That-clauses as event modifiers

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Introduction

My question
What is the status
that-clauses embedded under
attitude verbs in the grammar,
and why are embedded
DPs vs. CPs interpreted in
systematically different ways?

Spoiler alert!
That-clauses are never thematic
arguments; they modify
the embedding verb, specifying
the propositional content
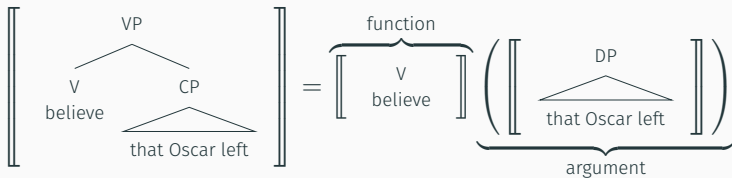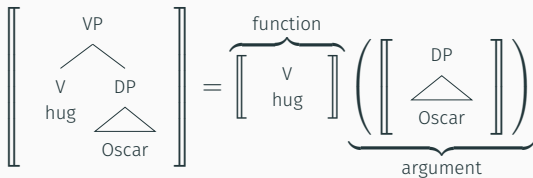of the eventuality argument.

Consequences for the syntax-semantics interface

- Logical Forms must be neo-Davidsonian – all thematic arguments are severed from the verb (Schein 1993, Lasersohn 1995).
- There is no type distinction between *eventualities* and other entities – *individuals*, *events*, and *states* are sorted sub-domains of D_e.
- Attitudes are anchored to a contentful eventuality introduced by the embedding predicate (Hacquard 2006).
- *that*-clauses combine with verbs and nouns in a uniform way.

N.b. family resemblance to Stowell 1981, Kratzer 2006, 2013, 2014, Moulton 2009, 2015.
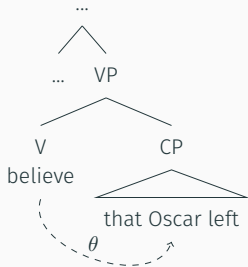
Embedding DPs and CPs

Some received wisdom

That-clauses, much like DPs, can function as *arguments*.

$$
\left[\!\!\left[
\begin{array}{c}
\text{VP} \\
\diagup\,\diagdown \\
\text{V} \quad \text{DP} \\
\text{hug} \quad \triangle \\
\qquad \text{Oscar}
\end{array}
\right]\!\!\right]
=
\overbrace{\left[\!\!\left[\begin{array}{c} \text{V} \\ \text{hug} \end{array} \right]\!\!\right]}^{\text{function}}
\left(
\underbrace{\left[\!\!\left[\begin{array}{c} \text{DP} \\ \triangle \\ \text{Oscar} \end{array} \right]\!\!\right]}_{\text{argument}}
\right)
$$

$$
\left[\!\!\left[
\begin{array}{c}
\text{VP} \\
\diagup\quad\diagdown \\
\text{V} \qquad \text{CP} \\
\text{believe} \quad \triangle \\
\qquad \text{that Oscar left}
\end{array}
\right]\!\!\right]
=
\overbrace{\left[\!\!\left[\begin{array}{c} \text{V} \\ \text{believe} \end{array} \right]\!\!\right]}^{\text{function}}
\left(
\underbrace{\left[\!\!\left[\begin{array}{c} \text{DP} \\ \triangle \\ \text{that Oscar left} \end{array} \right]\!\!\right]}_{\text{argument}}
\right)
$$

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Typically, this is captured in the semantics via the arity of the predicate, e.g.

(1) $[\![\text{believe}]\!] = \lambda p_{st}.\lambda y_e.y$ believes p

And/or in the syntax via θ-roles.

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A large class of verbs may embed both DPs and CPs.

In some cases, embedded DPs and CPs are interpreted in the same way.

(2)   Abed believes [$_{CP}$ that Shirley is upset].

(3)   Abed believes [$_{DP}$ the rumour that Shirley is upset].

(4)   Abed believes [$_{CP}$ that Shirley is upset]
        and [$_{DP}$ the rumour that Britta messed things up].

