FOR ROUTLEDGE SEMANTICS HANDBOOK, NICK RIEMER (ED.)

Compositionality

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Abstract

How do people glean meaning from language? A Principle of Compositionality is generally understood to entail that the meaning of every expression in a language must be a function of the meaning of its immediate constituents and the syntactic rule used to combine them. This paper explores perspectives that range from acceptance of the principle as a truism, to rejection of the principle as false. Controversy has arisen based on the role of extra-constituent linguistic meaning (idioms; certain cases of paradigmatic morphology; constructional meanings; intonation), and context (e.g., metonymy; the resolution of ambiguity and vagueness).

1. Introduction

How do people glean meaning from language? A Principle of Compositionality is generally understood to entail that the meaning of every expression in a language must be a function of the meaning of its immediate constituents and the syntactic rule used to combine them. Frege (1982) is often credited with the principle that natural languages are compositional, although no explicit statement has been found in his writings (and it is not entirely clear that he even embraced the idea) (Pelletier 2001; section 3). Partee (1984: 153) states the Principle of Compositionality thus: "The meaning of an expression is a function of the meanings of its parts and of the way they are syntactically combined" (cf. also Dowty 2006: 3). Likewise, Cann (1993:4) notes, "The meaning of an expression is a monotonic function of the meaning of its parts and the way they are put together."

Montague (1970) stated the condition that there must be a homomorphism—a structure preserving mapping--from syntax to semantics. That is, the meaning of the whole is taken to result from applying the meanings of the immediate constituents via a semantic operation that corresponds directly to the relevant syntactic operation (Dowty 1979; 2006). We can represent the claim as follows in (1), where σ is understood as a function that maps expressions to meaning.

1. $\sigma(x +_{\text{syntactic-composition}} y) = \sigma(x) +_{\text{semantic-composition}} \sigma(y)$ (Goldberg 1995: 13)

Dowty provides the following example for the phrase, *Fido barks* (2006: 11):

2. meaning-of (Syntactic-Combination-of(Fido, barks)) = Semantic-Function-of(meaning-of (Fido), meaning-of (barks))

Although what is intended by "meaning" and "syntactic combination" are not universally agreed upon, it is clear that the principle of compositionality espouses a bottom-up, or building block model of meaning: the meaning of the whole is built from the meanings of the parts. The principle is typically assumed to further imply that the syntactic composition ("$+_{\text{syntactic-composition}}$") must be straightforwardly related to semantic composition ("$+_{\text{semantic-composition}}$") (although see section 2 for more complicated ways in

which syntax and semantics can be related). Because the principles of semantic combination are so widely assumed to be transparent, it is easy to overlook the fact that there are any substantive principles at all. Carter 1976 observed, "In a strictly compositional language, all analytic content comes from the lexicon, and no semantic rules...are needed to account…[for] adding meaning to the sentence which is not directly contributed by some lexeme of the sentence." Even Jackendoff (1990) who has recently explicitly challenged the Principle of Compositionality (Culicover and Jackendoff 2006), had said, "It is widely assumed, and I will take for granted, that the basic units out of which a sentential concept is constructed are the concepts expressed by the words in the sentence, that is, lexical concepts" (Jackendoff 1990:9). Compositionality implies that words are the key conveyers of meaning, and there is much to be said in favor of this idea. *Hypochondria*, *football*, *exam, bodice*, *lemonade*, *anaconda, wedding,* and *death* certainly evoke particular meanings, however we are to construe the notion of "meaning."

