Compositional semantics and event semantics: a case study in inter-theoretic relations

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1 Introduction

- Eventless compositional semantics: a verb is a relation over its arguments

(1) $[\![\text{stab}]\!] = \lambda y \lambda x.\textbf{stab}(x, y)$
$\approx \{\langle y, \langle x \rangle | \langle x, y \rangle \in \textbf{STAB}\}$

- Neo-Davidsonian event semantics (Davidson, 1967; Castañeda, 1967; Parsons, 1990): a verb is a predicate of events; linked to its arguments by thematic roles. Event bound by existential quantifier.

(2) $[\![\text{stab}]\!] = \lambda e.\textbf{stabbing}(e)$
$\approx \{e | e \in \textbf{STAB}\}$

(3) Brutus stabbed Caesar.

Eventless semantics:	$\textbf{stab}(b, c)$
Neo-Davidsonian event semantics:	$\exists e[\textbf{stabbing}(e) \wedge \textbf{agent}(e) = b \wedge \textbf{theme}(e) = c]$

2 Compositional semantics

- Following Montague (1974), many successful theories of scope-taking expressions that have counterparts in predicate logic:

(4) a. Quantifiers (*some, every*): (e.g. Montague, 1974)
b. Coordination (*and, or*) (e.g. Partee and Rooth, 1983)
c. Truth-functional negation (*not*) (e.g. Horn, 1989)

- Here are three issues in which compositional semantic theories disagree, and in which event semantics has been claimed to favor one view over another:

2.1 Intertheoretic relations: Quantification $\leftrightarrow$ event semantics

- Some theories analyze quantifier scope as covert syntactic movement

(5) John kissed every girl.

  - Montague (1974): Quantifying-In
  - May (1985): Quantifier Raising (QR)

(6) [[every girl] 1 [John kissed t_1]]

- Some theories provide semantic accounts:

  - Hendriks (1993): argument raising
  - Barker (2002): continuation semantics

(7) [[John [TYPE-SHIFT(kissed)] [every girl]]]

- I will show that event semantics is compatible with both syntactic and semantic accounts of quantifier scope.

- **Why should we care?**

  - Some people believe otherwise (Beaver and Condoravdi, 2007; Eckardt, 2009)
  - Syntactic accounts are sometimes viewed as problematic (e.g. Beaver and Condoravdi, 2007; Eckardt, 2009), for example because it entails the presence of a representational level (Logical Form) (Jacobson, 1999; Barker, 2002)
  - QR is probably absent in some languages such as Chinese (Huang, 1998).

2.2 Intertheoretic relations: Conjunction $\leftrightarrow$ event semantics

- Does *and* mean "Intersect"? (Partee and Rooth, 1983; Winter, 2001; Champollion, 2013, 2014f)

(8) John walks and talks. $j \in \mathbf{WALK} \cap \mathbf{TALK}$

- Or does *and* mean "Form a collective entity"? (Krifka, 1990; Lasersohn, 1995; Heycock and Zamparelli, 2005)

(9) John and Mary met. $j \oplus m \in \mathbf{MEET}$

- I will show that event semantics is compatible with both.

- **Why should we care?**

- The intersective theory has an edge in noun and noun-phrase conjunctions Winter (2001); Champollion (2013, 2014f).
- Lasersohn (1995): event semantics favors the collective theory.

2.3 Intertheoretic relations: Negation $\leftrightarrow$ event semantics

- Does truth-functional *not* correspond to classical negation? (Horn, 1989)

(10) a. It did not rain today.
b. "It is not the case that (there was an event in which) it rained today."

- Or does it involve reference to maximal fusions? (Krifka, 1989)

(11) "The fusion(-state) of all the events that took place today does not contain any subevents in which it rained."

- I will show that event semantics is compatible with both.
- **Why should we care?**
  - Fusion-based negation has been both influential and controversially debated (de Swart, 1996; de Swart and Molendijk, 1999; Zucchi and White, 2001; Condoravdi, 2002; Giannakidou, 2002; Csirmaz, 2006).
  - Krifka (1989): event semantics requires the fusion theory.

