

# Frege on Compositionality

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## Introduction

Even the intuitive, pretheoretic notion of compositionality has various formulations in the literature, to say nothing of the more technical and refined characterizations. The intuition behind much of these seems to be that, except for idioms and the like<sup>1</sup>, the "meaning" of complex expressions "depends on" the meaning of its parts and the "way" the complex is assembled. The basic consideration for this seems to be due in large part to Frege --i.e. it is the best way to account for the ability to produce and understand novel utterances. Sometimes, other considerations are bruited. For instance, that it makes a (natural) language "learnable".<sup>2</sup> This is probably not an independent point, since such learning is commonsensically tantamount to gaining the capacity to produce and understand novel utterances --when one learns a language one is constantly learning (understanding and producing) novel utterances. It is hard to see how language learning could take place without handling novelty. Another line of consideration has been an consideration from "productivity", the (purported) fact that speakers have the "ability" to produce an unlimited number of well-formed expressions in their language.<sup>3</sup> More recently, and in partial response to worries about the open-ended or infinite character of our linguistic abilities, the point has been put in terms of "systematicity" --the ability to see recurrent expressions and constructions in (even a finite number of) complex expressions.<sup>4</sup>

It is worth noting a common feature of each of these considerations (novelty, learnability, productivity and systematicity) viz that they argue from a feature of speakers of a language, to properties of the language (spoken). It is fair to ask what legitimates such an inference:

[1] Speakers of L have feature F,

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<sup>1</sup> See below for a qualification.

<sup>2</sup> See e.g. Davidson (1965).

<sup>3</sup> This is sometimes put in terms of the ability to produce an "infinite" number of well-formed expressions, but this puts severe strain on the notion of such an "ability". Hence the milder formulation.

<sup>4</sup> See e.g. Fodor (1986), and Fodor and Pylyshyn (1989).

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[2] So L has feature C (= is compositional).

This inference is not sound for many instances of 'F'. For example, although speakers of L are or have been alive, in the sense of breathing, eating etc., no language is alive in that sense. So why is it ok for the special, chosen F's?

One line of consideration is to close the gap between [1] and [2] by turning the language L into a psychological state of the speaker-hearer.<sup>5</sup> The account of why L is C would then flow fairly directly from the fact that speakers have F, and F is psychologically based. A related<sup>6</sup> line of consideration is not to internalize the language, but to keep it external,<sup>7</sup> and to imagine the move from [1] to [2] not as a deductive inference, but an inference to the best explanation, which could be defeated by a better explanation.<sup>8</sup> We will not pursue these motivational issues here, though some of the terminological issues will be revisited. Instead we turn to formulations of the notion of compositionality and its near-relations.

### A. Compositionality

**Intuitive Compositionality** In some form or other, many (most?) philosophers and linguists have a conception of compositionality which can be stated in rough, intuitive and preliminary manner as follows (Intuitive Principle of Compositionality):

#### (IPoC)

The meaning of a semantically and syntactically complex expression E is compositional iff it is determined by, and only by, the linguistic (conventional) meanings of its components plus their syntactic relations.<sup>9</sup>

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<sup>5</sup> See especially Fodor (1981), and Chomsky (1986, 1990, 2000).

<sup>6</sup> Related, because it still seems we have to have a psychological premiss to get an explanation of [1] from [2].

<sup>7</sup> See Chomsky (1986, 1990, 2000) for a discussion of "I (internal) conceptions of language vs "E (external) conceptions of language. We consider Chomsky's discussion of the "commonsense" conception of language to be external as well, since it is social, and therefore at least inter-personal.

<sup>8</sup> I.e. something other than compositionality might explain the facts. See here Pelletier (1994, section 11) and his interesting notion of "groundedness".

<sup>9</sup> See Pelletier (1994, footnote 1) on "by and only by".

A closely related version of this is the following "Principle of Semantic Compositionality":<sup>10</sup>

**(PSC)**

The meaning of an expression is a function of, and only of, the meaning of its parts together with the method by which those parts are combined." (Pelletier, 1994, 11)

This statement is both more specific ('determines' becomes 'is a function of') and more general ('syntactic relations' becomes 'method of combination'). Either can serve as a first approximation to the intuitive notion. An each leaves open a number of options that a serious theory utilizing the notion of compositionality would have to close, beyond the obvious ones of saying more about meaning, syntax, constituents, parts etc.. For instance: (i) do compositional principles have access only to the meanings of the constituents, or do they have access to the forms which have those meanings? (ii) Is the compositional function total or partial<sup>11</sup> (iii) Is this function computable? Is it decidable? etc.. (iv) Is the compositional process "strictly local", in the sense of being sensitive only to immediate constituents?<sup>12</sup> (v) Is the compositional processes "purely interpretive" in the sense of introducing no new structure.<sup>13</sup> Each of these further conditions themselves need clarification and motivation, something we will not pursue here.

There is a cottage industry devoted to finding the historical origins of, refining, refuting, or other wise impugning, (IPoC).<sup>14</sup> But without more ado the (IPoC) makes no claims about what expressions fall under it. It is compatible with (IPoC), as it stands, that it should be empty. Usually (IPoC) is conjoined implicitly with some other principle dictating the scope of (IPoC):

**(LIPoC)**

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<sup>10</sup> Pelletier (1994, section 2) contains a representative sample of quotations from various philosophers and linguists regarding the formulation of compositionality.

<sup>11</sup> Pelletier (1994, footnote 1) plausibly reads this as asking whether all meanings of constituents play roles in the meaning of the complex, and the answer to that seems to be no -- syntactic and semantic restrictions can "filter" out meanings during the process of composition.

<sup>12</sup> See Segal and Larson (1995), and the discussion of this in Pelletier (2004).

<sup>13</sup> See Larson and Segal (1995) and the discussion of it in Pelletier (2004).

<sup>14</sup> See Pelletier (1994, especially sections 4, 6 and 10), and Recanati (2004), for a recent survey --discussed by Harnish (2005).

