<tr>
<td>a. [[ quickly ]] = [ \lambda x : x \text{ is quick} ]</td>
</tr>
<tr>
<td>b. [[ around South College ]] = [ \lambda x : x \text{ is around South College} ]</td>
</tr>
<tr>
<td>c. [[ before 3PM ]] = [ \lambda x : x \text{ is before 3PM} ]</td>
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</tbody>
</table>

(4) **Immediate Problem:**

If we assume the lexical entries in (4), then interpreting the structure in (3) via PM will yield truth-conditions that don’t sound quite right.

<table>
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<th>Immediate Problem</th>
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<tbody>
<tr>
<td>a. [[ Dave walked quickly ]] = T iff Dave walked and Dave is quick. [not bad]</td>
</tr>
<tr>
<td>b. [[ Dave walked around South College ]] = T iff Dave walked and Dave is around South College. [erm…]</td>
</tr>
<tr>
<td>c. [[ Dave walked before 3PM ]] = T iff Dave walked and Dave is before 3PM. [this is insane]</td>
</tr>
</tbody>
</table>
What’s Going Wrong Here? (Davidson 1967)

- In sentences like those in (1), it isn’t Dave that is ‘quick’, ‘around South College’ or ‘before 3PM’.
- Rather, it’s his walking that is ‘quick’, ‘around South College’, ‘before 3PM’.
- Or, to put a slightly different spin on it, it’s the event of Dave walking that is ‘quick’, ‘around South College’, ‘before 3PM’.

Ever since the work of Davidson (1967), philosophers and linguists have found the following core hypotheses to be extremely productive:

Core Hypotheses Behind Event Semantics

1. VPs are predicates of events (a semantic type distinct from entities or t-values)
2. Adverbs are also predicates of events
3. Adverbs modifying VPs are interpreted via PM (or a similar such rule)

We’ll now work towards implementing these core hypotheses using the tools already at our disposal!...

2. Basic Implementation of Event Semantics

Let There Be Events

Events exist, and they are a primitive type of thing.

- The event of Dave dancing ≠ Dave
  The time of the smoking
  The location of the smoking
  The time & location of the smoking
  The world where the smoking happens

1. Semantic type for events: \( \epsilon \) (epsilon)
2. Domain of Events: \( D_\epsilon \)
3. Meta-language variable for events: \( e \) (don’t confuse with type \( e \))

1 Some authors use ‘I’ as the type for events.
(8) **Events, Entities, Times, Locations**
While events are type-theoretically distinct from entities, times, etc., there is a family of important functions that relate events to entities, times, etc.

a. \( T(e) = \) The interval of time that \( e \) takes place in
   ‘The temporal trace of \( e \)’

b. \( L(e) = \) The physical space (location) that \( e \) takes place in
   ‘The path of \( e \)’

c. \( Ag(e) = \) The agent of \( e \) (if any)

d. \( Thm(e) = \) The theme of \( e \) (if any)

(9) **The Semantics of Adverbs**
As previewed above, we’ll view adverbs as denoting predicates of events.

a. \([ \text{quickly}]\) = \[ \lambda e : e \text{ is quick} \]

b. \([ \text{around South College}]\) = \[ \lambda e : L(e) \text{ is around South College} \]

c. \([ \text{before 3PM}]\) = \[ \lambda e : T(e) \text{ is before 3PM} \]

(10) **Problem: The Syntactic Position of the Subject**

- The core ideas in (6a) and (6c) imply that VPs and adverbs are of type \( <e,t> \).
- But, if this is the case, *how is the subject combined semantically with the VP?*

![Diagram of sentence structure]

- The proper solution to this problem will not be possible until we’ve covered the syntax and semantics of *movement structures.*
- For now, however, suspend your disbelief, and accept the provisional (though presently unclear) idea in (11) below.

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2 The ‘agent’ of an event is the ‘doer’, the thing that brings the event about. (See LING 610.)
3 The ‘theme’ of an event is the ‘do-ee’, the thing affected by the event. (See LING 601.)
(11) **Solution: The VP-Internal Subject Hypothesis**

The syntax of “Dave walked quickly / around South College / before 3PM” is as follows:

- The subject is initially merged within the VP

  a. **Base Structure:**

      S t

      … VP <ε,t> …

      VP <ε,t>                     AdvP <ε,t>

      NP e V                      {quickly around South College before 3PM}

      Dave walked

- The subject then undergoes movement to the surface position above the VP

  b. **Surface Structure:**

      S

      NP VP AdvP

      Dave1 VP AdvP

      t1 V walked

      {quickly around South College before 3PM}

- Since we don’t have a semantics for movement yet (though we will later), we will assume that our semantics interprets the original base structure for the sentence (11a)

(12) **Key Observation 1:**

In order for the types here to all work out, we have to assume that intransitive verbs like walked are of type <e , <ε,t>>.