Before discussing various problematic issues that Compositionality faces, we first motivate why the principle has been so compelling to so many. The reason seems to be that Compositionality is widely assumed to follow from the fact that we can assign meanings to new (i.e., productively created) sentences (Dowty 2006: 3; Groenendijk & Stokhof 2004). That is, it is assumed that people would be unable to glean meaning from new combinations of familiar words unless there exist predictable ways in which meaning is derived from the words and the way those words are combined. Paraphrasing the reasoning of Dowty (2006: 3-4) for example:

> ★ **Standard argument in favor of compositionality** (based on Dowty 2006: 3-4)
> a. Speakers produce and listeners parse sentences that they have never spoken or heard before.
> b. Speakers and listeners generally agree upon the meanings of sentences.
> c. Since there exists an infinite number of sentences, they cannot all be memorized.
> d. There must be some procedure for determining meaning.
> e. Sentences are generated by some grammar of the language.
> f. The procedure for interpreting sentences must be determined, in some way or other, by the syntactic structures generated by the grammar together with the words.

The Principle of Compositionality is widely acknowledged to be a foundational claim in formal semantics (Groenendijk & Stokhof 2004; Partee, ter Meulen, & Wall 1990), which is compositional by design. Insofar as natural languages lend themselves to description within a formal language, they too should be compositional. And yet, there are many ways in which natural languages depart from formal languages. Several of these divergences present challenges to strict claims of compositionality.

2. Challenges to compositionality: Critical issues and topics

2. 1. Idioms

If we define idioms to be phrasal patterns in which the meaning of the whole is more than a simple combination of the meanings of the parts, then idioms are, by definition,

noncompositional. Expressions such as those in (3), for example, convey something above and beyond what the words mean:

3.a. *Get hitched* (≈ "become married")
b. *Keep a straight face* (≈ "prevent oneself from laughing")
d. *Stay the course* (≈ "continue doing what has been done despite difficulties")

In order to preserve compositionality, one could deny that such idioms have internal constituent structure, and instead assign the meaning directly to the whole (Hodges 2012), but in fact there is ample evidence that idioms do have constituent structure. For example, the verbs involved can typically be inflected for tense and agreement, and in many cases idioms are *deformable* in that they allow, for example, modification, passivization or conjunction. It has been observed that deformable idioms are typically 'compositional' in the sense that the constituents that are semantically modified or appear in non-canonical positions are interpretable (Nunberg, Wasow and Sag 1994; but cf. Fellbaum 2011). *To pull strings* is an example of a deformable idiom, since it can passivize and *strings* may be modified as in (4):

4. A lot of strings were pulled to get him the part in the movie.

The quantification of *strings* indicates that *strings* is interpreted to mean roughly "connections," so that the meaning of the idiom in this case can be assigned at least in part to the interpretation of the words that make it up. In order to preserve compositionality, then, we might adopt the position that each of the words of a deformable idiom is assigned a part of the meaning of the whole. But of course *strings* only means "connections" when it is pluralized and is the theme argument of *pull*, (and *pull* means "make use of" but only in the context of *strings)*. The reliance on context for determining the intended senses of words within idioms appears to violate Compositionality; e.g., the meaning of *strings* depends on its linguistic context, not simply on the constituent immediately dominating it (*a lot of strings*).

As noted above, the primary argument in favor of Compositionality relies on the existence of linguistic creativity: since we can produce and understand sentences we have never heard before, meanings must be arrived at compositionally. Although the Principle of Compositionality, as generally understood and as stated at the outset, is a statement about *all* of language, the possibility of creativity does not demand that all of language be strictly compositional. If we weaken Compositionality to the claim that *some* of language is compositional, idioms need not present a problem. We can allow idioms to be non-compositional, and recognize that they may not be interpreted correctly if heard for the first time.

2.2. Discontinuous semantic units

The Principle of Compositionality does not specify whether it applies to the surface structure or the "underlying" structure of sentences. Pelletier (1994) points out certain cases of non-lexical ambiguity e.g., *Every linguist knows two languages*, could be viewed as preserving compositionality if two distinct underlying structures are posited. In fact, the existence of semantic units that appear discontinuously in the surface string requires that Compositionality must hold of some level other than surface structure. For example,

free word order languages allow meaningful semantic units to correspond to discontinuous syntactic phrases (e.g., "the woman's dog" in 5); and even fixed word order languages like English occasionally allow discontinuous semantic units (6):

5. Walpiri (Austin and Bresnan 1996):

Kupuju-lu	*kaparla-nha*	yanga-lkin	*warirra-ku-nha*
Child-erg	dog-acc	chase-pres	woman-dat-acc

"The child chased the woman's dog."

