

# Compositionality and Context

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## Abstract

This paper contains a discussion of how the concept of compositionality is to be extended from context invariant to context dependent meaning, and of how the compositionality of natural language might conflict with context dependence. Several new distinctions are needed, including a distinction between a weaker (*e*-) and a stronger (*ec*-) concept of compositionality for context dependent meaning. The relations between the various notions are investigated. A claim by Jerry Fodor that there is a general conflict between context dependence and compositionality is considered. There is in fact a possible conflict between *ec*-compositionality and context dependence, but not of the kind Fodor suggests. It turns on the presence of so-called *unarticulated constituents*, in John Perry's sense. Because of this phenomenon, on some semantic accounts there might be a variation in the meaning of a complex expression between contexts without any corresponding variation in any of the syntactic parts of that complex. The conflict can be resolved in several ways. One way is to make the unarticulated context dependence explicit only in the meta-language, which makes it into an *unarticulated constituent* account. A recent argument by Jason Stanley against such accounts is discussed. According to Stanley, certain readings of English sentences involving binding of contextual variables, are unavailable in these theories. After considering a reply to Stanley by François Recanati, I present an outline of a fully compositional theory, of the unarticulated constituent variety, which does deliver these readings. Concluding remarks on, *inter alia*, the semantics/pragmatics distinction.

## 1. Fodor on linguistic compositionality

In his contribution to a series of Millennial articles in *Mind & Language*, Jerry Fodor (2001) confronts the question of the priority between thought and language. As Fodor adequately frames it, the question comes down to whether one of thought content and linguistic meaning is derived from the other. His chosen method is an appeal to *compositionality* (Fodor 2001:6): that which is primary must be compositional. For reasons of productivity and systematicity<sup>1</sup>, Fodor thinks, there must be compositionality of content (2001:6-7). Hence, he says, 'if, as between language and thought, only one of the two has compositional content, then that must be the one whose content is underived'. Fodor then goes on to argue that linguistic meaning in fact is *not* compositional. He concludes that thought is prior to language.

At present I shall leave the question of the compositionality of mental content, as well as that of the priority between thought and language, to a footnote.<sup>2</sup> What will interest

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1. See e.g. Fodor 1987:147-53.

me in this context is Fodor's reason for the claim that natural language isn't compositional. Fodor's argument for this conclusion appeals to the heavy *context dependence* in natural language. Terminologically, I shall use 'context dependence' precisely for the *depending* on context. To make this more precise, let  $\mu$  be a meaning function that takes linguistic expressions from a language  $L$  and contexts of utterance (i.e. actual or possible utterances) in a domain  $C$  of contexts to semantic values in a domain  $K$ . That is  $\mu: L \times C \rightarrow K$ . Then we say that  $\mu$ , or  $K$ , is *context dependent* iff there is an expression  $e$  of  $L$ , and contexts  $c_1$  and  $c_2$  in  $C$  such that

$$\mu(e, c_1) \neq \mu(e, c_2)$$

We say that the  $K$ -value of  $e$ , or of expressions in  $L$  in general, depends on context.

If it holds for all  $e \in L$  and all  $c_1, c_2 \in C$  that

$$\mu(e, c_1) = \mu(e, c_2)$$

then  $\mu$ , or  $K$ , is *context independent*.

If the sentence (or other expression) has a standing, context *invariant* meaning, such that what is expressed by way of this meaning in a context depends on the context, then that sentence has a meaning that is context *sensitive*, not context dependent. Again, let  $\mu'$  be a context invariant function from  $L$  to a domain  $M$  of semantic values,  $\mu': L \rightarrow M$ . I shall say that  $\mu'$  is *context sensitive* if the  $M$ -value in a context  $c$  determines a  $K$ -value where  $K$  is context dependent. We can then regard elements  $\mu'(e) \in M$  of standing mean-

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2. I do in fact think that the arguments from productivity and systematicity give very poor support for the priority of the mental. To the extent that these arguments do provide good reasons for compositionality it is by appeal, sometimes tacit and sometimes not, to facts about linguistic communication: we frequently succeed when communicating with new sentences. That a speaker can *produce* arbitrarily many meaningful sentences does not by itself give a reason to think that there is some systematic connection between syntax and semantics. Only when we add the fact that novel sentences produced are understood *as meant* by other speakers do we get a reason for believing that this can be explained by appeal to such a systematic connection. The appeal to communicative success is explicit in some formulations by Chomsky of the productivity argument (Chomsky 1966:74, 1980:76-78). It is emphasized in Frege 1923:1. The argument from systematicity suffers from the same problem: either there is an appeal to linguistic communication, or the argument is very weak (because needing an additional premise which in itself is not very plausible). Only in this case the situation is more complicated. Since there is no good argument for the compositionality of the mental that is independent of arguments for the compositionality of linguistic meaning, no support for the priority of the mental is forthcoming.

This does not, however, mean that the order of priority is the reverse. For one thing, considerations about communicative success do provide reasons for the compositionality of mental representations, reasons not so far mentioned by Fodor (see Pagin 2003:315). Further, the proper definition of communicative success does appeal to an independent notion of thought content. In this sense it is a mentalistic definition (Pagin *unpublished*). However, no assumption about semantic structure is needed in this definition. If any general conclusion is to be drawn, it is that Fodor's strategy of settling the priority issue by appeal to compositionality results in a draw.

The issue of justifying compositionality is discussed in Pagin 1999 and 2002 and will be given a fuller treatment eventually.

ings as *functions* from contexts to *K*-values. We will then have, for all  $e \in L$  and  $c \in C$

$$(c\text{-app}) \quad (\mu'(e))(c) = \mu(e, c)$$

That is, the standing meaning of  $e$  applies to a context argument and delivers a context dependent semantic value, the same value as the original context dependent function  $\mu$  delivers for that expression in that context. To exemplify, David Kaplan's notion of *content* (Kaplan 1989) is context dependent, for the content of

(1) I am walking

will vary with context, the content being the singular proposition

(2) *walking, S, t*

where the elements are the property of walking, the speaker  $S$  and the time  $t$  of utterance. With a different speaker or a different time, the content of the utterance of (1) will be different accordingly. By contrast Kaplan's notion of *character*, i.e. the standing meaning of an indexical like 'I' and a sentence like (1), does not vary between contexts. Kaplan considers it as a *function* from contexts to contents, i.e. to context dependent values. In the present terminology, character is context sensitive while content is context dependent. Instead of Kaplan's terminology, and without any specific semantic theory in mind, I shall borrow terminology from Quine and speak of standing meaning (*M*-values), and *occasion* meaning (*K*-values).

There is a second, related phenomenon of context dependence, namely that contextual semantic variation can occur even though there is no surface part of the expression to which the variation can be traced. Both these phenomena are illustrated by a standard example. The sentence

(3) It rains

is used to say different things on different occasions of utterance. A speaker  $S$  who utters (3) says that it is raining where  $S$  is (or at some other contextually salient location) at the time of utterance (or at some other contextually salient time). So there is a variation in communicated content, which exemplifies the first phenomenon. But (3) also exemplifies the second, for there is a double context dependence, only one of which is explicit. First, the speaker says something about the time of utterance (that it is a rainy time), and the relation between the utterance and the time is articulated in the sentence by the present tense of the verb. Second, the speaker also says something about the contextually salient *location* (that it is a rainy place), but the relation between the utterance and the location is not articulated by anything overtly in the sentence. It can be made explicit as in

(4) It rains here

where the place of utterance is the referent of the indexical 'here', but that element is missing in (3), even though what is said or communicated is the same.

Other standard examples concern incomplete definite descriptions and domain restrictions of quantifiers. By uttering

(5) The book is on the table

the normal speaker is communicating something about a contextually salient book on a contextually salient table. He is not claiming nor presupposing that there is exactly one book and one table in the universe. However, the extra conditions (the book such that....; the table such that...) that are needed to identify the objects are not overtly expressed in the sentence. And by uttering

(6) Everyone left at midnight

the normal speaker says that everyone in a contextually salient group of people (not everyone in the universe) left at midnight, and again the restriction of the quantifier 'everyone' to this group is not overtly expressed.

Fodor appeals to examples like these for showing that what we utter often is inexplicit about the thought expressed, and goes on to argue as follows:

First, the content of a sentence is ('plus or minus a bit') the thought it is used to express (2001:11). Second, language is 'strikingly elliptical and inexplicit about the thoughts it expresses' (2001:11). Third, language cannot be elliptical and inexplicit about the thoughts it expresses if it is compositional ('in anything like strict detail') (2001:11). The third point is expounded on as follows:

For, if it were (and assuming that the content of a sentence is, or is the same as, the content of the corresponding thought) the structure of a sentence would indeed have to be explicit about the structure of the thought it expresses; in particular, the constituents of the sentence would have to correspond in a straightforward way to the thought's constituents. For, if there are constituents of your thought that don't correspond to constituents of the sentence you utter, then since compositionality requires that the content of a thought contains all of the content of its constituents, it must be that there was something in the thought that the sentence left out (Fodor 2001:11-12).

The conclusion is that language isn't compositional.

## **2. How to refute compositionality**

A difficulty with this argument, as presented, is that Fodor hasn't said what compositionality is. On the contrary, he says explicitly that he is not going to tell us, and further that nobody knows exactly what it demands (2001:6). This casts some doubt on Fodor's third premise. The doubt grows when we consider the standard conception of compositionality. The principle of compositionality is usually rendered something like

(PoC) The meaning of a complex expression is a function of the meanings of its parts and its mode of composition.

This, in turn is usually understood in a strong sense, as stating that the meaning of a complex expression is determined by the meanings of its *immediate* parts and its mode of composition. To make this formally more precise, let  $\mu$  be a function from expressions of a language  $L$  to meanings in some domain  $M$ . Let ‘ ’ be a parameter for syntactic operations, and ‘ $e_1$ ’ etc terms for expressions of  $L$ . Then we can restate (PoC) as the requirement that  $\mu$  be a compositional meaning function.  $\mu$  is compositional just if there is a function  $g$  such that for any  $n$ , any of arity  $n$  and expressions  $e_1, \dots, e_n$  (such that  $\mu$  is defined for  $(e_1, \dots, e_n)$ )

(comp)  $\mu( (e_1, \dots, e_n)) = g( \mu(e_1), \dots, \mu(e_n))$

A function  $g$  satisfying (comp) will be called a *composition function*, or, more precisely, a *composition function for  $\mu$* .<sup>3</sup>

Understood in this way, if the compositionality of a language consists in the fact that PoC is true of it, then Fodor’s third premise certainly seems false. It is not a violation of compositionality, in this standard sense, that a complex expression has a meaning that is much richer than what you intuitively get out of the meanings of the parts. For instance, suppose we have expressions  $e_1$  and  $e_2$ , a syntactic operation and a meaning function  $\mu$  such that  $\mu(e_1)$ =George W Bush,  $\mu(e_2)$ =Silvio Berlusconi and  $\mu( (e_1, e_2))$ =*the proposition that George W Bush and Silvio Berlusconi will never have visited Bhutan together*. However odd, this wouldn’t be a violation of PoC. Whether the sentence  $(e_1, e_2)$  also is inexplicit about the thought it expresses, in Fodor’s sense, is a further question, but since it e.g. does express a thought with reference to Bhutan, without there being any constituent in the sentence that carries that reference, it seems inexplicit enough.<sup>4</sup>

The claim that natural language is not compositional, given that compositionality is understood in terms of PoC and (comp), amounts to a claim that there is *no* function which, given such and such syntactic and semantic data, maps the meaning of constituent expressions and syntactic structure of a complex expression on the meaning of that

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3. (comp) amounts to the algebraic requirement that  $\mu$  be a *homomorphism* from  $L$  to  $M$ . The requirement that natural language semantic be compositional in this sense was put forward by Richard Montague (cf. Montague 1970:227), and elaborated on by Montague himself and others in the Montague tradition, including Partee (1984), Jansen (1984, 1997) and Hendriks (2001). A simplified algebraic treatment was later proposed by Hodges (1998, 2001). Hodges’ framework is used in Westerstahl (2002, *forthcoming*) and Pagin (2003).

4. Maybe in this context Fodor by ‘compositionality’ means what he also calls ‘biconditional compositionality’ (2001:9). He says ‘[...] compositionality requires that host concepts receive their semantic properties solely from their constituents, *and also that constituent concepts transmit all of their semantic properties to their hosts*’ (Fodor 2001:9, italics in the original). As stated, this principle concerns contents and the constituent relation between contents. It does not concern the expression-content *relation*, and so it is irrelevant to natural language semantics.

expression. That is, the claim is that for a natural language (or any natural language)  $L$ , and any admissible meaning function  $\mu$  for  $L$ , there is *no composition function* for  $\mu$ .

