Negative events

Timothée Bernard	Lucas Champollion
Université Paris Diderot	New York University
timothee.bernard@ens-lyon.org	champollion@nyu.edu

Introduction Negative perception and causation reports like (1) pose problems for analyses in terms of logical negation (Higginbotham 1983, 2000).

(1) a. I saw Mary not leave. $\neq$ *It's not the case that I saw Mary leave*
b. I kept the child awake by not turning off the light.

(2) a. [Mary did not leave]$_i$. b. { This$_i$ / Mary's non-departure } made John happy.

Along with cases of anaphoric reference and definite descriptions as in (2), these phenomena have prompted analyses in terms of "negative events" (e.g. Higginbotham 1983, 2000); but the logic and compositional semantics of these events remain ill-understood. Here we show how negative events can be integrated into standard model-theoretic semantics for a suitable fragment of natural language.

The proposal Following the philosophical lead of Bentham (1789: ch. 7, §10) and Varzi (2006), we assume that events are not "negative" intrinsically but only under certain descriptions: Mary's non-departure is negative under the description "leave" but not under the description "stay". Events may be actual ($\approx$ exist at the actual world) or non-actual. Two events may *preclude* each other; in that case they cannot both be actual. Thus, Mary's departure and her non-departure preclude one another. We take verbal projections to denote sets of events. We focus here on VP negation, which denotes a function *Neg* that sends every set of events P to $Neg(P)$, its "canonical precluding event". This will be actual for some P and nonactual for others. At the heart of our account is this axiom:

(3) For any set of events P, $Neg(P)$ is actual if and only if no event in P is actual.

If $P =$"Mary sleep", $Neg(P)$, her being awake, is actual iff no sleeping event by her is actual. We represent *Mary slept* as $\exists e.\ actual(e) \wedge sleep(e) \wedge \mathtt{Ag}(e) = m$ and *Mary didn't sleep* as $actual(Neg(\lambda e'.\ sleep(e') \wedge \mathtt{Ag}(e') = m))$. By (3), both cannot be true. (3) also enforces downward entailment: Suppose $Neg(P)$ is actual; then by (3), nothing in P is actual. Then for any $Q \subseteq P$, nothing in Q is actual; then by (3), $Neg(Q)$ is actual.

Perception reports Our analysis extends smoothly to perception reports with quantifiers. It fulfills the following desiderata formulated by Higginbotham (1983):

(4) a. (i) *Mary saw John not leave* entails (ii) *Mary did not see John leave*.
b. (i) *Mary saw someone leave* is equiv. to (ii) *There is s.o. that Mary saw leave.*
c. (i) *Mary saw nobody leave* does not entail (ii) *Mary saw that nobody left.*

We analyze (4.a.i) with two events, as a perception report without negation: a seeing event and its theme, in this case the John-not-leaving event. Assuming that Mary's vision is coherent (i.e. she cannot see two events precluding each other), (4a) holds automatically. We use type raising to allow quantifiers to scope over an embedding perception verb, which ensures both (4b) (because the two sentences receive the exact same semantic interpretation) and (4c). In (4.c.i), we analyze *nobody* as contributing a *Neg*, so that the sentence expresses that the negation of the events of Mary seeing someone leave is actual.

Advantages Our analysis respects double negation (*It is not not raining* is equivalent to *It is raining*) and tracks the difference between simultaneous nonactual events. Thus if at noon Mary actually neither walked nor talked, there will be two distinct actual events; each can enter causal and anaphoric relations and figure in perception reports. These points improve on Krifka (1989), who treats *not P* as stating that the maximal mereological fusion of all events within a given interval does not contain P events. For Krifka, if the double negation of P is true of an event e, then for every sub-period of time t' of the temporal trace of e there exists an event satisfying P whose temporal trace is included in t'. So, if yesterday Mary did not *not* arrive, for Krifka she arrived constantly throughout the day (not just once). Moreover, the sum of everything that happened during some interval t cannot represent two distinct simultaneous negative events. Krifka would have to invoke the same maximal event for Mary's not walking and her not talking.

Our analysis is in the spirit of Higginbotham (1983, 2000) and improves on it in two points: (i) we provide an explicit syn-sem interface; (ii) for us, *Mary slept* and *Mary did not sleep* cannot both be true. In his account, negation combines with an event predicate P to produce a "negative predicate" $\overline{P}$. Higginbotham's counterpart of axiom (3) states that if no event in P is actual, some event in $\overline{P}$ is actual. Because his axiom is not a biconditional, it is compatible with the coexistence of P events and $\overline{P}$ events. Our account uses a biconditional axiom, viz. (3). Why did Higginbotham not strengthen his axiom to a biconditional as well? He doesn't say, but here is one possible reason. Suppose VP negation does not take semantic scope over the subject and its thematic role. E.g. suppose *Mary did not sleep* is represented as $\exists e.\ \texttt{Ag}(e) = m \wedge \overline{sleep}(e)$. Under a biconditional version of Higginbotham's axiom, the existence of a $\overline{sleep}$ event would entail that no *sleep* event exists. That is, it would not only prevent Mary from sleeping but also everybody else. To avoid this problem, Higginbotham could, and we will, give VP negation semantic scope over the subject even though its syntactic scope does not include the subject.