6. *The man* walked across the tightrope *with a monkey on his shoulders.*

The need for Compositionality to apply to some sort of underlying structure raises the issue of just how complex and distinct from surface structure the underlying structure is allowed to be. Without limits, just about any meaning could be attributed to any overt linguistic string (Janssen 1986). Moreover, there is a risk of circularity if we assume that speakers know the meanings of new sentences because of the way those sentences are put together, and yet we also assume that the way sentences are put together depends on the meanings of the sentences.

7. Circularity in appealing to underlying structure to retain Compositionality:
a. The agreed-upon meaning of a sentence is determined by the meanings of the words and the way those words are put together underlyingly.
b. The way the words of a sentence are put together underlyingly is determined by the agreed-upon meaning of the sentence.

What would be needed in order to escape the circularity is a further assumption that speakers are able to "read off" the underlying structure(s) of a sentence on the basis of the sentence's surface structure. But as we will see in section 3, sentences' surface structure is generally quite underdetermined and/or ambiguous.

2. 3. Aspects of Morphology

It is unclear whether the Principle of Compositionality is intended to apply within the word level, but the same argument made in ★ would seem to apply equally well to productive morphology. If speakers can create new words they have not witnessed before, and the meanings of those words is agreed upon by other speakers, the meanings of new words would seem to need to be derivable from the component parts and the way those parts are put together. However, Gurevich (2006: section 3.2) provides a compelling case of productive yet noncompositional morphology in Georgian, a language notorious for its complex morphology. Consider her examples:

Pre-verb	**Agree-ment**	**Version**	**ROOT**	**Thematic suffix**	**Screeve**	**Agree-ment**

1. you draw				*xat'*	*av*		
2. you will draw	*da*			*xat'*	*av*		
3. he was drawing				*xat'*	*av*	*di*	
4. if you would draw	*da*			*xat'*	*av*	*di*	
5. you drew	*da*			*xat'*		*e*	
6. you should draw	*da*			*xat'*		*o*	
7. you have drawn	*da*	*g*	*i*	*xat'*	*av*		*s*
8. you should have drawn	*da*	*g*	*e*	*xat'*		*a*	

Table 1: Georgian morphological paradigm based on Gurevich (2006: section 3.2)

Notice that based on the interpretations in 1 and 2 of Table 1, it would seem that *–av* is a second person subject agreement marker, and that *da-* is a future tense marker. However, we find the same form, *–av,* followed by *–di* used in a sentence with third person subject agreement in 3. One might hypothesize that *–avdi* is interpreted as third person, but in 4 we see the same suffix interpreted with a second person subject. Moreover, in 5, we see a second person interpretation assigned to a combination of a preverb *–da* together with a new suffix *–e*. Gurevich (2006) ultimately makes sense of this complex Georgian morphology by appealing to morphological templates that provide top-down interpretations. There simply is no compositional way to assign consistent meanings to the individual morphemes in Table 1. The interpretation of individual morphemes relies on the appearance of other morphemes in a non-monotonic (non additive) way. Thus we see that morphemes do not necessarily combine in a compositional way, even in a highly agglutinating language like Georgian.

The issue in morphology is a general one with the majority of morphologists arguing in favor of a templatic or *realization based* approach, as opposed to a compositional item & arrangement view (e.g., Ackerman and Nikolaeva 2004; Blevins, 2001; Aronoff, 1983; Booij, 2010). But if Compositionality does not apply at the word level, it is not clear why it must apply at the sentence level. In both cases, new forms can be created and are readily interpreted.