A language L as a set of expressions<sup>15</sup> is (intuitively) compositional iff every syntactically and semantically complex expression in it is compositional.

Although (LIPoC) might be so weak as to be not very interesting, it is not vacuous, since it apparently rules out many (most?) idioms, which can be viewed as syntactically complex, and semantically complex but non-compositional. We can also use (IPoC) to carve off that portion (subset) of a language which is completely compositional:

**(SLIPoC)**

A subset L' of L is compositional iff (LIPoC) holds of it<sup>16</sup>

Since compositionality could, in this sense, visit a language in degrees, we might characterize a graded intuitive notion:

**(GLIPoC)**

A language L as a set of expressions is (intuitively) compositional to the degree that complex expressions in it are compositional, given the linguistic meaning of its words, idioms and syntax.

For instance, some (or even all) idioms might have parts that compose compositionally and parts that do not.<sup>17</sup> However we should distinguish cases where the "compositionality" is based on a nonliteral construal of the components, from cases where it is not. Thus '(to) kick the bucket' is not compositional with respect to both the conventional meaning 'kick', 'the' and 'bucket' (as compositionality requires), nor with respect to its idiomatic meaning (to) die. On the other hand '(to) spill the beans' has an element of "compositionality" over the non-conventional meaning of the constituents 'spill' (divulge) and 'the beans' (the secrets). This sense in which '(to) spill the beans' is compositional is derivative, and not the notion we are investigating.

**Theoretical Compositionality** The intuitive notion of compositionality suffers from the vagueness and imprecision of many of its terms, most notoriously, the term 'meaning' (not to mention

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<sup>15</sup> A language as a system of rules and/or principles can be defined off of the above, or perhaps directly. For instance, Larson and Segal (1995) say: "Semantic rules of this kind are compositional. They give the semantic content of a sentence by specifying the semantic contributions of its parts and the semantic significance of putting those parts together according to a definite mode of syntactic combination." (11)

<sup>16</sup> Using this we can define the maximum compositional part of the language in terms of the largest subset of L that is compositional.

<sup>17</sup> See McGinnis (2004) for considerations of aspect in idioms.

'components' and 'syntactic relations').<sup>18</sup> There may well be as many explications of the notion of 'meaning' in semantics as there are writers on the subject. We might impose some broad order on this by distinguishing "formal" from "nonformal" semantics.

**Formal semantics**, perhaps better called "logical" semantics, descends from Frege's work on his logical language 'Begriffsschrift'. The hallmark of this tradition is the application of the semantics of logic (concepts, notation) to natural language, in particular the notions of reference (extension, denotation) truth-condition and truth-preserving relations between sentences.<sup>19</sup> The Fregean strain typically makes use of his influential distinction between sense and reference, as well as his function-argument analysis of semantic structure.<sup>20</sup> A rival formal semantics can be traced back to Russell and the logical language of Principia Mathematica, which attempts to do without the notion of sense.<sup>21</sup> These two traditions continued through theorists such as (i) Carnap (1956), Church (1951), Montague<sup>22</sup>, and (ii) Tarski (1936), and Davidson (1967). Recent work, such as Kaplan (1989) and Perry (2001) can be seen as attempting to reconcile the tension between Fregean and Russellian approaches.

**Nonformal semantics** is an attempt to construct a rigorous theory of meaning, but without the assumption that the formalism and techniques of logic play a central, dominant role.<sup>23</sup> It gives the impression of being a more diverse tradition than the logical tradition.<sup>24</sup> Meaning is theorized about in all sorts of different ways: as conceptual structures (Jackendoff 1983), as prototype structures (Putnam 1975), as informational frames (Minsky 1975, Fillmore 1975), as aspects of use (Schiffer

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<sup>18</sup> For instance Higginbotham (1986) comments "In natural languages, then, the phrase markers are the fundamental objects for which we aim to provide a theory of semantic values ..." (32)

<sup>19</sup> Truth conditions and truth-preserving inference can be generalized so as to include moods other than the indicative by using a more general notion of 'satisfaction'. Here we will follow tradition and concentrate on truth.

<sup>20</sup> See Heim and Kratzer (1998) for an explicitly Fregean introduction to formal semantics.

<sup>21</sup> See Larson and Segal (1995) for an introduction to Russell-Tarski-Davidson style formal semantics.

<sup>22</sup> See Thomason (1974) for a collection of Montague's works, and D. Dowty et al (1981) for an introduction to Montague style formal semantics.

<sup>23</sup> They of course play a role in an account of the 'logical' vocabulary of a language.

<sup>24</sup> See Allan (2001) for an introduction to predominantly nonformal theories of semantics.

1972, Alston 2000), and so forth. What is the role of compositionality is this? Typically, compositionality in some form or other is considered a desideratum of formal theories, but is not so emphasized by nonformal theories. In fact, its scope is sometimes severely restricted to the point of it being denied that natural languages are in any interesting sense compositional.<sup>25</sup>

We cannot keep all of these theories (formal and nonformal) in the air while we discuss compositionality, so we will concentrate on the intuitive notion as far as possible.

**Compositionality and Innocence** The various principles known as "semantic innocence" come from Barwise and Perry, the label being inspired by a comment of Davidson's:

"Since Frege, philosophers have become hardened to the idea that content sentences in talk about propositional attitudes may strangely refer to such entities as intensions, propositions, sentences, utterances, and inscriptions ... If we could but recover our pre-Fregean semantic innocence, I think it would be plainly incredible that the words 'the earth moves uttered after the words Galileo said that' mean anything different, or refer to anything else, than is their wont when they come in other environments." (1968)

As Barwise and Perry state it:<sup>26</sup>

### **Principle of Innocence (PoI)**

"An innocent semantics takes the reference of a statement --that aspect of signification that depends on the reference of its parts --to be just that which contributes to the reference of the wholes in which it is embedded." (1981, 406)

Fodor & Pylyshyn (1989) complicate the terminological picture by calling what we have called 'compositionality' by the term 'combinatorial', and using 'compositional' for 'innocent':<sup>27</sup>

### Combinatorial Syntax and Semantics

<sup>25</sup> See Alston (2000, part II) for an attempt to give an illocutionary use based semantics for a natural language where the issue of compositionality hardly arises, or Recanati (2004) where traditional compositionality seems to be denied (or severely restricted).

