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Compositionality

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INTRODUCTION

'Compositionality' is used in two different senses, and sometimes the literature seems to be antagonistic because the discussants are employing the different senses. In one sense, let's call it the "ontological sense", some complex thing is compositional if it is identical with its parts (with due consideration to the way the parts are arranged). In another sense, let's call it the "functional sense", something is compositional if some *property* of a complex thing can be defined in terms of a *function* of the *same property* holding of its parts (with due consideration to the way the parts are combined). In formal semantics and philosophy of language, the complex things are (usually) *syntactically* complex items of language, and the property of interest is (usually) *meaning*. So the question of whether some complex thing is compositional is normally understood as asking whether the meaning of some complex piece of language is a function of the meanings of its parts together with consideration as to how those parts are syntactically combined. Many of the writings about compositionality have occurred in the philosophical literature, and there the contrast has often been with *meaning holism*. In the "formal" literature, the question has been about the conditions on a language (and associated meaning function) that will guarantee that there is *some* compositional semantics. Within the linguistics literature, much of the writing has been to show how some apparently non-compositional construction can be given a compositional treatment, or argue that it can't be. There has also been a separate discussion about the effects of context on meaning, and how that interacts with communication. Many of these works have broached the topic of whether and how context can be accommodated compositionally.

GENERAL OVERVIEWS AND DEFINITIONS

Most of the millions of works that deploy the notion of compositionality in any way at all will also make a statement as to what the author believes compositionality to be. But these statements are not usually accompanied by an analysis of terms used in their explanation. This section contains some works that analyze the notion of compositionality. Partee 2004 (originally published in 1984) is one of the earliest works on compositionality, introducing most of the issues that have been taken up by later writers. Pelletier 1994 discusses the relevance of compositionality to semantics, and surveys the various considerations that have been prominent in discussions of the notion. Dowty 2007 is written by one of the earliest authors of textbooks that employ the classical version of compositionality as put forward by Montague 1970 (see the section *Problem of Logic*). Hodges 1998 argues that many statements of compositionality are instead statements of some other (perhaps related) notion; notably, his discussion makes the Montague version be "not compositionality" and be the cause of what "lies behind the bid to describe [various claims about linguistics] as 'problems for compositionality'." Janssen 1997 also provides much historical detail concerning the development of compositionality. Jacobson 2012 describes a particularly "pure" version of compositionality. Pagin and Westerståhl 2010 offers a detailed exposition of the various terms employed in discussions of compositionality, while Sandu and Hintikka 2001 also discusses different interpretations of compositionality that are in the literature. Szabo 2007 is a large descriptive survey of work on compositionality together with some recommendations on which of the interpretations is best.

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Dowty, David. "Compositionality as an Empirical Problem." In *Direct Compositionality*. Edited by C. Barker and P. Jacobson, 23-101. Oxford: Oxford University Press, 2007.

The early portions of this article describe the variety of formulations that have been offered for compositionality, and tries to adjudicate among them.

Hodges, Wilfrid. "Compositionality is not the Problem" *Logic and Logical Philosophy* **6** (1998): 7-33.

Hodges analyzes the terms involved in defining 'compositionality', investigating the historical usage of the term and the general idea behind the term. This is a fundamental paper in the new understanding of compositionality.

Jacobson, Pauline. "Direct Compositionality." In *The Oxford Handbook of Compositionality*.

Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

A clear statement of the notion of direct compositionality—the idea that there should be no "movement rules" in the syntax and that each syntactic rule will give rise to a unique semantic interpretive rule.

Janssen, Theo. (1997) "Compositionality" in J. van Benthem & A. ter Meulen (eds.) *Handbook of Logic and Language* (Amsterdam: North-Holland) pp. 417-473.

This work includes many topics from Janssen's 1983 underground classic dissertation. It discusses various formal statements of compositionality and its relation to the "context principle".

Partee, Barbara H. "Compositionality" Reprinted in *Compositionality in Formal Semantics:*

Selected Papers of Barbara Partee Edited by Barbara Partee, 153-181. Oxford: Blackwell, 2004.

This article points out that there are various interpretations of the notion of compositionality, that some of the popular versions obviate the need for an "intermediate" level of representation, and a discussion of some putative violations of the principle. Originally printed in F. Landman and F. Veltman (Eds.), *Varieties of Formal Semantics* (Dordrecht: Foris) pp. 281-312, 1984.

Pagin, Peter and Dag Westerståhl. "Compositionality I: Definitions and Variants" *Philosophy Compass* **5** (2010): 250-264.

This portion of the two-part survey article explains the various terms used in definitions of compositionality, and provides a variety of different formulations of the notion. The logical relationships among the different formulations are shown.

Pelletier, Francis Jeffry "The Principle of Semantic Compositionality" Reprinted, with additions, in *Semantics: A Reader*. Edited by S. Davis and B. Gillon, 133-156. Oxford: Oxford University Press, 2004.

Contains a discussion of the terms used in most statements of compositionality, such as 'meaning', 'function', 'whole', 'part', and the like. The position taken is that these terms are vague in their meaning and have given rise to differing accounts and criticisms of compositionality. Originally printed in *Topoi* **13** (1994): 11-24.

Sandu, Gabriel and Jaakko Hintikka. (2001) "Aspects of Compositionality" *Journal of Logic, Language and Information* **10**: 49-61.

Introduces three different senses of 'compositionality' and shows how they are related by applying Hodges' Theorem (Hodges 2001 in the section * Problem of Logic*.) to the Hintikka/Sandu version of logics of imperfect information (within "independence friendly languages").

Szabó, Zoltán. (2007)

"*Compositionality[<http://plato.stanford.edu/archives/spr2007/entries/compositionality>]*" In E. Zalta (ed.) *Stanford Encyclopedia of Philosophy*.

This thorough discussion of the philosophical aspects of compositionality includes the author's earlier views of compositionality as supervenience...which is one of the standard viewpoints concerning the topic.

HISTORICAL ANTECEDENTS

Many scholars trace the conscious employment of a notion of compositionality to Gottlob Frege (1848—1925). However, there are also scholars who doubt this attribution. When discussing this principle in the context of Frege, it is important to pay attention to his mid-career introduction of the Sense-Reference distinction. While it is widely thought that Frege held the principle of compositionality for Reference, it is argued by some (Janssen 2001, Janssen 2012, Pelletier 2001) that it is less clear that he held it for Sense. Carnap 1947 first attributed the principle to Frege, and Dummett (Dummett 1981a, Dummett 1981b) both found places where it might plausibly be thought to occur in Frege. Besides studying Frege for this notion, there have been attempts to find it at work in earlier works, especially in the non-Western tradition. Hodges 2006 and Pagin and Westerståhl 2010 investigate such places. In the modern era, the term seems to have been employed for the first time in something like the modern sense by Katz and Fodor 1963.

Carnap, Rudolf. (1947) *Meaning and Necessity* (Chicago: University of Chicago Press).

Carnap was the first to call compositionality 'Frege's Principle', and to attribute both compositionality for Reference and compositionality for Sense to Frege (p. 121).

Dummett, Michael. *Frege: Philosophy of Language*, 2nd Edition. Cambridge: Harvard University Press, 1981a.

Dummett (pp.152ff) identifies compositionality of sense as the first of the important theses of Frege's, and cites numerous places in Frege's writings where this is suggested. However, Dummett also identifies Frege's "context principle" as a basic thesis of Frege's. So the apparent tension between compositionality and contextuality is a basic interpretative crux for understanding Frege. Much of these books is taken up with that issue.

Dummett, Michael. *The Interpretation of Frege's Philosophy*. London: Duckworth, 1981b.