2.4. Argument Structure Constructions

Recall that the semantics associated with syntactic combination is widely assumed to be straightforward and direct. That is, the syntax should directly determine which argument is where in the sentence (e.g., an agent is subject in an active sentence, but in an adjunct *by*-phrase in a passive), but it is typically assumed that the contentful relational meaning comes from the specifications of the main verb. It is the main verb, for example, that determines that there is an agent; more generally, the main verb is assumed to determine

who did what to whom. Almost any traditional grammar book, or beginning logic or linguistics class will likely begin a discussion of sentence types with a classification of verbs according to how many arguments they "take." It is generally taken for granted, for example that *sneeze* is intransitive, *kick* is transitive, and *give* requires an agent, a theme, and recipient arguments. In this way, basic sentence patterns of a language are believed to be determined by syntactic and semantic information specified by the main verb. For example, the sentence pattern in (8) appears to be due to the specifications of *put:*

8. Pat put the ball on the table.

That is, *put* is a verb that requires an agent, a theme and a location, and it is *put*'s meaning that determines that the agent "puts" the theme on or in a location (see chapter 25, Participant roles).

But if argument structure is *always* projected exclusively from the main verb's semantics, we would need special verb senses for each of the verbs in the expressions in (9) (e.g. Goldberg 1995, 2006, Jackendoff 2002):

9. a. "he was drinking the heart right out of a fine spring afternoon." (James Crumley, The Last Good Kiss [1978])
   b. "The people of this small town […] have been unable to pray Mrs. Smith's two little boys home again." (Mark Turner, personal communication)
   c. "his thousands of travelling fans […] had roared him into the Thomas and Mack Center ring." (www.topix.net/wire/world-soccer/manchester-united)
   d. "She tried to avoid blinking the tears onto her cheeks." (Anne Tyler, *Dinner at the Homesick Restaurant* [1992])
   e. "Demi Moore thinks this will Halle Berry her back to the B List." (personal communication 2007)
   g. "I actually had a moth go up my nose once. I […] coughed him out of my mouth." (bikeforums.net/archive/index.php/t-292132)

That is, we would need a sense of *drink* that meant roughly "to spend time by drinking"; a special sense of *pray* "to cause to move by praying," a special sense of *roar* that entails motion and so on. These senses are implausible in that one doesn't find languages that devote unique stems to these meanings. For example, it is unlikely that one would find a word *kamo*, meaning "to cause to move by coughing" because this is not a situation that is likely to occur regularly enough to warrant a lexical meaning (Goldberg 2010).

In order to avoid such implausible verb senses, it has been proposed that argument structure patterns are associated with abstract meanings independently of the verbs that appear in them. On this view, verbs can occasionally combine with argument structure constructions on the fly to create novel sentences like those in (9). Examples of such *argument structure constructions* are given in Table 2.

Table 2: English Argument Structure Constructions (Goldberg 1995)

Ditransitive: (Subj) V Obj1 Obj2	X CAUSES Y to RECEIVE Z

Caused-Motion: (Subj) V Obj Oblique_{path}	X CAUSES Y to MOVE Z
Resultative: (Subj) V Obj Pred	X CAUSES Y to BECOME Z
Transitive: (Subj) V Obj	X ACTS on Y; X EXPERIENCES Y
Removal: (Subj) V Obj Oblique_{source}	X CAUSES Y to MOVE from Z
Way construction: (Subj_i) V [poss_i *way*] Oblique_{path}	X CREATES PATH & MOVES Z_{path}