There is one clear and definitive way of demonstrating that no composition function exists: by giving a *counterexample to functionality*. That is, we show that the language contains four expressions  $e_1$ ,  $e_2$ ,  $A$ , and  $A[e_2/e_1]$ , such that  $A$  contains  $e_1$  as a constituent,  $A[e_2/e_1]$  is the result of substituting  $e_2$  for  $e_1$  in  $A$ , and the meaning function  $\mu$  for this language is such that  $\mu(e_1)=\mu(e_2)$  and  $\mu(A) \neq \mu(A[e_2/e_1])$ .  $\mu$  does not give the meanings of  $A$ , and  $A[e_2/e_1]$  as a function of the meanings of the parts, for if it did  $A$  and  $A[e_2/e_1]$  would mean the same. Moreover, no other meaning function that respects these semantic data, i.e. agrees with  $\mu$  on these four expressions, does either. This is a clear and definitive way of showing that a language fails to be compositional. It has been claimed, e.g. by Jeff Pelletier (1994a), that because of the hyperintensionality of belief contexts, truth conditions as the meanings of sentences aren't functionally determined by the meanings of sentence parts. I shall refer to

$$(SF) \quad \mu(e_1)=\mu(e_2) \text{ and } \mu(A) \neq \mu(A[e_2/e_1]),$$

understood as above, as the *substitution failure* schema.<sup>5</sup>

Are there other ways of establishing the failure of compositionality? In principle yes, but other ways do not easily take you all the way to the goal. For instance, you might want to claim that natural language fails to be compositional because some complex expressions have other meanings than they compositionally *ought* to. That is, we assume that we have identified the meanings of the parts of a complex expression, the syntactic operations by which it is formed and also the semantic significance of these operations, and then it turns out that the complex expression itself has a different meaning (in addition to or instead of) from what was to be expected. That is, we may assume that in general we have

$$\mu(e_i, e_j) \neq g(\mu(e_i), \mu(e_j))$$

for some composition function  $g$ , and now it turns out that

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5. It is assumed here that  $\mu$  is defined for both  $A$  and  $A[e_2/e_1]$ . Substitutivity can fail in a weaker sense if  $\mu$  fails to be defined for exactly one of them ( $A$  or  $A[e_2/e_1]$  is meaningless), even though there is a composition function for  $\mu$  (giving the value of  $\mu$  for any argument for which it is defined). A semantics is called *Husserlian* by Hodges (2001:11) if synonymous expressions can always intersubstituted without loss of meaningfulness.

Conversely, if a constituent of a meaningful complex expression is itself meaningless, then the meaning the complex expression is not a function of the meanings of its parts and the mode of composition. The substitutivity principle may still hold, in that any *meaningful* constituent may be exchanged for a synonymous one without change of meaning of the containing complex. The principle that meaningful compounds have only meaningful parts is called the *Domain principle*. If the Domain principle holds for a Husserlian semantics  $\mu$ , then there is composition function for  $\mu$  just in case  $\mu$  has no substitution failure (cf. Hodges 2001:12-13). I shall in general assume that the conditions for this equivalence are met.

$$\mu(e_1, e_2) = g(\mu(e_1), \mu(e_2))$$

(or perhaps that in addition to  $g(\mu(e_1), \mu(e_2))$ ,  $(e_1, e_2)$  has another meaning). For instance, it has been claimed that because of the existence of idioms, like ‘kick the bucket’ (as meaning *die*), English isn’t compositional. However, just because a certain familiar composition function  $g$  on the meanings of the parts does not give the right meaning of the whole, this does not mean that no *other* function does either. We might be able to define a modification or extension  $g^*$  of  $g$ , agreeing with  $g$  on all other arguments, such that

$$\mu(e_i, e_j) = g^*(\mu(e_i), \mu(e_j))$$

for all relevant  $e_i, e_j$ , including  $e_1$  and  $e_2$ . Then the functionality condition is met after all.<sup>6</sup>

Secondly, you might want to claim that compositionality fails because some parts just don’t *have* any meaning. You might have defined rules that give the meaning of every sentence on the basis of its syntax, but such that they do not invariantly make use of meanings of constituents. For instance, Jaakko Hintikka’s game theoretic semantics is of this kind, and Hintikka and Gabriel Sandu (1997) have claimed that although there is a proper game-theoretic semantics for their *independence-friendly logic*, IF, no compositional semantics exists. This claim has been refuted by Wilfrid Hodges, who provided a compositional semantics for IF, and also proved that any partial semantics that satisfies certain conditions (including that of being *Husserlian*) can be extended into a total compositional semantics.<sup>7</sup> Hodges’ theorem has since been generalized by Dag Westerståhl (dropping the *Husserlian* condition).<sup>8</sup>

Third, you might want to claim that compositionality fails because an expression contributes different meanings to different containing expressions, or contribute another meaning than what it has in isolation. That is, compositionality would fail because there is no single meaning that can be assigned to a certain expression so that the meaning of the containing expressions would follow compositionally. This is an argument from *linguistic* context dependence. Thus James Higginbotham (1986) has claimed that ‘unless’ means *and not* in

(7) No person will eat steak unless he eats lobster

but *or* in

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6. For a comprehensive formal treatment of idioms in a compositional framework, see Westerståhl (2002). Note that *learning* what this  $g^*$  is will involve learning the idiom separately. That much is right in calling idioms ‘non-compositional’; the idiomatic meaning is not predictable from what you know in advance.

7. Hodges 1997, 1998, 2001.

8. Westerståhl *forthcoming*.

(8) Every person will eat steak unless he eats lobster.

However, if this is a straight claim about difference in the meaning of ‘unless’ in different contexts, then it seems natural to conclude that we here have a case of lexical ambiguity, to be treated e.g. as a case of homonymy, which then does not provide any difficulty for compositionality. This is one of the options suggested by Pelletier (1994).

Therefore, the claim should rather be that on the one hand we have a single unambiguous word ‘unless’ such that no meaning can be assigned to it which gets the right truth conditions for both (7) and (8) in a compositional way. The range of solutions must be restricted so that intuitive or theoretically established facts about the meanings of the other words and the syntax are respected. But this still leaves the possibility of a composition function  $g$  such that  $g(\mu(\text{‘no person’}), \mu(\text{‘will eat steak unless he eats lobster’}))$  and  $g(\mu(\text{‘every person’}), \mu(\text{‘will eat steak unless he eats lobster’}))$  are the truth conditions of (7) and (8) respectively, and which agrees with the data on meanings of unproblematic verb phrases. Non-compositionality has not been demonstrated.<sup>9</sup>

Fourth, you might claim that compositionality fails because of general speaker creativity. The claim is that speakers are creative in a more radical sense than having the ability to compose and interpret new sentences. We can also create new sentences with practically unpredictable intentions, and still be understood by equally creative interpreters, as e.g. emphasized by Davidson (1986). However, this does not imply that compositionality fails for the set of sentences that *do* have well-defined meanings. Few if any have claimed that compositional semantics by itself is sufficient for explaining all of successful linguistic communication, and I certainly don’t. Neither do I claim that there is a finite list of pragmatic principles that together with some compositional semantics for (some variety of) English can explain all episodes of successful communication in (that variety of) English. There is genuine novelty, and compositionality cannot be blamed for not assigning a meaning to an expression that does not yet have it.

It may also be claimed that natural language meanings are too fuzzy for serving as arguments and values to compositional functions. However, if we can talk about meanings at all, then they are not too fuzzy to be referred to by means of linguistic expressions, and if this is possible in general, then it is hard to see why this would be impossible precisely with expressions for compositional functions.

There are yet further options for rejecting compositionality, but this is enough to show

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9. Pelletier (1994:606-08) suggests solving the semantic problem by giving a kind of higher order meaning to ‘unless’, taking linguistic contexts as arguments, but this move is not necessary. Moreover, Higginbotham’s ambiguity claim is spurious. The incongruence in truth conditions between (7) and (8) does not depend on properties of ‘unless’. To see this, note that if we generate (7’) and (8’) by substituting ‘if he does not eat’ for ‘unless he eats’ in (7) and (8), respectively, we preserve truth conditions (‘No person eats steak if he does not eat lobster’ has the same truth conditions as (7), in similarly for (8’) and (8)). However, it is plainly not the case that ‘if not’ means *and not* in (7’) and *or* in (8’). Rather, the phenomenon seems to depend on a difference between how the quantifiers ‘no person’ and ‘every person’ interact with the conditional. Notice that we preserve the truth conditions of (7) by replacing the *antecedent* with its logical equivalent ‘everyone does not eat steak’.

that without a clear counterexample to functionality, it is difficult to find a conclusive refutation. Given this, the question is how context dependence can provide one.

### 3. Context dependence against compositionality

Assuming the need to counter functionality, how can context dependence conflict with compositionality? The key, I believe, lies in Fodor's first premise above:

(Rad) The *meaning* of a sentence is the thought (proposition) it is used to express.

Since Fodor actually says 'plus or minus a bit' (and 'content' instead of 'meaning') it is not clear how much one can hold him to, but let's put that question aside and consider the radical thesis itself. (Rad) amounts to one extreme view on the semantics/pragmatics distinction, according to which everything is semantics. That is, although conscious psychological processes are deeply involved in most linguistic communication, still there is no ingredient in what is expressed or communicated that is not held to be part of the meaning of the sentence used. Because of context dependence, what is communicated with a context dependent sentence varies from one utterance of it to the next. According to (Rad), the meaning changes as well. Thus, (almost) no standing meaning.

That the meaning of a sentence changes between contexts is not itself in conflict with compositionality. But we can get an intuitive conflict by combining *invariance* of occasion meaning of the sentence parts, with *variation* in occasion meaning of the sentence itself. Thus, suppose that in (3), the impersonal pronoun 'it' has context independent occasion meaning, and that the same holds for the feature placing verb 'rains'. With two occasions of utterance,  $c_1$  and  $c_2$ , we get two different occasion meanings of (3),  $\mu(\text{'it rains'}, c_1)$ , i.e. the meaning of 'it rains' in  $c_1$ , and  $\mu(\text{'it rains'}, c_2)$ . Since by assumption  $\mu(\text{'it'}, c_1) = \mu(\text{'it'}, c_2)$ ,  $\mu(\text{'rains'}, c_1) = \mu(\text{'rains'}, c_2)$ , and  $\mu(\text{'it rains'}, c_1) \neq \mu(\text{'it rains'}, c_2)$  (and there are no other parts, nor any change in syntax), we seem to have a counterexample to functionality.

However, when we extend the notion of compositionality from standing meaning to occasion meaning, the extra argument place for context creates a complication. We can extend it in two different ways, a weaker and a stronger. According to the weaker version, *e*-compositionality ('*e*' for expression) a meaning function  $\mu$  counts as compositional iff there is an *e*-composition function  $g$  such that

$$(e\text{-comp}) \quad \mu((e_1, \dots, e_n), c) = g(\mu(e_1, c), \dots, \mu(e_n, c), c).$$

Notice that the arguments for  $g$  is the syntactic operator  $\mu$ , the meanings of the parts in the context, *and* the context itself. It may be that the context dependence is influenced by the syntax, and it may be that the context parameter contributes in a uniform way.<sup>10</sup> Either way, the extra context parameter is supposed to be non-vacuous. Having the context itself as an extra argument cannot be objected to as violating compositionality, since the meaning function  $\mu$  itself takes a context argument to begin with.

If  $e$ -compositionality holds, then the substitutivity requirement is fulfilled. That is, for any context  $c$ , if  $\mu(e_1, c) = \mu(e_2, c)$ , then  $\mu(A, c) = \mu(A[e_2/e_1], c)$ . Moreover, the converse holds as well: if the substitutivity condition is met, then  $\mu$  satisfies ( $e$ -comp).<sup>11</sup> Hence, in one natural way of extending compositionality from standing meaning to occasion meaning, compositionality holds if  $e$ -compositionality holds. However, in another it doesn't, simply because the meaning of the whole in the context isn't a function of just the mode of composition and meanings of the parts in the context. There is therefore room for a stronger notion,  $ec$ -compositionality (' $c$ ' for context), requiring the existence of an  $ec$ -composition function  $g$  such that

$$(ec\text{-comp}) \quad \mu(e_1, \dots, e_n, c) = g(\mu(e_1, c), \dots, \mu(e_n, c))$$

where the extra context argument place is dropped. Since there is nothing but syntax and part meanings in context that is the arguments of the  $ec$ -composition function  $g$ ,  $ec$ -compositionality is in one sense closer to compositionality for standing meaning.<sup>12</sup> Other things equal,  $ec$ -compositionality embodies a simpler method of determination of the occasion meaning of a compound than  $e$ -compositionality, and is therefore in general preferable. However, it is an open question whether an  $ec$ -compositional semantics can be given whenever an  $e$ -compositional semantics is available. Maybe in some cases that possibility is blocked.<sup>13</sup>

The example above, with variation in occasion meaning of the sentence 'it rains' without any corresponding variation in occasion meaning of the parts, is not a violation of  $e$ -compositionality, since it is allowed that the context influences occasion meaning over and above its influence on part meanings. However, it is a violation of  $ec$ -compositionality. It instantiates what we can call *the schema of context shift failure*: where

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10. In the former case we could have two operations  $g_1$  and  $g_2$  such that

$$g_1(e_1, c) \neq g_2(e_2, c)$$

(where  $g_1(e_1, c)$  and  $g_2(e_2, c)$  are functions from  $n$  occasion meanings of the parts to an occasion meaning for the compound), and a function  $h$  such that

$$g_1(e_1, c) = g_2(e_2, h(c))$$

where the value of  $h$  depends only on  $c$ , such as mapping the time of  $c$  to time  $k$  hours later.