3 Quantification

- **Generalization:** (adapted from Landman (2000)): The event quantifier always takes scope under all other quantifiers

(12) Spot didn't bark.
a. = "There is no event in which Spot barks"
b. ≠ "There is an event in which Spot did not bark"

(13) No dog barks.

(14) a. $\neg\exists x[\mathbf{dog}(x) \wedge \exists e[\mathbf{barking}(e) \wedge \mathbf{agent}(e) = x]]$ No >> $\exists e$
"There is no barking event that is done by a dog"
b. *$\exists e[\neg\exists x[\mathbf{dog}(x) \wedge \mathbf{barking}(e) \wedge \mathbf{agent}(e) = x]]$ *$\exists e$ >> No
"There is an event that is not a barking by a dog"

(15) Every dog barks.

(16) a. $\forall x[\mathbf{dog}(x) \rightarrow \exists e[\mathbf{barking}(e) \wedge \mathbf{agent}(e) = x]]$ Every >> $\exists e$
"For every dog there is a barking event that it did"

b. $*\exists e \forall x[\mathbf{dog}(x) \rightarrow [\mathbf{barking}(e) \wedge \mathbf{agent}(e) = x]]$ $*\exists e >> \textsc{Every}$
"There is a barking event that was done by every dog"

- Thematic roles are partial functions (Carlson, 1984; Dowty, 1989; Parsons, 1990; Landman, 2000) so there have to be different barking events
- Situating this analysis:

	No Events	Events
Covert movement	e.g. May (1985)	e.g. Landman (2000)
Type shifting	e.g. Hendriks (1993)	*this presentation*

3.1 Neo-Davidsonian semantics: the standard analysis

- Neo-Davidsonian semantics lends itself to a natural compositional process in terms of intersection with an existential quantifier at the end (Carlson, 1984; Parsons, 1990, 1995; Landman, 2000).
- This is found in state-of-the-art analyses (e.g. Kratzer, 1996; Landman, 2000):
  - Verbs and their projections (VP, v', vP...) are predicates over events
  - Functional heads introduce thematic roles
  - A silent operator ("existential closure") binds the event variable

(17) a. $[\![\text{[agent]}]\!] = \lambda x \lambda e[\mathbf{ag}(e) = x]$
b. $[\![\text{[theme]}]\!] = \lambda x \lambda e[\mathbf{th}(e) = x]$
c. $[\![\text{stab}]\!] = \lambda e[\mathbf{stab}(e)]$
d. $[\![\text{[ag] Brutus}]\!] = \lambda e[\mathbf{ag}(e) = \mathbf{brutus}]$
e. $[\![\text{[th] Caesar}]\!] = \lambda e[\mathbf{th}(e) = \mathbf{caesar}]$
f. $[\![\text{Brutus stab Caesar}]\!] = (17c) \cap (17d) \cap (17e)$ (sentence radical)
g. $[\![\text{Brutus stabbed Caesar}]\!] = \exists e.e \in (17c) \cap (17d) \cap (17e)$

- This has been elevated to a principle, *conjunctivism*, in Pietroski (2005, 2006).
- A VP has to apply to an event, but there is no single event to which a verb phrase like "kiss every girl" and "kiss no girl" could apply.

(18) $[\![\text{kiss every/no girl}]\!] = \lambda e.???$

- One solution is quantifier raising: give an assignment-dependent meaning

(19) $[\![\text{kiss } t_1]\!] = \lambda e.\mathbf{kissing}(e) \wedge \mathbf{th}(e) = x$

- Problem: this analysis requires a syntactic level of representation (LF) distinct from surface order. This is shown in Fig. 1.