There exists theoretical and experimental evidence in support of argument structure constructions. Theoretical arguments have typically emphasized the ad hoc and implausible nature of certain verb senses that would otherwise be required, as just mentioned (see Goldberg 1995, 2006, to appear for further arguments). Other work has noted that learners use the semantics associated with syntactic patterns in order to figure out what new verbs mean (Fisher 1996, Gillette, Gleitman, Gleitman and Lederer 1998, Landau and Gleitman 1985); this "syntactic bootstrapping" process presupposes the idea that the syntactic patterns are associated with meanings independently of the main verb. More recent work based on a sorting paradigm (Bencini & Goldberg 2000), off-line comprehension (Kaschak and Glenberg 1997; Goldwater and Markman 2009; Kako 2006), on-line priming (Johnson & Goldberg 2012), and neural representations (Allen et al. 2012) provides further evidence that argument structure patterns are associated with contentful semantics. It is possible to posit multiple senses for each verb, but in order to determine which sense is involved, the comprehender must attend to the phrasal array of grammatical relations. That is, even if one did wish to posit a special sense of *drink*, for example, that meant "to spend time drinking" in order to account for (9a), it is clear that that sense could only be identified by the comprehender by observing the complement array. Therefore, at least from a comprehension point of view, the pairing of argument structure patterns with meanings must be primary. As Goldberg (1995) points out, it is possible to preserve Compositionality for these cases by recognizing that the syntactic means of combination can be paired with richer semantics such as the meanings suggested in Table 2. Nothing rules this out, other than an assumption that the rules of composition must be trivial. Montague (1970), Gazdar et al. (1985), and Jacobson (2002) allow for multiple rules of composition that could in principle be richer than is often assumed.

2.5. Intonation

Intonation would seem to provide part of what we generally think of as the "meaning" of an utterance. The meaning of a sentence with default intonation in (10) is not the same as the same sentence with question intonation (11), sarcastic intonation (12), or sentence focus intonation (13) as these are all felicitous in distinct contexts.

10. Sam CALLED again.
11. Sam called AGAIN? (question intonation)
12. Sure, the President called for you. (sarcastic intonation)
13. SAM called again. (sentence focus, possible answer to "what happened?")

If intonation is incorporated into what is intended by "syntax" in claims about Compositionality, these sorts of distinctions could be accounted for. Alternatively,

intonation could be included as part of "context," which clearly plays a role in the determination of interpretations.

3. Context

Oddly enough, given that he is often credited for the Principle of Compositionality, Frege is the author of a distinct Principle of Contextuality. The Principle of Contextuality requires that the meaning of each part relies on the meaning of the whole: "Only in the context of a sentence does a word stand for anything" (Frege 1884 p. xxii; cf. also Wittgenstein 1921). Insofar as Compositionality requires that word meanings exist in isolation, and Contextuality asserts that they do not, the two principles appear to contradict one another (Janssen 1986; 1997; Pelletier 2001; Filip 2012). The Principle of Contextuality argues that context is used in the full interpretation of utterances, and there are many ways in which this clearly holds true.

3.1. Quantifiers

As is widely recognized, the interpretation of quantifiers often relies on context (Westerstahl 1985). For example, the quantifiers in the following examples do not refer to *all* entities, but instead refer to some contextually determined set of entities:

14.a. They fixed <u>all the roads</u>. *(*= all the roads that need to be fixed*)*
b. When it snows in Aspen, <u>everyone</u> is happy. (= everyone in Aspen)
c. <u>No one</u> is here. (= no one other than the speaker; or no one who the speaker wished to see)

That is, the sentence in (14b) implies that the city fixed all the roads that needed fixing, not all the roads in the universe nor even all the roads within city limits. More specifically, *all the roads* is not interpreted compositionally, but requires appeal specifically to the verb, *fixed*, which is a part of the sentence, but not part of the constituent *all the roads*. The sentence in (14b) is likely to mean that everyone *in Aspen* is happy, although, depending on the context, it could mean everyone who is looking forward to the X-games (which are held in Aspen) is happy, or that everyone in a particular family who is planning a ski trip is happy. While the meaning is generally agreed upon in context, the quantifiers themselves do not determine their universe of discourse.