11. The argument is simple. If substitutivity holds, then it holds for each context  $c$  that there is a function  $g_c$  such that

$$\mu(e_1, \dots, e_n, c) = g_c(\mu(e_1, c), \dots, \mu(e_n, c)).$$

But then there is a function  $g$  such that for any  $c$ ,  $g(c) = g_c$ . Such a function  $g$  is clearly an  $e$ -composition function for  $\mu$ .

12. I guess it is  $ec$ -compositionality that Recanati (1993:268) and Crimmins and Perry (1989:710-11) have in mind when they claim that natural language isn't fully compositional, and that they would agree that it is violated by instances of (CSF) below.

$e_1, \dots, e_n$  are the immediate constituents of  $A$ , we have

$$(CSF) \quad \mu(e_i, c_1) = \mu(e_i, c_2), \text{ for } 1 \leq i \leq n, \text{ and } \mu(A, c_1) \neq \mu(A, c_2).$$

(CSF) provides an independent method of failing *ec*-compositionality.<sup>14</sup> Thus, the suggested semantics for ‘it rains’ violates *ec*-compositionality in a way clearly different from that of substitution failure.

Not many would accept the above view of the semantics of ‘it rains’, and for good reasons. The present tense in ‘rains’ is an explicitly context sensitive device, similar to referring indexicals. And we can characterize the meaning of the present tense form of the verb ‘to sleep’ by saying

‘sleeps’ is true of an object  $a$  at a time  $t$  iff  $a$  sleeps at  $t$ .

Following this pattern, we characterize the standing meaning of an expression by specifying its *extension* in a context  $c$ , or at a time  $t$ , for variable  $c$  and  $t$ , or the condition for belonging to this extension. A necessary and sufficient condition for belonging to the extension of ‘sleeps’ at a time  $t$  is that of sleeping at  $t$ .

We should now take account of the corresponding context sensitivity in the standing meaning of present tense ‘rains’. For the purposes of the present discussion, let’s first

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13. What is the relation between the compositionality for standing meaning and for occasion meaning? Given a meaning function  $\mu$  for occasion meaning we can form a function  $\mu'$  from expressions to functions  $h$ , where each function  $h$  applied to a context delivers an occasion meaning. This is done simply by functional abstraction on the context variables  $c$  and  $e$ , in that order. Thus the function  $\lambda e ( \lambda c (\mu(e, c)))$  is such that

$$\lambda e ( \lambda c (\mu(e, c)))(e_1) = \lambda c (\mu(e_1, c))$$

It is natural to conclude that  $\lambda e ( \lambda c (\mu(e, c)))$  maps expressions on standing meanings, for standing meanings are precisely such functions. However, a radical contextualist denies that there are standing meanings. According to the radical thesis, we only have occasion meaning and no general understanding of an expression by which we know what its occasion meaning in a particular context is. Linguistic meaning is then completely particularist, and we don’t know how to explain that two persons generally agree on what occasion meaning an expression has in a new context. But if radical contextualism is false,  $\lambda e ( \lambda c (\mu(e, c)))$  will (normally) be a meaning function mapping expressions on standing meanings. We can then ask about the relation between compositionality for standing meanings and *e*- and *ec*-compositionality for occasion meaning. The answer is that compositionality for occasion meaning, *e*- or *ec*-, implies compositionality for standing meaning, and that the converse does not hold (see Appendix 1).

14. To prove independence, let  $L$  be the set of expressions  $\{e_1, e_2, (e_1, e_1), (e_1, e_2), (e_2, e_1), (e_2, e_2)\}$ .

Let  $\mu$  be such that  $\mu(e_1, c_1) = \mu(e_1, c_2)$ ,  $\mu(e_2, c_1) = \mu(e_2, c_2)$ ,  $\mu(e_1, c_1) \neq \mu(e_2, c_1)$ ,  $\mu(e_1, c_2) \neq \mu(e_2, c_2)$ ,  $\mu((e_1, e_2), c_1) \neq \mu((e_1, e_2), c_2)$ . Then  $\mu$  instantiates the schema of context shift failure but not the schema of substitution failure.

For the other direction, let  $\mu$  be such that  $\mu(e_1, c_1) \neq \mu(e_1, c_2)$ ,  $\mu(e_2, c_1) \neq \mu(e_2, c_2)$ ,  $\mu(e_1, c_1) \neq \mu(e_2, c_2)$ ,  $\mu(e_2, c_1) \neq \mu(e_1, c_2)$ ,  $\mu(e_1, c_1) = \mu(e_2, c_1)$ ,  $\mu((e_1, e_2), c_1) \neq \mu((e_2, e_2), c_1)$ . Then  $\mu$  instantiates the schema of substitution failure but not the schema of context shift failure.

assume that the standing meaning of 'rains' is given by

(9) 'rains' is true of a time  $t$  iff it rains (somewhere) at  $t$ .

Let's say further simply that the standing meaning of impersonal 'it' is the identity function applied to contexts, i.e.

(10) for any context  $c$ ,  $(\mu('it'))(c) = c$

(for a different treatment, see Appendix 2). The composition rule for impersonal 'it'+present tense feature placing verb phrase can then be given as

(11) ' $it' \wedge Present( )$ ' is true in a context  $c$  iff  $\mu('it')$  is true of all relevant elements of  $(\mu('it'))(c)$ .

where 'Present' operates on a verb to give the present tense. Since by (9) the element of a context  $c$  that is relevant to 'rains' is just the time of  $c$ , (9), (10) and (11) combine to give

(12) 'it rains' is true in a context  $c$  iff it rains (somewhere) at the time of  $c$ ,

or, after simplification,

(12') 'it rains' is true at a time  $t$  iff it rains (somewhere) at  $t$ .

With (12) we give the standing meaning of 'it rains' by specifying, for any time  $t$ , the condition for the sentence to be true at  $t$ . In order to complete the account, we need to provide a principle determining the content of an utterance of 'it rains'. So we add

(UC) The content of an utterance of a sentence  $s$  in a context  $c$  is given by specifying the conditions under which  $s$  is true in  $c$ .

(UC) is somewhat imprecise, since there is no mention of how the truth conditions should be specified, but I'll presently leave that difficulty aside, together with further questions about indirect speech acts and other complications.

Assuming that we can extract a time  $t$  from a context  $c$  as the time of that context, we combine (12) and (UC) to arrive at

(13) the content of an utterance of 'it rains' in a context  $c$  is that it rains at the time of  $c$ ,

or, simplifying with the assumption that the time of  $c$  is the time of utterance,

(13') the content of an utterance of 'it rains' at a time  $t$  is that it rains at  $t$ .

However, this brings us to a point parallel to Fodor's. For (13) and (13') are obviously false. Uncontroversially, the correct clause is

- (14) the content of an utterance of ‘it rains’ in a context  $c$  is that it rains at the time of  $c$  at the location of  $c$ .

Assuming that (12) gives us the full *standing* meaning of ‘it rains’, it follows that the standing meaning is not enough to generate the utterance content, at least not by means of a principle like (UC)). Again assuming (UC), we have to conclude that beside the standing meaning of ‘it rains’ there must be variable meanings to fill the gap. We will need one meaning for each location  $l$ , thus replacing (12) with

- (12<sub>1</sub>) ‘it rains’<sub>1</sub> is true at a time  $t$  iff it rains at  $l_1$  at  $t$   
 (12<sub>2</sub>) ‘it rains’<sub>2</sub> is true at a time  $t$  iff it rains at  $l_2$  at  $t$   
 .  
 .  
 .

Assuming that (9) and (10) are correct, i.e. give us the standing meanings of impersonal ‘it’ and of ‘rains’, respectively, this again gives us a violation of *ec*-compositionality. For the occasion meaning of ‘it rains’ will be different at different locations, even though there is no change in occasion meanings of parts, nor of syntax.

In order avoid this, we would need to get (14) with the help of (UC) while only relying on the standing meaning of ‘it rains’.<sup>15</sup> And for this we would need as the standing meaning of ‘it rains’ something like Davidson proposed almost 30 years ago:

- (15) ‘it rains’ is true as uttered by  $S$  at  $t$  iff it rains near  $S$  at  $t$

(Davidson 1967:34, 1974:135).<sup>16</sup> There are three obvious alternatives for deriving a clause like (15). The two first alternatives amount to replacing (9) as the clause for ‘rains’, and the third is to replace (11) as the compositional clause. Making the variables explicit, the first alternative gives us

- (16) ‘rains( $x, y$ )’ is true of a time  $t$  and a location  $l$  iff it rains at  $t$  at  $l$

by which ‘rains’ is a two-place predicate with context sensitive standing meaning, true of times and locations. The second gives us

- (17) ‘rains( $x$ )’ is true of a time  $t$  at a location  $l$  iff it rains at  $t$  at  $l$ .

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15. An alternative is to reject (UC), and replace it with a principle according to which there is a *pragmatic* addition to the content which brings in dependence on location. You can then keep (12). What is literally said by means of ‘it rains’, on this view, is that it rains somewhere at the time of utterance. It is implicated, and thus communicated, but not literally said, that it rains at the location of the speaker. This view is defended by Emma Borg (*forthcoming*).

Concerning my views on the semantics/pragmatics distinction, see section 7.

16. Davidson’s clause simplifies matters by assuming that the contextually salient time and location of an utterance is the time and location of that utterance.

On this alternative ‘rains’ is a one-place predicate with context sensitive standing meaning, true of times *at* locations. The difference between being true *of* a location and being true *at* a location reflects the presence and absence, respectively, of a location argument in the predicate. Suppose we identify occasion meaning with occasion *extension*. That is, we assume that the extension of the predicate in a context is its occasion meaning in that context. We also assume that we get the occasion extension by assigning values to syntactic context variables. On these assumptions, the occasion meaning of ‘rains( $x, y$ )’, according to (16), is a truth value (or something equivalent, like the universal or empty set of assignments), whereas the occasion meaning of ‘rains( $x$ )’ according to (17) is a function from locations to truth values (or something equivalent). In both cases, the occasion meaning is context dependent. In the latter case, the occasion meaning *itself* (under the assumptions) is context sensitive, i.e. yields a further value as applied to a context. If this description is right, we need three levels of meaning, where the first, standing meaning, is at most context sensitive, the second, occasion meaning, can be both context sensitive and context dependent, and the third, for which a name is wanting, is at most context dependent. Alternatively (and this is the view I shall settle for), one can take the view that the semantics of ‘rains( $x$ )’ according to (17) is the same as that of ‘rains( $x, y$ )’ according to (16), and that the difference is *only* syntactic.

The third alternative is to replace (11) by e.g.

- (18) ‘it’  $\wedge$  Present( ) is true in a context  $c$  iff    is true at  $l$  of all relevant elements of  $(\mu(\text{‘it’}))(c)$ .

Here, the context sensitivity is introduced in the composition rule itself.

As it happens, none of these three alternatives is uncontroversial. The first method runs counter to pre-theoretic intuitions about syntax, for there does not seem to be anything in ‘rains’ that registers contextually salient location. The third method, to introduce context sensitivity in the composition rule, may be claimed to violate compositionality, the reason being that in a compositional semantics, the rules must not be context sensitive. Construed in one way, this claim is correct, construed in others incorrect.<sup>17</sup> But even in a framework where the claim is wrong, it is a problem that (18) relies on the assumption that what it is for    to be true *at*  $l$  is well-defined, and typically this is defined only in clauses like (17). Similarly, (17) requires that truth at  $l$  is an argument or a condition in the corresponding composition rule. Normally, then, (17) and (18) are applied together, which leaves us with only two alternatives. However, there is an argument in the recent literature, due to Jason Stanley (2000), that context sensitivity must be carried by an element in the syntax. In a weak sense, this is what is required by *ec*-compositionality: all context dependence must be traceable ultimately to lexical meaning of atomic parts. However, Stanley means this in a stronger sense: to each dependence on a context element there must correspond, in logical form, a unique syntactic variable. If Stanley’s argument for this claim is successful, it rules out the second and third alternatives. The remainder of this paper is concerned with this argument and its motivation.