<sup>26</sup> This is related to Higgenbotham's (1986, 33) 'indifference principle': "the value of a constituent does not depend upon what it is embedded in."

<sup>27</sup> It is worth noting that Fodor and Pylyshyn are engaged in a dispute about the virtues of 'classical' vs 'connectionist' representational schemes, and not engaged in discussing natural language semantics (directly).

"Classical theories ... take mental representations to have a combinatorial syntax and semantics, in which (a) there is a distinction between structurally atomic and structurally molecular representations; (b) structurally molecular representations have syntactic constituents that are themselves either structurally molecular or structurally atomic; and (c) the semantic content of a (molecular) representation is a function of the semantic contents of its syntactic parts, together with its constituent structure." (1989, 12)

### The Principle of 'Compositionality'<sup>28</sup>

"the principle of compositionality': insofar as a language is systematic a lexical item must make approximately the same contribution to each expression in which it occurs." (1989, 42)

We will not follow Fodor and Pylyshyn in this usage. Rather, we will formulate a stronger version of compositionality, one that combines the above intuitive compositionality with an intuitive Principle of Innocence.

(POI)

The meaning of a semantically and syntactically complex expression E is determined by a semantically innocent processes iff each constituent of E makes available a meaning, or range of meanings, that it makes available to every other complex expression E' of which it is a constituent.

We will call it "innocent compositionality":

(PoIC)

The meaning of a semantically and syntactically complex expression E is innocently compositional iff (i) it is compositional and innocent. I.e.:

The meaning of E is determined by, and only by, the linguistic meanings of its components plus their syntactic relations (compositional), and (ii) each constituent makes available a meaning, or range of meanings, that it makes available to every other complex expression E' of which it is a constituent (innocence).

This (PoIC) is not a trivial extension of (IPoC). Frege's semantics, containing as it does his doctrine of indirect (opaque) contexts, seems to be a counterexample to the necessity of (POIC). I.e. Frege's semantics is broadly compositional, but not innocent.

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<sup>28</sup> We presume the qualification 'approximately' is meant to accommodate the possibility that a constituent is ambiguous, and so contributes the same range of semantic values.

## B. Frege and Compositionality

Fregean compositionality can be broken down into two major sets of principles, the syntactic principles and the semantic principles. Neither set of principles are uncontroversial, but for now we will simply set them out, with a minimum of motivation and textual support.

### Syntax

The Principle of Syntactic Compositionality (SC) All syntactically complex expressions can be syntactically composed (not necessarily uniquely) by fitting function names to argument names (singular terms, or names of lower level functions).

The Principle of Syntactic Decompositionality (SD) All syntactically complex expressions can be syntactically decomposed (not necessarily uniquely) into argument names and function names.

### Semantics

In formulating Fregean principles of compositionality at the semantic level (at the levels of sense and reference) there are a number of doctrines that must be kept in mind for a complete account:

1. The manner in which sense determines reference is best understood on the model of sense being (or setting down) conditions on reference --conditions that a referent must meet for the sense to determine it.<sup>29</sup> For convenience let's call the conditions imposed by sense for determining reference to objects 'object-determining-conditions', and for functions 'function-determining-conditions'. For a sense to determine the reference it does, the world must meet the condition set by sense. So sense determines reference relative to the world being a certain way. Borrowing a term from Frege's early period we might call the states of the world that meet these conditions (possible) "circumstances".<sup>30</sup> So senses determine reference relative to circumstances, which we notate '/C'.

The Principle that Sense Determines Reference Relative to Circumstances (SDR/C) Sense determines reference, relative to circumstances.

Indicative sentences get special treatment and terminology from Frege. Such sentences express a

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<sup>29</sup> This accommodates virtually all the passages in which Frege discusses sense after its introduction in 1891, and meshes well with his explicit identification of the sense of a sentence with the thought that its conditions for naming the True are met --its truth conditions (Grundgesetze #32). I.e. we get sentential conditions on reference (truth) by fitting together sub-sentential conditions on reference.

<sup>30</sup> See (1879), #2 and *passim*.

'Thought' as their sense, and have the object 'The True' or 'The False' as their reference.<sup>31</sup> Since senses in general are (or set down) conditions on reference, and the reference of an indicative sentence is a truth value, the sense of an indicative sentence, the Thought expressed, is (or sets down) a condition for referring to a truth value (the True), hence can be called a "truth condition".<sup>32</sup>

According to Frege, the sense expressed by a linguistic item is not always determined by the conventions of the language alone. There are two kinds of cases.

2. On the one hand, some expressions, such as (real) proper names, can have different senses relative to different speakers ("speaker-relative" senses). Typically proper names retain their senses for the speaker and hearer from occasion to occasion, until there is sufficient reason to change it.<sup>33</sup>

The Principle that Real Proper Names are Speaker Relative (RPNSR) A (real) proper name has a sense relative to a speaker.

3. On the other hand, some expressions, such as indexicals and demonstratives (sometimes called "deictic" expressions), can express different senses relative to different contexts of use ("context-relative" senses).<sup>34</sup>

The Principle that Indexicals and Demonstratives are Context Relative (IDCR) Indexicals and demonstratives express a sense relative to a context of utterance.

Frege seems, unlike contemporary theorists such as Kaplan and Perry<sup>35</sup>, not to systematically distinguish the "circumstances" that determine reference given a sense, from the "context" that determines sense, given a deictic linguistic expression, nor either of these from the facts about communicants (speaker, hearer). It is not too much of an historical distortion to role these all together under the label of being relative to "circumstances" when stating our principles of compositionality, because the context and speaker relativities are in fact a part of the way the world is.

