Comment

Compositionality, context, and cognition
Comment on "Embodied language, best fit analysis, and formal compositionality" by J. Feldman

Barbara H. Partee

University of Massachusetts, Amherst, United States

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Feldman's project [1] has the ambitious goal of giving a compositional account of the "full range of meanings" in human language, one which meets the high standards of formalization found in formal semantics but is built on a theory of "embodied cognition", takes into account the neurobiological substrate of language, and makes use of representations of world knowledge and discourse and situational context as well as linguistic knowledge. His exposition is marred by some misconceptions about compositionality and about formal semantics. My goals in this comment are (i) to clarify what is meant by compositionality in formal semantics and how formal semanticists capture more aspects of meaning than Feldman suggests, and (ii) to discuss the striking differences between the methods and goals of formal semantics and those described by Feldman concerning modularity and the division or lack thereof between theories of syntax and semantics and psycholinguistic theories of language processing.

What is compositionality? First of all, the principle of compositionality in semantics concerns the relation between form and meaning; it does not apply to forms or to meanings separately. Hence it is not straightforward to make sense of a notion of "compositionality of thought", which Feldman wants to take as more basic; perhaps 'compositionality' is being confounded with 'productivity', the way that wholes are built up recursively from parts.

The principle of compositionality is commonly stated as follows:

(C1) The meaning of an expression is a function of the meanings of its parts and of the way they are syntactically combined [9].

Relativity to a language can be made explicit:

(C2) For every complex expression e in L, the meaning of e in L is determined by the structure of e in L and the meanings of the constituents of e in L [11].

The principle has several crucial theory-dependent terms; especially relevant here are "meaning" and "syntax/structure". For simple logical languages, meaning can reasonably be identified with extension (simple truth and

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reference). Frege and Carnap recognized that for natural languages and modal logical languages, one needs a notion at least as rich as intensions – functions from possible worlds to extensions. Montague was explicitly concerned with the context-dependence of demonstratives (*this, that*) and indexicals (*I, here, now*), as well as free-variable uses of pronouns (*he, she, it*), and formalized "meanings" as functions from possible contexts of use to "senses" (intensions). "The intuitive distinction is this: meanings are those entities that serve as interpretations of expressions (and hence, if the interpretation of a compound is always to be a function of the interpretations of its components, cannot be identified with functions of possible worlds alone), while senses are those intensional entities that are sometimes *denoted* by expressions" [8].

It is clear from this passage that Montague regarded compositionality as a primary methodological constraint on what meanings can be. Semanticists follow the advice of [7, p. 22]: "In order to say what a meaning is, we may first ask what a meaning does, and then find something that does that." With meanings as functions from contexts to functions from possible worlds (or possible situations [5]) to extensions, much context-dependence can be accounted for straightforwardly, and the analysis of difficult cases of context-dependence, contrary to Feldman's assertions, are very much the concern of formal semantics, now usually augmented by and integrated with formal pragmatics [2,10]. Nor are homonyms and ambiguity a problem for compositionality, since what are interpreted are expressions together with their syntactic structure; "disambiguated representations" include discrimination among distinct but homonymous lexical items. For more subtle sorts of context-dependent lexical variation as with *red*, see [3,4].

Ditransitive sentences in Mandarin with unexpressed arguments are presented as a "fundamental limitation of strong compositionality", but while all such null-pronoun or "pro-drop" languages may have considerable surface ambiguity, one standard account of such phenomena divides the problem into two parts. The task of formal semantics and syntax proper is to generate all possible syntactic and semantic analyses for a given ambiguous sentence; it is regarded as a separate task, using different theoretical tools, to study how hearers choose one or another structure for an ambiguous sentence. Psycholinguists study how speakers and hearers unconsciously employ their linguistic knowledge to parse and interpret sentences and how linguistic and non-linguistic context is involved in selecting and evaluating most likely interpretations – this is a much broader sense of "context-dependence" than that involved in the semantic/pragmatic analysis of context-dependent expressions like *here, now, nearby, ahead, local, enemy*. Feldman wants to make ambiguity resolution part of the semantics; that is representative of a broad difference in research strategies between "formal" linguists, who generally pursue more modular descriptions of various aspects of linguistic knowledge plus theories of their interfaces or their integration with non-linguistic factors, and "cognitive" linguists, who are skeptical about modularity. (I put "formal" and "cognitive" in scare-quotes, since the formal linguists also seek cognitively robust accounts and cognitive linguists like Feldman aim for formally explicit theories.)

Other phenomena putatively outside the bounds of formal semantics, such as the analysis of non-declarative sentences, have also been treated satisfactorily. As with any developing science there are constant challenges and a continual expansion of the domain of study. But many well-known properties of natural languages presented by Feldman as obstacles to compositionality for formal semantics have in fact been quite well formalized compositionally.

No formal semanticist would argue that meaning is independent of context. Feldman's citation from [6] concerning a strict version of compositionality that would make interpretation totally independent of context is taken out of its full context; Krifka goes on to discuss how "in general, compositionality has led to more refined ways of understanding *meaning*".

Many of Feldman's further goals seem to me to blur distinctions among semantics, pragmatics, "world knowledge", and language processing, the topic of the last part of his article. Debates pitting formal linguists' more modular approaches against the less modular approaches of cognitive linguists and of Feldman are bound to continue.

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