#### 4. Stanley on unarticulated constituents

In his paper ‘Context and logical form’, Jason Stanley presents three alternative ways of drawing a semantics/pragmatics distinction, or three different usages of the terms ‘semantic’ and ‘pragmatic’. According to the first (Stanley 2000:393), semantics is the study of context invariant aspects of meaning. On this conception, the *semantic content* (Stanley’s term) of two different utterances of a sentences like ‘I am tired’ is the same. According to the corresponding use of ‘pragmatic’, pragmatics is the study of those aspects of communication that depend on context, including the assignment of reference to indexicals.

According to the second usage (2000:393-94), semantics is concerned both with context invariant meaning *plus* the assignment of denotations to elements of the logical form, including indexicals. Pragmatics is concerned with further aspects of utterance content, which an interpreter arrives at by way of applying conversational maxims.

On the third usage (2000:394), semantics is concerned with the primary assignment of *truth conditions* to a sentence, relative to a context of utterance. Pragmatics is concerned with the further process of taking those truth conditions of a linguistic act as input, to yield other propositions implicated by that speech act as output.

Stanley himself favours the second way of drawing a semantics/pragmatics distinction. However, he also claims, as a positive thesis (2000:395), that the second and the third distinctions *coincide*. That is, Stanley’s thesis is that standing meaning plus assignment of reference to elements of logical form is both necessary and sufficient for determining the truth conditions of an utterance relative to a context. This thesis amounts to a wholesale rejection both of non-sentential utterances with truth conditional content, and of so called *unarticulated constituents*.

The term ‘unarticulated constituent’ was introduced by John Perry (1986:206),

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17. The rule (18) introduces an extra context dependence in the occasion meaning of an ‘it’+verb compound. For instance, the truth value in a context of such a sentence will, because of this rule, depend on location. In virtue of this, (18) also introduces an extra context sensitivity in the standing meaning of sentences of this kind.

Does such a rule violate compositionality? It does not violate compositionality for standing meaning, since standing meaning is allowed to be context sensitive and since the syntactic operation is an argument to the composition function anyway. Neither does it violate *e*-compositionality for occasion meaning, since according to (*e*-comp), the composition function does take an extra context argument, depending or not depending on the syntactic operation. However, it *does* violate *ec*-compositionality, since (*ec*-comp) does not allow the composition function to depend on context for more than what serves to determine the occasion meaning of the parts.

That composition rules ‘must not vary with context’ is a condition stated in Stanley 2000:395. It is further claimed in Stanley and Szabo 2001:255-56, that a certain form of semantics for effecting quantifier domain restriction fails to meet this condition. That claim is rejected as incorrect in Pelletier 2003:153-56. However, since neither party of the debate clearly distinguishes between context dependence and context sensitivity, nor between different versions of compositionality for context dependence, it may well be that both are right in their way and that Pelletier misinterprets. On the other hand, Stanley and Szabo (2001:255) incorrectly present the rule (43b) as context dependent; the real composition rule in that case is simply functional application, which itself is context invariant.

although a related idea can be found in Frege.<sup>18</sup> Perry was followed by Mark Crimmins (1992) and François Recanati (1993, 2002), among others. The definition, as given by Stanley (2000:410) runs:

$x$  is an unarticulated constituent of an utterance  $u$  iff (1)  $x$  is an element supplied by the context to the truth-conditions of  $u$ , and (2)  $x$  is not the semantic value of any constituent of the logical form of the sentence uttered.

Although this formulation suggests that truth conditions are treated as structured entities with identifiable elements as constituents,<sup>19</sup> it seems not to be what Stanley has in mind, since he regards the following as a standard unarticulated constituent clause (2000:415):

R: “It is raining( $t$ )” is true in a context  $c$  if and only if the denotation of “rains” takes  $t, l$  to the True, where  $l$  is the contextually salient location in  $c$ .

This indicates that for being an element supplied by the context to the truth conditions to an utterance, it is enough that reference to that element is required in *stating* the truth conditions. Clause R is taken to give the logical form of ‘it is raining’, making it explicit that there is a variable for time, but no variable for location. The relevant dependence on the contextually salient location is made explicit only in the meta-language, where there is both a time and a location variable. Davidson’s clause (15) also counts as of the unarticulated constituent variety, provided that the object language sentence is given in logical form. In that case, assuming that in logical form context sensitivity is articulated by a variable, both time and location are unarticulated in Davidson’s case.

Consistent with his general view, Stanley thinks that ‘it rains’ in logical form does have both a time and a location variable, so that, at least, it should be given as ‘it

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18. In ‘The thought’, Frege says

If a time indication is needed by the present tense one must know when the sentence was uttered to apprehend the thought correctly. Therefore the time of utterance is part of the expression of the thought. If someone wants to say the same today as he expressed yesterday using the word ‘today’, he must replace his word with ‘yesterday’. Although the thought is the same its verbal expression must be different so that the sense, which would otherwise be affected by the differing times of utterance, is readjusted. The case is the same with words like ‘here’ and ‘there’. In all such cases the mere wording, as it is given in writing, is not the complete expression of the thought, but the knowledge of certain accompanying conditions of utterance, which are used as means of expressing the thought, are needed for its correct apprehension (Frege 1918:24).

On a plausible interpretation, Frege is here arguing from (*ec*-) compositionality to a kind of non-linguistic articulation: the expression of the thought must include as much as is needed for avoiding to instantiate the schema of context shift failure.

19. Perry’s view in this connection is that propositions do have the objects, relations etc. they are about as constituents. See Perry 1986:207. It should also be noted that Perry more recently (2001:47-48) has distanced himself from Stanley’s notion of an unarticulated constituent. As Perry explains it, unarticulated constituents are argument roles of relations that are not represented by explicit argument places or variables in the expressions of those relations.

rains( $t, l$ )' (actually, as we shall see in section 7, it is more complex). Contrary to the time variable, which is reflected in the tense of the surface form, the location variable is unexpressed in the simple

(3) it rains

whereas it is made explicit in surface form by means of the indexical 'here' in

(4) it rains here

where the indexical fills the argument place. In both cases context supplies a location as a value to a syntactic element, visible in (4) but invisible in (3).

Moreover, Stanley has a general argument for this view and against semantic clauses of the unarticulated constituent kind, and he exemplifies it by means of (3). The argument turns on the phenomenon of *binding*. The sentence

(19) Every time John lights a cigarette, it rains

has, as Stanley points out (2001:415-16), as one natural reading

(20) For every time  $t$  at which John lights a cigarette, it rains at  $t$  at the location in which John lights a cigarette at  $t$ .

The problem for an unarticulated constituent analysis, according to Stanley, is that this reading is unavailable. The only reading available on this analysis is (2001:416):

(21) For every time  $t$  at which John lights a cigarette, the denotation of "rains" takes takes  $t, l$  to the True, where  $l$  is the contextually salient location in  $c$ .

This claim about clause R in relation to sentence (19) is correct, as far as I understand, and just about refutes it.

As Stanley points out, semantically, the location variable for 'it rains' is *bound* in (19). Stanley explains binding as follows (2001:412): 'Let us say that  $\alpha$  semantically binds  $\beta$  if and only if the interpretation of  $\beta$  systematically depends on the values introduced by  $\alpha$ , which seems adequate for present purposes. Further, it is Stanley's view that an interpretation by which semantic binding takes place reflects the occurrence of *syntactic* binding, i.e. the occurrence of variables and corresponding variable binding operators in the syntax. This seems to be the import of his *Binding Assumption* (2001:412). As I understand it, Stanley takes this view to be confirmed by the failure of R to deliver the proper bound reading of (19).

However, in a brief passage, Stanley does concede the possibility of an account by which 'the semantic elements corresponding to bound variables can be supplied by the semantics, with no corresponding syntactic elements denoting them' (2001:413), and credits Jeff King with the point. I am going to propose precisely such a semantic account.

That is, I shall attempt to refute Stanley's *binding* argument against unarticulated constituent analyses by providing such an analysis that can deliver the desired reading of (19). This semantics will be somewhat more complex, allowing binding of context variables in the semantic meta-language.

The main ideas of this account will be presented in section 6, and the full semantics is given in Appendix 2. In section 7 I shall compare the proposed semantics with Stanley's own account, and also locate the issue in the broader setting of natural language compositionality and the semantics/pragmatics distinction. In the next section, however, I shall briefly discuss a response given to Stanley's argument from binding by Recanati.

### 5. Digression: Recanati on the argument from binding

In his response to Stanley, Recanati makes three major claims. First, Stanley, Perry and others have concentrated on the wrong kind of examples: true unarticulated constituents are not required at all for expressing a complete proposition, but are optional. Second, Stanley's *binding* argument is fallacious, since as stated it will overgenerate variables, i.e. prove that there must be variables in logical form where it is obvious that none is required. Third, even when properly restricted, the argument from binding doesn't work, which is demonstrated by Recanati's own semantic account of the binding phenomena.

In Recanati's first example (2002:300), a speaker is asked whether he is hungry, and replies

(22) I've had a very large breakfast.

The conversational implicature is that the speaker is not hungry, and for that to come across the speaker must have stated, by means of (22), that he had a large breakfast on the day of utterance, even though no time is assigned to the breakfast event in the sentence itself. The time is then supplied by context, and it is a *true* unarticulated constituent, in Recanati's sense. The reason it qualifies is that the additional supply of time is a *free enrichment*, one that is not made obligatory by anything in the sentence. The sentence itself is adequate for expressing the less specific proposition that the speaker has had a large breakfast at some time or other.

Other examples involve sentences that *require* completion for the expression of a proposition, such as

(23) Gentlemen prefer blondes

(to  $x$ , for some  $x$ ; the example, in Recanati (2002:309) is taken over from Bach 1994:268-69). In cases like this, Recanati says, there is a sense in which the contextually provided element *is* articulated, namely in the sense that an expression in the sentence triggers the search for some completing entity.

That was also the case with Perry's original example, the sentence 'It is raining'. According to Perry, no proposition is expressed with this sentence, unless a location is

contextually provided (Recanati 2002:309, 316, Perry 1986:206). In Recanati's sense, the location is on this view not a true unarticulated constituent, but 'is really the value of a hidden variable' (2002:316). However, Recanati does think that 'It is raining' *can* be used for saying simply that it is raining somewhere or other, i.e. for saying something true or false even if no location is provided, and imagines a context in which that will be natural (2002:317).<sup>20</sup> On this view, the supply of location is optional, hence truly unarticulated. The example of 'it rains' can therefore still be used.

It is not completely clear whether Recanati wishes to change the *terminology*, so that something should (truly) be called 'articulated' just if it must be provided for the expressing of a proposition, whether or not there is a variable in the syntax that takes it as value, or whether he sticks with the accepted definition and pushes the *thesis* that whenever some value must be provided, then there in fact is a corresponding variable in the syntax. This question does not, however, matter for his further comments on Stanley.

Recanati's second claim is that Stanley's binding criterion of articulatedness is misguided, for it can be applied also to cases where it is clear that there is no hidden argument. Recanati takes the sentence

(24) The policeman stopped the car

(2002:325, taken over from Rumelhart 1979:78). There is a natural tendency to interpret an utterance of this sentence as meaning that the policeman stopped the car by means of a signal to the driver. However, with some additional contextual information, such as that the policeman was driving the car, we will assume that he stopped it in a different way. What we get from the sentence itself is only that the policeman stopped the car in some way or other. Recanati claims, plausibly, that any extra assumption about the manner of stopping interpreted as expressed by an utterance of it, is nothing but an optional pragmatic embellishment, corresponding to nothing in the semantics, and that this is quite uncontroversial. Yet, he says, if the argument from binding is valid, we will get the absurd consequence that (24) has a hidden variable for manner. For we can say

(25) However he did it, the policeman stopped the car

or

(26) In some way or other, the policeman stopped the car.

The meaning, in both cases, is that given by

(27) For some manner of stopping *m*, the policeman stopped the car in manner *m*.

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20. The story is that rain detectors have been installed all over a territory, or the whole Earth, such that each triggers a bell in some central Monitoring Room when detecting rain. Upon hearing the bell, the operator may say 'It is raining', meaning that it is raining at some place or other (2002:317)

This argument is elegant if correct, but it is not obviously correct. In a case of binding, when an argument place has been made explicit by means of a bindable indexical (such as ‘he’, ‘she’, ‘it’, ‘that’), that indexical gets bound when made anaphoric on an appropriate quantifier. For instance, ‘it’ in

(28) Gizella smiles at it

gets bound in

(29) Whichever animal she encounters, Gizella smiles at it.

And ‘that place’ in

(30) It rains in that place

gets bound in

(31) Wherever I go, it rains in that place.