In order to allow for facts such as these, the compositional meaning of a sentence must be viewed as partially underspecified. For example, quantifiers may contain an open variable for the domain of discourse. This variable must be fixed before a sentence can be fully interpreted, but it may depend on context. This then requires a distinction between "meaning" and "interpretation." Similarly, the existence of ellipsis and deixis also require that the meaning that is determined compositionally must be underspecified allowing certain aspects of interpretation to be filled in by context (see chapter 12, Contextual adjustment of meaning).

3.2. Ellipsis, Deixis

Fodor (2001) argues that language is not compositional on the basis of definite descriptions that are typically interpreted in context-sensitive ways (cf. also Janssen

1983). E.g., *He saw the dog* does not entail that he saw the one and only one dog existing in the universe, but rather that he saw the particular dog that is assumed to be identifiable to the listener in a given context. Likewise, (15) can refer to Queen Beatrix or Queen Wilhelmina, depending on when the sentence was uttered:

15.The Queen of Holland is married to Prince Claus. (Janssen 1983: 3)

One could conceivably stipulate that the time of utterance is somehow syntactically represented in each utterance, but we would have to also include the place being discussed or the place of speaking (e.g., *of Holland* goes unmentioned in 16), and potentially all of the speaker's and listener's common ground (e.g. if an epithet is used as in 17).

16. The Queen is married to Prince Claus.

17. You-know-who is in jail.

This would seem to lead to a *reductio ad absurdum*, as language is rife with ellipsis and deictic references. "Either the content of the thought is different from the content of the sentence that expresses it, or the sentence isn't compositional. I take it that the first disjunct is preposterous; so I take it that the second disjunct must be true (Fodor 2001: 12)." Those who *do* grant a distinction between "meaning" and "interpretation" (the latter equivalent to Fodor's "thought"), not finding the distinction "preposterous," may instead allow an underspecified level of compositional meaning (Partee 1995); interpretation or "thought" then would require the combination of meaning and context, including the background knowledge of speaker and listener. We return to examine this proposal more fully in section 4.

3.3 Polysemy

Words that are used frequently tend to have more than one related sense because old words often get extended for use in new contexts (see X chapter on Polysemy). Initially, these extended senses are created on the fly, but they often become conventionalized senses over time. Polysemous senses often center around a rich, prototypical (or stereotypical) sense, with extensions being based on some attribute of the prototypical sense (Lakoff 1987; see X chapter on prototypes). For example, prototypically, *home* evokes a house where a family unit lives and sleeps, where children grow into adulthood, where one feels comfortable and a sense of belonging. Yet it can be used for many of these aspects in isolation from the others (Fillmore 1992):

18. HOME

a.138 Main Street is Aliza's and Zach's home.	a. House, where one grows up, lives with one's family, feels comfortable and belongs
b. She owns 14 homes.	b. House
c. She went home to her dorm room.	c. Place where one lives and sleeps
d. She traveled home to see her family.	d. Place where one grows up
e.She's at home in the mountains.	e. Place where one feels a sense of belonging

Which sense of a word is intended typically depends on the linguistic and non-linguistic context (Piantadosi, Tily, & Gibson 2012). That is, the meanings of words often cannot be determined in isolation and then combined as one would combine building blocks to arrive at the meaning of a whole. Information beyond the immediate constituent is used in order to arrive at the meanings of words, and there are not always any linguistic cues about the required interpretation. In addition, we often use a word or phrase to appeal to a conceptually related but distinct meaning via a process of *metonymy* (Nunberg 1994). For example,

19. The tummy tuck in 3A is asking for some chocolate.
20. Nunberg's on the top shelf.
21. We have guests, so please set another couple of plates.

The tummy tuck in (19) refers to the person who received a tummy tuck, *Nunberg* refers to a book by Nunberg in (20), and the perhaps more familiar case of *plate* in (21) refers to an entire place setting. The meanings of the sentences do not make sense without the meanings supplied by these metonymies and yet it is not obvious that the meanings are "in" the words of the sentence. Instead, the metonymic interpretation is supplied by context via semantic and pragmatic principles (Culicover and Jackendoff 2006).