4. Frege typically speaks of linguistic items (he often calls this class "signs") as referring (or

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<sup>31</sup> We capitalize 'Thought' when discussing Frege's special, non-psychological usage (except for quotations where it is not capitalized). The same should probably be done with 'Concept'.

<sup>32</sup> See (1893, #32).

<sup>33</sup> See (S&R, 1892) the 'Aristotle' footnote, (TT, 1918) the 'Gustav Lauben' example.

<sup>34</sup> See (TT, 1918). Frege gives no hint in these passages of how that sense is determined by context, nor even if it has to be unique. We leave this issue unresolved for now.

<sup>35</sup> See Kaplan (1989), Perry (2001).

purporting to refer) to their referents (we might call this the "abbreviated" way of speaking), and any statement of compositionality principles should reflect that fact. But as we have seen, he had an account of the "mechanisms of reference" (to steal a phrase from McGinn), mechanisms connecting linguistic items to referents via linguistic items expressing a sense and sense determining a reference (we might call this the "unabbreviated" way of speaking). On this way of speaking, the reference of a sign is shorthand for speaking of the relative product (composition) of two relations: the expressing relation and the determining relation. And both relations, we have seen, are relative to circumstances.

Here is how we will proceed. First, we will pursue the "unabbreviated" strategy: we will state the compositionality principles for sense i.e. relating the senses of constituent linguistic items to the senses of complex linguistic items, and we will state the compositionality principles for reference. Then we will use the principle of sense determining reference, relative to circumstances, to infer the compositionality principles of reference for linguistic items. This will result in principles identical to the "abbreviated" strategy.

### **The "Unabbreviated Strategy": Reference of Linguistic Items as the Relative Product of "Expressing" and "Determining"**

We start with the syntactic compositionality principles to give us a class of expressions such that each expression conforms to (SC). We next assume that each (semantically) non-complex linguistic item expresses a sense (or set of senses). Finally, each (semantically) complex linguistic item expresses a sense(s) conforming to the principles to follow.<sup>36</sup>

#### **Sense**

The Principle of Strong Compositionality for Senses Relative to Circumstances (SCS/C)<sup>37</sup> Let sense S be a sense composed of constituent senses  $s_1 + s_2 + \dots + s_n$ , (which may have been expressed relative to circumstances), then S is constituted by (built out of) the senses  $s_1 \dots s_n$ , relative to their logico-syntactic relations, and relative to those circumstances.

The Principle of Weak Compositionality for Senses Relative to Circumstances (WCS/C) Let sense S be a sense composed of constituent senses  $s_1 + s_2 + \dots + s_n$ , (which may have been expressed relative to circumstances), then S is uniquely determined by (is a function of) senses  $s_1 + s_2 \dots + s_n$ , relative to their logico-syntactic relations, and relative to those circumstances.

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<sup>36</sup> We state these in terms of the senses expressed rather than the senses had (in the language) to accommodate the possibility of such a distinction in the case of (real) proper names, indexicals, demonstratives and indirect speech contexts (see below).

<sup>37</sup> The terminology "strong" and "weak" compositionality comes from Hale (1997).

How is the weaker principle (WCS/C) related to the stronger principle (SCS/C)? We argue below that given certain intuitive mereological assumptions regarding wholes and their relations to parts and their organization, the weak follows from the strong.

## Reference

The Principle of (Weak) Compositionality for Reference Relative to Circumstances (WCR/C) Let  $S$  be a sense composed of constituent senses  $s_1 + s_2 + \dots + s_n$  (which may have been expressed relative to circumstances), then the reference determined by  $S$  is uniquely determined by (is a function of) the references determined by  $s_1 + s_2 + \dots + s_n$ , relative to their logico-syntactic relations, and relative to those circumstances.

There is no analog of the strong sense principle, given that a truth value does not seem to be constituted by the references of the parts of a sentence. Just after drawing the sense-reference distinction in 1891, Frege toys with the part-whole terminology at the level of reference:

"One might also say that judgments are distinctions of parts within truth values" (S&R, 148)

but quickly qualifies this by saying:

"I have here used the word 'part' in a special sense" and he continues "This way of speaking can certainly be attacked ... a special term would have to be invented" (ibid)

Later Frege makes his position crystal clear:

"We can regard a sentence as a mapping of a thought: corresponding to the whole-part relation of a thought and its parts we have, by and large, the same relation for the sentence and its parts. Things are different in the domain of [reference: Bedeutung]. We cannot say that Sweden is a part of the capital of Sweden." (NfLD, 255).

## The "Abbreviated Strategy": The Reference of Expressions Simpliciter

We can now use the above principles to state the compositionality of reference simpliciter. As before we assume that the syntactic compositionality principles give us a class of expressions such that each expression conforms to (SC), and each expression expresses a sense (perhaps relative to circumstances). Then, forming the relative product of (SCS/C) or (WCS/C) and WCR/C) we get the derived principle:

The Principle of Compositionality of Reference for an Expression Relative to Circumstances (CRE/C) Let  $E$  be an expression composed of constituent expressions  $e_1 + e_2 + \dots + e_n$ , then the reference determined by  $S$  is uniquely determined by (is a function of) the references determined by  $s_1 + s_2 + \dots + s_n$ , relative to their logico-syntactic relations, and relative to circumstances.

There are four important consequences of the compositionality principles:<sup>38</sup>

### **Consequences of the Compositionality Principles**

The Principle of Substitution for Reference (SR/C) The reference of E remains unchanged by substitution of a co-referential expression for a constituent  $e_1 \dots e_n$  of E, relative to circumstances.

The Principle of Substitution for Sense (SS/C) The sense of E remains unchanged by substitution of a co-sensical expression for a constituent  $e_1 \dots e_n$  of E, relative to circumstances.

The Principle of Failure: Reference (FR/C) If a constituent expression  $e_1 \dots e_n$  of E fails to refer, relative to circumstances, then E fails to refer, relative to those circumstances.