By contrast, ‘that way’ in

(32) The policeman stopped the car in that way

does not seem to get bound in

(33) However he did it, the policeman stopped the car in that way

or in

(34) In some way or other, the policeman stopped the car in that way.

Rather, (33) and (34) are odd, or at best interpreted as quantifying over sub-manners to a manner referred to by ‘that way’.<sup>21</sup> It is therefore not obvious that the argument from binding works for manner *if* it works for location.<sup>22</sup>

Recanati’s third claim is that, although binding indeed does occur in

(19) Every time John lights a cigarette, it rains

he has an unarticulated constituent analysis that accounts for it. The flaw in Stanley’s argument, according to Recanati (2002:328-29) is the assumption that it is the *same* sentence of the surface form ‘it rains’ that occurs in (19) as occurs isolated. On Recanati’s

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21. Unless I misrepresent her, I owe this argument to Elisabeth Engdahl, who used it much the same way against Ernie Lepore at the Stockholm-Rutgers conference of cognitive science, June 2003.

Note that although ‘For some manner, the policeman stopped the car in that manner’ is well-formed, this is irrelevant. It would be relevant only if ‘For some manner, the policeman stopped the car’ were also well-formed, so that this latter sentence were a candidate for covert binding.

account, there is an ambiguity: ‘It rains’ as occurring in (19) does have a location variable, whereas ‘it rains’ as occurring in isolation doesn’t. Recanati compares this ambiguity with that between the transitive and the intransitive verb ‘eat’. The intransitive verb is a one-place predicate true of eaters, whereas the transitive verb is a two-place predicate true of eaters and what is eaten.

On Recanati’s account you can generate new predicates with an increased or decreased number of argument places by means of so-called *variadic functions*. In the increase case, this is represented by means of a family of operators called ‘Circ’. It is exemplified (2002:321) with the adding of a location argument to the intransitive ‘eat’:

$$\text{Circ}_{\text{location}}(\text{Eats}(x)) = \text{Eats\_in}(x, l)$$

The prepositional phrase ‘in Paris’ adds a location argument to the verb in this manner, but it also contributes Paris as the *value* of the location variable. This is represented as

$$\text{Circ}_{\text{location:Paris}}(\text{Eats}(\text{John})) = \text{Eats\_in}(\text{John}, \text{Paris})$$

In simplified notation this can be rendered as

$$\text{In Paris } \langle \text{John eats} \rangle$$

where the angular brackets indicate that the location assignment is optional (2002:330).

In the case of binding, quantifier phrases can achieve the same as the prepositional phrase above. Thus ‘everywhere I go’ both contributes a location variable and *binds* that variable. On this analysis

(35) Everywhere I go, it rains

is analyzed as

(36) [Fore every place *l* such that I go to *l*] (in *l* (it rains))

(2002:330). On this analysis, ‘it rains’ as occurring in (35) corresponds to the formula

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22. A similar counter-argument is proposed by Cappelen and Lepore (2002:273). According to Cappelen and Lepore, one could apply the same argument from binding to the sentence

(\*) ‘Everywhere I go,  $2+2=4$ ’,

getting the reading ‘For all places, *x*, I go to *x*,  $2+2=4$  at *x*’, demonstrating the existence of a hidden location variable in ‘ $2+2=4$ ’. Since this is absurd, the binding argument is refuted, according to Cappelen and Lepore.

The problem with this argument is that there is a crucial difference between (\*) and Stanley’s (19). In (19) the two interpretations, with a bound and with a free location variable, can have different truth values, confirming the hypothesis that the truth value depends on the value of the location parameter. In (\*), this is not the case. Hence, although (\*) is grammatical, it has not been shown that there is a semantic location dependence.

‘(in  $l$  (it rains))’ in the logical form, and thus has a location variable. The simple sentence ‘it rains’, as used in isolation, corresponds to the proper constituent of that formula which does not contain the variable. This makes the ambiguity explicit.<sup>23</sup>

In Stanley’s (19) it is more complex, since the location variable is not introduced by a location quantifier but as a function of time introduced by a time quantifier. The way to supply a location argument and the location value as a function of time, is therefore

in location  $f(t)$  (it rains)

(2002:333), and the full analysis comes out as

(37) [For every  $t$  such that John lights a cigarette at  $t$ ] (at  $t$  ( in  $l$ :John lights a cigarette in  $l$  at  $t$  )(it rains)

(2002:334, where ‘ ’ is a description operator; Recanati actually applies the analysis to ‘Everywhere I sing, it rains’, rather than to (19)).<sup>24</sup>

This is an interesting account, and when properly worked out might well result in a plausible semantics. However, this is not enough for Recanati’s purpose, since there is a problem with the further claim that it saves the unarticulated constituent analysis. That claim depends on the positive thesis of ambiguity (or optionality), while the semantics itself is independent of this thesis, since it is possible that even isolated occurrences of ‘it rains’ should be analyzed as having the form ‘(in  $l$  (it rains))’. In fact, there is reason to think that this is the case (in Recanati’s framework). For it seems that even when ‘it rains’ is used in the supposed non-locating sense (for boosting your intuitions, consult footnote 20), anaphoric reference to location is possible. In the examples

(38) It rains. John wants to go there.

(39) Whenever it rains, John wants to go there.

we seem to get exactly the same readings as in

(40) It rains somewhere. John wants to go there.

(41) Whenever it rains somewhere, John wants to go there.

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23. Recanati has commented (personal communication) that in the article he expressed himself misleadingly on this point. His real view is that the overt ‘it rains’ always corresponds to the proper part with the same wording in ‘in  $l$  (it rains)’. His claim should then be rendered simply as the claim that the location variable is optional; i.e. ‘it rains’ sometimes occurs and sometimes does not occur with a location variable, whether overt or covert.

24. Recanati is seriously worried by the fact that a bound variable occurs in the representation of the unarticulated constituent, i.e. within the angular brackets, since ‘a variable has got to be articulated... for variables are *linguistic expressions*’ (2002:335, italics in original). This I find hard to understand. Bound variables are part of our way to *represent* dependencies. Either Recanati has confused the representation of dependence with the dependence itself, or else there is more to the idea of an unarticulated constituent than I have understood so far.

(40) and (41) are straightforward cases of cross sentence and donkey anaphora, respectively, to be treated by your favorite account<sup>25</sup> as having the bound readings

(40') There is a location  $l$  such that it rains in  $l$  and John wants to go to  $l$ .

(41') For any location  $l$ , whenever it rains in  $l$ , John wants to go to  $l$ .

Since Recanati's account does not offer any other way to supply the bound reading of 'there' than making it anaphoric on a noun phrase antecedent, his only option is to treat 'it rains' in (38) and (39) as elliptical for 'it rains somewhere'. On Recanati's account this is analyzed as

(42) [For some location  $l$ ](in  $l$ (it rains)).

Finally, it seems that such anaphoric back reference is always possible, and if this is true, then on Recanati's own account, all isolated occurrences of non-locating 'it rains' have the form of (42). Hence, the argument free version of 'it rains' is never actually encountered in natural English, but only the prefixed form '(in  $l$ (it rains))', with or without existential closure. Again, if this is right, Recanati's ambiguity claim (or optionality claim) is false. His account does not save the unarticulated constituent analysis.

## 6. Quantifying over contexts

In this section I shall briefly set out the idea by which the bound readings of (19) and similar sentences can be produced by a semantics of the unarticulated constituent type. First, as was done in Kaplan (1989) and in Montague (1968, 1970) we can model contexts as sequences of context elements, or equivalently as assignments of values to a set of context parameters. For any context  $c$ , the associated model will contain as elements, to begin with, the speaker of  $c$ , if any, the addressee, if any, the (contextually salient) time of  $c$ , the location. The context model must be so well defined that projection functions can be applied to contexts. That is, we can have a function  $Sp(c)$  which returns the speaker of context  $c$ , and  $Ad(c)$  the addressee of  $c$ , if any.  $T(c)$  is the time of  $c$ , and  $L(c)$  is the location of  $c$ . One cannot take for granted that every context returns a value to every projection function. For instance, we may need, as David Kaplan has emphasized, to take account of contexts where no utterance is made, and so there is no speaker. The projection functions must therefore be partial.

What is supposed to be included in contexts? As I see it, the context includes anything over and above the sentence (actually or potentially) uttered that is available and may be employed for achieving communicative success. It is not likely that a definitive list of potentially relevant context features can be produced, and things will get much worse if we include in contexts what is needed for pragmatic phenomena like conversational implicature. For the the more limited concerns of the fragment treated in Appendix 2, we

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25. For instance, PFO. See Pagin and Westerståhl 1993.

will still need more what is suggested so far. For instance, we will need a function (call it ‘TopMale<sub>i</sub>(c)’) the for a given context  $c$  delivers the  $i$ :th most salient male of  $c$ , intended to provide a referent to an occurrence of unbound ‘he’ or ‘him’. Similarly for ‘she’ and ‘her’. The appendix also suggests a function  $D_i(c)$  for handling contextual quantifier domain restriction. Cf Appendix 2.<sup>26</sup>

A context variable ‘ $c$ ’ is an individual variable of the semantic meta-language. It can be bound by quantifiers in the meta-language, and this is used for handling expressions that quantify over context elements, such as ‘every time’. At first we could try

(t) ‘Everytime’  $\wedge s$  is true iff for every context  $c$   $s$  is true at  $T(c)$ .

This is ok, except that the original sentence, ‘Everytime’  $\wedge s$ , might itself be context sensitive, and will in that case be evaluated relative to a context  $c$ . In that case, ‘everytime’ introduces quantification over contexts  $c'$  that differ from  $c$  with respect to time but not in other respects. This will make the treatment parallel to the handling of assignments in first-order semantics:

(tc) ‘Everytime’  $\wedge s$  is true at  $c$  iff for every context  $c' \ c/t, s$  is true at  $c'$

where ‘ $c' \ c/t$ ’ is to be read as ‘context  $c'$  differs from context  $c$  at most with respect to time’. In this case time will vary but e.g. location will be constant across the contexts  $c'$ .

However, to get the desired reading for Stanley’s (19), we need to let location vary *together* with time. That is, we need to consider the location of each context  $c'$  where the embedded sentence is true, not just the time of  $c'$ . We can call this *concomitant* variation of context elements. Notationally, the change is small:

(tcl) ‘Everytime’  $\wedge s$  is true at  $c$  iff for every context  $c' \ c/t+l, s$  is true at  $c'$

where we consider all contexts  $c'$  differing from  $c$  at most with respect to time *and* location. The addition of the location variable simply reflects the availability of the corresponding reading of (19). Other variables may be added to the extent this is interpretationally adequate.

To get the bound reading of (19) we need a *locating* reading of its antecedent,

(43) John lights a cigarette

i.e. the reading under which

(44) ‘John lights a cigarette’ is true at  $c$  iff John lights a cigarette at  $T(c)$  at  $L(c)$

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26. It is a further interesting question whether contexts should be seen as subjective or intersubjective. Sometimes communication fails because of a mismatch in attention between speaker and hearer. A salience function like TopMale<sub>1</sub>( $c$ ) might then deliver a different value for the speaker and for the hearer, implying that the speaker context is different from the hearer context. At other times we might explain communicative success by reference to intersubjectively salient features of the environment.

as opposed to an non-locating reading where only  $T(c)$  matters. Let's assume the locating reading and that (19) is to be interpreted as a quantified conditional:

(45) 'Everytime'  $\wedge$  'if John lights a cigarette, then it rains'

we get

(46) 'Everytime'  $\wedge$  'if John lights a cigarette, then it rains' is true at  $c$  iff for every context  $c' \ c/t+l$ , 'if John lights a cigarette, then it rains' is true at  $c'$ .

With the locating reading we will get (after a number of recursive steps in the semantics)

'if John lights a cigarette, then it rains' is true at  $c'$  iff  
(if John lights a cigarette at  $T(c')$  at  $L(c')$ , then it rains at  $T(c')$  at  $L(c')$ ).

Making use of this equivalence in (46) we finally get

(47) 'Everytime'  $\wedge$  'if John lights a cigarette, then it rains' is true in  $c$  iff  
for every context  $c' \ c/t+l$ , if John lights a cigarette at  $T(c')$  at  $L(c')$ , then it rains at  $T(c')$  at  $L(c')$

This seems to be (a semi-formal rendering of) the desired reading of (19). It is the desired reading provided we get the quantification over contexts right. But by (47) we only take into account contexts  $c'$  which share other features with  $c$ , such as perhaps that of having Elsa as the most salient female, a feature irrelevant to the interpretation of (19). This runs the risk of getting the truth conditions of (19) wrong, for the relation between rain and John's lightings of cigarettes is supposed to hold also in contexts where Elsa isn't the most salient female.