\[
[[ \text{walked} ]] = [ \lambda x_e : [ \lambda e : e \text{ is an event of walking and } x \text{ is the agent of } e ] ]
\]

\[
= [ \lambda x_e : [ \lambda e : \text{walk}(e) \& \text{Ag}(e) = x ] ]
\]
Major Semantic Predictions

a. \([[ [\text{vp Dave walked}]] = \text{by FA}] \quad [\lambda e : \text{walk}(e) & \text{Ag}(e) = \text{Dave}]]\)

b. \([[ [\text{vp Dave walked quickly}]] = \text{by FA and PM}] \quad [\lambda e : \text{walk}(e) & \text{Ag}(e) = \text{Dave and } e \text{ is quick}]]\)

c. \([[ [\text{vp Dave walked before 3PM}]] = \text{by FA and PM}] \quad [\lambda e : \text{walk}(e) & \text{Ag}(e) = \text{Dave and } T(e) \text{ is before 3PM}]]\)

d. \([[ [\text{vp Dave walked around South College}]] = \text{by FA and PM}] \quad [\lambda e : \text{walk}(e) & \text{Ag}(e) = \text{Dave and } L(e) \text{ is around South College}]]\)

Key Observation 2

In order for the types here to all work out, we have to assume that there is some kind of phonologically null thingy just below S, which takes the VP as argument and returns a truth-value.

\[ S t \]

\[ \emptyset \]

\[ < <\epsilon,t>, t > \]

\[ \text{Dave walked quickly} \]

• But what does this phonologically null thingy actually denote?

• To develop an answer, let’s lay out some assumptions regarding the truth-conditions of sentences like the ones in (2).

Assumptions Regarding the Truth-Conditions of the Sentences in (2)

a. \([[ \emptyset \text{ Dave walked quickly }]] = \text{T iff} \quad \text{There is an event } e \text{ such that } \text{walk}(e) & \text{Ag}(e) = \text{Dave} & e \text{ is quick}.

b. \([[ \emptyset \text{ Dave walked around South College }]] = \text{T iff} \quad \text{There is an event } e \text{ such that } \text{walk}(e) & \text{Ag}(e) = \text{Dave} & L(e) \text{ is around S. College}.

c. \([[ \emptyset \text{ Dave walked before 3PM }]] = \text{T iff} \quad \text{There is an event } e \text{ such that } \text{walk}(e) & \text{Ag}(e) = \text{Dave} & T(e) \text{ is before 3PM}.

With these truth-conditions, and the assumption that \( \emptyset \) is of type \(<<\epsilon,t>,t>\), we can deduce \([[\emptyset]]\)
Deducing the Extension of ‘∅’, Part 1

- First, by FA, we know that:
  \[ [\emptyset \text{ Dave walked quickly }] = [\emptyset][[\text{Dave walked quickly}]] \]

- Next, by (13b), we know that:
  \[ [\emptyset][[\text{Dave walked quickly}]] = [\emptyset][[\lambda e : \text{walk(e) & Ag(e) = Dave & e is quick}]] \]

- Next, given our notation, we know that:
  There is an event e such that e is an event of walking and Dave is the agent of e and e is quick \(\iff\)
  There is an event e such that \([\lambda e : \text{walk(e) & Ag(e) = Dave & e is quick}](e) = T \]

- Putting this together, we know that:
  \[ [\emptyset][[\lambda e : \text{walk(e) & Ag(e) = Dave & e is quick}]] = T \iff\]
  There is an event e such that \([\lambda e : \text{walk(e) & Ag(e) = Dave & e is quick}](e) = T \]

- Thus, \([\emptyset]\) denotes a function which takes as argument a predicate of events \(P\), and returns \(T \iff\) there is an event \(e\) such that \(P(e) = T\)

The Deduced Semantics

\[
[[\emptyset]] = [\lambda P_{<e,t>} : \text{there is an event e such that } P(e) = T ]
\]

\[ = [\lambda P_{<e,t>} : \exists e . P(e) = T ] \]
(18) **Putting the Pieces Together**

- In the system we’ve developed, the sentences in (1) are assumed to have the syntactic structure in (18a).

- Given the lexical entries in (9), (12), and (17), these sentences are predicted to have the truth-conditions in (18b)

\[\textbf{a. Syntax:} \quad S \bullet \]

\[
\begin{align*}
\text{Dave} & \quad \text{walked} \\
\text{NP} & \quad \text{e} \\
\text{VP} & \quad \text{V}<\text{e},<\text{e},t>> \\
\text{AdvP} & \quad \text{AdvP}<\text{e},t> \\
\text{VP} & \quad <\text{e},t> \\
\text{S} & \quad \emptyset <<\text{e},t>,t> \\
\end{align*}
\]

\[\text{b. Predicted Truth Conditions:} \]

\[
[[S]] = \text{T if and only if } \exists e. \text{walk(e)} \land \text{Ag(e)} = \text{Dave} \land e \text{ is quick}
\]

There is an event e such that e is an event of walking and Dave is the Agent of e, and e is quick.

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3. **Extending This to Transitive Verbs**

Under the regime of ideas above, we would need to assume that transitive sentences like (19a) have the syntax in (19b).