The Principle of Failure for Sense (FS/C) If a constituent expression  $e_1 \dots e_n$  of E fails have a sense, relative to circumstances, then E fails to have a sense, relative to those circumstances.<sup>39</sup>

### **Unrelativized Principles of Sense**

We have been relativizing (semantic) principles to "circumstances" because the senses expressed by (real) proper names, indexicals and demonstratives are relative to speaker-hearer and context of utterance. But one could abstract from the expression of the sense to the sense itself, treating it as if it were a sense had (in the language) for the purposes of compositionality. In this case one gets the sort of unrelativized principles generally found in the literature on Frege. Note, however, that determination of reference is still relative to circumstances.

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<sup>38</sup> Pelletier (2001, 89) claims that given certain conditions, substitution and compositionality are equivalent. One of those conditions involves the idea that substituted expressions have the same type, and he adds "One might wonder if two items from different syntactic categories, e.g. a sentence and a noun phrase, can have the same semantic value" (ibid). He is probably alluding to the fact that for Frege 'the True' (a NP) and 'Snow is white' (a sentence) have the same semantic value. Since the argument is not given, it is not clear how threatening this Fregean fact is to the conclusion.

<sup>39</sup> there is a way in which this is dubious and needs qualification. Suppose 'Flounders snore' expresses the sense that flounders snore, but that 'igabuga' expresses no sense. Then 'Flounders snore ugabuga', by FS/C, would not express a sense. Yet the sense that flounders snore still seems to be expressed. But the idea is that somehow the whole expression does not express a sense. It is tempting to put this: the whole expression does not express a sense distinct from a proper part, and propose that FS/C should be read that way. But this could leave the principle vulnerable to counterexamples from redundancy. What to do?

## Indirect Contexts and Non-Local Compositionality

It is well known (and see below) that Frege protected his principle(s) of substitution from counterexamples with his doctrine that expressions occurring within "indirect quotation" (what we would call, following Quine, referentially 'opaque' contexts) have their "indirect" sense and reference. Their indirect sense is specified by a description of the form 'the sense of X' and the indirect reference of an expression is, at the first level, its customary sense. Thus, within a sentence such as:

(4) Columbus believed [that the Earth is round]

the linguistic items in the embedded clause would have their indirect sense and reference, thereby licensing the substitution not of customarily coreferential expressions, but of expressions with the same customary sense. But this raises the question of whether these indirect senses (at all levels) and references (above the first level) are had by the linguistic item, or are only expressed by the item in the context. There is textual evidence on both sides. But assuming that such senses and references are "expressed" in the linguistic context<sup>40</sup> and not "had" by them in the language, then the function that characterizes the compositional process will, in the case of the above example, have to work its way up to 'believe' before it can correctly assign the indirect semantic value to everything in the lower clause in brackets. Thus it seems that Fregean principles of compositionality cannot be strengthened (restricted) to purely "local" logico-syntactic relations.

## Lexical Meaning and Compositionality

So far we have said nothing about the relation of words to meaning independent of the constructions in which they occur. There are at least two positions here, a kind of holistic position and a kind of atomistic position. On the holistic position, one can cite the particular contribution of an expression to the meaning of the whole of which it is a constituent, maybe because that is what its meaning consists in. On the atomistic position, one can not only cite the meaning contribution of every constituent expression, but that constituent has that meaning independently of all expressions it is a constituent of --that the constituent brings an antecedently specifiable meaning to each expression it is a constituent of.

Holistic-Meaning (HM) The meaning of a constituent expression can be specified as the contribution it makes to the meaning of every expression it is a constituent of.

Atomistic-Meaning (AM) The meaning of an expression can be specified independently of the meaning of any expression it is a constituent of.

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<sup>40</sup> There are arguments for this alternative involving the plausible objects of the attitudes, but if so, does this reinstate some version of the "context principle"?

**Frege** Given his two-factor theory of semantic value, these positions need to be restated, once for sense and once for reference:

Holistic-Sense (HS) The sense of a constituent expression can be specified as the contribution it makes to the sense of every expression it is a constituent of.

Atomistic-Sense (AS) The sense of an expression can be specified independently of the sense of any expression it is a constituent of.

Holistic-Reference (HR) The reference of a constituent expression can be specified as the contribution it makes to the reference of every expression it is a constituent of.

Atomistic-Reference (AR) The reference of an expression can be specified independently of the reference of any expression it is a constituent of.

One consideration to keep in mind when evaluating these positions is the context dependency of senses for indexicals, demonstratives and many (most? all?) actual proper names, as well as the general context dependency for reference. This is particularly important when assessing (AS) and (AR). Perhaps these can all be accommodated by simply relativizing the above principles to "circumstances".

### **Textual Evidence**

Some of the above claims and formulations are controversial and in need of some textual justification, and here is a sample (only).

#### **Textual Evidence: Indexicals are Context-Sensitive**

"Therefore the time of utterance is part of the expression of the thought" (TT, 522)

"In all such cases the mere wording ... 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." (TT, 522)

"Only a sentence supplemented by a time-indication and complete in every respect expresses a thought." (TT, 533)

#### **Textual Evidence: Proper Names are Speaker-Relative**

"In the case of an actual proper name such as 'Aristotle' opinions as to the sense may differ. It might, for instance, be taken to be the following: the pupil of Plato and teacher of Alexander the Great. Anybody who does this will attach another sense to the sentence

'Aristotle was born in Stagira' than will a man who takes as the sense of the name: the teacher of Alexander the Great who was born in Stagira." (S&R, 159)

In "The Thought" (1918), Frege imagines a conversation involving Gustav Lauben, Leo Peter, and Rudolf Lingens. In the condition Where GL says 'I have been wounded' and LP and RL both know of GL as "the doctor who lives as the only doctor in a house known to both LP and RL", then Frege says, the same Thought is grasped by LP and RL. but under the circumstance where HG knows "GL was born in 13 September 1875 in N. N.", then, Frege says, different thoughts were grasped:

"I say, therefore, in this case: the thought which Leo Peter expresses is not the same as that which Dr. Lauben uttered." (TT, 523)

Frege concludes:

"Accordingly, with a proper name, it is a matter of the way the object so designated is presented. This may happen in different ways, and to every such way there corresponds a special sense of the sentence containing the proper name." (TT, 524)

### **Textual Evidence: Substitution<sup>41</sup> and Failure<sup>42</sup>**

The Principle of Substitution for Reference (SR/C) This is the most commonly cited principle, for Frege, probably because his concern was mainly with the logic, which studies "the laws of truth" and truth lies at the level of reference, not sense.