This work also touches on much of the same issues concerning compositionality as Dummett 1981a, but in a somewhat wider arena where a larger portion of Frege's philosophical interests are considered.

Hodges, Wilfrid. (2006) "Two doors to open". In D. Gabbay, S. Goncharov, and M.

Zakharyashev (eds.), *Mathematical Problems from Applied Logic I: New Logics for the 21st Century* (New York: Springer), pp. 277–316.

In Part 2 of this article, Hodges traces the notions involved with the "infinity of language" as they appear in medieval Arabic linguists and commentators. He also remarks on some

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unpublished work of Brendan Gillon's that finds similar sentiments in the Sanskrit linguist Patanjali, in his commentary on Panini.

Janssen, Theo. (2001) "Frege, Contextuality and Compositionality" *Journal of Logic, Language and Information* **10**: 115-136.

Discusses the relative importance of compositionality and contextuality in Frege's writings, taking a chronological approach to investigate the development of Frege's thoughts on the two concepts. Janssen concludes that Frege embraced contextuality throughout his career, and that the various places where one is tempted to read compositionality (such as those places where he appears to employ the argument from understandability) can be otherwise explained.

Janssen, Theo. "Compositionality: Its Historic Context." In *The Oxford Handbook of Compositionality*. Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

Discusses the development of compositionality and contextuality from mid-19th century, through Frege, to its modern employment. Although both principles were discussed in the early days, it was contextuality that was accepted. Janssen concludes with the view that compositionality nowadays is accepted for "practical reasons", not for principled ones.

Katz, Jerrold and Jerry Fodor. "The Structure of a Semantic Theory" *Language* **39** (1963): 170-210.

This article seems to be the first to use the term 'compositionality' in more or less the modern sense – even though the authors seem to be more concerned with lexical composition than composition in larger portions of syntax.

Pagin, Peter and Dag Westerståhl. "Compositionality I: Definitions and Variants" *Philosophy Compass* **5** (2010): 250-264.

Part 1 of this first part of their two-part article discusses "particular semantic analyses that are in fact compositional" that were given by early theorists. As examples they mention Plato, 'Sabara, Jaimini, Abelard, Buridan, Peter of Ailly, and Frege. However, it seems that the pre-Frege thinkers didn't really have an idea of compositionality in quite the modern manner.

Pelletier, Francis Jeffry (2001) "Did Frege Believe Frege's Principle?" *Journal of Logic, Language and Information* **10**: 87-114.

This paper argues, by looking at a wide variety of Frege's texts, that he held neither the principle of compositionality nor the principle of contextuality in any firm manner. It also evaluates the various attempts made by scholars who claim that Frege held *both* principles.

COLLECTIONS

There are only a small number of collections that focus on compositionality, all of which have been put together in the last decade. The most thorough is Werning, Hinzen, and Machery 2012, and it is expected to be the standard reference for topics involved in compositionality, although it is perhaps geared more towards philosophical issues than to linguistic issues. Pagin and Westerståhl 2001 contains many papers that are regarded as foundational in the various aspects of the topic. Unfortunately, Machery, Werning and Schurz 2005 and Werning, Machery and Schurz 2006 are often quite difficult to obtain, but many of the authors of papers in these volumes

(as well as in Pagin and Westerstahl 2001) have written contributions Werning, Hinzen, and Machery 2012. Barker and Jacobson 2007 describes a particular direction within linguistics that employs compositionality.

Barker, Chris and Pauline Jacobson, eds. *Direct Compositionality*. Oxford: Oxford University Press, 2007.

This book examines the hypothesis of "direct compositionality", which requires that semantic interpretation proceed in tandem with syntactic combination. This was the dominant view in formal semantics of the 1970s and 1980s, and the present volume is an attempt at reviving it by considering a number of different phenomena in various languages.

Pagin, Peter and Dag Westerståhl, eds. Special Issue of *Journal of Logic, Language and Information* "Compositionality: Current Issues" vol. 10/1, 2001.

This special issue contained six articles plus introduction, and all of them have attained a special place within the area of compositionality. The articles will find their place in other areas of this article.

Machery, Edouard, Markus Werning and Gerhard Schurz, eds. *The Compositionality of Meaning and Content. Volume 1: Foundational Issues*. Frankfurt: Ontos Verlag, 2005.

Volumes 1 and 2 of this two-volume set are the result of a very successful two-part conference. Volume 1 of this two-volume set reports the papers that were presented in the first of the two parts, which was held in Düsseldorf.

Werning, Markus, Edouard Machery and Gerhard Schurz, eds. *The Compositionality of Meaning and Content. Volume 2: Applications to Linguistics, Psychology and Neuroscience*. Frankfurt: Ontos Verlag, 2006.

Volume 2 of the two-volume set reports the papers from the second portion of the two-part conference, which was held in Paris. . The second volume represents this second part. These conferences and the resulting papers are, to some considerable degree, responsible for the modern interest in compositionality.

Werning, Markus, Wolfram Hinzen and Edouard Machery, eds. *The Oxford Handbook of Compositionality*. Oxford: Oxford University Press. 2012.

This is the result of a very intensive search for accounts of the role of compositionality in very many areas of philosophy and formal semantics. The authors of the articles are well-known in the area, and most of them have contributed to the other volumes mentioned above in this category.

PRO-ARGUMENTS

Arguments in favor of compositionality take one of two forms: (a) it is the only coherent, or anyway the best, way to organize a linguistic theory, (b) it is the only way to account for the way language can be employed. The former style of argument is often seen as "a matter of aesthetic taste in theory-construction", but the latter style is usually taken to be quite telling. This latter style turns on a feeling of "unboundedness" in aspects of people's use of language: that people can understand an unbounded number of distinct sentences, that people can employ novel sentences to express thoughts that are new to them, that children learn the meanings of an unbounded number of sentences, and that people can produce sentences that they've never before heard. These four arguments have respectively been called "the argument from

understandability”, “the argument from creativity”, “the argument from learnability”, and “the argument from productivity”. The conclusion of any of these arguments is that semantic theory must be compositional, since that is the only (or: the only known) way that people could have such abilities. Almost every work on compositionality mentions one or another of these arguments, so we will restrict our attention to those who discuss the argumentation in more detail.

In Favor of Unboundedness Arguments

This style of argument is usually traced to Frege 1963. Davidson 1965 and Davidson 1967 brought these considerations to the attention of modern philosophers. Grandy 1981 added an important consideration to these arguments: that learning an infinity of things was not essential, since if the amount learned was finite but sufficiently large, the arguments retain their force.

Davidson, Donald. (1965) “Theories of Meaning and Learnable Languages” in Y. Bar-Hillel (ed.) *Proceedings of the International Congress for Logic, Methodology, and Philosophy of Science* (Amsterdam: North-Holland) pp. 383-394.

Here Davidson emphasizes the idea that any adequate theory of language must show how it is possible for people to have learned language, and he emphasizes the role that compositionality would play.

Davidson, Donald. “Truth and Meaning” *Synthese* 17 (1967): 304-328.

Although the argument from creativity can be found in Frege, the version that emphasizes learnability and understandability was brought to philosophers’ attention by these two very influential articles of Davidson’s.

Frege, Gottlob. Translated by R. Stoothof as “Compound Thoughts” in *Mind* 72: 1-17 (1963).

The opening two paragraphs of this work are usually taken to be the first clear statement of (what is now called) the arguments from productivity and understandability. Originally published in 1923 as “Logische Untersuchungen. Dritter Teil: Gedankengefüge” *Beiträge zur Philosophie des Deutschen Idealismus III*, 36-51.

Grandy, Richard “Understanding and the Principle of Compositionality” *Philosophical Perspectives* 4 (1990): 557-572.