This complication parallels the situation in first-order truth definitions where we need to show that a particular assignment satisfies a closed sentence  $s$  iff *all* assignments satisfy  $s$ . More generally, an assignment  $f$  satisfies a formula  $s$  iff  $s$  is satisfied by any assignment  $f'$  differing from  $f$  at most with respect to variables not free in  $s$ . Analogously, it will hold for *truth-in-a-context* that if the truth of  $s$  in  $c$  does *not* depend on some context element  $P(c)$ , then  $s$  is true in  $c$  iff  $s$  is true in any context  $c'$  differing from  $c$  at most with respect to  $P$ . Whether the truth of  $s$  *does* depend on  $P$  is determined by the semantic clauses. Where  $I(s)$  is the set of context elements irrelevant to the evaluation of  $s$ , we will have in general

(I)  $s$  is true in  $c$  iff for all  $c' \ c/I(s)$ ,  $s$  is true in  $c'$

Because (I) is true, we can be sure that if a statement like (47) is true of a particular context  $c$ , it will be true of all contexts  $c'$  differing from  $c$  at most with respect to  $I(s)$ . Hence the truth conditions will not be wrong.

For the complete outline of the context semantics, see Appendix 2.

## 7. Concluding remarks

Since the context semantics proposed is of the unarticulated constituent variety, and since it does deliver the reading claimed by Stanley to be outside the reach of semantics of that kind, the claim is refuted. This does not, however, imply, that this context semantics is the right or best theory, or even better than Stanley's own proposal.

Stanley suggests that in logical form 'rain' is

(48)  $\text{rain}(f(x), g(y))$

such that one argument gives time and the other location (Stanley 2000:416). Context supplies the values both to individual variables and function variables. In the normal case, the individual values are the salient time and location of the utterance, respectively, and the functions simply identity functions. For the bound reading of (19), Stanley suggests that the location argument gives the time as value to the individual variable and a function from times to locations to the function variable. Since the time variable will be bound by 'every time', the location value will be a function of the time introduced by that same expression, and thus bound by it. In the case of (19), the function is from a time  $t$  to the location of John at  $t$ .

Clearly, Stanley's proposal delivers the desired reading. The problem is that there is no clear limit to the readings that this framework delivers, since there is no clear limit to the possible values for the variables. Why not a function from a time  $t$  to the location where John's *mother* is at  $t$ , at least if she is contextually prominent in some way or other? Without a clear criterion of admissibility of values, especially function values, Stanley's account will overgenerate readings, and no such criterion is offered.

But even if this objection is correct, some other articulated analysis may do better.<sup>27</sup> Is there in principle any reason to prefer the context semantics offered to any articulated competitor? I think there is a reason, in that speaker intuitions about syntax should count more than speaker intuitions about semantics, and I think speaker intuitions tell against treating 'rain' as a two-place predicate. Similarly, and maybe more obviously, it is strongly counterintuitive to treat a predicate like 'red' as two-place, taking object and time arguments, even though in the semantics we must treat the corresponding concept as a relation between objects and times, or objects and contexts. I think that speaker intuitions about syntax are closer to how speakers consciously represent facts to themselves, while semantics should correspond to the real relation between the representation and what is represented. Still, even setting aside that I may simply be wrong about what speakers think, their intuitions can be overruled by strong theoretical concerns, and I don't want to place much emphasis on this reason against an articulated analysis. An

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27. In fact you get one from the context semantics of Appendix 2 by simply adding a location argument to 'rains( $t$ )' and adjusting the meaning of ' $it_i$ ' accordingly. Similarly, the time argument may be dropped. Clearly, from the semantic point of view, it does not matter whether time and location variables are in the syntax or not, as long as they are in the semantics. Note that on Stanley's preferred usage (cf. section 4), the theory is fully semantic only if both variables are in the syntax, and partly pragmatic otherwise.

articulated analysis that delivers the desired readings is on the whole acceptable.

My real concern is not really with the best analysis of (19) and sentences like it, but with the general phenomenon of context sensitivity in sentence meaning, even in case that sensitivity cannot be uniquely traced to particular syntactic constituents. Thus, I am concerned with the viability of the idea of unarticulated constituents, and therefore with the claim that it cannot be applied to ‘rains’ because of sentences like (19).

Why be concerned with unarticulated constituents? Part of the reason is that I find it extremely implausible that there is a fully articulated sentence, even if only in logical form, whenever a speaker successfully communicates a thought by linguistic means. This is one of Stanley’s theses. He spends section 2 of his 2002 on arguing that *prima facie* examples of thoughts communicated by means of non-sentential expressions are really examples of ellipsis, so that in each case there is a full sentence the speaker uses for expressing the thought, only that what he actually utters goes proxy for that sentence. I find some of Stanley’s examples convincing but others unconvincing. In general, I think it is not too rare that a speaker manages to get across a thought with poor linguistic means, falling far short of what would be needed to get the thought across to an audience less in tune with the speaker. And this happens even in cases where the speaker would need much hard work to produce an adequate, fully articulated sentence. Since I don’t have space to go into the matter in any detail, I’ll simply assume here that such things happen. That is, I’ll assume that pragmatic processes influence primary truth conditions, sometimes in compensation of poor linguistic articulation. This is what King and Stanley (2003:9) call ‘strong pragmatic effects’. Strong pragmatic effects thus include inferential processes that influence primary truth conditions, as well as the presence of unarticulated constituents, e.g. as in the context semantics of Appendix 2.

Now, if strong pragmatic effects occur, and if we accept two premises from Stanley, then the result is likely to be a failure of *ec*-compositionality. The first premise is that semantics is concerned with nothing else than context invariant meaning *and* the assignment of denotations to elements of the logical form, including indexicals (Stanley 2000:393-94), and the second that semantics is concerned with the primary assignment of truth conditions to a sentence, relative to a context of utterance (Stanley 2000:393-94). This does not go as far as the (Rad) thesis of section 3, according to which the (occasion) *meaning* of a sentence is the thought (proposition) it is used to express (since it stops short of conversational implicatures used for deriving secondary truth conditions). However, it goes far enough.

For *if* the occasion meaning of a sentence in a context of utterance is the primary truth condition of the utterance itself, and that results from combining standing part meanings with context dependent part meanings (like reference to indexicals), even though the sentence is too poor to fully articulate those truth conditions and might have been used for conveying a different thought even with the *same* part meanings, then we will have an instance of the schema of context shift failure (cf section 2). That is, the meanings of all the parts of a complex expression *e* will be the same in two different context  $c_1$  and  $c_2$ , the mode of combination will be the same, and still *e* will have a different meaning in

$c_1$  than in  $c_2$ . This is a violation of *ec*-compositionality for occasion meaning. It is not bound to happen, but it is likely that it will, given the three premises. We are almost back to Fodor's argument against compositionality of natural language.

What is needed to avoid this conclusion, if one believes in strong pragmatic effects, is a different view of the semantics/pragmatics distinction. I'll conclude with a few words about this. On my view, one major task of the general theory of language is to *explain* why linguistic communication succeeds so frequently, even when performed with new word combinations and between speakers with very little knowledge of each other and with very little help from the context. 'Pragmatics', in a wide sense, may be taken to stand for the general enterprise of understanding utterance content, both from the production side and from the interpretation side, for achieving such an explanation.

It is then, I think, a very plausible empirical *hypothesis* that a successful pragmatic theory, in this wide sense, will include as a proper part a *semantic* theory, i.e. a theory relating syntactic parts to entities in a standing, context independent way, where these entities can be objects, properties, relations, functions, truth conditions or yet something else, and including general principles for assigning some such entities to syntactically complex expressions, as depending on the mode of combination and on what is assigned to the parts. This will be a *semantic* theory provided it does have a uniform explanatory role within the wide pragmatic theory.

A pragmatic theory in the *narrow* sense will be roughly what fills the gap between the wide pragmatic theory and the semantic theory. That is, a narrow pragmatic theory will be concerned with those ingredients in—and factors determining—an utterance content that go beyond what is given by the semantics alone. It will be concerned with general features of communication, independent of any particular lexical or structural properties. It may be a Gricean account or a Relevance theoretic or Optimality theoretic account, or something yet further.

The present conception is closest to Stanley's first usage alternative, according to which semantics is concerned only with context independent meaning (but note that this includes the study of how occasion meaning depends on context). However, there is no assumption here that there must be something like a *semantic content*, in an intuitive sense of 'content', and for which semantics gives a full account. On the present conception, the semantics/pragmatics distinction is of a highly *theoretical* nature; a semantic value does not also have to belong a phenomenologically real layer of content of an utterance. A claim that something  $x$  is 'strictly and literally said', or 'literally expressed', as opposed to something  $y$  that is implied or implicated in one way or other, does have a clear sense to the extent that  $x$  and  $y$  are *both* communicated, and  $y$  by means of  $x$ , but in case  $x$  is not itself communicated, the sense is not so clear. It *may* mean that we achieve the simplest overall theory when accounting for  $x$  by semantic methods and for  $y$  by a combination of semantic and pragmatic methods. But then one runs the risk that 'said' and 'expressed' are simply misnomers.<sup>28</sup>

## Appendix 1

Assume that we have an  $e$ -compositional meaning function  $\mu:L \times C \rightarrow K$ , from expressions in a language  $L$  and contexts in a domain  $C$  to occasion meanings in a domain  $K$ . By functional abstraction over contexts and expressions, in that order, we arrive at a function  $\mu' = \lambda e ( \lambda c (\mu(e,c)) )$ . Applied to an expression  $e_i$  of  $L$ , we have

$$\mu'(e_i) = \lambda c (\mu(e,c))(e_i) = c(\mu(e_i,c))$$

by  $\lambda$ -conversion. Assume that  $c(\mu(e_i,c))$  is the standing meaning of  $e_i$ , and that for each  $e \in L$  we get the standing meaning of  $e$  from  $\mu$  this way. Then  $\mu':L \rightarrow M$  is a meaning function from  $L$  to a domain  $M$  of standing meanings that are functions from  $C$  to  $K$ .

We want to show that if  $\mu$  is  $e$ -compositional, then  $\mu'$  is compositional. We need to show that there exists a composition function for  $\mu'$ . By assumption there is one for  $\mu$ , i.e. there is a function  $g$  such that for any (non-atomic) expression  $e = (e_1, \dots, e_n)$  and any context  $c$ ,

$$(+) \quad \mu((e_1, \dots, e_n), c) = g(\mu(e_1, c), \dots, \mu(e_n, c), c).$$

Since (+) holds for arbitrary  $c$  we can abstract over contexts to get

$$(++) \quad c(\mu((e_1, \dots, e_n), c)) = c(g(\mu(e_1, c), \dots, \mu(e_n, c), c)).$$

Note that

$$(i) \quad c(\mu((e_1, \dots, e_n), c)) = \mu'((e_1, \dots, e_n))$$

Second, by  $\lambda$ -conversion it holds for each term ' $\mu(e_i, c)$ ' that

$$(ii) \quad \mu(e_i, c) = c'(\mu(e_i, c'))(c)$$

where  $c'(\mu(e_i, c'))$  is the standing meaning of  $e_i$ , i.e.

$$(iii) \quad \mu(e_i, c) = c'(\mu(e_i, c'))(c) = \mu'(e_i)(c)$$

Substituting in (++) according to (i), (ii) and (iii) we get

$$(iv) \quad \mu'((e_1, \dots, e_n)) = c(g(\mu'(e_1)(c), \dots, \mu'(e_n)(c), c))$$

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28. I owe much to comments by readers of the first draft. I am grateful to Emma Borg, Kathrin Glüer, Ernie Lepore, Per Martin-Löf, François Recanati and Jason Stanley. Ideas in the paper have been discussed in seminars at the departments of philosophy, linguistics and English at Stockholm University and the department of linguistics at Uppsala university. Many thanks to participants in those seminars, among others Maria Koptjevskaja-Tamm, Alan McMillion, Roussanka Loukanova, Claus Oetke, Dag Prawitz, Tor Sandqvist, Dag Westerståhl, and Åsa Wikforss.

The work has been financially supported by the The Bank of Sweden Tercentenary Foundation, for the project *Mening, Kommunikation, Förklaring*.

which is a form of (comp), with  $c(g(c))$  as the composition function for  $\mu'$ . Hence  $e$ -compositionality for occasion meaning implies compositionality for standing meaning. Since  $ec$ -compositionality implies  $e$ -compositionality it also implies compositionality.