**1891** "... '2<sup>4</sup>=4<sup>2</sup>' and '4x4=4<sup>2</sup>' express different thoughts; and yet we can replace '2<sup>4</sup>' by '4x4', since both signs have the same reference." (F&C, 29 emphasis added)

"And yet both sentences ['The Evening Star is a planet with a shorter period of revolution than the Earth' and 'The Morning Star is a planet with a shorter period of revolution than the Earth'] must have the same reference; for it is just a matter of interchanging the words 'Evening Star' and 'Morning Star', which have the same reference i.e. they are proper names of the same heavenly body" (ibid emphasis added)

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<sup>41</sup> Contrast the Frege quotations with Russell (1903) "The denotation is unchanged by the substitution, for any part of the sentence, of a phrase or word having the same denotation as that part. but the meaning is changed, in such a case, if the meaning of the substituted phrase is different from the previous phrase or word." (284)

<sup>42</sup> Compare with Russell (1903): "We decided that proper names ... have only denotation, not meaning ...; but in the present case, the name denotes nothing ...It would seem to result that any phrase in which [the] name occurs must denote nothing." (285)

**1892** "Let us assume for the time being that the sentence has reference. If we now replace one word of the sentence with another having the same reference, but a different sense, this can have no bearing upon the reference of the sentence. Yet we can see that in such a case the thought changes." (S&R, 146 emphasis added)

**1902** "If a thought were the Bedeutung [reference] of a Satz [sentence], then it would not change if one of its parts were replaced by another expression of the same Bedeutung [reference]." (LtR, December 28, 1902, 152)

"The Bedeutung [reference] of the Satz [sentence] must be something which does not change when one sign is replaced by another with the same Bedeutung [reference] but a different sense." (ibid emphasis added)

**1919** "If in a sentence or part of a sentence one constituent is replaced by another with a different Bedeutung [reference], the different sentence or part that results does not have a different Bedeutung [reference] from the original; on the other hand it always has a different sense." (NfLD, 365)

The Principle of Substitution for Sense (SS/C) One consideration for this principle comes from Frege's doctrine that in indirect context, words refer to their customary sense, and so substitution of reference in these contexts (i.e. substitution of words with the same customary sense) preserves the thought expressed. So any passage propounding that idea is indirect evidence for (SS/C).

**1892** "Let us compare, for instance, two sentences 'Copernicus believed that the planetary orbits are circles' and 'Copernicus believed that the apparent motion of the sun is produced by the real motion of the Earth'. One subordinate clause can be substituted for the other without harm to truth. [RMH: i.e. reference] ... In such cases it is not permissible to replace one expression in the subordinate clause by another having the same customary reference, but only by one having the same indirect reference i.e. the same customary sense." (S&R, 149 emphasis added)

"In the sentence 'Columbus inferred from the roundness of the Earth that he could reach India by travelling towards the west' we have as the reference of the parts two thoughts, that the Earth is round and that Copernicus, by travelling to the west, could reach India ... it is not immaterial ["to the truth of the sentence"] whether we replace 'the Earth' by 'The planet which is accompanied by a mood whose diameter is greater than the fourth part of its own'. Here also we have the indirect reference of the words." (S&R, 150)

"Where we have a clause in indirect speech occurring within direct speech, and we replace a constituent clause by another which has the same [reference] in direct speech, then the whole which results from this transformation does not necessarily have the same [reference] as the original." (NfLD, 256)

Second, Frege does not allude to this principle as often as he does the sister principle for reference, and he often bundles his point about the substitution of co-referential (but not co-sensical) expressions together with the conclusion that reference (but not sense) of the result is preserved. For instance (we just change the emphasis in the above):

**1892** "Let us assume for the time being that the sentence has reference. If we now replace one word of the sentence with another having the same reference, but a different sense, this can have no bearing upon the reference of the sentence. Yet we can see that in such a case the thought changes." (S&R, 146 emphasis added)

The Principle of Failure: Reference (FR/C) Evidence for this principle would come from passages where a complex name, such as a sentence, would fail to have a truth value [reference] on condition that a part of it failed to have a truth value:

**1892** "The sentence 'Odysseus was set ashore at Ithaca while sound asleep' obviously has a sense. But since it is doubtful whether the name 'Odysseus', occurring therein, has a reference, it is also doubtful whether the whole sentence has one." (S&R, 146)

The Principle of Failure for Sense (FS/C) It is very hard to find clear textual evidence for this principle, since Frege is almost always concerned, in the relevant discussions, with the issue of when substitution of non-cosensical expressions fails to preserve the sense of the whole, especially regarding indirect contexts.

### **Textual Evidence: Compositionality<sup>43</sup>**

**1914** "As a sentence is generally a complex sign, so the thought expressed by it is complex too; in fact it is put together in such a way that parts of the thought correspond to parts of the sentence. So as a general rule when a group of signs occurs in a sentence it will have a sense which is part of the thought expressed." (LiM, 207-8, emphasis added)

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<sup>43</sup> Compare the following with Russell (1903): "When a word or phrase which both means and denotes occurs in a phrase, its meaning is a constituent of the meaning of the whole phrase, and its denotation of the denotation, or the meaning, according to circumstances." (284) Or with Russell (1918) "The proposition which asserts a fact consists of several words, each of which may occur in other contexts ... all propositions in which 'Socrates' occurs have to have something in common and again all propositions in which the word 'mortal' occurs have something in common... [they are] about Socrates or mortality." (1918, 52) "You can understand a proposition when you understand the words of which it is composed even though you have never heard the proposition before" (1918, 53)