Combining one polysemous word with *n* senses, and another polysemous word with *m* senses would require *n x m* possible meanings. If there are several polysemous words in a sentence, the computation becomes unwieldy extremely quickly. Even if our minds were able to perform this computation, it is clear that we have no conscious access to this large set of meanings. In order for us to arrive at the agreed upon meaning, (that *is* consciously accessible), we narrow down the result of a possibly huge computation to at most one or two meanings. To do this we have to rely on contextual cues.

4. Attempting to reconcile Context & Compositionality

From the discussion of quantifiers, ellipsis, deixis, and polysemy, it is clear and the way words combine into constituents does not deterministically convey the entirety of the *interpretation* or thought that is conveyed by utterances. Inferences that are drawn in particular contexts contribute importantly to the relevant range of a given quantifier, the intended referents of definite noun phrases, pronouns and all deictic terms, the intended interpretation of unexpressed or polysemous arguments, and all conversational inferences. As Gilles Fauconnier has described it, if the interpretation of a sentence is an

iceberg, the sentence itself provides only the above-the-water-line peaks of the iceberg. People supply the rest of the meaning on the basis of shared context and world-knowledge.

This recognition has led different researchers to differing conclusions about the fate of Compositionality. Groenendijk & Stokhof argue that thoughts or intended interpretations of sentences are not what is expressed by sentences (2003: 11). They thus draw a distinction between "thoughts," and the "meanings" of sentences, the latter being vague or underspecified. Sentential "meaning" is assumed to be context-free and compositionally determined. On the other hand, interpretation or thought is not conveyed directly by the "meaning" of an utterance and is not compositional. If "meaning" is not equivalent to interpretation or thought, then meaning would seem to be a formal construct created by theorists. In this way, Compositionality is not a claim that is open to empirical verification or falsification.

Returning to the deductive argument put forward in ★ in support of Compositionality, however, it seems necessary that whatever "meaning" is, it must be accessible to ordinary speakers, since that is an important assumption in the argument (see ★b). That is, what speakers recognize and agree on (more or less, most of the time) is the *intended interpretation of utterances in contexts*. Thus it would seem that assumption ★b in favor of compositionality actually presupposes access to contextual cues to meaning, since it is a combination of an utterance *and a context* that results in the agreed upon interpretation. This motivates Fodor's (2001) conclusion that meaning and thought are one in the same and are simply not compositional, since "language is strikingly elliptical and inexplicit about the thoughts that it expresses and as a simple matter of fact, in the general case, sentences are remarkably inexplicit with respect to how the thoughts they express are put together."

To see just how powerful context can be in the determination of intended meaning, consider the fact that a simple pointing gesture is typically readily understood in a given context.

4.1 Pointing is understood, but the meaning does not reside in the point

The reasoning in favor of compositionality in ★ seems to assume that the meaning of an expression must reside in the expression itself in order for the expression's meaning to be shared across people. And yet, humans are remarkably good at gleaning others' intended meanings even when language is not used. For example, we generally share an understanding of what is meant when someone points at something. If two boys are walking down the street and point to a hoagie restaurant, it could mean "let's get something to eat," "that place is still there!," or "let's cross the street because the school bully hangs out there." Oftentimes, no words need to accompany a pointing gesture as the intended interpretation is often recognized as obvious in context; and yet clearly, the meaning is not in the point itself (Tomasello 2009). Instead, the shared common ground provided by the context and background knowledge helps to determine what is intended. Language can be viewed as not entirely unlike pointing in that the language itself typically only offers incomplete clues to the overall interpretation of sentence.