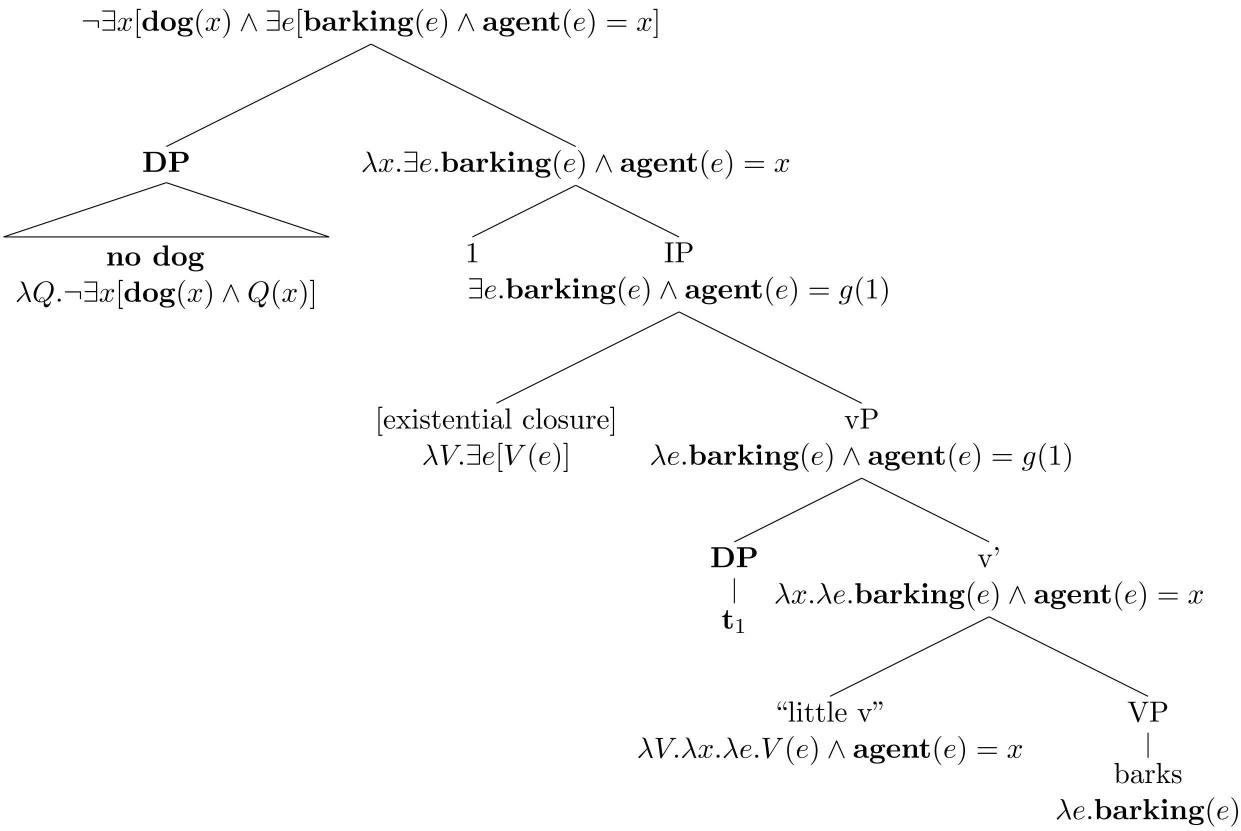

Figure 1: "No dog barks", Neo-Davidsonian style

4 The proposal

- Core idea: Include existential quantification into the meaning of the verb.

(20) $[\![\text{kiss}]\!] = \lambda f_{\langle vt \rangle}.\exists e.\mathbf{kiss}(e) \wedge f(e)$
$\approx \{F | F \cap \mathbf{KISS} \neq \emptyset\}$

- Start with a verb and successively apply its arguments and adjuncts to it, as in event semantics.
- This will automatically derive the fact that all other quantifiers always have to take scope above the event quantifier.
- Every argument is semantically a modifier.

(21) $[\![\text{kiss Mary[th]}]\!] = \lambda f.\exists e.\mathbf{kiss}(e) \wedge f(e) \wedge \mathbf{theme}(e) = mary$

- Now, "kiss every girl" applies to any set of events that contains a potentially different kissing event for every girl. Noun phrases can retain their usual analysis as quantifiers over individuals.