- 1914** "It is remarkable what language can achieve. With a few sounds and combinations of sounds it is capable of expressing a huge number of thoughts, and, in particular, thoughts which have not hitherto been grasped or expressed by any man [RMH: note expressing here as a relation between a thought and a speaker] How can it achieve so much? By virtue of the fact that thoughts have parts out of which they are built up, and these parts, these building blocks, correspond to groups of sounds, out of which the sentence expressing the thought is built up, so that the construction of the sentence out of parts of a sentence corresponds to the construction of a thought by which they are expressed." (ibid, 225 emphasis added)
- 1914** "Language has the power to express, with comparatively few means such a profusion of thoughts that no one could possibly command a view of them all. What makes this possible is that a thought has parts out of which it is constructed and that these parts correspond to parts of sentences, by which they are expressed." (ibid, 243, emphasis added)
- 1914** "But a proposition consists of parts which must somehow contribute to the expression of the sense of the proposition, so they themselves must somehow have a sense. Take the proposition 'Etna is higher than Vesuvius'. This contains 'Etna', which occurs also in other propositions, e.g. the proposition 'Etna is in Sicily'. The possibility of our understanding propositions we have never heard before rests evidently on this, that we construct the sense of a proposition out of parts that correspond to the words." (LtJ, 79 emphasis added)
- 1918** "The world of thoughts has a model in the world of sentences, expressions, words, signs. To the structure of the thought there corresponds the compounding of words into a sentence." (N, 123, emphasis added)
- 1919** "A saturated part obtained by analyzing a thought can sometimes itself be split up in the same way into a part in need of supplementation and a saturated part. The sentence 'The capital of Sweden is situated at the mouth of Lake Maelar' can be split up into a part in need of supplementation and the saturated part 'the capital of Sweden'. This can further be split up into the part 'the capital of', which stands in need of supplementation, and the saturated part 'Sweden'. Splitting up the thought expressed by a sentence corresponds to such splitting up of the sentence." (NfLD, 255, emphasis added)
- "We can regard a sentence as a mapping of a thought: corresponding to the whole-part relation of the thought and its parts we have, by and large, the same relation for the sentence and its parts." (ibid, 255 emphasis added)
- 1923** "It is astonishing what language can do. With a few syllables it can express in incalculable number of thoughts, so that even a thought grasped by a human being for the very first time can be put into a form of words which will be understood by someone to whom the thought is entirely new. This would not be possible were we

not to distinguish parts in the thought corresponding to the parts of the sentence, so that the structure of the sentence serves as an image of the structure of the thought ... If, then, we look upon thoughts as composed of simple parts, and take these, in turn to correspond to the simple parts of the sentences, we can understand how a few parts of sentences can go to make up a great multitude of sentences, to which, in turn, there correspond a great multitude of thoughts. (CT, 1, emphasis added)

"As a vehicle for the expression of thoughts, language must model itself upon what happens at the level of thought ... Once we have come to an understanding about what happens at the linguistic level, we may find it easier to go on and apply what we have understood to what holds at the level of thought --to what is mirrored in language." (LG, not before 1923, 259, emphasis added)

Note the two types of isomorphism in these quotations: the idea of corresponding parts or constituents, and the idea of corresponding structure. These are in principle dissociable ideas: two things can share the same parts, but structure them differently, and two things can share a structure, but fill them with different parts. However, Frege usually sees these two correspondences as going hand in hand (per the underscored portions of 1914 and 1923), and this is related to why the issue of understanding novel sentences is always in the vicinity.<sup>44</sup>

### **Textual Evidence: Lexical Meaning**

There is, of course the notorious "context principle", but that was stated in terms of 'Bedeutung' before the sense-reference distinction and it is not clear how the principle fares when factored into sense and reference.<sup>45</sup>

Atomistic Sense It is hard to find passages which clearly suggest atomistic sense. Typically such

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<sup>44</sup> Note the time period of these remarks --1914 and after. It would be interesting to know the significance of this, if any, particularly in light of Frege's association with Wittgenstein in the period prior to this. However, on the Tractatus view, Fregean compositionality principles are suspect, since sentences have a "sense", but no reference, and constituent names have a reference, but no "sense". On the other hand, we find Wittgenstein saying "To understand a proposition means to know what is the case if it is true. (One can understand it, therefore, without knowing whether it is true.) It is understood by anyone who understands its constituents. (4.024) "It belongs to the essence of a proposition that it should be able to communicate a new sense to us." (4.027) "A proposition must use old expressions to communicate a new sense". (4.03)

<sup>45</sup> See Pelletier (2001) for an excellent, detailed survey of these issues.

passages can have another reading. For instance:

"The sense of a proper name is grasped by everybody who is sufficiently familiar with the language or a totality of designations to which it belongs." (S&R, ???)

"different expressions quite often have something in common, which I call the sense, or, in the special case of sentences, the thought ... we must not fail to recognize that the same sense, the same thought, may be variously expressed." (C&O, 46)

Holistic Sense Other passages suggest some kind of holistic sense:

"And so instead of putting a judgment together out of an individual as subject and an already previously formed concept as predicate, we do the opposite and arrive at a concept by splitting up the content of possible judgment ... I could compare this with the behavior of the atom: we suppose an atom never to be found on its own, but only combined with others, moving in and out of one combination only in order to enter immediately into another." (BLC&CS, 17)

This is particularly interesting in that it also suggests a kind of in-between position: words "have" senses independently of any particular context, but not independently of any context at all.<sup>46</sup>

### **Interpreting the Textual Evidence**

What sort of evidence do these quotations constitute for the principles of compositionality? Or more precisely, what sort of evidence do these quotations constitute for one of the following claims:<sup>47</sup>

1. Explicit Frege formulated such principles explicitly, and in full generality,
2. Belief Frege did not explicitly formulate such principles, but Frege believed them to be true (explicitly or implicitly i.e. dispositionally)<sup>48</sup>,

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<sup>46</sup> Never mind the oddity of the analogy --we are only asked to "suppose" atoms not to exist outside any molecule.