This is already problematic for the received wisdom. N.b. I reject out of hand an ambiguity account (*believe*$_1$ and *believe*$_2$).

In many cases, embedded DPs and CPs give rise to systematic meaning alternations. Pietroski (2000) looks at one notable case – we'll return to this.

Explanans reading

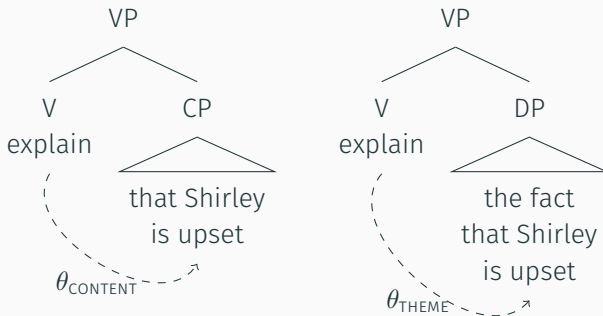(5)   Abed explained [$_{CP}$ that Shirley is upset].

≈ *Abed's explanation (for something) was that Shirley is upset.*

Explanandum reading

(6)   Abed explained [$_{DP}$ the fact that Shirley is upset].

≈ *Abed's explanation was of the fact that Shirley is upset.*

Pietroski's mapping principle

The verb *explain* assigns the CONTENT θ-role to its sister iff it is category CP, and the THEME θ-role iff its sister is category DP.

See Prior (1971), Uegaki (2015a,b) – "substitution failures"

(7) a.   Jeff fears [$_{CP}$ that he is balding].
     b.   Jeff fears [$_{DP}$ the rumour that he is balding].

(8) a.   Jeff imagined [$_{CP}$ that he is balding].
     b.   Jeff imagined [$_{DP}$ the rumour that he is balding].

(9) a.   Jeff predicted [$_{CP}$ that he would bald].
     b.   Jeff predicted [$_{DP}$ the rumour that he would bald].

No entailment between (a) and (b) examples. Pietroski's solution is tempting – in each case the CP intuitively provides the content of the eventuality expressed by the verb, e.g., the content of Jeff's fearing state in (7-a).

- Embedded DPs and CPs are interpreted in systematically different ways, and Pietroski's approach fails to explain this. Why aren't there verbs which assign the CONTENT role to a DP and the THEME role to a CP?

- No explanation for why the interpretation of an embedded CP is predictable (it specifies the content of an eventuality), unlike the interpretation of an embedded DP (Stowell 1981).

- Pietroski and subsequent literature (e.g., Kastner 2015) tie the interpretation of an embedded XP wrt the verb to its syntactic category. In the next section I show that this is empirically incorrect, before presenting a semantic analysis.

C- vs. s-selection and propositional DPs

(10) Jeff believes [$_{CP}$ that Britta will be late].

(11) Jeff believes
      [$_{DP}$ the {rumour|story|claim} that Britta will be late].

(12) Jeff {thinks|said} [$_{CP}$ that Britta will be late].

(13) *Jeff {thinks|said}
      [$_{DP}$ the {rumour|story|claim} that Britta will be late].

C-selection (Grimshaw 1979)? Abstract case (Pesetsky 1982)?

No – evidence from propositional DPs.

Varieties of propositional DP (propDPs)

- DPs headed by *thing*: *the same thing*, *a different thing*, *most things*, *two things*, *something*, *everything*, etc.
- The simplex *wh*-phrase *what*.
- Anaphoric expressions, such as *it* and *that*.
- Null operators in comparatives (Kennedy & Merchant 2000).

(14)   a.   Jeff thinks that Britta will be late,
              and Shirley thinks the same thing.
       b.   Jeff thinks that Britta will be late,
              and Shirley thinks that too.
       c.   What does Jeff think *t*?
       d.   Jeff is thinking everything that Shirley is.

(15)   a.   Jeff said that Britta will be late,
              and Shirley said the same thing.
       b.   Jeff said that Britta will be late,
              and Shirley said that too.
       c.   What did Jeff say *t*?
       d.   Jeff said everything that Shirley said

Other verbs: *hope, find out, argue,* etc.