An evaluation of the force of the Argument from Understanding. Notable in the article is the now commonly-cited fact that one needn’t employ the notion of infinity in these arguments—even a very large finite number will make the point quite well.

Opposed to Unboundedness Arguments

Although almost every writer pays homage to the Unboundedness arguments, it has frequently been noted that they are “inferences to the best explanation”. That is, the unboundedness is acknowledged, and then it is pointed out that the argument only says that compositionality is one way this could be accomplished. This means that there might be other explanations that could be better. Some other writers have complained that compositionality by itself doesn’t really give enough restrictions really to account for the unboundedness. Pelletier 2004 claims that his notion of semantic groundedness could also explain the unboundedness phenomena. And in Pelletier 2012 he claims that there are many forms of semantic atomism that are not compositional which can explain them also—it is atomism, not compositionality, that carries the explanatory force. Werning 2005 points to non-compositional systems that are nonetheless productive in the sense required by the Productivity Argument. And Schiffer 1986 claims that considerations of belief

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statements show that compositionality is false, even though there is unboundedness in natural languages. Robbins 2002 argues more radically that the facts of conceptual combination tell against compositionality of language and of mind. Pagin & Westerståhl 2010 wish to add restrictions on the sort of computability that is associated with the composition function. Szabó 2010 claims that the classic unboundness arguments don't carry over to the consideration of semantic-content-in-context, and other types of argument are required.

Pagin, Peter and Dag Westerståhl. "Compositionality II: Arguments and Problems" *Philosophy Compass* 5 (2010): 265-282.

The first portion of this second part of the two-part article discusses the arguments from learnability, novelty, productivity, systematicity, synonymy, intersubjectivity, and communication. It also includes a discussion of the role of computability in defining an appropriate compositional function.

Pelletier, Francis Jeffry "The Principle of Semantic Compositionality" Reprinted, with additions, in *Semantics: A Reader*. Edited by S. Davis and B. Gillon, 133-156. Oxford: Oxford University Press, 2004.

Elaborates the arguments from learnability, understandability, and creativity. Points out that these are abductive arguments for "compositionality being the best conclusion", and claims that the learnability (etc) facts can be explained as well by his theory of "semantic groundedness". Originally printed in *Topoi* 13 (1994): 11-24.

Pelletier, Francis Jeffry. "Holism and Compositionality." In *The Oxford Handbook of Compositionality*. Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

In this article, the arguments concerning learnability, productivity, understandability and creativity are claimed to be telling against theories of meaning holism. But if meaning holism is contrasted with meaning atomism, then this forms an argument for atomism. And although compositionality is a form of meaning atomism, it is claimed to be just one of a variety of different types.

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Patterson, Douglas. "Learnability and Compositionality" *Mind and Language* 20 (2005): 326-352. Argues that while considerations of learnability might require compositionality, they actively tell against Fodor's notion of "reverse compositionality".

Robbins, Phillip. "How to Blunt the Sword of Compositionality" *Nous* 36 (2002): 313-334.

Considers the argument that the facts about conceptual combination does not support compositionality. Since Robbins takes concepts to be the meanings of linguistic items, he concludes that natural languages are also not compositional. Also considered are "two-factored" theories of meaning with wide and narrow semantics. Robbins gives a discussion about compositionality for both aspects.

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Schiffer, Stephen. (1986) "Compositional Semantics and Language Understanding" in R. Warner & R. Grandy (eds.) *Philosophical Grounds of Rationality* (Oxford University Press) pp. 175-208.

An argument to the conclusion that no natural language has a compositional semantics. The argument proceeds by arguing that compositionality implies that belief statements are "relational" (between a believer and a proposition/mental representation, sentence, etc.),

and then arguing that this latter is false. Hence, natural languages do not have a compositional semantics. Thus the understandability requirement must have a different footing than compositionality.

Szabó, Zoltán. "The Determination of Content" *Philosophical Studies* **148** (2010): 253-272.

The topic here is the semantic content of an expression in a context of utterance. It is claimed that the traditional productivity and *systematicity* arguments cannot establish that a complex expression is compositionally determined from its structure and parts in this setting, and a new argument is given.

Werning, Markus. "Right and Wrong Reasons for Compositionality" In *The Compositionality of Meaning and Content. Vol. 1: Foundational Issues*. Edited by M. Werning, E. Machery, and G. Schurz, 285-309. Frankfurt: Ontos Verlag, 2005.

Evaluates the plausibility of the various "unboundedness of language" arguments as reasons to embrace semantic compositionality: particularly, productivity, *systematicity* and inferentiality. His conclusion is negative: productivity can occur in non-compositional languages, systematicity is not relevant to compositionality but instead to semantic categories, and there is no proof that inferentiality can occur only in compositional languages.

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FORMAL PROPERTIES

There have been a number of works that have analyzed the logical or mathematical features of some definition or other of compositionality. Some of these works prove claims about the class of languages to which a compositional semantics can be given. A recent trend in the formal analysis of compositionality started with the work of Wilfrid Hodges. *That sort of material is the focus of the sub-section "Problem of Logic". A separate issue is the question of whether compositionality is "formally vacuous".*

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Potential Formal Vacuity

Compositionality would be formally vacuous if it were the case that any language whatsoever can be given a compositional semantics. For then it would be only a matter of taste or methodological preference – and not an empirical claim – that such and so language was compositional. Although the topic had been discussed in many articles, such as Partee 2004 (in the section *General Overviews and Definitions*), it attained more prominence with the publication of Zdrozny 1994. This article spawned responses like Westerståhl 1998, Kazmi and Pelletier 1998 and Dever 1999.

Dever, Josh. "Compositionality as Methodology" *Linguistics and Philosophy* **22** (1999): 311-326.

A detailed response to Zdrozny's 1994 claim to construct a compositional semantics from any semantics at all. Dever shows that it always relies on what he calls "occult meanings", and that the "ordinary, manifest meanings" never play a role.

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Kazmi, Ali and Francis Jeffry Pelletier. "Is Compositionality Formally Vacuous?" *Linguistics and Philosophy* **21** (1998): 629-633.

A response to Zdrozny 1994 which complains that the technical apparatus being employed makes use of the string, in addition to the meaning, when doing the conversion to a compositional semantics. And that we haven't really been given a compositional semantics for the *same* meanings.

Westerståhl, Dag. "On Mathematical Proofs of the Vacuity of Compositionality" *Linguistics and Philosophy* **21** (1998): 635–643.

Discusses the various ways that theorists have attempted to prove that compositionality is vacuous, in the sense of there always being a compositional semantics for any grammar whatsoever. Westerståhl considers the attempts by Janssen, Hendricks, van Benthem, and Zadrozny in this regard, and finds implausible presuppositions in each.

Zadrozny, Wlodek. "From Compositional to Systematic Semantics" *Linguistics & Philosophy* **17** (1994): 329–342.

This paper famously claims to prove that *any* semantics can be turned into a compositional semantics that maintains the same meaning relations. It has garnered many replies.

Problem of Logic

The meta-logical characterization of compositionality started with Montague 1974, and was discussed in the 1980s by various logicians. The publication of Pagin and Westerståhl 2001 (in the section *Collections*) marked a new beginning in the formal studies, especially by including Hodges 2001 and Hendriks 2001. Follow-up papers to Hodges include Pagin 2003 and Westerståhl 2004, as well as Hodges 2012.

Hendriks, Herman. "Compositionality and Model-Theoretic Interpretation" *Journal of Logic, Language and Information* **10** (2001): 29–48.

