Change of state: From the BECOME operator to the mereotopology of events

Louise McNally

upf. Universitat Pompeu Fabra *Barcelona*

DGfS 2022 Workshop: Change of State Verbs – Empirical and Theoretical Perspectives
February 23, 2022

This talk is a kind of tour, part intellectual history, part personal history.

We will visit some key ideas in the history of analyzing verb meanings, and some of my experiences in grappling with them in linguistic analysis.

Our destination: The conclusion that, even though it can be easy to lump together truth conditions and reference, *simply providing truth conditions* for event descriptions can yield subtly – but crucially – different results from *explicitly modeling* event reference.

This is a conclusion going back at least to Kamp (2017) (first published in French in 1981), but it took me about 30 years to fully embrace it.

How I got started

(1) *La CNN **se enamora** de una ciudad espaola: aconseja ir a ella en vez de a Barcelona*

'CNN **falls in love** with a Spanish city: Encourages going there instead of to Barcelona' (huffingtonpost.es, 5/1/22)

How I got started

Marín (2001): *enamorarse* denotes an *estado acotado* 'bounded state' (in contrast to an "estado no acotado", e.g. *admirarse* 'to admire oneself' or, crucially, a dynamic change of state, e.g. *evaporarse* 'evaporate')

As an English speaker, I was skeptical!
I also did not really understand what an "estado acotado" was.

But Marín eventually convinced me that *enamorarse* was different from *to fall in love*, and along the way I realized I needed to change the way I thought about event reference.
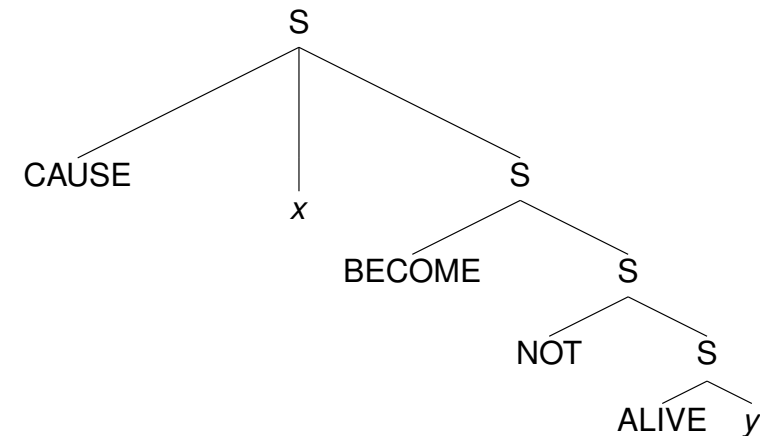
The start of our intellectual history: Lakoff (1965)

Lakoff (1965) presented an early attempt to syntactically analyze the relations between sentences such as the following, adapted from Dowty (1979):

(2) a. The soup was cool
 b. The soup cooled
 c. The chef cooled the soup

(3) a. The metal was hard
 b. The metal hardened
 c. The smith hardened the metal

Then there was Dowty...

Dowty (1979): A program to bring lexical semantics – specifically, insights from Generative Semantics – into the purview of Montague Semantics.

"I will try to show that the kind of decomposition analysis produced in G[enerative]S[emantics] can form a useful basis for expanding the class of entailments among English sentences that are formally provable in the theory..." (p. 31)

Shortly thereafter: McCawley (1968)

McCawley (1968), illustrating a more general proposal for post-transformation lexical insertion – what we might today call "spellout" – presented this now famous account of *x kills y*:

(Dowty's (1979, p. 44) rendering of McCawley's analysis)

A role for historical accident

► But there are multiple ways to account for intuitions about when sentences are true, and for logical (or more generally, inferential) relations between them.

► Importantly, Dowty's ontology did not include events.

► His approach to aspectual semantics was heavily conditioned by his choices concerning temporal semantics.