(16) a.   Jeff hopes for [$_{DP}$ a new bicycle].
      b.   *Jeff hopes for [$_{CP}$ that Shirley will leave soon].
      c.   Jeff hopes for the same thing as Abed
           – namely, that Shirley will leave soon.
      d.   Q: What does Jeff hope for *t*?
           A: [$_{CP}$ that Shirley will leave soon].
      e.   Abed hopes that Shirley will leave soon.
           Jeff hopes for that too.

(17) a. *It is believed [*DP* the rumour].
      b.   It is believed [*CP* that Jeff has a new bicycle].
      c. *It is believed the same thing as Abed
          – namely, that Shirley will leave soon.
      d.   Q: *What is it believed *t*?
           A: [*CP* that Shirley will leave soon].
      e.   It is believed by Abed that Shirley will leave soon.
           It is believed that by Jeff too.

Payoff

- No c-selectional/case-differences between *believe*-type verbs
  and *think*-type verbs.
- PropDPs are syntactically nominal but pattern with *that*-clauses
  in other respects.

PropDPs diagnose the source of meaning alternations

Pietroski's prediction

When the verb *explain* combines with a propDP, it must assign it the THEME role. Therefore only the *explanandum* reading is available.

(18) Abed explained [$_{DP}$ something]
– namely the fact that Shirley is upset. ✓ *explanandum*

(19) Q: What did Abed explain t_{DP}?
The fact that Shirley is upset. ✓ *explanandum*

(20) Abed explained [$_{DP}$ something]
– namely that Shirley is upset. ✓ *explanans*

(21) Q: What did Abed explain t_{DP}?
A: That Shirley is upset. ✓ *explanans*

Summary of results

- Embedded DPs and CPs are interpreted in systematically different ways: embedded CPs provide the "content" of the eventuality, whereas DPs are interpreted in potentially idiosyncratic ways.
- No satisfying account of this puzzle, on the assumption that both DPs and CPs are arguments of the embedding predicate.
- Contra received wisdom, no c-selectional/case difference between *think*-type verbs and *believe*-type verbs.
- PropDPs are compatible with both DP-type readings *explanandum* and CP-type readings *explanans*, despite being syntactically nominal.

Suggestion

DPs and CPs are interpreted differently because only DPs can be genuine thematic arguments (Stowell 1981).

The road ahead

Background

- Ontological assumptions
- Semantics of a *that*-clause
- Composing *that*-clauses and content nouns
- Neo-Davidsonian event semantics

Analysis

- Collapsing the type-distinction
- Semantics of embedding
- Deriving the *explanans* and *explanandum* readings
- Semantics of propDPs

Loose ends (time permitting): *that*-clause extraposition as base-generation, ruling out stacked *that*-clauses, ruling in conjoined *that*-clauses, displaced *that*-clauses and the DP requirement.

Background assumptions

As well as familiar objects such as tables, chairs, monarchs, and nuclear missiles, the domain of entities (D_e) contains abstract objects such as *facts* and *stories* that we can refer to and quantify over.

Unlike tables and chairs, things like stories are *contentful*. I assume that the content of a abstract object is a proposition (i.e. a set of worlds), and that this is retrievable via the function $\mathscr{F}_{cont}$ (cf. Kratzer 2006, Moulton 2015, Uegaki 2015a).

$$\mathscr{F}_{cont}(\text{\textcopyright})\left(\quad \right) = \{w' : \text{Paul McCartney is dead in } w'\}$$

Semantics of a *that*-clause

> **Proposition-to-property shift**
> $[\![F_{PROP}]\!] = \lambda p_{st}.\lambda x_e.\mathscr{F}_{cont}(w)(x) = p$

(22)   LF of a *that*-clause

$$\langle e, t \rangle$$

F_{PROP}: $\langle st, et \rangle$ CP: $\langle s, t \rangle$

that Shirley is upset
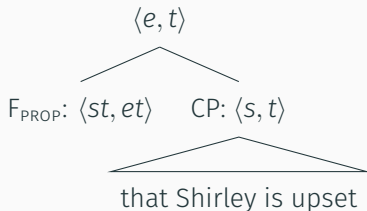
$= \lambda x_e.\mathscr{F}_{cont}(w)(x) = \lambda w'.\text{Shirley is upset}_{w'}$

Content nouns

Fact, rumour, story, idea, hypothesis, proposition, myth, desire, belief, knowledge, thought, suspicion, fear, dream, hope, expectation, etc.