The converse does not hold. To show this, let  $\mu$  be such that

$$\begin{aligned} \mu(e_1, c_1) &= \mu(e_2, c_1), \mu(e_1, c_2) \neq \mu(e_2, c_2) \\ \mu((e_1, e_2), c_1) &= \mu((e_2, e_2), c_1). \end{aligned}$$

Then

$$\mu'(e_1) = c(\mu(e_1, c')) \quad c(\mu(e_2, c')) = \mu'(e_2)$$

and hence there is no substitution failure for  $\mu'$ .  $\mu'$  is therefore compositional. But there is substitution failure for  $\mu$ , since

$$\mu(e_1, c_1) = \mu(e_2, c_1) \quad \text{but} \quad \mu((e_1, e_2), c_1) \neq \mu((e_2, e_2), c_1).$$

Hence compositionality for standing meaning does not imply  $e$ - or  $ec$ -compositionality for occasion meaning.<sup>29</sup>

*Note:* A context semantics need not take the standard form that every standing meaning is a function from contexts. For instance, assuming the the meaning of sentences are functions from contexts to truth values, and the meaning of singular terms are functions from contexts to objects, we have interrelated choices for the meaning of predicates and the composition function.

In the standard version, the composition function is as in the proof above, i.e.  $c(g(c))$ , built from functional application on occasion meanings and abstraction over contexts. The meanings of predicates are then functions from contexts to functions from objects to truth values.

The alternative is to take just functional application as the composition function for standing meanings, and let the meanings of predicates be functions from singular term meanings to sentence meanings. The net result for sentences is the same. On such a simpler approach, only expressions of the basic categories (usually terms and sentences) are of the standard form, i.e. functions from contexts to occasion meanings, whereas standing meanings of other types are functions from standing meanings. The context semantics in Appendix 2 is of this simplified kind.

## Appendix 2

I shall sketch a semantics for context sensitive expressions, whose distinctive feature is that object language quantifiers over context elements, such as ‘everytime’ or ‘everywhere’, whose effect is to reduce context sensitivity, are treated semantically by means of quantifying over the contexts themselves, rather than just over the corresponding *ele-*

29. These results were reported by Dag Westerståhl at the Stockholm-Rutgers conference on cognitive science, Stockholm June 2003, and the report is independently verified here.

*ments* of the contexts (time, location). We will then get different readings depending on which context elements are varied and which kept fixed.

Contexts are modelled as ordered  $n$ -tuples of context elements, as in Kaplan (1989) and as *indices* in Montague (1968, 1970). Unlike in Kaplan's and Montague's pragmatics, possible worlds are not included as context elements. What is included is anything that is contextually available as guiding communicative efforts. It is assumed that contexts are sufficiently well-defined so that certain projection functions can apply to them: the function  $T$  as applied to a context  $c$  yields the time of  $c$  as value,  $L$  the location of  $c$ , and  $S$  the speaker of  $c$ .

What I shall here call 'the meaning' of a sentence is a function from contexts to sets of assignment functions. As the truth definition will show, it is the function which maps a context on the set of assignments under which the sentence is true. As a concept of meaning, this is very meager, since it is not designed to treat intensional phenomena such modality or propositional attitudes. You can regard it either as a very poor notion of meaning, or as a very rich notion of extension, and in either case as in need of complementing for a full semantic theory. However, I shall also suggest a strengthened version, where the output of the meaning function are *structured* meanings.

Since this sketch is only intended to demonstrate the interpretive capacity of context binding, I shall try to keep everything else simple. The fragment will be minimal, and so will the syntax assumed. I shall not spell out the object language syntax more than what can be extracted from the semantic clauses. The theory is only supposed to handle the targeted phenomena of context sensitivity and the reduction of context sensitivity by binding.

#### *Object language vocabulary and syntax*

proper names: 'John', 'Elsa'

singular indexicals: 'I', 'me', 'you', 'he', 'him', 'she', 'her', 'it'

impersonal pronoun: 'it';

intransitive present tense verbs: 'eats', 'sings'

transitive present tense verbs: 'sees', 'loves', 'lights'

feature placing verbs: 'rains', 'snows'

common nouns: 'dog', 'book', 'cigarette'

logical particles: 'and', 'or', 'if, then', 'it is not the case that'

determiners: 'a', 'the', 'every'

adverbial quantifiers: 'every time', 'some time', 'everywhere', 'somewhere'

The syntax is given by simple phrase structure rules in the obvious combinations. Impersonal 'it' only combines with feature placing verbs, and *vice versa*.

However, the semantic meta-language will apply to a *regimented* version of the object language, with individual variables ( $x_1, x_2, \dots$ ) and argument places for all expressions except singular terms. This will be referred to as 'L'. The feature placing verbs are given a time argument, thus 'rains( $t$ )'. The relation between the regimented and the unregi-

mented version is intuitively clear, and I shall not provide translation rules.

I shall give a denotation to each element of the regimented object language, including variables, so that the form of the semantics conforms to standard statements of compositionality. Syntactic combination will in each case consist in an argument expression's filling a slot in a matrix expression. The corresponding semantic function, i.e. the composition function, is simply functional application. This is squarely in the Frege-Church-Montague tradition.

Finally, quantifier domain restriction will be implemented in the form of restrictions on assignments to variables. That is, in a contextually determined domain, variables will only be given values in the domain.

#### *Elements of the semantics*

'[...]'] will refer to the meaning function. In general, the meaning of a singular term will be a function from contexts to a function from assignment to objects. The meaning of an intransitive verb will be a function from such term meanings into formula meanings. Formula meanings will be functions from contexts to sets of assignments. And so on.

As usual, the lambda operator '...' will be used for functional abstraction. I shall not set out a special application operator, but simply let the lambda abstracts double as both singular terms and functional expressions, since this will not cause any harm in practice. There is a universe U of individuals, a universe C of contexts, and a universe V of assignments of values in U to variables in L.

The meta-language will contain the following variables and parameters:

- $a, a_1, \dots$  ranging over individuals in U,
- $c, c', c'', \dots, c_1, c_2, \dots$  ranging over contexts in C,
- $t, t', t'', \dots, t_1, t_2, \dots$  ranging over contexts in T(C),
- $f, f', f'', \dots, f_1, f_2, \dots$  ranging over assignments in V,
- $m_1, m_2, \dots$  ranging over meanings of formulas in L,
- $u, u_1, u_2, \dots, v, v_1, v_2, \dots$  ranging over meanings of singular terms in L,
- $b, b_1, b_2, \dots$  ranging over meanings of variables in L,
- $r, r_1, r_2, \dots$  ranging over meanings of feature placing predicates in L,
- $x, x_1, x_2, \dots$  ranging over variables in L,
- 'X', 'X<sub>1</sub>', 'X<sub>2</sub>' ... ranging over sets of context elements,
- 'i' and 'j' ranging over natural numbers.

There will be some special functions:

Sp( $c$ ) gives the speaker of context  $c$ , and Ad( $c$ ) the addressee of  $c$ , if any. T( $c$ ) is the time of  $c$ , and L( $c$ ) is the location of  $c$ . C( $S, t$ ) is the context determined by speaker S and time  $t$ .

TopMale <sub>$i$</sub> ( $c$ ) is a function giving the  $i$ -th most salient male of context  $c$ . Similarly, we have TopFemale <sub>$i$</sub> ( $c$ ) and TopN <sub>$i$</sub> ( $c$ ) for reference of unbound feminine and neuter pronouns.

D <sub>$i$</sub> ( $c$ ) gives the  $i$ -th most salient domain of assignments of context  $c$ .

Ind( $b$ ) takes the meaning of a variable as input and delivers the index of that variable

as output. Thus  $\text{Ind}([\text{'x}_1\text{'}])=1$ .

Comp takes a set of assignments into its complement in V.

$f \text{ f'}/\text{Ind}(b)$  holds iff assignments  $f$  and  $f'$  differ at most in what they assign to the variable with the index of  $b$ .  $c \text{ c'}/l+X$  holds iff contexts  $c$  and  $c'$  differ at most with respect to location and the contextual elements of  $X$  (i.e. differ at most with respect to location if  $X=$  ). Similarly,  $c \text{ c'}/t+X$  holds iff contexts  $c$  and  $c'$  differ at most with respect to time and the contextual elements of  $X$ .

The meta-linguistic counterparts to lexical elements of the regimented object language will be italicized.

### Semantic clauses

1.  $[\text{John}] = c( f(\text{John}))$   
 $[\text{Elsa}] = c( f(\text{Elsa}))$
2.  $[\text{I}] = c( f(\text{Sp}(c)))$  [same for 'me']  
 $[\text{you}] = c( f(\text{Ad}(c)))$   
 $[\text{he}] = c( f( i(\text{TopMale}_i(c))))$  [same for 'him']  
 $[\text{she}] = c( f( i(\text{TopFemale}_i(c))))$  [same for 'her']  
 $[\text{it}] = c( f( i(\text{TopN}_i(c))))$
3.  $[\text{it}_i] = c( r(r(c))(\text{T}(c)))$
4.  $[\text{eats}(\dots)] = u( c(\{f:\text{eats}((u(f))(c),c)\}))$   
 $[\text{sings}(\dots)] = u( c(\{f:\text{sings}((u(f))(c),c)\}))$
5.  $[\text{sees}(\dots,\dots)] = u( v( c(\{f:\text{sees}((u(f))(c),(v(f))(c),c)\}))$   
 $[\text{loves}(\dots,\dots)] = u( v( c(\{f:\text{loves}((u(f))(c),(v(f))(c),c)\}))$   
 $[\text{lights}(\dots,\dots)] = u( v( c(\{f:\text{lights}((u(f))(c),(v(f))(c),c)\}))$
6.  $[\text{rains}(\dots)] = c( t(\{f:\text{rains}(t,\text{L}(c))\}))$   
 $[\text{snows}(\dots)] = c( t(\{f:\text{snows}(t,\text{L}(c))\}))$
7.  $[\text{dog}(\dots)] = u( c(\{f:\text{dog}((u(f))(c),c)\}))$   
 $[\text{book}(\dots)] = u( c(\{f:\text{book}((u(f))(c),c)\}))$   
 $[\text{cigarette}(\dots)] = u( c(\{f:\text{cig}((u(f))(c),c)\}))$
8.  $[\dots\text{'and'}\dots] = m_i( m_j( c(m_i(c) \ m_j(c))))$   
 $[\dots\text{'or'}\dots] = m_i( m_j( c(m_i(c) \ m_j(c))))$   
 $[\text{'If'}\dots\text{'}, \text{then'}\dots] = m_i( m_j( c(\text{Comp}(m_i(c) \ m_j(c))))$   
 $[\text{'Not'}\dots] = m_i( c(\text{Comp}(m_i(c))))$

9.  $\llbracket \_ \rrbracket = c(f(f(\_)))$  [ranging over object language variables]
10.  $\llbracket a \rrbracket = b(m_1(m_2(c(i(\{f: f'(f' D_i(c) \& f f'/\text{Ind}(b) \& f'(m_1(c) m_2(c))\}))))))$
11.  $\llbracket \text{every} \rrbracket = b(m_1(m_2(c(i(\{f: f'((f' D_i(c) \& f f'/\text{Ind}(b) f'(Comp(m_1(c) m_2(c))\}))))))$
12.  $\llbracket \text{the} \rrbracket = b(m_1(m_2(c(i(\{f: f'(f' D_i(c) \& f f'/\text{Ind}(b) \& f'(m_1(c) m_2(c) \& f'((f' D_i(c) \& f f'/\text{Ind}(b) \& f''(m_1(c) (b(f''))(c')=(b(f''))(c'))\}))))))$
13.  $\llbracket \text{every time} \rrbracket = X(m(c(\{f: c'(c' c/t+X f' m(c'))\}))$   
 $\llbracket \text{some time} \rrbracket = X(m(c(\{f: c'(c' c/t+X \& f' m(c'))\}))$
14.  $\llbracket \text{everywhere} \rrbracket = X(m(c(\{f: c'(c' c/l+X f' m(c'))\}))$   
 $\llbracket \text{somewhere} \rrbracket = X(m(c(\{f: c'(c' c/l+X \& f' m(c'))\}))$
15.  $s$  is true as uttered by  $S$  at  $t$  iff  $\llbracket s \rrbracket(C(S,t))=V$
16.  $\{f:p\}=V$  iff  $p$   
provided ' $f$ ' does not occur free in what replaces ' $p$ '

### Applications

We shall see how this semantics works in three examples, 'it rains', 'Elsa sees the book', and the Stanley sentence (19), 'Every time John lights a cigarette, it rains'.

$$\begin{aligned}
(49) \llbracket \text{'it rains'} \rrbracket &= \llbracket \text{'it}_t \rrbracket(\llbracket \text{'rains (...)} \rrbracket) = \\
& r(c_1((r(c_1)(T(c_1)))[c(t(\{f: rains(t), L(c)\})])]) = \\
& c_1(c(t(\{f: rains(t), L(c)\})(T(c_1)))) \quad (\text{by } \_ \text{-conversion on } r) \\
& c_1(t(\{f: rains(t), L(c_1)\})(T(c_1))) = \\
& c_1(\{f: rains(T(c_1), L(c_1))\}) \quad (\text{by } \_ \text{-conversion on } c) \\
& c_1(\{f: rains(T(c_1), L(c_1))\}) \quad (\text{by } \_ \text{-conversion on } t)
\end{aligned}$$

With the truth definition clause 15, this gives us

$$\begin{aligned}
(50) \text{'it rains' is true as uttered by } S \text{ at } t \text{ iff} \\
(c_1(\{f: rains(T(c_1), L(c_1))\})(C(S,t))=V, \text{ iff} \\
\{f: rains(T(C(S,t), L(C(S,t)))\}=V \quad (\text{by } \_ \text{-conversion on } c_1)
\end{aligned}$$

With the additional axiom

$$17. \text{it } :s \text{ near } S \text{ at } t \text{ iff } \phi(T(C(S,t), L(C(S,t)))^{30}$$

---

30. Same oversimplification as in section 3. See note 16.

we get

(51) 'it rains' is true as uttered by  $S$  at  $t$  iff  $\{f: \text{it rains near } S \text{ at } t\} = V$

and finally, by axiom schema 16,

(52) 'it rains' is true as uttered by  $S$  at  $t$  iff it rains near  $S$  at  $t$

that is, Davidson's (15).