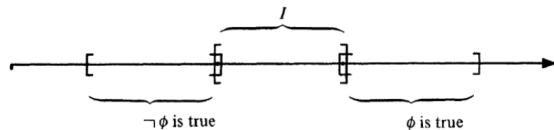► Things might have been very different had his ontology included events...

Dowty's *two* analyses of BECOME

Analysis 1: Truth defined at times as *instants t*.

Where ϕ is any formula, and t is any time, BECOME(ϕ) is true at t iff ϕ is true at t and false at $t-1$. (p. 76)

Analysis 2: Truth defined at times as *intervals I*.

BECOME(ϕ) is true at I iff (1) there is an interval J containing the initial bound of I such that $\neg\phi$ is true at J, (2) there is an interval K containing the final bound of I such that ϕ is true at K, and (3) there is no non-empty interval I' such that $I' \subset I$ and conditions (1) and (2) hold for I' as well as I. (p. 141)

Dowty's *two* analyses of BECOME

- ▶ Dowty advocates the interval analysis in Chapter 3 after identifying a series of problems with the instant analysis.

- ▶ He notes that "In fact, the analysis I will propose below turns out not to require the assumption that the meanings of accomplishments and achievements are exactly 'decomposable' in terms of operators like CAUSE and BECOME at all, but merely that these two classes of verbs logically entail BECOME-sentences (or other formulas with equivalent semantic properties)." (p. 137)
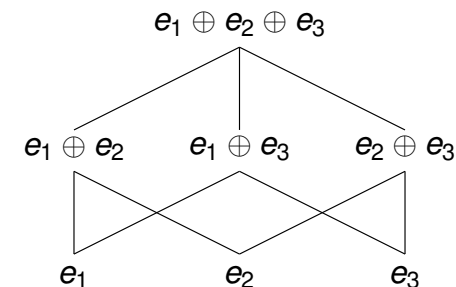
Enter eventualities

If, following Davidson (1967) and others, we include eventualities in our ontology, and observing that some of them look complex, we might be interested in analyzing their *parts* (= *mererological structure*).

- ▶ **"Classical" mereologies** (part-whole relations alone, e.g. Krifka 1989) have predominated.

- ▶ **Mereotopologies** (mereology + notions such as boundedness and connectedness, e.g. Pustejovsky 1991, Pianesi and Varzi 1996, Piñón 1997) have been proposed by some, but have gained little or no traction among semanticists.

- ▶ Yet considerable syntactically-informed or -oriented work on verbs points to the relevance of the latter.

- ▶ Arguably the two model complementary types of information.

"Classical" mereology: Lattice structure

- ▶ $e \oplus e'$: "the sum of e and e'".
  - ▶ No particular claims about what e or e' are like.
  - ▶ Could model, e.g., *Bart called and Lisa laughed*

- ▶ Used to analyze relations between events and times, conjunction, (controversially) telicity and the relation between nominal reference and temporal constitution.

Pustejovsky's (1991) event mereotopology

- 2 primitive types of eventualities: states, activities (not P's terminology).
- Different types of eventualities (with theoretically significant internal or "subevent" structures) can be composed of these.
- **Example:** Pustejovsky's "transition" consists of a process followed by a state.

$$
\begin{array}{c}
e \\
\diagup\diagdown \\
a \quad s
\end{array}
$$

- Mereotopologies can undergird theories of which aspects of the internal structure of entities are grammatically relevant (cp. Grimm 2012 on number/countability systems, or Wagiel 2018 on double hamburgers).

A personal interlude

- Heavily influenced by Dowty and Krifka's views on aspect, I confess to not appreciating Pustejovsky's arguments for event structure when I read *The Generative Lexicon*. I had similar reactions to related proposals (e.g., by Rothstein), and I did not look closely at other relevant syntactic work at the time (e.g., by Grimshaw).
- It took 20 years, but various observations convinced me that the mereotopological approach afforded crucial insights. These are visible, if not described in these terms, in syntactic approaches to event structure such as that in Alexiadou et al. (2015).
- The way I tell the rest of the story does not do full historical credit, but is about how I came to retool my thinking.