(23)   The fact/rumour/story/hypothesis that Bill went to the shops.

Intuitively, the *that*-clause provides the content of the fact/rumour/story/hypothesis, etc (Heim 1991).

(24) $\llbracket$ n $\sqrt{rumour}$ $\rrbracket = \lambda x.\text{rumour}_w(x)$

Since the *that*-clause is also of type $\langle e, t \rangle$, the two can combine via *Predicate Modification* (Heim & Kratzer 1998)

Content DP composition

$$
\left[\!\!\left[\; \begin{array}{c} \text{nP} \\ \overset{\displaystyle\wedge}{} \\ \text{n} \quad \sqrt{fact} \end{array} \;\right]\!\!\right] = \lambda x_e.\text{fact}_w(x)
$$

$$
\left[\!\!\left[\; \begin{array}{c} \text{CP} \\ \overset{\displaystyle\triangle}{} \\ \text{that Cameron} \\ \text{resigned} \end{array} \;\right]\!\!\right] = \lambda x_e.\mathscr{F}_{cont}(w)(x) = \lambda w'.c \text{ resigned}_{w'}
$$

$$
\left[\!\!\left[\; \begin{array}{c} \text{nP} \\ \overset{\displaystyle\wedge}{} \\ \text{nP} \qquad \text{CP} \\ \overset{\displaystyle\wedge}{} \quad \overset{\displaystyle\triangle}{} \\ \text{n} \quad \sqrt{fact} \quad \text{that Cameron} \\ \text{resigned} \end{array} \;\right]\!\!\right] = \begin{array}{c} \lambda x_e.\text{fact}_w(x) \\ \wedge\, \mathscr{F}_{cont}(w)(x) = \lambda w'.c \text{ resigned}_{w'} \end{array}
$$

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DP: *e*

D: $\langle et, e \rangle$
the

nP: $\langle e, t \rangle$

nP: $\langle e, t \rangle$

n $\sqrt{fact}$

CP: $\langle e, t \rangle$

F_{PROP}: $\langle st, et \rangle$ $\langle s, t \rangle$

that Cameron
resigned
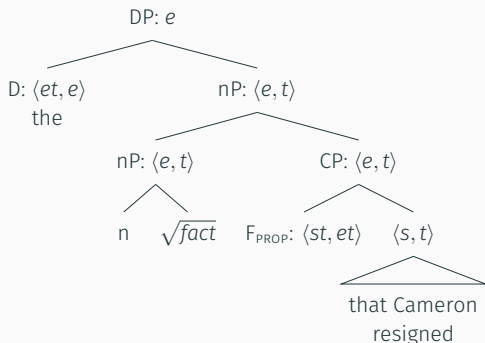
$$= \iota x[\text{fact}_w(x) \,\wedge\, \mathscr{F}_{cont}(w)(x) = \lambda w'.c \text{ resigned}_{w'}]$$

The semantics given here *equates* the content of the abstract object with the proposition expressed by the *that*-clause. This will be important later for ruling out stacked *that*-clauses.

(25)   a.   #...the/two/most facts that *P*.
       b.   #...a fact that *P*.
       c.   ...the fact that *P*.

(26)   a.   ...the/two/most rumours that *P*.
       b.   ...a/the rumour that *P*.

Identity criterion for *facts*

In a world *w*, given two entities x, y, if $fact_w(x)$ and $fact_w(y)$ and $\mathscr{F}_{cont}(w)(x) = \mathscr{F}_{cont}(w)(y)$ then $x = y$

All verbs take a single eventuality argument.

