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conversely, if the ‘referential connection’ problem could be solved for primitive features, the same solution might very well be applicable to words as a whole. So, if noncircularity does not solve the referential problem as such, decomposition is not *a priori* to be preferred over nondecompositional approaches, and psychological evidence for one or the other can be taken into account (see Aitchison, 2003 for an overview of the psychological issues).

However, even within those approaches that do not consider semantic decomposition to be epistemologically indispensable, componential analysis may be used as a heuristic device. For instance, in Geeraerts *et al.* (1994), a work that is firmly situated within the tradition of cognitive semantics, the internal prototypical structure of lexical categories is analyzed on the basis of a componential analysis of the referents of the words in question.

It would seem, in other words, that there is widespread agreement in linguistics about the usefulness of componential analysis as a descriptive and heuristic tool, but the associated epistemological view that there is a primitive set of basic features is generally treated with much more caution.

See also: Cognitive Semantics; Lexical Fields; Natural Semantic Metalanguage; Semantic Primitives.

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Compositionality: Philosophical Aspects

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There are three different but loosely related conceptions that are associated with the term ‘compositionality’ in the literature of philosophical and linguistic semantics.

One conception, taking its lead from the more literal sense of this technical term, concerns the manner of composition of objects in the world. In this sense, an object or type of object is compositional if it is identical with its parts when they are assembled in some specified way. A slogan for this notion of compositionality is: “An object is the sum of its parts.” However, this is a slightly misleading slogan, because

it does not distinguish between two different types of objects made of the same parts but put together differently. This notion of compositionality is meta-physical in nature: it provides a characterization of the ontology of objects in the world, saying that they can all be described in terms of some basic atomic elements and their combinations. Along with this ontological feature often goes an epistemological feature: that one can know objects in the world by understanding what the atomic items are and the ways they can be assembled. Both the ontological and the epistemological aspects here are further associated with reductionism: the view that objects are “nothing more than” their parts. In this meaning of compositionality, the compositionists are often called ‘atomists,’ and anti-compositionists are called ‘holists’ or sometimes ‘wholists.’ These latter theorists deny that all objects can be described and known in terms of their parts and the arrangement of the parts – for instance, they might deny that a corporation, a nation, or a group is “nothing more than” the class of individuals making them up together with their relationships – and hence they are antireductionistic. They might also hold that there are emergent properties and gestalt properties that cannot be described and known in the way required by atomism. A slogan for these theories is: “The whole is more than the sum of its parts.”

In the field of semantics, whether semantics of natural language or of mental items, there is a somewhat different conception of compositionality in play. In this realm, it is meaning that is claimed to be compositional; but since meaning is always meaning of something, it is this other something that defines the parts and the whole, unlike the case of the first sort of compositionality. The slogan for this second conception of compositionality is: “The meaning of a whole is determined by the meaning of its parts and the way these parts are combined.” What we see here is that a **feature** of a whole (its meaning) is claimed to be **determined** by the similar feature in the parts of the whole, plus the mode of combination of these parts – unlike the case of the first type of compositionality, in which it was the whole itself that was alleged to be “nothing more than” its parts. In the second type of compositionality, the notions of ‘part’ and ‘whole’, as well as their mode of combination, are presupposed to be already defined in terms of an independent syntax (in the case of language) or an independent mental economy (in the case of concepts). So the realm of syntax or mental economy is presupposed to be compositional in the first sense, and the issue is whether the property of meaning that is associated with the parts and wholes will likewise compose. Since the second conception assumes that

the first conception applies to the background syntax, this second conception presupposes basic or primitive meanings for the atomic (syntactic or mental) parts out of which all other (syntactic or mental) items are composed. (Once this second notion of compositionality is acknowledged, where there is a presupposed part-whole structure and it is then asked whether a feature of the whole is somehow determined by the similar features in the parts, one can see questions of compositionality arising in many fields, not just in semantics. For example, one might wonder whether the intrinsic value of an action is determined by the values of the parts of the action and the way the parts are ordered. One might wonder whether the beauty of a whole is determined by the beauty of its parts and the way the parts are combined. One might wonder whether the duties and obligations of a corporation or a society are determined by those of its members and the way these members fit together to form the corporation or society.)

Obviously, whether semantic compositionality is true or false depends upon the presupposed syntax or mental economy, the conception of meaning under consideration, and what is meant by the phrase “is determined by.” Indeed, many theorists have thought that this indeterminism inherent in semantic compositionality shows that its truth or falsity is merely “a methodological matter.” For a small alteration in the underlying syntax or mental economy might make a given semantics become non-compositional; a slight change in the assumed notion of ‘determination’ might make it become compositional again; an inclusion or exclusion of some property as “being semantic meaning” (as opposed, say, to “being pragmatics”) makes it become non-compositional again; and there might be no reason to make these changes other than to keep or deny compositionality.