Phase 1: Spanish reflexive psych verbs

- Marín and McNally (2011) argue that *enamorarse* and related verbs are stative, but carry a felicity condition that use of the verb must include reference to the onset of the state.
- These tests crucially differentiated reflexive psychological verbs from inchoative verbs like *evaporarse* 'evaporate' as atelic and nondynamic.

(4) a. ??*Una vez **preocupados** tus padres por tu situación, te ayudarán.*
     Intended: 'Once your parents are worried about your situation, they will help you.'

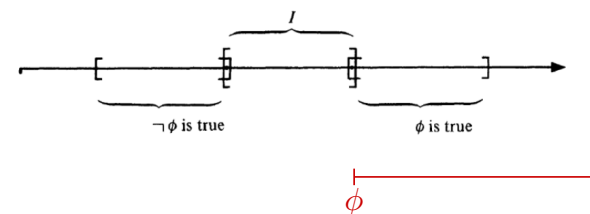   b. *Una vez **evaporada** el agua, se extrae la sal.*
      'Once the water has evaporated, the salt is extracted.'

Piñón's mereotopology to the rescue

- Piñón (1997) proposed an ontology for events that made eventuality boundaries ontologically first-class citizens.
- Explicitly including reference to boundaries in our semantics for *enamorarse* allowed us to capture the fact that using the verb entails a change of state without forcing the verb to actually refer to a change, as Dowty's semantics for BECOME would have required.

Enter Levin and Rappaport Hovav

- Rappaport Hovav and Levin's (2001) analysis of resultatives and their Argument-per-Subevent condition deeply impacted me.

  (5) a. Bond wiggled free. (no distinct subevent structure?)
       b. Bond wiggled himself free.   (2 subevents)

- Although I did not connect it to mereotopological thinking or the analysis of the Spanish verbs, it offered further evidence of the linguistic salience of event ***reference***, beyond simple truth conditions.

- I won't go down this path here, but I have since seen multiple pieces of evidence that reference to eventualities and properties needs to be anchored in discourse referents for at least one of their participants.

Resultatives *à la* Williams

A resultative **Komp**osition rule combines **Means** and **Result** predicates:

Komp($\lambda x \lambda e[$**pound**$(e) \wedge$ **Agent**$(e, x)]$,
$\lambda y \lambda e'[$**flat**$(e') \wedge$ **Patient**$(e', y)])$

$\equiv \lambda y \lambda x \lambda e_1 \exists e_2 \exists e_3 [$**pound**$(e_2) \wedge$ **flat**$(e_3) \wedge K(e_1, e_2, e_3) \wedge$
Agent$(e_1, x) \wedge$ **Patient**$(e_1, y)]$

Williams makes this work with 3 additional assumptions:
1. $K(e_1, e_2, e_3) \equiv$ **Means**$(e_1, e_2) \wedge$ **End**(e_1, e_3)

2. **Means**$(e_1, e_2) \wedge$ **Agent**$(e_1, x) \models$ **Agent**(e_2, x)

3. **End**$(e_1, e_2) \wedge$ **Patient**$(e_1, x) \models$ **Patient**(e_2, x)

Enter Pietroski and Williams

- Williams (2015), building on various works by Pietroski, argues against the use of a CAUSE predicate in the analysis of resultatives.

- Instead, he argues that sentences like *The smith pounded the metal flat* describe **processes**, where a process is understood as a complex event with a "means" subpart and an "end" subpart. The means leads to the end.

- There is no explicit CAUSE event; causal inferences are pragmatic.

Williams' implicitly mereotopological view

- Williams does not use the term *mereotopology*, but his analysis is clearly in the mereotopological spirit.
    - It focuses on eventualities and their parts, and offers one example of how linguistic expressions that describe simplex eventualities can be combined into descriptions of complex eventualities containing those simplex ones.