(27) $[\![_{vP} \text{ v } \sqrt{hug}]\!] = \lambda e.\text{hugging}_w(e)$

Thematic arguments are introduced via *thematic functions*.

(28)   a. $[\![\text{AGENT}]\!] = \lambda f.\lambda x.\lambda e.\text{AGENT}_w(e) = x \wedge f(e)$
       b. $[\![\text{THEME}]\!] = \lambda f.\lambda x.\lambda e.\text{THEME}_w(e) = x \wedge f(e)$
            etc.

$\lambda w.\exists e[\text{AGENT}_w(e) = \text{Jeff} \wedge \text{THEME}_w(e) = \text{Shirley} \wedge \text{hugging}_w(e)]$
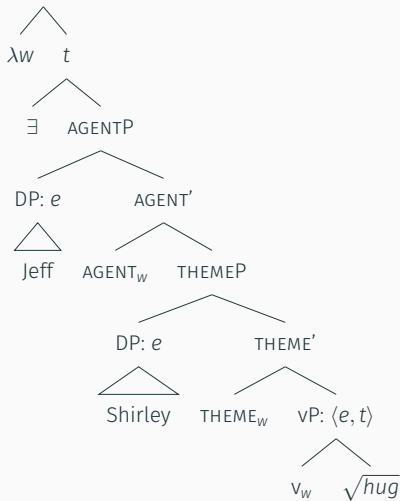
Analysis

Standard assumption

There is a domain of individuals D_e, and a domain of eventualities D_s.

Is there a good *linguistic* reason for making a type-distinction between individuals and eventualities? No

(29)   a.   John's running was slow.

           b.   #John's running was blonde.

(30)   a.   The assailant is fierce.

           b.   #The wardrobe is fierce.

Assumption here

Individuals and eventualities are sorted sub-domains of the domain of entities D_e (following Lasersohn 1995).

Central idea: all attitude verbs are properties of eventualities of type $\langle e, t \rangle$, and may combine with an embedded *that*-clause via PM.

$$= \quad \begin{aligned} &\lambda w. \exists s [\text{belief}_w(s) \wedge \\ &\quad \text{HOLDER}_w(s) = j \wedge \\ &\mathscr{F}_{cont}(w)(s) = \lambda w'. s \text{ upset}_{w'}] \end{aligned}$$
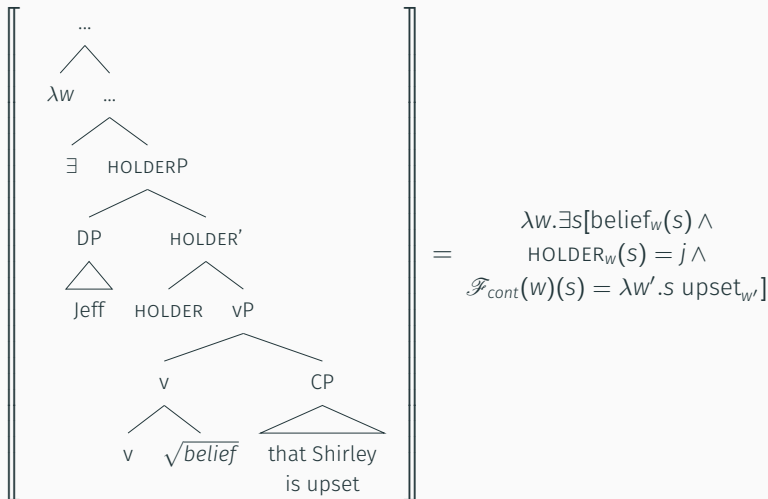
A semantics for *believe* after Hintikka 1969.

(31) $[\![\text{believe}]\!] = \lambda w_s.\lambda p_{st}.\lambda x_e.\forall w' : w' \in \text{Dox}_{x,w}, p(w') = 1$
        Where $\text{Dox}_{x,w} = \{w' :$
         it is compatible with what *x* believes in *w* for *w* to be $w'\}$

A radically neo-Davidsonian semantics for *believe*(!)