The most popular explanation of “is determined by” in the semantic compositionist’s slogan is that it means ‘is a (mathematical) function of’; so the slogan becomes: “The meaning of a complex syntactic unit is a (mathematical) function of the meanings of its syntactic parts and the way in which they are syntactically combined.” But according to some, this notion allows too much: it is claimed that if no constraints are put upon the function, nearly any meanings of parts and syntactic combination can be compositionally related to the meaning of a whole. Some theorists would want to make the function be natural or systematic (and so on), without saying much about what, exactly and in the abstract, would make a function be natural or systematic. More usual is to be given examples of what sort of mathematical function should be ruled out. Consider the idea that an adjective like *red* means something

different depending on what noun it modifies. For example, according to this view, *red wine* vs. *red rose* vs. *red hair* vs. *red skin* vs. *red grapefruit* all employ a different meaning of *red*. And then compositionality is false, because these phrases are all constructed by the same syntactic rule and yet the meaning of *red* changes as a result of some syntactic item (viz., the noun being modified) that is not a part of the lexical item *red*. But a defender of compositionality could respond that the meaning of *red* is constant throughout, by being disjunctive (“when modifying *wine* it means r_1 ; when modifying *hair* it means r_2 ; etc.”). This is a perfectly good mathematical function and would obviously yield the right meanings of wholes if there were enough disjuncts. Those who object to the mathematical notion of function in the definition of compositionality might claim here that disjunctive functions are “not natural.”

The notion opposed to semantic compositionality is ‘semantic holism’. However, this notion means different things to different theorists, and it is not always just taken to mean merely that there is no mathematical function that will generate the required meanings. For example, some people call semantic holism the view that “words have meaning only in the context of a sentence” or that no word or other syntactic unit (including sentences, paragraphs, and discourses) has meaning in itself, but only in the setting of an entire theory or worldview or form of life. Others take semantic holism to be that the meaning of a syntactically defined item is determined not only by the meanings of its syntactic parts and their syntactic combination but also by the nonlinguistic context in which the utterance is made. (For example, it might be thought that the meaning of *There is no money* depends on who is speaking, whether the audience knows which business deal is being discussed, and so forth.) And still other holists, not necessarily wanting to bring these nonlinguistic items into meaning, nonetheless might hold that there are cases where the meaning of a syntactically complex item depends on meanings of linguistic items that are not syntactic parts of the complex. (For example, in *The first man landed on the moon in 1969*, we cannot take the meaning of *the first man* and combine it with *landed on the moon in 1969* to get the right meaning, for there is no sense in which the sentence really is talking about *the first man*. Rather, the relevant meaning of the subject term is that of *the first man who landed on the moon*. But to obtain that meaning, we need to get information from the verb phrase. Hence, to get the meaning of the subject term we need information of items that are not syntactic parts of the subject term.)

A third conception for (semantic) compositionality is less definite than the preceding, and comes through

considerations that might be called ‘the magic of language’. A set of closely related considerations have been pointed at in various times in the history of philosophy, both Western and Indian:

- We can **understand** an infinite number of novel sentences, so long as they employ words we already understand. We understand sentences and combinations that we have never encountered.
- We can **create** new sentences that we have never heard or used before, and we know that they are appropriate to the situation in which we use them.
- We are finite creatures who are exposed to a finite amount of information concerning our language. Nonetheless, we **learn** a system that is capable of infinite expression.

These considerations all point to the same features: (1) that language is something special (infinite, novel, creative, or whatever) and (2) that people manage to use/learn/understand language despite their finite nature. It is natural to see compositionality as an explanation of this ability – people have a finite stock of atomic items whose meanings are learned primitively, and there is a finite number of rules of combination whose effect on meaning are learned. But given that the rules are recursive in nature, this allows for an infinite number of sentences whose meanings are finitely knowable. (The opening paragraph of Frege [1923] is often taken to be an endorsement of this argument for compositionality, but it is a matter of scholarly dispute as to whether or not Frege actually believed in semantic compositionality. See Pelletier, 2001 and Janssen, 2001 for discussion and further references.)

This third conception of (semantic) compositionality is a ‘functional’ one and thus less definite than the preceding two. It amounts to saying that compositionality is *whatever* accounts for the magic of language. It might be the second conception of compositionality, with its mathematical functions, that will do the trick, or it might be some other, more exotic type of function. Or it may be some function that operates on items that are not necessarily syntactic subparts of the expression to be evaluated, and somehow thereby brings in information from context (of both linguistic and nonlinguistic varieties).

The magic of language considerations are the only arguments in favor of compositionality that do not seem merely to turn on such methodological considerations as the aesthetics of the syntax-semantics interface. However, it should be noted that they are not conclusive in relation to compositionality-as-mathematical-function. The second notion of compositionality does not guarantee the magic, nor does

non-compositionality in this second notion necessarily deny the magic. For it might be that the meaning of every syntactic whole is a function of the meanings of its parts and its syntactic mode of combination, but if these functions are not computable functions, then the language cannot be learned/used/understood in the way required by the magic. On the other hand, even if there is no function defined solely by the meanings of the parts and their modes of combination that will yield the meanings of the wholes, it could nonetheless be true that these meanings are computable in some other way ... and then the magic would still be there. (An example of this possibility is Pelletier's 1994/2004 'semantic groundedness'.)