(22) $[\![\text{every girl[th]}]\!] = \lambda V \lambda f.\forall x[\mathbf{girl}(x) \rightarrow V(\lambda e[\mathbf{theme}(e) = x \wedge f(e)])]$

(23) $[\![\text{kiss every girl[th]}]\!] = \lambda P.\forall x.\mathbf{girl}(x) \rightarrow \exists e.\mathbf{kiss}(e) \wedge P(e) \wedge \mathbf{theme}(e) = x$

- "kiss no girl" is similar.
- For scope ambiguities, type-shift the thematic roles (Champollion, 2014f).
- Finally apply (24) to assert that the predicate is true of the set of all events.

(24) $[\![\text{[closure]}]\!] = \lambda e.\mathbf{true}$

(25) a. $[\![\text{it rains}]\!] = \lambda f.\exists e[\mathbf{rain}(e) \wedge f(e)]$
b. $[\![\text{[closure] it rains}]\!] = \exists e[\mathbf{rain}(e) \wedge \mathbf{true}$

(26) a. $[\![\text{John kissed every girl}]\!] = \lambda f.\forall x[\mathbf{girl}(x) \rightarrow \exists e[\mathbf{kiss}(e) \wedge \mathbf{ag}(e) = j \wedge \mathbf{th}(e) = x \wedge f(e)]$
b. $[\![\text{[closure] John kissed every girl}]\!]$ $\forall x[\mathbf{girl}(x) \rightarrow \exists e[\mathbf{kiss}(e) \wedge \mathbf{ag}(e) = j \wedge \mathbf{th}(e) = x \wedge \mathbf{true}]$

- For full detail, see Figure 2.

5 Conjunction

- Lasersohn (1995, ch. 14) claims that event semantics favors the collective theory.