(32) $[\![\text{believe}]\!] = \lambda w_s.\lambda s_e.\text{belief}_w(s)$

Hintikkan meaning postulate for *believe*

In a world *w*, Given a state *s*, and an individual *x*, if $\text{belief}_w(s)$ and
$\text{HOLDER}_w(s) = x$, then for every world w', if $w' \in \text{Dox}_{x,w}$, then $w' \in$
$\mathscr{F}_{cont}(w)(s)$

Semantics of embedded DP

Central idea: content DPs denote (or quantify over) individuals, and therefore must be integrated via a thematic function to compose.
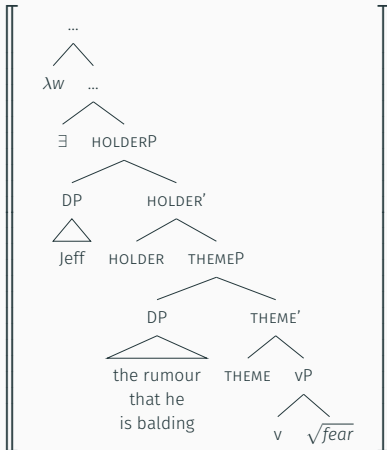
$$\lambda w.\exists s[\text{fear}_w(s) \land$$
$$\text{AGENT}_w(e) = j \land$$
$$\text{THEME}_w(e) = \iota x[\text{rumour}_w(x) \land$$
$$\mathscr{F}_{cont}(w)(x) = \lambda w'.j \text{ is balding}_{w'}]]$$
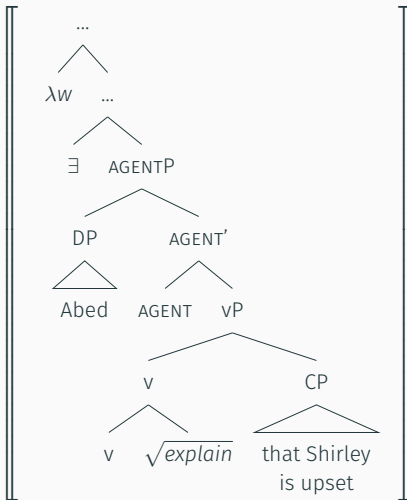
$$\lambda w.\exists e[\text{explaining}_w(e) \wedge \\ \text{AGENT}_w(e) = a \wedge \\ \mathscr{F}_{cont}(w)(e) = \lambda w'.s \text{ is upset}_{w'}]$$

31
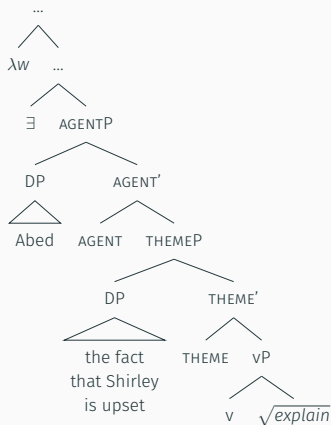
$$\lambda w.\exists e[\text{explaining}_w(e) \wedge$$
$$\text{AGENT}_w(e) = a \wedge$$
$$\text{THEME}_w(e) = \iota x[\text{fact}_w(x) \wedge$$
$$\mathscr{F}_{cont}(w)(x) = \lambda w'.s \text{ is upset}_{w'}]]$$

(33) $[\![\text{THING}_{\text{PROP}}]\!] = \lambda P_{et}.\forall x, y[(P(x) \land P(y)) \to \mathscr{F}_{cont}(x) = \mathscr{F}_{cont}(y)]$

(34) $[\![\text{SOME}]\!] = \lambda P_{\sigma t}.\lambda Q_{\sigma t}.\exists x_\sigma[P(x) \land Q(x)]$

(35) $[\![\text{SOMETHING}_{\text{PROP}}]\!]$
      $= \lambda Q_{et,t}.\exists P_{et}[(\forall x, y[(P(x) \land P(y)) \to \mathscr{F}_{cont}(x) = \mathscr{F}_{cont}(y)]) \land Q(P)]$