Compositional implementation Sentences like (5) suggest that *not* takes syntactic scope at VP below adverbial *each* and thus below the subject (see Schwarzschild 2014).

(5) John and Mary each did not build a raft.

In simpler sentences like *Mary didn't eat* and *John didn't eat*, the same VP picks out different negative events. To this end, we give VP negation semantic scope outside of its syntactic scope, viz., over the subject. For this we use continuation semantics (Barker & Shan 2014). Let v be the type of events; we write f for variables of type vt and V for those of type $\langle vt, vt\rangle$. We translate $[\![\text{not}]\!]$ as $\lambda V f e.\ e = Neg(\lambda e'.\ V f e')$, $[\![\text{build}]\!]$ as $\lambda f e.\ build(e) \wedge fe$, and $[\![\text{John and Mary}]\!]_{\texttt{Ag}}$ as $\lambda e.\ \texttt{Ag}(e) = j \oplus m$. The mode of composition is the operator @, defined as $\lambda A B f e.\ A(\lambda e'.\ Be' \wedge fe')e$; the closure operator is $\lambda S.\ \exists e.\ actual(e) \wedge S(\lambda e'.\ \top)e$. Building on Champollion (2016), we translate $[\![\text{each}]\!]$ in agent position as $\lambda V f e.\ (e \in {}^*\lambda e'.\ atom(\texttt{Ag}(e')) \wedge V(\lambda e''.\ \texttt{Ag}(e'') = \texttt{Ag}(e'))e') \wedge fe$. The clause $\texttt{Ag}(e'') = \texttt{Ag}(e')$ passes information about the agent into the continuation of *not VP*. For *John did not build a raft*, this yields (6a), while for (5), it yields (6b). Assuming a sum of events is actual only if each of its subevents is, (6b) entails (6a) as desired.

(6) a. $\exists e.\ actual(e) \wedge e = Neg(\lambda e'.\ build(e') \wedge \texttt{Ag}(e') = j \wedge raft(\texttt{Th}(e')))$
b. $\exists e.\ actual(e) \wedge \texttt{Ag}(e) = j \oplus m \ \wedge e \in {}^*\lambda e'.\ (atom(\texttt{Ag}(e')) \wedge e' = Neg(\lambda e''.$ $\texttt{Ag}(e'') = \texttt{Ag}(e') \wedge build(e') \wedge raft(\texttt{Th}(e')))$

Conclusion We provide a comprehensive and compositional implementation of negative events based on the intuitive notion of precluding. We provide a simple and coherent logic and an explicit syntax-semantics interface for a suitable fragment of natural language.

References

Barker, Chris & Chung-chieh Shan. 2014. *Continuations and natural language*. Oxford, UK: Oxford University Press.

Bentham, Jeremy. 1789. *An introduction to the principles of morals and legislation*. London, Great Britain: T. Payne & Son.

Champollion, Lucas. 2016. Overt distributivity in algebraic event semantics. *Semantics and Pragmatics* 9(16). 1–65. http://dx.doi.org/10.3765/sp.9.16.

Higginbotham, James. 1983. The logic of perceptual reports: An extensional alternative to situation semantics. *The Journal of Philosophy* 80(2). 100–127. http://dx.doi.org/10.2307/2026237.

Higginbotham, James. 2000. On events in linguistic semantics. In James Higginbotham, Fabio Pianesi & Achille C. Varzi (eds.), *Speaking of events*, 18–52. Oxford, UK: Oxford University Press. http://dx.doi.org/10.1093/acprof:oso/9780199239313.003.0002.

Krifka, Manfred. 1989. Nominal reference, temporal constitution and quantification in event semantics. In Renate Bartsch, Johan van Benthem & Peter van Emde Boas (eds.), *Semantics and contextual expression*, 75–115. Dordrecht, Netherlands: Foris. http://amor.cms.hu-berlin.de/~h2816i3x/Publications/Krifka%201989%20Nominal%20Reference.pdf.

Schwarzschild, Roger. 2014. Distributivity, negation and quantification in event semantics: Recent work by L. Champollion. Ms. Massachusetts Institute of Technology. http://web.mit.edu/schild/www/papers/public_html/champ.pdf.

Varzi, Achille C. 2006. The talk I was supposed to give. In Andrea Bottani & Richard Davies (eds.), *Modes of existence: papers in ontology and philosophical logic*, 131–152. Frankfurt am Main, Germany: Ontos.