(19) **Event Semantics and Transitive Verbs: Syntax**

\[\textbf{a. Sentence:} \quad \text{Dave kissed Mary quickly.} \]

\[\textbf{b. Syntax:} \quad S \bullet \]

\[
\begin{align*}
\text{Dave} & \quad \text{kissed} \\
\text{NP} & \quad \text{e} \\
\text{VP} & \quad \text{V}<\text{e},<\text{e},t>> \\
\text{AdvP} & \quad \text{AdvP}<\text{e},t> \\
\text{VP} & \quad <\text{e},t> \\
\text{S} & \quad \emptyset <<\text{e},t>,t> \\
\end{align*}
\]
Consequently, we can deduce that transitive verbs in this system must be of type \(<e,\epsilon,\epsilon,t,\epsilon,\epsilon,t>\).

- We can assume that they have a lexical semantics akin to that in (20)

(20) **Event Semantics and Transitive Verbs: Semantics**

\[
[[\text{kissed}]] = \\
[\lambda y. [\lambda x. [\lambda e. \text{e is an event of kissing and } x \text{ is the agent of } e, \text{ and } y \text{ is the theme of } e ]]]
\]

\[
[\lambda y. [\lambda x. [\lambda e. \text{kiss} (e) \& \text{Ag} (e) = x \& \text{Thm} (e) = y ]]]
\]

(21) **Predicted Truth-Conditions of Transitive Sentences**

\[
[[((19b))] = T \text{ iff } \exists e. \text{ kiss} (e) \& \text{Ag} (e) = \text{Dave} \& \text{Thm} (e) = \text{Mary} \& e \text{ is quick}
\]

*There is an event e such that e is an event of kiss, the agent of e is Dave, the theme of e is Mary, and e is quick.*

4. **Severing External Arguments and the Little vP**

For reasons that you’ll learn about in LING 601, there is evidence that transitive verbs like “kiss” are actually of type \(<e,\epsilon,t>\), and only take their ‘themes’ as arguments.

- That is, there is reason to suspect that the lexical entry for ‘kiss’ should be as in (22)

(22) **Revised Lexical Semantics for Transitive Verbs**

\[
[[\text{kissed}]] = [\lambda y. [\lambda e. \text{kiss} (e) \& \text{Thm} (e) = y ]]
\]

(23) **Obvious Immediate Question**

How the heck does a VP like ‘kissed Mary’ combine semantically with the subject ‘Dave’ in (19)??
(24) **The Answer: Little-v**

a. **Step 1: Syntactic Assumption**
   The VP is dominated by a projection vP (‘little vP’). The subject appears in the specifier of ‘little’-v

   \[
   \begin{array}{c}
   NP \\
   \downarrow \\
   Dave \\
   \end{array}
   \quad
   \begin{array}{c}
   v \\
   \downarrow \\
   vP \\
   VP \\
   \end{array}
   \quad
   \begin{array}{c}
   V \\
   \downarrow \\
   \text{kissed} \\
   NP \\
   \end{array}
   \]

b. **Step 2: Semantic Assumption**
   The meaning of the little-v head does the work of introducing the ‘Agent’ role into the semantic representation of the sentence.

   \[
   [ [ \lambda P_{<e,t>} : \lambda x : [ \lambda e : P(e) = T \land Ag(e) = x ] ] ]
   \]

With these ideas in place, we can now derive the desired event-based semantics for the sentence *Dave kissed Mary.*

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**Side Note:**
Under these assumptions, we must also assume that adverbs are modifiers of vP (not VP)

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(25) **The Semantics of Transitive Sentences with vP**

a. **Sentence:** Dave kissed Mary quickly.

b. **Syntax:**

   \[
   \begin{array}{c}
   S \\
   \end{array}
   \quad
   \begin{array}{c}
   {\emptyset} <e,t>, t> \\
   \end{array}
   \quad
   \begin{array}{c}
   VP <e,t> \\
   \end{array}
   \quad
   \begin{array}{c}
   vP <e,t> \\
   \end{array}
   \quad
   \begin{array}{c}
   AdvP <e,t> \\
   \end{array}
   \quad
   \begin{array}{c}
   NP e \\
   \downarrow \\
   Dave \\
   \end{array}
   \quad
   \begin{array}{c}
   v \quad <e,t>, <e,t>> \\
   \end{array}
   \quad
   \begin{array}{c}
   vP <e,t> \\
   \end{array}
   \quad
   \begin{array}{c}
   NP e \\
   \downarrow \\
   Mary \\
   \end{array}
   \]

kissed
c. Predicted Truth Conditions:

\[
[[ S ]] = T \iff \exists e \text{. kiss}(e) \& \text{Ag}(e) = \text{Dave} \& \text{Thm}(e) = \text{Mary} \& e \text{ is quick}
\]

There is an event e such that e is an event of kiss, the agent of e is Dave, the theme of e is Mary, and e is quick.

(26) **Now Forget Everything You’ve Just Seen**

- As interesting and important as the ideas presented here are, we are going to put them on the ‘backburner’ for a while.

- That is, in the immediately following units, we’ll revert back to the idea that VPs are of type <e,t> and that transitive verbs directly take the subject as argument.

- We’ll come back to the ideas in this handout towards the end of the course…