<sup>47</sup> Pelletier (2001), in his interesting and important study, poses the following question regarding compositionality for sense: "whether Frege believed it, or believed anything that directly implied it, as a central feature of his philosophical system. I will argue that he did not." (2001, 105 emphasis added). This could be true, yet it still be a feature of Frege's system.

<sup>48</sup> Dispositional in the sense that either he would have assented to them had he asked himself, or they follow fairly directly from beliefs he did hold explicitly.

3. Theoretical "Commitment" Frege's theory (or conception) of language is "committed", i.e. best seen as containing, such principles, though he never formulated them explicitly, and may not have believed them explicitly.<sup>49</sup>

The first claim may be false, as Pelletier (2001) has ably argued, but the last two may well be true. One of the best reasons to suppose that at least the third is true is inference to the best explanation: if his theory were committed to (and perhaps if Frege believed) the principles of compositionality, then the principles of substitution and failure would follow, and would not have to be stated as independent principles.<sup>50</sup>

After reviewing most of the above quotations, Pelletier comes to a variety of conclusions. First, regarding the substitution citations: (i) there is no "guarantee of functionality as required by compositionality" (ibid, 106) in the substitution quotations. That seems right. (ii) These quotations are "compositionality-friendly" (we can agree to that), but he then continues:

"... this cannot be taken as evidence without any straightforward statement on Frege's part that he embraces compositionality." (ibid)

This is controversial because if there was such a "straightforward statement" of compositionality we would not need to be collecting "evidence". We can agree that these citations cannot be taken as proof, but why not as evidence that his theory is committed to compositionality (by inference to the best explanation)?

Second, regarding the part-whole citations for sense: (i) Pelletier notes that:

"one would at least have to argue from this presumed 'mereological picture of Sinn' to the conclusion that compositionality followed. And I do not see that any of our commentators have done this ..." (ibid, 106)

Fair enough, but that might be because, short of a formal proof (involving formalization of mereological and compositional principles), the connection has been taken to be intuitive. For instance, given the intuitive supposition that the identity of a (complex) sense (and anything else

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<sup>49</sup> How are these related --are they ranked by "strength"? We assume that if something is explicitly stated it is explicitly believed, but that one could believe something implicitly and not explicitly. And one's theory could be "committed" to a position one does not hold explicitly, though one could be committed to believing it implicitly, if the connection were close enough. Thanks to Jeff Pelletier for discussion here.

<sup>50</sup> And Frege does not state them explicitly as general principles, though his wording suggests that this was his belief.

mereologically complex) is fixed by its parts plus their organization, then if one denies "functionality" one must deny one of these assumptions. I.e. suppose "functionality" is false, then two<sup>51</sup> (complex) senses could be made of the same parts in the same organization. But this contravenes the assumption that there is nothing more to such complexes than parts and organization. (ii) Pelletier sets aside the (1914 LiM) quotations because they occur in a discussion of definition, and so:

"it certainly does not seem that he is making compositionality be a central tenet of his semantic doctrines." (ibid, 107)

Two things here: on the one hand we have distanced ourselves from the issue of centrality, we just want commitment simpliciter. On the other hand, the first quotation talks about "a sentence" in full generality, not just in definitions --the qualification "as a general rule" would be pointless otherwise. So the quotation may have more punch than it is given credit for. (iii) Lastly, Pelletier is concerned in his article with whether compositionality can legitimately be called "Frege's Principle", and as Frege never articulated it explicitly:

"it would be pretty much as case of wishful thinking to call such a possibly-held-but-hardly-ever-mentioned-in public position 'Frege's Principle'." (ibid, 108)

We can again agree with that, but Pelletier is here after a different target than we are. We are not after compositionality as "Frege's Principle", but rather compositionality as a feature of Frege's theory.

In sum, we could agree with Pelletier's conclusion regarding his concern, and still hold that the quotations given are relevant to our concern of seeing whether or not there is evidence that Frege held, or Frege's theory was "committed" to, compositionality principles. We have argued "Yes" to that conclusion primarily on the basis of (i) inference to the best explanation based on fairly explicit principles of substitution and failure, (ii) mereological considerations regarding complex senses.

### **Conventional Signalling Systems**

Finally, Frege explicitly contrasts natural languages with "signalling systems" for communicating a limited number of thoughts.

**1914** "We could indeed adopt the convention that certain signs were to express certain thoughts, like railway signals ('The track is clear'); but in this way we would always be restricted to a very narrow area, and we could not form a completely new proposition, one which could be understood by another person even though no special convention had been adopted

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<sup>51</sup> Remember, senses are abstract entities, so we are not allowed two tokens of the same type --we are trading in types here.

beforehand for this case." (LtJ, 79)

## Conclusion

Apprehending a certain Thought is mentally tokening a linguistic type that expresses that Thought, and a speaker learns what Thought(s) a sentence expresses when they learn the language. If the "language" is a conventional signalling system, then the Thought expressed by each "sentence" must be learned separately, and so a new "sentence" would not be understood without knowing the convention beforehand. With natural languages the situation is fundamentally different. The structure of the Thought is isomorphic<sup>52</sup> with the structure of the sentence expressing it. Hence knowing the sense of the words, plus knowing how structures guide putting together these senses into a whole (or wholes), allows one to grasp a Thought expressed by a sentence one has never heard or understood before --no prior convention need be adopted beforehand (short of knowing the language). This isomorphism also suggests that one sequence of words can express more than one Thought provided that the sequence of words has two (or more) structures, each corresponding one of the two (or more) Thoughts. We have proposed that Frege thought that natural languages are compositional, though that claim remains to be clarified and defended from both its proponents, who claim too much for it (or contrariwise, cheapen its coin), and its critics, who also sometimes claim too much for it. We seek a moderate compositionality, a thinking person's compositionality, the kind of compositionality we trust Frege would have endorsed.

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<sup>52</sup> Note "as a general rule" in LiM 1914 above.

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