PropDPs are higher-order quantifiers over properties, and can therefore leave behind a type $\langle e, t \rangle$ trace, which may combine with the verb via *PM*

Semantics of propDPs
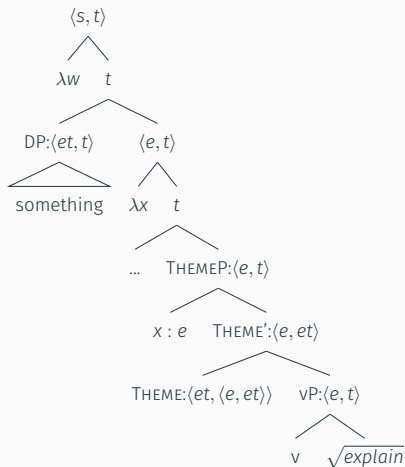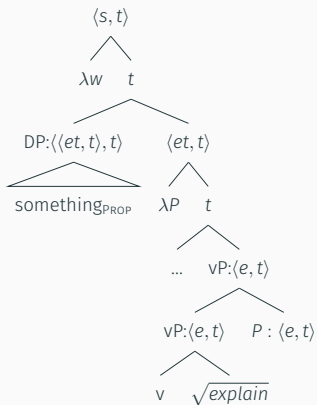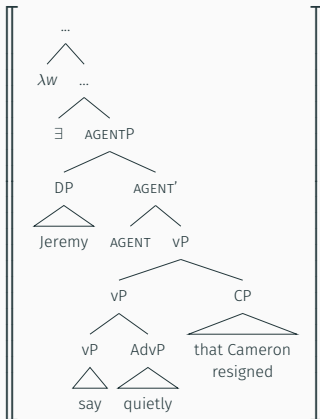
$$\lambda w.\exists e[\text{AGENT}_w(e) = \text{J.} \wedge$$
$$\text{saying}_w(e) \wedge \text{quiet}_w(e) \wedge$$
$$\mathscr{F}_{cont}(w)(e) = \lambda w'.\text{Cameron resigned}_{w'}]$$

(36) a. *John believes the rumour that Mary left that Sally is upset.

  b. *John believes that Mary left that Sally is upset.

$$\llbracket (36\text{-b}) \rrbracket = \begin{array}{l} \lambda w.\exists s[\text{belief}_w(s) \wedge \text{HOLDER}_w(s) = j \wedge \\ \quad \mathscr{F}_{cont}(w)(s) = \lambda w'.m \text{ left}_{w'} \wedge \\ \quad \mathscr{F}_{cont}(w)(s) = \lambda w'.s \text{ is upset}_{w'}] \end{array}$$

Contradiction!

Stacked *that*-clauses give rise to a contradictory Logical Form, since $\mathscr{F}_{cont}$ is a function.

Conjunction (which I assume is boolean) takes place at the propositional level, below F_{PROP}.

$\langle e, t \rangle$

F_{PROP}: $\langle st, et \rangle$ andP: $\langle s, t \rangle$

CP$_1$: $\langle s, t \rangle$ and'

that Mary left   and   CP$_2$: $\langle s, t \rangle$

that Sally is upset
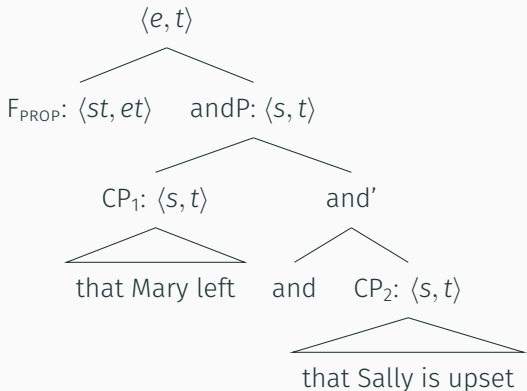
$[\![and]\!]([\![CP_2]\!])([\![CP_1]\!]) = \lambda w'. m \text{ left}_{w'} \wedge s \text{ is upset}_{w'}$

> ### The DP requirement (revised)
> The gap of a fronted CP (sentential subject or topic) must be ~~a DP~~ type *e*. (Moulton 2013)

(37)   a.   ?*That Mary will leave, John hopes ~~that Mary will leave~~.
       b.   That Mary will leave, John hopes for ~~that Mary will leave~~.