- This work, like my experience with the Spanish psych verbs, emphasized that there are different ways of capturing the entailment relations that originally interested Dowty (as Dowty himself foresaw).

- We should look carefully at the syntax/semantics interface data, rather than relying excessively on pure semantic intuitions, when deciding for one analysis over another.

The last word goes to Hans Kamp

"[T]he relation between the sentences ... we employ in verbal communication and that which these sentences...are about [is] mediated by ... representations ... determined by the syntactic structure of the sentences which they represent. [T]hey ... can be linked to the subject matter of the sentences from which they derive in a very direct and intuitively plausible manner. **Indeed**, the linkage ... is much more satisfying conceptually than that which emerges when we attempt to state ... the truth conditions of sentences by a recursion that operates on syntactic sentence structure directly. ... **Truth** [is] equated with the existence of an embedding of [a sentence's] representation in [a] model.... **There** is a sense implied by this definition of truth, in which the representation of a bit of discourse functions as a picture of reality, a picture that is correct iff it can be matched flawlessly with what it is a picture of by means of a correlation ... in accordance with the "pictorial code" for this type of picture." (2017, p. 3-4)

Alexiadou, A., Anagnostopoulou, E., and Schäfer, F. (2015). *External Arguments in Transitivity Alternations. A Layering Approach*. Oxford University Press, Oxford.

Davidson, D. (1967). The logical form of action sentences. In Rescher, N., editor, *The Logic of Decision and Action*, pages 81–95. University of Pittsburgh Press, Pittsburgh, PA.

Dowty, D. R. (1979). *Word meaning and Montague Grammar*. Reidel, Dordrecht.

Grimm, S. (2012). *Number and individuation*. PhD thesis, Stanford University.

Kamp, H. (2017). Events, discourse representations and temporal reference. *Semantics and Pragmatics*, 10(2):1–67.

Krifka, M. (1989). Nominal reference, temporal constitution and quantification in event semantics. In Bartsch, R., van Benthem, J., and van Emde Boas, P., editors, *Semantics and Contextual Expression*, pages 75–115. Foris, Dordrecht.

Lakoff, G. (1965). *On the nature of syntactic irregularity*. PhD thesis, Indiana University, Bloomington, IN. Published 1970 as *Irregularity in syntax*. New York: Holt, Rinehart, and Winston.

Marín, R. (2001). *El componente aspectual de la predicación*. PhD thesis, Universitat Autònoma de Barcelona.

Marín, R. and McNally, L. (2011). Inchoativity, change of state, and telicity: evidence from Spanish reflexive psychological verbs. *Natural Language and Linguistic Theory*, 29(2):467–502.

McCawley, J. (1968). Lexical insertion in a transformational grammar without deep structure. In *Proceedings of the Fourth Regional Meeting of the Chicago Linguistic Society*, pages 71–80. Chicago, IL: Chicago Linguistic Society.

Pianesi, F. and Varzi, A. C. (1996). Events, topology, and temporal relations. *The Monist*, 79:89–116.

Piñón, C. (1997). Achievements in an event semantics. In Lawson, A. and Cho, E., editors, *Proceedings of SALT 7*, pages 273–296. URL `http://pinon.sdf-eu.org/covers/aes.html`.

Pustejovsky, J. (1991). The syntax of event structure. *Cognition*, 41:47–82.

Pustejovsky, J. (1995). *The Generative Lexicon*. MIT Press, Cambridge, MA.

Rappaport Hovav, M. and Levin, B. (2001). An event structure account of English resultatives. *Language*, 77:766–797.

Wagiel, M. (2018). *Subatomic quantification*. PhD thesis, Mazaryk University.

Williams, A. (2015). *Arguments in Syntax and Semantics*. Cambridge University Press, Cambridge.