Hendriks' reformulation of Montague's theory (Montague 1974) used a many-sorted algebra rather than Montague's single-sorted one. Hendriks argues against Montague's requirement that syntax and semantics be "similar" algebras, and urges the more liberal requirement that syntax be "interpretable" into semantics. Hendriks claims this is a clearer formulation of the roles played by intermediate languages, *by* "model-theoretic interpretation" of a grammar, and *by* "meaning postulates".

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Hodges, Wilfrid. "Formal Features of Compositionality" *Journal of Logic, Language and Information* **10** (2001): 7–28.

Hodges initiated a new direction in studying compositionality, focusing attention onto synonymy and its properties rather than meaning. Laying down various restrictions on synonymy (such as full abstraction, co-finality or the "Husserl property"), the resulting theory of semantic properties can be analyzed. Hodges' innovation has moved the discussions of compositionality into both a new direction and a higher level of clarity.

Hodges, Wilfrid. "Formalising the Relationship between Meaning and Syntax." In *The Oxford Handbook of Compositionality*. Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

Hodges axiomatizes the notion of a constituent and proves that, under some weak conditions, a semantics defined on sentences always generates a compositional semantics on all expressions. The paper also contains a discussion of some of the historical antecedents to modern discussions, including those coming from the Arabic tradition.

Montague, Richard. "Universal Grammar" Reprinted in *Formal Philosophy: Selected Papers of Richard Montague*, 222-246. Edited by R. Thomason, New Haven: Yale University Press, 1974.

The classic place where compositionality was described and joined to the formal semantics for natural language. Compositionality here was described as a meaning algebra being a homomorphic image of the syntactic algebra. Compositionality became one of the main themes in linguistic semantics through the discussion of Montague's works by Partee 2004 (in *Works that Discuss Many Linguistic Constructions*). Originally printed in *Theoria* **36** (1970): 373-98.

Pagin, Peter. "Communication and Strong Compositionality" *Journal of Philosophical Logic* **32** (2003): 287-322.

Investigates various formal notions of compositionality and inverse compositionality within the Hodges 2001 framework. Argues that they call for a notion of structured proposition in order to account for synonymy and for communicative success.

Westerståhl, Dag. "On the Compositional Extension Problem" *Journal of Philosophical Logic* **33** (2004): 549-582.

Considers the problem of extending a compositional semantics that is partial (only covers a portion of the language) to a complete compositional semantics. Illustrates several ways this might occur in practice, and shows that there is a "weak" condition (viz., that the set of meaningful terms is closed under subterms) from which it can be guaranteed that there is a compositional extension.

NON-STANDARD INTERPRETATIONS AND ALTERNATIVES

Over the years, a variety of somewhat different understandings of what compositionality applies to and how it is to be understood, have been put forward. For example there is the Deflationary Understanding, Strong Compositionality and the Fuzzy Theory of Compositionality. Additionally, there have been slight(?) alterations and additions to compositionality such as Reverse Compositionality, Semantic Groundedness, and Systematicity. Striking against all these has been the Simpler Syntax Hypothesis.

Deflationary Theory

A deflationary theory of compositionality tries to show that compositionality "automatically follows" from other principles, and hence is not therefore an independent constraint on anything. This understanding of compositionality is associated with Horwich 1998. It was strongly attacked in Fodor & Lepore 2001, but was in turn defended in Horwich 2001. In the meantime, Robbins 2001 investigated what remains of the arguments in favor of compositionality if we adopt the deflationary understanding. And Rauti 2009 asks whether the deflationary principle can be derived from considerations brought forth from related fields.

Fodor, Jerry and Ernie Lepore. "Why Compositionality Won't Go Away: Reflections on Horwich's 'Deflationary' Theory" *Ratio* **14** (2001): 350-368.

Fodor & Lepore argue against Horwich's deflationary theory that he confuses metaphysical theories about meaning with epistemological theories of what makes it true that a language-user understands an expression. Compositionality is deflatable when one abstracts from its role in explaining productivity, systematicity and the like, but that is the main rationale for compositionality, and so it should not be abstracted from.

Horwich, Paul. *Meaning*. Oxford: Oxford University Press, 1998.

Gathers a number of articles of Horwich's on deflationary theories of meaning; particularly on his deflationary theory of compositionality of meaning. According to his theory, compositionally turns out to be "automatically satisfied" as part of a theory of understanding a complex expression, imposing no constraint on how the meaning properties of words are constituted. Complex expression understanding is similar to a "translation manual."

Horwich, Paul. "Deflating Compositionality" *Ratio* **14** (2001): 369–385.

This is a defense of Horwich's deflationary theory of compositionality against the attack of Fodor & Lepore 2001. One crux of this defense is that a certain 'uniformity assumption' is false, namely the assumption that if meanings of lexical items are determined by a given class of properties (e.g., their inferential roles) then so too are the meanings of complexes made up of these items.

Rauti, Antonio. "Can We Derive the Principle of Compositionality (If We Deflate Understanding)?" *Dialectica* **63** (2009): 157-174.

Rauti considers Horwich's claim that a kind of compositionality principle "automatically follows" from a deflationary account of understanding a complex expression. But he claims that Horwich doesn't present a detailed derivation, and so Rauti provides one such. But the account is circular, and Rauti argues that any other such derivation is also likely to be circular.

Robbins, Philip. "What Compositionality Still Can Do" *Philosophical Quarterly* **51** (2001): 328-336.

Argues that both a "strong" and a "weak" version of deflationism about meaning is credible. In particular, Robbins argues that weak deflation (which is held to be more plausible) cannot be maintained in conformity with deflationist commitments to explaining meanings of complex expressions in compositional terms (by appeal to facts about the lexicon).

Reverse Compositionality

Reverse compositionality, as introduced by Fodor, is the view that, in a complex expression, each part "contributes the whole of its meaning" to the complex (Fodor 1998a and Fodor 1998b). As stated, it seems to imply that the meaning of a word is derivable from the meaning of *any single* complex containing it (and syntactic rule's semantic effect). Many writers have thought this implausible (Robbins 2005, Johnson 2006, Patterson 2005), but Pagin's 2003 re-description of the point of reverse compositionality's role in communication is quite interesting.

Robbins, Philip. "The myth of Reverse Compositionality" *Philosophical Studies* **125** (2005): 251-275.

Considers arguments given (by Fodor) in favor of reverse compositionality, and finds them wanting. Also gives two arguments against reverse compositionality.

Johnson, Kent. "On the Nature of Reverse Compositionality" *Erkenntnis* **64** (2006): 37-60.

Johnson thinks there is a fundamental flaw in reverse compositionality, but which flaw depends on whether the principle is viewed as a metaphysical or an epistemological thesis. Johnson also gives many "empirically plausible" counterexamples to the principle,

which deserve attention by anyone wishing to formulate some principle similar to reverse compositionality.

Jerry Fodor. "There are no Recognitional Concepts — Not even RED". Reprinted in *In Critical Condition*, 34-48. Edited by Jerry Fodor. Cambridge, MA: MIT, 1998a.

Here Fodor introduces the notion of reverse compositionality, arguing that concepts cannot be prototypes, stereotypes, exemplars, etc. Also, reverse compositionality shows that a concept cannot express more than what the concept contributes to a complex concept in which it occurs. So, a complex concept cannot contain "emergent features" that are not already present in component concepts. **Originally printed in *Philosophical Issues* 9 (1998).**

Jerry Fodor. "There are no Recognitional Concepts — Not even RED, Part 2: The plot thickens". In *In Critical Condition*, 49-62. Edited by Jerry Fodor. Cambridge, MA: MIT, 1998b.