(38)   That Cameron resigned, Jeremy explained ~~that Cameron resigned~~.   ✓*explanandum*, **explanans*

Since the lower copy of the CP is type $\langle e, t \rangle$, *trace conversion* predicts this (Fox & Johnson 2016). Insertion of a bound definite determiner implements a *property-to-entity shift* of the lower copy. This algorithm for interpreting movement chains is independently motivated.
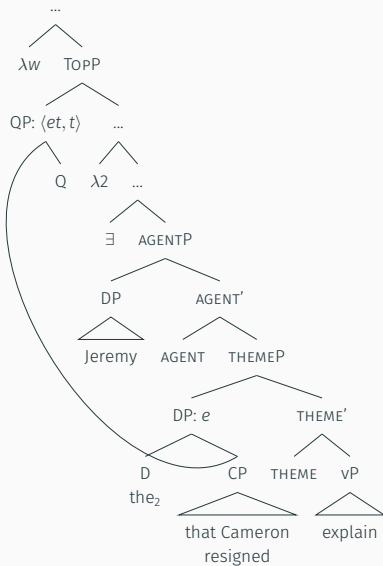
Conclusion

Take-home message

We can capture the systematic meaning alternations associated with embedded DPs vs. CPs by rejecting the received wisdom that CPs are true thematic arguments – clausal "complements" are event modifiers.

- Along the way, we made some non-trivial assumptions about the syntax-semantics interface, e.g. full-thematic separation (neo-Davidsonianism).
- We also explained some puzzling facts about the distribution of clausal complements, including CP extraposition and the DP requirement.

THANK YOU!

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
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(39) John believes that Mary is at the party and her best friend isn't there.
⇒ John believes that Mary is at the party.

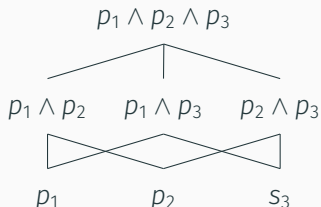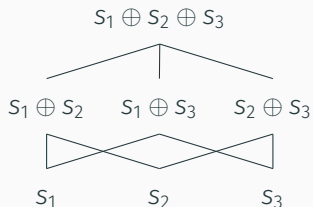(40) John is surprised that Mary is at the party and her best friend isn't there.
⇏ John is surprised that Mary is at the party.

$\exists s[\text{belief/surprisal}_w(s) \land \text{HOLDER}_w(s) = j \land \mathscr{F}_{cont}(w)(s) = \lambda w'.\text{Mary is at the party}_{w'} \text{ and Mary's best friend isn't there}_{w'}]$

$\exists s[\text{belief/surprisal}_w(s) \land \text{HOLDER}_w(s) = j \land \mathscr{F}_{cont}(w)(s) = \lambda w'.\text{Mary is at the party}_{w'}]$

Good predictions for verbs like *surprise* but (apparently) not for *believe*.

$$s_1 \oplus s_2 \oplus s_3 \qquad\qquad p_1 \wedge p_2 \wedge p_3$$

$$s_1 \oplus s_2 \quad s_1 \oplus s_3 \quad s_2 \oplus s_3 \qquad\qquad p_1 \wedge p_2 \quad p_1 \wedge p_3 \quad p_2 \wedge p_3$$

$$s_1 \qquad s_2 \qquad s_3 \qquad\qquad p_1 \qquad p_2 \qquad s_3$$

In w...

- If $s \leq s'$ then $\mathscr{F}_{cont}(w)(s') \supseteq \mathscr{F}_{cont}(w)(s)$
- If $s'' = s + s'$ then $\mathscr{F}_{cont}(w)(s'') = \mathscr{F}_{cont}(w)(s) \wedge \mathscr{F}_{cont}(w)(s')$
- Note that this only holds for the subdomain of *belief* states. Neither of these things holds for, e.g. surprisal states.