Next, we shall look at contextual quantifier domain restriction in 'Elsa sees the book'. We have

(53)  $[\text{'Elsa sees the book'}] = [ \text{'the } x_1 \text{ (book } x_1 \text{) (sees (Elsa, } x_1 \text{))} ] =$   
 $[ \text{'the'} ] ([x_1]) [ \text{'book'} ] ([x_1]) [ \text{'sees'} ] ([x_1]) [ \text{'Elsa'} ]$

Taking the parts separately, we have

(54)  $[\text{'the'}] ([x_1]) =$   
 $b( m_1( m_2( c( \{f: f'(f' D_i(c) \& f' f'/\text{Ind}(b) \& f' (m_1(c) m_2(c)) \&$   
 $f''(f' D_i(c) \& f' f''/\text{Ind}(b) \& f'' (m_1(c))$   
 $(b(f''))(c') = (b(f''))(c') \} ) ) ) ) ([x_1]) =$   
 $m_1( m_2( c( \{f: f'(f' D_1(c) \& f' f'/\text{Ind}([x_1]) \& f' (m_1(c) m_2(c)) \&$   
 $f''(f'' D_1(c) \& f' f''/\text{Ind}([x_1]) \& f'' (m_1(c))$   
 $([x_1](f''))(c') = ([x_1](f''))(c') \} ) ) ) =$   
 $m_1( m_2( c( \{f: f'(f' D_1(c) \& f' f'/1 \& f' (m_1(c') m_2(c')) \&$   
 $f''(f'' D_1(c) \& f' f''/1 \& f'' (m_1(c')) f''(x_1) = f'(x_1) \} ) ) )$

after  $-$ conversion on  $b$  and  $i$  and applying axiom 9.

(55)  $[\text{'book'}] ([x_1]) = u( c_2( \{f: \text{book}((u(f))(c_2), c_2) \} ) ) ([x_1]) =$   
 $c_2( \{f: \text{book}([x_1](f))(c_2), c_2) \} ) =$  (with  $-$ conversion on  $u$ )  
 $c_2( \{f: \text{book}(f(x_1), c_2) \} )$  (applying axiom 9)

(56)  $([\text{'sees'}] ([x_1]) ([\text{'Elsa'}])) =$   
 $( u( v( c_3( \{f: \text{sees}((u(f))(c_3), (v(f))(c_3), c_3) \} ) ) ) ([x_1]) ([\text{'Elsa'}]) =$   
 $( v( c_3( \{f: \text{sees}([x_1](f))(c_3), (v(f))(c_3), c_3) \} ) ) ) ([x_1]) =$   
 $c_3( \{f: \text{sees}([x_1](f))(c_3), ([x_1](f))(c_3), c_3) \} ) =$   
 $c_3( \{f: \text{sees}(Elsa, f(x_1), c_3) \} )$

after  $-$ conversion on  $u$  and  $v$  and applying (axioms 1 and 9).

Applying (54) to (55), with  $-$ conversion on  $m_1$  and  $c_2$ , we get

$$(57) \quad m_2( c(\{f: f'(f' D_1(c) \& f f'/1 \& f' (\{f:book(f('x_1'),c)\ m_2(c) \& f''(f'' D_1(c) \& f f''/1 \& f'' \{f:book(f('x_1'),c)\ f''('x_1')=f'('x_1'))\}))\})) =$$

$$m_2( c(\{f: f'(f' D_1(c) \& f f'/1 \& book(f('x_1'),c) \& f' m_2(c) \& f''(f'' D_1(c) \& f f''/1 \& book(f''('x_1'),c) f''('x_1')=f'('x_1'))\}))$$

Applying (57) to (56), with  $\lambda$ -conversion on  $m_2$  and  $c_3$ , we get

$$(58) \quad c(\{f: f'(f' D_1(c) \& f f'/1 \& book(f('x_1'),c) \& sees(Elsa,f('x_1'),c) \& f''((f'' D_1(c) \& f f''/1 \& book(f''('x_1'),c)) f''('x_1')=f'('x_1'))\}))$$

With some obvious axioms relating the existence of assignments to the existence of objects, from (58) we get, informally,

$$(59) \quad c(\{f: \text{there is an object } a \text{ in the contextually most salient domain of } c \text{ such that } a \text{ is a book in } c \text{ and Elsa sees } a \text{ in } c \text{ and any object } b \text{ in the contextually most salient domain of } c \text{ that is a book in } c \text{ is identical with } a\})$$

which, with some overkill, yields the context-relative Russellian interpretation.

Now to (19). With steps very similar to those above we get

$$(60) \quad c(\{f: f'(f' D_1(c) \& f f'/1 \& cig(f('x_1'),c) \& lights(John,f('x_1'),c)\}))$$

as an interpretation of

$$(61) \quad \text{John lights a cigarette.}$$

On this interpretation, John lights in  $c$  something that is a cigarette in  $c$ . That is, the lighting takes place at the location of  $c$ . However, there is also the non-locating reading, according to which John lights a cigarette at some location or other. We get that by applying the *somewhere* operation in the meta-language. There is no quantifier domain restriction of the intended interpretation ('a cigarette'):

$$(62) \quad [\textit{somewhere}]( c(\{f: f'(f f'/1 \& cig(f('x_1'),c) \& lights(John,f('x_1'),c)\})) =$$

$$X( c(\{f: c'(c' c/l+X \& f' ( c(\{f: f'(f f'/1 \& cig(f('x_1'),c) \& lights(John,f('x_1'),c)\})(c')\}))\})) =$$

$$X( c(\{f: c'(c' c/l+X \& f'(f f'/1 \& cig(f('x_1'),c) \& lights(John,f('x_1'),c)\}))\}))$$

Since we are interested here only in the variation of location, we set  $X = \lambda x. x$ . We then get

$$(63) \quad c(\{f: c'(c' c/l \& f'(f f'/1 \& cig(f('x_1'),c) \& lights(John,f('x_1'),c)\}))\})$$

as the non-locating reading of (61). Similarly, we assume with Recanati that there is a non-locating reading of ‘it rains’:

$$(64) \quad c_1(\{f: c'(c' \ c_1/l \ \& \ rains(T(c'),L(c')))\})$$

and since  $c' \ c/l$  we have  $T(c')= T(c_1)$ , so (64) is the same as

$$(65) \quad c_1(\{f: c'(c' \ c_1/l \ \& \ rains(T(c_1),L(c')))\}).$$

Now we shall apply the ‘if, then’ clause to the respective meanings of (3) and (61), and then apply the ‘every time’ clause to the results. We shall consider two applications of [every time], depending on whether  $X=$  or  $X=\{l\}$ , i.e. depending on whether it is only time, or time plus location that is varied. Then, since there are locating and non-locating readings of antecedent and consequent, we have three independent parameters, giving us the possibility of eight readings. If we just write ‘here’ for the contextually salient location, and ‘there’ for the bound location variable, we have, informally:

- (a) Every time John lights a cigarette here, it rains then here
- (b) Every time John lights a cigarette here, it rains then somewhere
- (c) Every time John lights a cigarette somewhere, it rains then here
- (d) Every time John lights a cigarette somewhere, it rains then somewhere
- (e) Every time and place John lights a cigarette, it rains then there
- (f) Every time and place John lights a cigarette, it rains then somewhere
- (g) Every time and place John lights a cigarette somewhere, it rains then there
- (h) Every time and place John lights a cigarette somewhere, it rains then somewhere

However, (d) is equivalent with both (f) and (h). The last but one reading, (g) (where ‘there’ is anaphoric on ‘place’, not on ‘somewhere’), is odd, and should maybe be filtered out. It says that every time John lights a cigarette somewhere, it rains everywhere. What remains, then, is five or six admissible readings of (19).

Of these readings, (c) is what Stanley claims the unarticulated constituent analysis can deliver, and (e) is what he claims that analysis definitively cannot deliver. I shall therefore spell out the formal rendering of that reading. First, we have

$$(66) \quad ([\text{‘If ...’, ‘then’ ...}](c_1(\{f: rains(T(c_1),L(c_1))\}))(c_2(\{f: f'(f' \ D_1(c_2) \ \& \ f \ f'/1 \ \& \ cig(f('x_1'),c_2) \ \& \ lights(John,f('x_1'),c_2)\})) = \\ c(\text{Comp}(\{f: f'(f' \ D_1(c) \ \& \ f \ f'/1 \ \& \ cig(f('x_1'),c) \ \& \ lights(John,f('x_1'),c)\} \ \{f: rains(T(c),L(c))\}))$$

after  $\lambda$ -conversion on  $m_1, m_2, c_1$  and  $c_2$ . Then, applying *every time*, with  $X=\{l\}$ , we get,

(67)  $\llbracket \text{every time} \rrbracket(\{l\})(\{66\}) =$

$$c_1(\{f: c'(c' \ c_1/t+l \ f \ \text{Comp}(\{f: f'(f' \ D_1(c') \ \& \ f \ f'/1 \ \& \ \text{cig}(f'(x_1'), c') \ \& \ \text{lights}(\text{John}, f'(x_1'), c') \ \{f: \text{rains}(\text{T}(c'), \text{L}(c'))\})\}))$$

after  $\lambda$ -conversion on  $m$  and  $c$ ,

Applying the truth definition and informally translating back, replacing talk of assignments with talk of objects, we get

(68) ‘Every time John lights a cigarette, it rains’<sub>(e)</sub> is true as uttered by  $S$  at  $t_0$  iff for any context  $c'$  differing from  $C(S, t_0)$  at most in time and location, it holds that if there is an object  $a$  which is a cigarette in  $c'$  such that John lights  $a$  in  $c'$ , then it rains at the time of  $c'$  at the location of  $c'$ .

which is the desired reading.

#### Comments

The semantics offered is inadequate insofar as it doesn’t provide for the binding of pronouns, but lets that be handled by informal translation of pronouns into bound variables of the regimented object language. Moreover, even with this translation it doesn’t deliver the donkey anaphora readings of some sentences that belong to the fragment (e.g. ‘if John sees a dog, it eats’). In order to extend the theory to account for this we would need a dynamic machinery. For instance, one could use the PFO principle of variable binding and let the context variables  $c$  contain information about variables that have been quantified.<sup>31</sup> This would then amount to a dynamic setting in which contexts get updated after each clause of a sentence. In this respect the semantic would resemble other dynamic frameworks, such as DRT, or DPL.<sup>32</sup>

Another deficiency is that the semantics proposed only offers unstructured entities, functions from contexts to sets, as meanings, whereas there are reason for thinking that structured meanings are required (cf. Pagin 2003). However, this can easily be achieved. Instead of letting the function from meanings of parts to meaning of whole be function application, let it be pair formation. Thus, the meaning of ‘it rains’ would be simply  $\llbracket \text{‘it’}_i \rrbracket, \llbracket \text{‘rains}(\dots)\text{’} \rrbracket$ . Meanings of complex expressions will then be tree structures: pairs of pairs etc, where the leaves are the meanings of the simple expressions. The old unstructured meanings will then be returned by means of an evaluation function  $\text{Eval}$ . For each meaning  $w$  of a simple expression,  $\text{Eval}(w) = w$ , and for any well-formed meaning pair  $\langle w_1, w_2 \rangle$ , it will hold that

$$\text{Eval}(\langle w_1, w_2 \rangle) = (\text{Eval}(w_1))(\text{Eval}(w_2)),$$

31. See Pagin and Westerståhl 1993. Something like this would also be needed for an adequate treatment of sentences like (39) and (41).

32. See Kamp and Reyle 1993, and Groenedijk and Stokhof 1991, respectively.

i.e. the old function application.

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