In this article, Fodor argues that Reverse Compositionality prohibits recognitional concepts (e.g., RED). In general, one cannot understand a complex concept without understanding the simpler ones that comprise it. Finally, what is said here about concepts goes for the semantics of natural language. (Importantly, reverse compositionality also features in Fodor and Lepore 2001 [in the section "Deflationary Theory"].)

Pagin, Peter. 'Communication and Strong Compositionality.' *Journal of Philosophical Logic* **32** (2003): 287–322.

Compositionality must be a function that is effectively computable, and also be cognitively *symmetric* in the sense that both a producer and an interpreter can employ it. This calls for an *inverse* notion of compositionality. Compositionality and inverse compositionality together are called 'strong compositionality'. Time is spent on the question of whether English is inversely compositional.

Patterson, Douglas. "Learnability and Compositionality" *Mind and Language* **20** (2005): 326–352.

Argues that the learnability argument for compositionality is actively opposed to reverse compositionality. Furthermore, some facts about ignorance of meaning in a natural language show that the natural languages can't be reverse compositional. Also, arguments in favor of complex meanings having a structure are criticized.

Semantic Groundedness

Semantic groundedness is explained in Pelletier 2004 as a kind of semantic atomism...all terms in the language have some specific value, and meaning is not "holistically" explained. But this is not strictly speaking compositionality, because not everything needs its meaning to be defined in terms of the meanings of its syntactic parts.

Pelletier, Francis Jeffry "The Principle of Semantic Compositionality" Reprinted, with additions, in *Semantics: A Reader*. Edited by S. Davis and B. Gillon, 133-156. Oxford: Oxford University Press, 2004.

Semantic groundedness is defined as a sort of atomism (with a computability constraint), and is urged as a way to capture the desirable features of compositionality and yet violate the specific aspects of compositionality that are found to be false. Originally printed in

Simpler Syntax Hypothesis

The idea behind the Simpler Syntax Hypothesis that is explained in Culicover and Jackendoff 2006 (and many other articles by the authors separately) is that "syntax should trump semantics". If there is a choice between a very pleasing simple syntax that is not semantically compositional and a very complex and syntactically-unmotivated syntax which is semantically compositional, one should always choose the simple syntax. *This is a methodology that is opposed by most linguists who are concerned to maintain compositionality: they will "syntactically complicate" an apparently simple and straightforward syntactic analysis of some construction so that the resulting syntax allows for a compositional semantic account.*

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Culicover, Peter and Ray Jackendoff. "The Simpler Syntax Hypothesis" *Trends in Cognitive Science* 10 (2006): 413-418.

The position in this work poses a challenge to compositionality in semantics. The idea is that "the simplest syntax" which will account for all the standard syntactic features of a natural language (English, in their example) will be non-compositional in its semantics. So one needs to choose: adequate syntax? Or inflate the syntax merely to save compositionality?

Strong Compositionality

Strong compositionality is introduced as an explanation of the notion that is in common use in linguistics (although possibly not what is commonly understood in philosophy of language). It should be noted that this use is different from Pagin's 2003 use of 'strong compositionality' (in the section *Communication*). Larson & Segal's 1995 notion is what Pagin called 'compositionality', whereas Larson & Segal's 'compositionality' is a weaker principle to the effect that meaning depends on total structure and meanings of simple expressions.

Larson, Richard and Gabriel Segal. (1995). *Knowledge of Meaning: An Introduction to Semantic Theory*. (Cambridge, MA: MIT Press).

The authors of this textbook introduce constraints on semantic theory called 'strictly local' and 'purely interpretive'. Together these are called 'strong compositionality', and this notion is widely appealed to by many linguistic-oriented theorists. This definition is in the section pp. 78-82; see also the remarks pp. 11-16 and 54-56.

Systematicity

Systematicity is the idea that one does not come to know one sentence at a time, but rather learns a group of different sentences all at once. A standard example is that if you know that 'John loves Mary' is a well-formed sentence, then you will also know that 'Mary loves John' also is a well-formed sentence. This notion was introduced in Fodor 1987, but the main place that attracted attention to it was Fodor & Pylyshyn 1988, where it was employed in an argument that connectionist theories can't have systematicity, and hence were inadequate models of the mind. This conclusion was widely attacked by neural network theorists and their allies, such as in Chalmers 1993, Hadley 1994 and Aizawa 2003. Others have complained that systematicity is not in fact a feature of language or language learning, for instance Johnson 2004 and Pullum & Scholz 2007.

Aizawa, Kenneth. *The Systematicity Arguments*. Dordrecht: Kluwer, 2003.

This book investigates the logic of the “argument from productivity” and the “argument from systematicity”. The starting point for this book is the systematicity objection to connectionism in Fodor & Pylyshyn 1988.

Fodor, Jerry. *Psychosemantics*. Cambridge, MA: MIT Press, 1987.
Systematicity is introduced and explained on pp. 147-150.

Fodor, Jerry and Zenon Pylyshyn (1988) “Connectionism and Cognitive Architecture: A Critical Analysis” *Cognition* **28**: 3–71.

The famous “systematicity objection” to connectionist models of cognition is first brought out in this piece. The discussion sparked a vast literature throughout the 1990s concerning the role of representations within connectionism.

Chalmers, David. “Connectionism and Compositionality: Why Fodor and Pylyshyn Were Wrong” *Philosophical Psychology* **6** (1993): 305-319.

Challenges Fodor/Pylyshyn 1988 on both theoretical and empirical grounds. Chalmers claims that Fodor/Pylyshyn have conflated localist and distributed representations. The empirical evidence are examples where distributed representations support direct structure-sensitive operations, but not in a classicalist way.

Hadley, Robert. “Systematicity in Connectionist Language Learning” *Mind & Language* **9** (1994): 247-272.

Takes Fodor/Pylyshyn-systematicity as plausible, thinks that certain connectionist architectures appear to have answered certain understandings of the challenge, but also thinks that there are a series of ways understanding systematicity that have not been answered by these connectionist models. (The same issue contains replies by various connectionists and the next issue contains a response by Hadley.)

Kent Johnson (2004) “On the Systematicity of Language and Thought” *Journal of Philosophy* **101**: 111–139.

Objects to systematicity on the grounds that there is no formulation of the notion which will correctly describe natural language. Numerous violations of systematicity in English are cited.

Pullum, Geoff & Barbara Scholz. “Systematicity and Natural Language Syntax”. *Croatian Journal of Philosophy* **7** (2007): 375–402.

Gives various definitions of ‘systematicity’, showing that each seem to miss capturing the intent of the proponents of systematicity. These various definitions are formally shown to capture certain classes of languages and methodologies, none of which are what the proponents wish. In the end the authors despair of finding any definition of the concept that accords with natural language.

Fuzzy Theory

Fuzzy theory takes the attitude that sentences are not merely true vs. false, but rather can take any of the real number values between 0 (completely false) and 1 (completely true). This gives rise to a rather different notion of compositionality, as explained in Zadeh 1983.

Zadeh, Lofti. "A Fuzzy-Set-Theoretic Approach to the Compositionality of Meaning: Propositions, Dispositions and Canonical Forms" *Jour. Semantics* 2 (1983): 253-272.

Claims that compositionality as traditionally conceived does not have a very wide applicability to natural language; but it can be modified in a fuzzy logic context to be that the meaning of a proposition is composed from the meaning of a collection of fuzzy relations that form an "explanatory database" that is associated with the proposition.