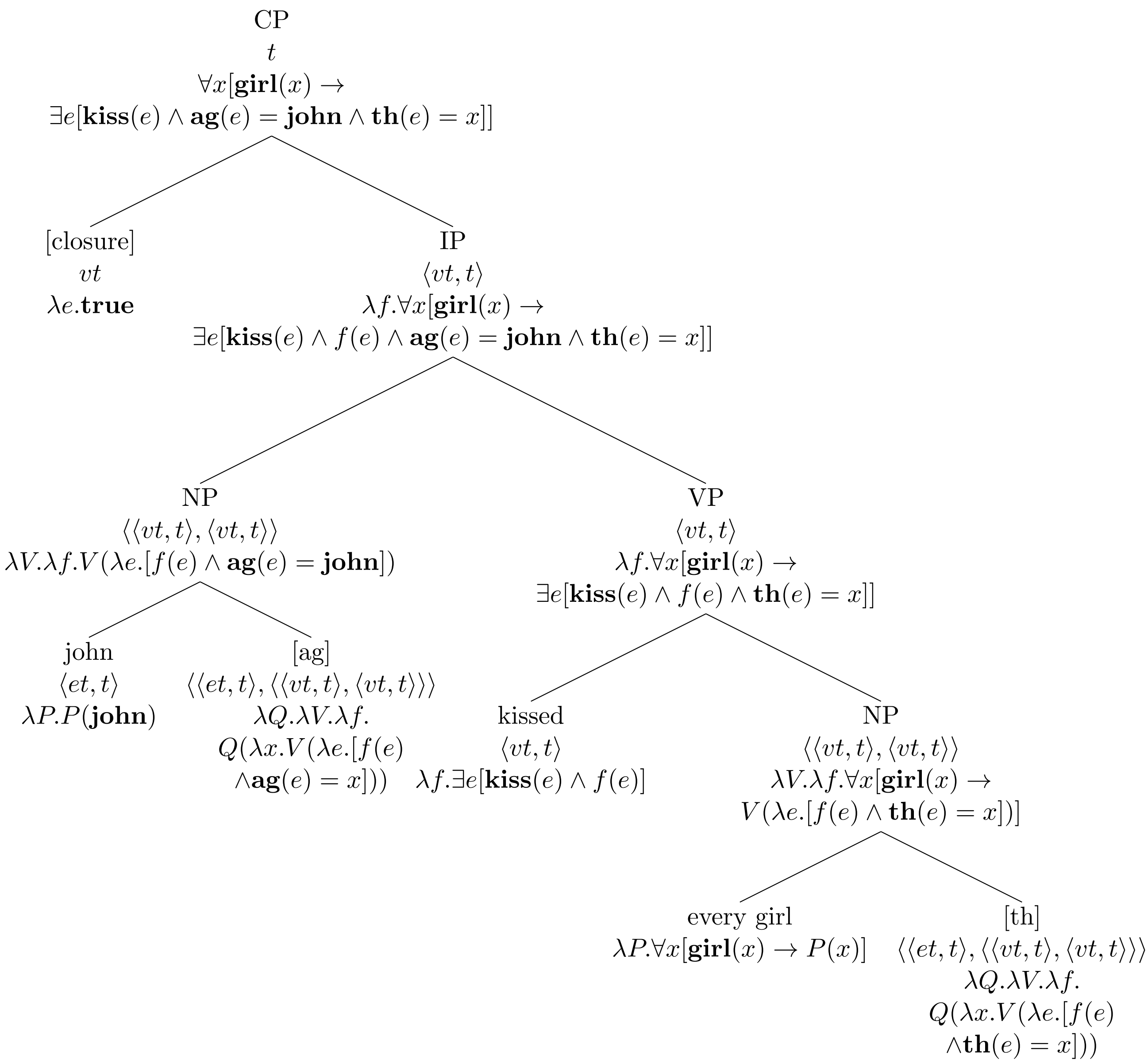

Figure 2: Illustration of this framework, using the sentence "John kissed every girl."

- Lasersohn translates sentence radicals as event predicates.

(27) a. $[\![\text{and}]\!]_{Lasersohn} = \lambda P_1.\lambda P_2.\lambda e.\exists e_1 \exists e_2.P_1(e_1) \wedge P_2(e_2) \wedge e = \{e_1, e_2\}$
b. $[\![\text{sing and dance}]\!]_{Lasersohn} = \lambda e.\exists e_1 \exists e_2.\mathbf{sing}(e_1) \wedge \mathbf{dance}(e_2) \wedge e = \{e_1, e_2\}$

- I will show that event semantics is also compatible with the intersective theory.
- The intersective theory identifies *and* with intersection (suitably generalized – see (e.g. Partee and Rooth, 1983)).
- Applied to event predicates and event quantifiers:

(28) **Conjunction of sets of events:** (no event quantifier!)
$[\lambda e.\mathbf{sing}(e)] \cap [\lambda e.\mathbf{dance}(e)]$
$= [\lambda e.\mathbf{sing}(e) \wedge \mathbf{dance}(e)]$

- In set terms: we intersect SING and DANCE. This might yield the empty set.
- The one-event view in (28) doesn't work well because it forces both verbal predicates to apply to the same event.
- But there must be two events involved on pain of contradiction:

(29) The ball rotated quickly and heated up slowly. (Davidson, 1969)

- This is immediately predicted on the two-event view.

(30) **Conjunction of sets of sets of events:** (two event quantifiers!)
$[\lambda f.\exists e.\mathbf{sing}(e) \wedge f(e)] \cap [\lambda f.\exists e.\mathbf{dance}(e) \wedge f(e)]$
$= [\lambda f.[\exists e.\mathbf{sing}(e) \wedge f(e)] \wedge [\exists e'.\mathbf{dance}(e') \wedge f(e')]]$

- Intersect the set of all sets that contain a singing event, and the set of all sets that contain a dancing event. Result: the set of all sets that contain one of each.