Considerations Against Semantic Compositionality

The linguistic semantics literature is rife with demonstrations of how some linguistic phenomenon can or cannot be given a compositional description. It often seems that these works would more accurately be described as demonstrating how a phenomenon can or cannot be given a compositional description **employing some particular syntactic-semantic device or within some specific syntactic-semantic theory**. There are, however, three more general arguments that have been presented against semantic compositionality. The first is an argument from (nonlinguistic) context, of the sort mentioned above, where it is claimed that the meaning of a sentence in a context just cannot be derived from the meanings of the words and their combinations. In evaluating this argument, scholars need to distinguish between (what might be called) 'literal meaning' and 'occasion meaning'. The former is thought of as the meaning-in-language, while the latter is thought of as the meaning-in-a-context. If there is such a distinction, then there will be two principles of semantic compositionality – one for each type of meaning. And it is not so clear that either of them is overturned by considerations of context. The only casualty would be a mixed principle that no one believes, i.e., that the occasion meaning of a complex expression is a mathematical function of the literal meanings of its parts and their manner of combination.

The second general argument against compositionality comes from the existence of synonymy and Mates-like (Mates, 1950) considerations. Given that there is synonymy, so that x_1 and x_2 mean the same, then there are two sentences, S_1 and S_2 , that differ only in that one contains x_1 while the other contains x_2 . Given compositionality, it follows that S_1 and S_2 are synonymous too; and by compositionality again, it follows that *Mary believes S_1* and *Mary believes S_2*

are synonymous. But for any such S_1 and S_2 , it can be the case that the former is true, while the latter is false. However, it cannot be the case that, of two synonymous sentences, one is true and the other false. Hence, either there is no synonymy or else compositionality is wrong. And the existence of synonymy is more secure than that of compositionality.

The third general argument comes from the existence of ambiguity. If compositionality implies that the meaning of a whole is a mathematical function of the meanings of its parts (and combination), then there cannot be any ambiguity of the sort where **one and the same item** has two or more meanings, for that would deny that it was a function that computed meaning. As with synonymy, one could of course deny the existence of ambiguity; but most theorists find that this is too lavish a position to take. So it is usually admitted by compositionists that individual words can be ambiguous; therefore, sentences using these ambiguous words may also be ambiguous (but the ambiguities are always traceable to the ambiguity of the words). Also, it is pointed out that strings of words such as *Visiting professors can be fun* are ambiguous (is it the professors or the activity of visiting the professors that can be fun?), but this ambiguity is traceable to the fact that the words are put together in different ways – that is, there are different structural descriptions that can be associated with this string of words. Hence, this ambiguity is not a challenge to compositionality. However, Pelletier (1994/2004) points to a number of examples that seem neither to have ambiguous words nor to have different structural descriptions but which are nonetheless ambiguous. For example: *When Alice rode a bicycle, she went to school*. This seems to have but one syntactic analysis within any particular theory, but its meaning is ambiguous: *On those occasions where Alice rode a bicycle, she took it to school vs. Back in the days when Alice was a bicyclist, she was a student*.

Formal Considerations

There have been a number of works concerned with the question of whether compositionality is a nonempirical issue on the grounds of certain formal features that are required by compositionality. A review article that surveys this work is Westerståhl (1998). More recent work on formal features of compositional semantics is in the important work of Hodges (2001) and material based on this.

History

Although the general principle of compositionality seems to have been around for some time, as

mentioned earlier, it is not clear when the term ‘compositionality’ came into the linguistic semantics literature (unlike ‘holism,’ which was introduced by Smuts, 1926). ‘Compositionality’ is used by Katz (1973) and Thomason (1974).

See also: Context Principle; Holism, Semantic and Epistemic; Human Language Processing: Connectionist Models; Reductionism; Representation in Language and Mind; Systematicity.

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Compositionality: Semantic Aspects

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According to the principle of compositionality, the meaning of a complex expression depends only on the meanings of its constituents and on the way these constituents have been put together. The kind of dependence involved here is usually a functional one.

Principle of Compositionality (PC): The meaning of complex expression is a function of the meanings of its constituents and of the rule by which they were combined.

PC is rather vague unless one specifies the meanings of ‘is a function of’ and ‘meaning(s)’, something that

is easier said than done. A more rigorous formulation of these notions is possible for formal languages and is due to Richard Montague.

Montague (1974) defined compositionality as the requirement of the existence of a homomorphism between syntax and semantics, both to be understood as ‘structures’ in the mathematical sense. To keep technicalities down to a minimum, Montague’s requirement of a compositional interpretation was that for each syntactic operation ‘O’ that applies to n expressions e_1, \dots, e_n in order to form the complex expression ‘O(e_1, \dots, e_n)’, the interpretation of the complex expression ‘O_{*i*}(e_1, \dots, e_n)’ is the result of the application of the semantic operation ‘C_{*i*}’, which is the interpretation of ‘O_{*i*}’ to the interpretations m_1, \dots, m_n of ‘ e_1 ’, ‘ \dots ’, ‘ e_n ’, respectively. In other