ANTI-ARGUMENTS

A number of linguistic constructions have been thought to pose extreme difficulties for semantic compositionality. (Some more general considerations are raised under *Meaning Holism*, *Context in General*, and *Communication*). Authors divide into those who think the difficulties are unavoidable and hence compositionality is false, and those who work at finding a "compositional solution" to the construction. The case of Adjectives is the most commonly cited: 'red' in 'red wine', 'red wagon', 'red hair', 'red watermelon', 'red apple' means quite different things. This must be the effect of the noun it is modifying, yet that *modified noun* is not a part of the meaning of 'red', *and so compositionality is false. The "synonymy objection" works like this.* If expressions A and B are synonymous, then compositionality demands that any complex structures must mean the same, if they are otherwise identical except that one contains A where the other contains B. Yet some have claimed this to be violated. Similarly, a number of cases involving anaphora, genitives, verb phrase operators and relative clauses have been brought forward as counterexamples to compositionality. Since the direct quotation of a linguistic item changes its use from expressing meaning to naming itself, it has seemed to many that quotation must also violate compositionality. Yet many have worked on trying to give a compositional account of this phenomenon. Idioms are normally defined as violations of compositionality (i.e., where the meaning of the phrase is not determined by the literal meaning of the parts and their combination). Yet theorists have been at work trying to bring this phenomenon under the wing of compositionality. Finally, cognitive grammarians, who trace linguistic meaning to pre-existing mental operations and functions, have argued that this itself will show that compositionality is wrong.

Adjectives

Issues concerning adjectives are probably the most commonly-cited (alleged) counterexample to semantic compositionality, except possibly for concerns over non-linguistic context. The argument that adjectives violate compositionality often takes this form: 'red' in 'red wine', 'red wagon', 'red hair', 'red watermelon', 'red apple' means quite different things. This must be the effect of the noun it is modifying, yet that is not a part of the meaning of 'red'. **Jau: Please make sure subsection covers no more than 9 cited works. Please either remove 2 works from this subsection or add 3rd level section(s) to accommodate the additional works.]**

Adjectives in Context

The argument that the meaning of adjectives (and common noun phrases containing adjectives) are not compositionally describable can be found both in Travis 1997 and Lahav 1989, although they give rather different accounts of the phenomenon. This challenge has been criticized by Siebel 2000, Szabó 2001, Reimer 2002, Predelli 2005, Rothschild & Segal 2009, Kennedy & McNally 2010.

[▲] *Ran Lahav (1989) "Against Compositionality: The Case of Adjectives" Philosophical Studies 57:*

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261-279.

Lahav argues that the propositional content of an adjective varies with the noun it modifies. On this basis Lahav claims that adjectives violate compositionality, and that there is no "easy fix" to compositionality that accommodates this type of variation and at the same time explains productivity. (Lahav also generalizes this phenomenon to verbs.) This article has spawned many responses.

Christopher Kennedy & Louise McNally (2010) "Color, Context, and Compositionality" *Synthese* 174: 79-98.

This paper provides a linguistic perspective on the issue of color adjectives, which they believe defuses Travis's 1997 challenge. They provide empirical arguments that color adjectives are in fact ambiguous between gradable and nongradable interpretations, and that this simple ambiguity, together with independently motivated options concerning scalar dimension within the gradable reading, accounts for the Travis facts.

Stefano Predelli (2005). Painted leaves, context, and semantic analysis. *Linguistics and Philosophy*, 28, 351-374.

According to contextualism, utterances of non-elliptical, nonambiguous, and non-indexical sentences may be associated with contrasting truth-conditions. In this essay, Predelli grants the contextualist analysis of the sentences in question and the contextualist assessment of the truth-conditions for the corresponding utterances. But he argues that the resulting situation is not incompatible with the traditional approach to semantics.

Marga Reimer (2002) "Do Adjectives Conform to Compositionality?" *Philosophical Perspectives* 16: 183-198.

Reimer distinguishes "literal meaning" and "contextual meaning". Since "adj+noun" means "<noun> which is <adj>", these phrases are obviously compositional in their literal meaning. Reimer says that the terms are "contextual" in the same way that indexicals are: they mean the same across contexts but like an indexical, adjectives designate different things in different contexts. (Adjectives are "semantically underdetermined".)

Daniel Rothschild & Gabriel Segal (2009) "Indexical predicates" *Mind and Language* 24: 467-493.

The authors discuss the challenge to truth-conditional semantics presented by apparent shifts in extension of predicates such as 'red', as outlined by Lahav. They propose an explicit indexical semantics for 'red' and argue that their account is preferable to the alternatives on conceptual and empirical grounds.

Mark Siebel (2000) "Red Watermelons and Large Elephants: A Case Against Compositionality?" *Theoria (Madrid)* 15: 263-280.

Explains Lahav's 1989 argument using adjectives, but then provides a vigorous explanation and defense of the point of view of Fodor (something which is not done very often in the literature), with however two provisos that make Siebel think that more needs to be added to Fodor's theory.

Charles Travis (1997). Pragmatics. In B. Hale & C. Wright (Eds.), *A Companion to the Philosophy of Language* (Oxford: Blackwell) pp. 87-106.

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Deleted: Hans Kamp (1975) "Two Theories of Adjectives" in E. Keenan (ed.) *Formal Semantics of Natural Language* (Cambridge: Cambridge University Press), pp. 123-155. Kamp, like Katz 1964, considers adjectives to be noun-modifiers in the sense of the adjective's meaning being determined in part by the noun being modified...so that 'large mouse' amounts to "large for a mouse". But he also allows for further contextual factors to be relevant: 'Smith is a remarkable violinist' might be true in one context but false in another.

Jerrold Katz (1964) "Semantic Theory and the Meaning of 'Good'" *Journal of Philosophy* 61: 739-766.

Katz is working in the semantic theory developed in Katz & Fodor (1963), cited under "Historical Antecedents". His goal in the paper is to show how "an adequate semantic theory" can give a rigorous (and compositional) account of the meaning of philosophically interesting words, such as 'good'. His development of a semantic meaning for 'good' in terms of a "syncategorematic account" is noteworthy.

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Lahav argues that the propositional content of an adjective varies with the noun it modifies. On this basis Lahav claims that adjectives violate compositionality, and that there is no "easy fix" to compositionality that accommodates this type of variation and at the same time explains productivity. (Lahav also generalizes this phenomenon to verbs.) This article has spawned many responses.

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This is a more careful description of the "syncategorematic account" of adjectives that was offered by Katz 1964. Here we are introduced to different categories of such adjectives, such as 'subsective' (such as 'red'), 'alienating' (e.g., 'fake'), and 'neutral' (such as 'alleged').

Travis argues that structurally isomorphic sentences containing color adjectives can shift truth-value from context to context depending on how they are used and in the absence of effects of vagueness or ambiguity/ polysemy, and concludes that a deterministic mapping from structures to truth conditions is impossible. There are a number of examples that have become standard in the literature.

Zoltán Szabó (2001) "Adjectives in Context" In I. Kenesei and R. M. Harnish (eds.) *Adjectives in Context*. (Amsterdam: John Benjamin) pp. 119-146.

Discusses a variety of not-so-challenging challenges to compositionality before taking on Travis' examples of painted leaves. Szabó canvasses a number of possible solutions from a compositional viewpoint, and shows its similarity to older views in ethics about the meaning of 'good'. Szabó adopts an intensional language to develop this intuition, and then postulating a "hidden variable" that gets values in context in the adjective.

Adjectives and Syncategorematicity

Since the problem for compositionality seems to be that adjectives require information about the particular (type of?) noun it is modifying in order to give it the required meaning, one response has been to deny that adjectives have any "independent" meaning, but rather are functional terms that operate on nouns or common noun phrases. This idea goes back to Aristotle, who remarked that 'healthy' meant different things when applied to food, lifestyle, doctors, etc., but nonetheless had a "central meaning" that involved the noun being modified. And it has featured in many semantic treatments especially in the middle ages. But in more modern (formalistic) times it can be found in Katz 1964, and then again in Parsons 1972 and Kamp 1973. (Most modern references are to Kamp). Although none of these authors were especially concerned with compositionality, this treatment can be applied to the issues raised by Travis and Lahav (in the subsection "Adjectives in Context"...see also Szabó's and Reimer's contributions there for an application of this idea to compositionality).