(31) $[\![\text{rotate quickly}]\!] \cap [\![\text{heat up slowly}]\!] =$
$\lambda f.[\exists e.\mathbf{rotate}(e) \wedge \mathbf{quickly}(e) \wedge f(e)]$
$\wedge [\exists e'.\mathbf{heat\text{-}up}(e') \wedge \mathbf{slowly}(e') \wedge f(e')]$

- See Champollion (2014f) for more details (interaction with *alternately*, sentences like *John caught and ate a fish*).

6 Negation

- Negation has been considered difficult for event semantics (Krifka, 1989).

- We have seen earlier that negation always takes scope above the event quantifier.
- But on the old approach, we get the wrong reading:

(32) a. $[\![\text{bark}]\!] = \lambda e.\mathbf{bark}(e)$
b. $[\![\text{not bark}]\!] = \lambda e.\neg\mathbf{bark}(e)$???
c. $[\![\text{Spot[ag] didn't bark}]\!] = \exists e[\mathbf{ag}(e) = s \wedge \neg\mathbf{bark}(e)]$???

- Krifka (1989) suggests that negation takes scope under the event quantifier.
- But this decision requires translating negation in a nonstandard way. Krifka uses fusion (mereological sum) for this purpose.

(33) $[\![\text{did not}]\!]_{\mathbf{Krifka}}$
$= \lambda P \lambda e \exists t[e = \mathbf{FUSION}(\lambda e'[\tau(e') \leq t]) \wedge \neg\exists e''[P(e'') \wedge e'' \leq e]]$

- For Krifka, *Spot didn't bark* means that there is a fusion of all the events within some time, and that none of them is an event of Spot barking:

(34) $[\![\text{Spot did not bark}]\!] =$
$\exists e \exists t[e = \mathbf{FUSION}(\lambda e'[\tau(e') \leq t])$
$\wedge\neg\exists e''[e'' \leq e \wedge \mathbf{bark}(e'') \wedge \mathbf{ag}(e'') = \mathbf{spot}]]$

- We can formulate the meaning of *not* in terms of logical negation, without fusions.

(35) a. $[\![\text{not}]\!] = \lambda V \lambda f \neg V(f)$
b. $[\![\text{bark}]\!] = \lambda f \exists e[\mathbf{bark}(e) \wedge f(e)]$
c. $[\![\text{not bark}]\!] = \lambda f \neg\exists e[\mathbf{bark}(e) \wedge f(e)]$
d. $[\![\text{spot [ag]}]\!] = \lambda V \lambda f.V(\lambda e.\mathbf{ag}(e) = s \wedge f(e))$
e. $[\![\text{spot [ag] (did) not bark}]\!] = \lambda f \neg\exists e[\mathbf{bark}(e) \wedge \mathbf{ag}(e) = s \wedge f(e)]$
f. $[\![\text{[closure] spot [ag] (did) not bark}]\!] = \neg\exists e[\mathbf{bark}(e) \wedge \mathbf{ag}(e) = \mathbf{s}]$

- See Champollion (2014f) for more details (interaction with tense and aspectual adverbials) and for a treatment of modals in this style.

7 Conclusion

- Neo-Davidsonian event semantics does not pose a particular problem when it is combined with standard accounts of quantification, conjunction, and negation.
- I have provided a simple account for the fact that argument quantifiers always take scope above existential closure.
- The framework proposed here combines the strengths of event semantics and type-shifting accounts of quantifiers.

- It is well suited for applications to languages where word order is free and quantifier scope is determined by surface order.

7.1 Further Reading

- Champollion (2010): an early version. Available online at `http://dx.doi.org/10.4148/biyclc.v6i0.1563`
- Champollion (2014c): under review. Available online at `http://ling.auf.net/lingbuzz/002118`.
- Champollion (2014b): ESSLLI lecture notes. Available online at `http://ling.auf.net/lingbuzz/002143`.
- Schwarzschild (2014) and Champollion (2014e): integrating the system presented here with Champollion (2014a,d). Second citation available online at `http://ling.auf.net/lingbuzz/002165`
- Active research program, comments welcome at `champollion@nyu.edu`.

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