5. Current contributions and research.

Piantadosi, Tily, & Gibson (2012) point out that the underspecification inherent in language is advantageous. They note that utterances routinely underspecify meaning, relying on context for full interpretation due to the need for efficiency. It would be needlessly long-winded to spell out every aspect of intended meaning, or the intended sense of every potentially ambiguous word. Instead, context supplements the cues provided by utterances. This allows interlocutors to arrive at a shared interpretation while minimizing the redundancy that would occur if language were to spell out all of the information that is already accessible in context.

Although the Principle of Compositionality is generally interpreted as entailing that the meaning of each constituent be determined only with reference to its immediate daughters, the argument provided in ★ does not entail that this is the only way for meaning to be determined. Instead, language could involve a network of formal patterns, which may contain open slots. Some of these slots may be defined recursively, and this in itself would allow for infinite creative potential. The argument structure constructions in Table 2 are examples of formal patterns with open slots. Another example is the English *The Xer, the Yer* construction exemplified in (22) (see Fillmore, Kay, and O'Connor 1988):

(22) The larger the audience, the easier the show. (COCA corpus, Davies 2008)

The construction requires that the comprehender construct a relationship between two variables, one independent (determined by the first comparative phrase), and the other dependent (determined by the second comparative phrase). The rule of composition is thus nontrivial, in that syntax itself is quite unusual—it is not even clear what type of phrase *the larger the audience* is—and the linked variable interpretation does not come from any particular word, at least in any obvious way. Still, the construction licenses an open-ended set of sentences.

The original argument suggested in favor of Compositionality does not require that the rules of combination are trivial, that world knowledge and context are irrelevant, or that meaning is determined in a strictly bottom-up way on the basis of the words and their immediate constituents. Shared interpretation can be arrived at by recognizing the existence of constructions that can contribute non-trivial aspects of semantics, and by recognizing that people come to the task of interpretation with a vast amount of shared world knowledge and context. This allows for interpretation to involve a top-down component, moving us away from the building block metaphor of meaning.

Kirby (2000) has investigated *why* languages tend to involve component pieces that can be reconstituted in new ways (or why languages involve templates with open slots that can be combined). He creates simulations of computer "agents" that aim to maximize expressive power while minimizing the number of rules. The simulations begin by generating random forms that correspond to intended meanings, but over time, as multiple agents interact and aim to express new meanings, a type of compositionality emerges. Namely, the simulations eventually settle into a system that involves component pieces that can be reassembled in new ways. Intuitively, it is clear that learning a completely noncompositional language—wherein each distinct meaning would correspond to a wholly unique form--would not only be extremely cumbersome but would fail to allow agents any way to express or comprehend any new meanings.

The issues involved in any approach to meaning are complex and quite daunting. A measure of the difficulty involved is evident in the fact that the field of machine understanding has made little progress over the past half century. Both Piantadosi, Tily, & Gibson (2012) and Kirby (2000) provide computational models that aim to motivate how and why new utterances are interpretable, and this promises to be a rich arena for additional research.

6. Conclusion

It is often debated whether the principle of compositionality is an empirical claim (Fodor 2001; Pelletier 1994) or a methodological assumption (Barker and Jacobson 2007; Dowty 2006; Groenendijk & Stokhof 2004; Janssen 1983; Partee 1995). The present overview tends toward the position that there exist empirical questions that need to be addressed in order for the Principle of Compositionality to be upheld.

An understanding of how humans interpret language has been a goal of philosophy, literature, and linguistics for hundreds of years. The present paper does not pretend to solve the problem in any way, but only to present evidence that the issues involved are complex. The apparently noncompositional meaning evident in idioms, discontinuous semantic units, and complex words must be addressed, and the contribution of argument structure constructions, intonation, and non-linguistic context to our shared interpretation of sentences must be taken into account.

Acknowledgments

I'd like to thank Christiane Fellbaum, Hana Filip, Sam Glucksberg, Clarice Robenalt, Nick Riemer, and Edwin Williams for helpful discussion and references on this topic. Any errors are solely my own responsibility.

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