Hans Kamp (1975) "Two Theories of Adjectives" in E. Keenan (ed.) *Formal Semantics of Natural Language* (Cambridge: Cambridge University Press), pp. 123-155.

Kamp, like Katz 1964, considers adjectives to be noun-modifiers in the sense of the adjective's meaning being determined in part by the noun being modified...so that 'large mouse' amounts to "large for a mouse". But he also allows for further contextual factors to be relevant: 'Smith is a remarkable violinist' might be true in one context but false in another.

Jerrold Katz (1964) "Semantic Theory and the Meaning of 'Good'" *Journal of Philosophy* **61**: 739-766.

Katz is working in the semantic theory developed in Katz & Fodor (1963), cited under "Historical Antecedents". His goal in the paper is to show how "an adequate semantic theory" can give a rigorous (and compositional) account of the meaning of philosophically interesting words, such as 'good'. His development of a semantic meaning for 'good' in terms of a "syncategorematic account" is noteworthy.

Terence Parsons (1972) "Some Problems Concerning the Logic of Grammatical Modifiers" in G.

Harman & D. Davidson (eds) *The Semantics of Natural Language* (Dordrecht: Reidel), pp. 127-141.

This is a more careful description of the "syncategorematic account" of adjectives that was offered by Katz 1964. Here we are introduced to different categories of such adjectives, such as 'subsecutive' (e.g., 'red'), 'alienating' (e.g., 'fake'), and 'privative' (such as 'alleged').

Ambiguity and Synonymy

If the meaning of a complex is entirely determined by the meanings of its parts and the way the parts are combined, then an ambiguous complex must either have ambiguous parts or be able to be put together in two different ways. But Pelletier 1994 challenged this. Likewise, if two complexes are put together in the same syntactic way, and out of pair-wise synonymous parts, then they must mean the same. But Pelletier 2000 challenged this also. Werning 2005 considers whether these are reasonable challenges.

Pelletier, Francis Jeffry. (1994) "Semantic Compositionality: The Argument from Synonymy" in R.Casati, B.Smith, G.White (eds) *Philosophy and the Cognitive Sciences* (Vienna: Hölder-Pichler-Tempsky) pp. 208-214.

This argument uses Mates-style violations, where synonymies are distinguished by means of a person not having the same intensional attitude toward each of the synonymies. It is argued that this constitutes a violation of compositionality.

Pelletier, Francis Jeffry (2000) "Semantic Compositionality: The Argument from Ambiguity and Free Algebras" in M. Faller, S. Kaufmann, M. Pauly *Formalizing the Dynamics of Information* (Stanford: CSLI Press), pp. 207-218.

If the syntax of a language is freely generated, then there can be no ambiguities other than lexical or (surface-) structural ones. And from this it follows that the language has a compositional semantics. But it is argued (a) that it is question-begging to assume this, and (b) there are examples that violate this stricture on ambiguity.

Werning, Markus. "Right and Wrong Reasons for Compositionality" In *The Compositionality of Meaning and Content. Vol. 1: Foundational Issues*. Edited by M. Werning, E. Machery, and G. Schurz, 285-309. Frankfurt: Ontos Verlag, 2005.

Discusses the constraints that unique readability and presence vs. lack of synonymy has on whether compositionality is a "vacuous constraint" and on other consequences of compositionality.

Anaphora, Genitives, and Verb Phrase Operators

These are some example linguistic constructions that have provoked questions about compositionality. Landman & Moerdijk 1983 is an early investigation into compositionality in Montague Grammar, focusing on the feature of Montague's analysis that requires an index on pronouns. Siegel 1987 looks at pairs of VPs that are not related by domination and yet one semantically wants one of the two VPs to have scope over the other. Partee 2004 investigates the very rich domain of genitive constructions. When one says "John's coat", for example, there are many different relations that might hold between John and the coat. This seems like a *prima facie* counterexample to compositionality, and Partee has investigated the phenomenon deeply.

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Pylkkänen 2008 looks at “adjuncts” to VPs and tries to give a compositional analysis of this sort of phenomenon.

Fred Landman & Ieke Moerdijk (1983) “Compositionality and the Analysis of Anaphora” *Linguistics and Philosophy* 6: 89-114.

Discusses the effect of compositionality on the form of grammatical rules within a Montague grammar containing a strong version of the compositionality principle. The examples under discussion concern anaphora that requires indexed pronouns and a version that employs Tanya Reinhart’s non-c-command condition.

Barbara H. Partee “The Genitive, a Case Study” (Appendix B to Theo Janssen “Compositionality.” Reprinted in *Compositionality in Formal Semantics: Selected Papers of Barbara Partee* Edited by Barbara Partee, 182-189. Oxford: Blackwell, 2004.

It is claimed that, although the problems with genitive constructions can be solved by positing a free variable and say that the genitive always expresses one argument of the relation. But further problems arise in that the resulting theory seems “inelegant”, according to Partee. Originally printed in *Handbook of Logic and Language*. Edited by J. van Benthem and A. ter Meulen, 464-470. Amsterdam: Elsevier, 1997.

Liina Pylkkänen, *Introducing Arguments*. Cambridge, MA: MIT Press, 2008.

This monograph offers a compositional theory of verbal argument structure in natural languages that focuses on how “non-core” arguments of the verb (arguments that are not introduced by verbal roots themselves) are introduced into argument structures.

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Muffy Siegel, “Compositionality, Case, and the Scope of Auxiliaries” *Linguistics and Philosophy* 10 (1987): 53-75.

Siegel discusses cases where a syntactic element of one verb phrase has to be interpreted as having scope over a separate verb phrase that it does not dominate. This is a prima facie failure of compositionality.

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Cognitive Grammar

Cognitive Grammar is a linguistic theory that takes as a starting point that psychological states and functions should serve as the basis for linguistic theory. Thus, factors such as how people understand new or unusual situations are employed to explain how sentences that describe such situations should be linguistically expressed. Pretty much all varieties of Cognitive Grammar are opposed to compositionality, usually on the grounds that the semantics of complexes involves “emergent properties”. This seems to be a complaint that the “ontological compositionality” version is false. But it is not yet proved, at least not by this reason, that the “functional compositionality” version is false. Langacker is one of the original writers on the theory of Cognitive Grammar, and Langacker 1987 is widely cited in discussions of compositionality within Cognitive Grammar. Coulson & Fauconnier 1999 use the types of materials that fall under the “Adjectives” category, but give a distinctively cognitive grammar account, which denies that these can be given a compositional description.

Seana Coulson, and Giles Fauconnier. “Fake Guns and Stone Lions: Conceptual Blending and Privative Adjectives.” In *Cognition and Function in Language*, 143-158. Edited by B. Fox, D. Jurafsky & L. Michaelis. Stanford: CSLI Press, 1999.

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This variety of cognitive grammar denies that there is compositionality because the complexes that are formed by “conceptual blending” and by methods that *construct* conceptual content, give rise to semantic properties not predictable from those of the parts. Hence, there will be “more” in the complexes than in the parts. The present article focuses on privative adjectives, such as *fake* and *stone* (when applied to lions).

Ron Langacker, *Foundations of Cognitive Grammar, Vol. I*. Stanford: Stanford University Press, 1987. Chapter 12 “Composition”.

Composition, as understood here, is the relation between ‘component structures’ and the ‘composite structure’ that derives from them. The composite structure results when two or more component structures blend or combine in some way. The given reason for denying compositionality is that the resulting composite structures can have “more meaning” than would be given by the ‘building block model’ of combination—which is identified with compositionality.

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Conditionals, Quantifiers and Related Constructions

Quantifiers in natural language give rise to difficulties for compositional semantics in three directions. First, as discussed in Cooper 1983, in sentences with multiple quantifiers there are (*semantically*) different “scopes” that the quantifiers can take, and these different scopes generate different meanings. But there seems to be but one syntactic analysis of such sentences. Cooper introduces a syntactic-semantic mechanism to deal with this problem. Second, not every language handles quantifiers in the same way as English. Bittner 1995 describes how Eskimo syntax works to prevent the standard methods of compositional semantic analysis in English for quantifiers. And third, the quantifier ‘any’ poses special problems because of its “ambiguous” nature that is resolved by sentential position. Hintikka 1980 shows that one standard explanation of the meaning of ‘any’ – as captured in his game-theoretic semantics – forces non-compositionality on such a quantifier. Higginbotham 2003 is a revised version of an earlier paper that challenged compositional analyses of quantified conditional sentences on the grounds that they seem to require a semantic understanding of the quantifier before one could adequately understand the connective being employed. But this violates compositionality because the connective is not a part of the quantifier phrase. This challenging paper has gathered responses from Pelletier 1994 and Leslie 2009, who offer differing types of solution to the apparent violation of compositionality.

Maria Bittner, “Quantification in Eskimo: A Challenge for Compositional Semantics”. In *Quantification in Natural Languages*, 59-80. Edited by E. Bach, E. Jelinek, A. Kratzer & B. H. Partee. Dordrecht: Kluwer, 1995.

(West Greenlandic) Eskimo is a heavily polysynthetic language in which the English distinctions between sentence adverbial quantification and nominal quantification exists but the surface constituent structure is very different from their English equivalents. These facts about a natural language can be seen as challenging the hypothesis that the truth conditions of sentences can be derived systematically by applying compositional semantic rules to independently motivated structures.

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Robin Cooper (1983) *Quantification and Syntactic Theory* (Dordrecht: Reidel).

Cooper introduced the technique “Cooper storage” to handle sentences that have no syntactic (nor lexical) ambiguity that corresponds to a semantic ambiguity of quantifier scope, where there is no corresponding syntactic ambiguity. Cooper proposed that in the

semantic evaluation, one “store” the quantifiers, then interpret the matrix, and then “remove” the quantifiers from the store. This (quasi?) compositional maneuver was adopted widely.

James Higginbotham (2003) “Conditionals and Compositionality” *Philosophical Perspectives* 17: 181–194.

This is a revision and updating of a 1986 paper of Higginbotham's that has been widely circulated underground, but was very difficult to get the published version of (which appeared in the proceedings of a Logic, Methodology and Philosophy of Science meeting). It famously describes cases where the interpretation of a lexical item (*unless* and *if*) depends on material that occur in other clauses. This forms a counterexample to compositionality.

Jaakko Hintikka (1980) “On the *Any*-Thesis and the Methodology of Linguistics” *Linguistics and Philosophy* 4: 101-122.

Within the game-theoretic approach to semantics favored by Hintikka, the *any*-thesis says that *any* is unacceptable if exchanging it for *every* yields an equivalent sentence. Hintikka claims that this shows that the set of sentences of English are not recursively enumerable. The *any*-thesis also violates semantic compositionality because one needs to check whether a putative meaning is or isn't the same as that of some different sentence.

Sarah-Jane Leslie (2009) “‘If’, ‘Unless’, and Quantification.” In R. Stainton & C. Viger (eds.), *Compositionality, Context, and Semantic Values* (Berlin: Springer) pp. 3-30.

A response to Higginbotham 2003, arguing that the steps he takes in trying to salvage compositionality from his own examples are unsatisfactory as accounts of *if* and *unless* in natural language. An account that takes them as restricting quantifier domains is argued to give a better analysis.

F.J. Pelletier (1994) “On an Argument Against Semantic Compositionality” in D. Prawitz & D. Westerståhl (eds) *Logic and Philosophy of Science in Uppsala* (Dordrecht: Kluwer) pp. 599-610.

This is a response to Higginbotham's examples of the non-compositionality of *unless*. It argues that there are two different ways to avoid all examples of the Higginbotham sort: a syntactic strategy and a semantic strategy.

Direct Quotation

Direct quotation is normally seen as a matter of changing the semantic value of an *occurrence* of an expression to become the expression itself. This change from *using* the expression to *mentioning* it seems at first glance to be an instance of non-compositionality, since the semantic value of the expression appears to play absolutely no role in computing the semantic value of the resulting quoted expression. Furthermore, it seems to require having an infinite set of semantic primitives (=values of everything that can be quoted). Yet some authors have challenged that attitude. Davidson 1979 put the problem on the semantic agenda, arguing for a “paratactic” theory of quotation. Parsons 1982 was concerned to see if a Fregean style theory could work, as an alternative explanation. Washington 1992 offers a critique of these views and offers a view where quotation is punctuation. Various authors have argued against the Fregean account on the grounds that it is not “semantically innocent” while others have tried to merge the Fregean and Davidsonian accounts (e.g., Pietroski 1999; Reimer 1996). Botterell & Stainton 2005 argues

against the Davidson account while Lepore 1999 defends it. Potts 2007 offers a somewhat different account of quotation and compositionality.

Botterell, Andrew and Robert Stainton. "Quotation: Compositionality and Innocence Without Demonstration" *Critica* **37(110)** (2005): 3-33.

The paper discusses both direct and indirect quotation. With respect to direct quotation, they ask the question of whether a semantic theory can be both compositional and innocent, and argue against a Davidsonian paratactic account and in favor of pure quotation as a kind of identity function.

Davidson, Donald. "Quotation" *Theory and Decision* **11** (1979): 27-40.

Argues against "naming theories" and "description theories" of quotation. Significant for claiming that a satisfactory account of the conditions under which an arbitrary sentence containing a quotation is true must be given. Since there are an infinite number of quotation mark names, it follows that there has to be some recursively specifiable method of creating the names or else the language would be unlearnable.

Lepore, Ernest. "The Scope and Limits of Quotation". In *The Philosophy of Donald Davidson*, 691-714. Edited by L. Hahn. LaSalle, IL: Open Court Publishers, 1999.

Argues against a "disquotational semantics" account of quotation on the grounds that the class of quotable items is not recursively definable, and hence a semantic theory would be impossible. Lepore claims that whatever is tokened between quotation marks in a sentence is in *no* sense a constituent of the sentence.

Potts, Christopher. "The Dimensions of Quotation." In *Direct Compositionality*. Edited by C. Barker and P. Jacobson, 405-431. Oxford: Oxford University Press, 2007.

Potts analyzes expressions as triples, and allows the quotation function to apply to these triples. This blends nicely with a "recursive" semantics, as Potts shows. But it is not strictly compositional.

Parsons, Terence. "What Do Quotation Marks Name? Frege's Theories of Quotations and *That*-Clauses" *Philosophical Studies* **42** (1982): 315-328.

Parsons is concerned with giving a true-to-Frege account of quotation, despite Frege's very meager assertions about quotation. Quotation marks are functional names. Then the appropriate Fregean question is "What are the sense and reference of such a function-name?"

Pietroski, Paul. (1999) "Compositional Quotation (without Parataxis)", In *Philosophy and Linguistics*. Edited by K. Murasugi and R. Stainton, 245-258. Boulder: Westview Press.

Pietroski works to give a "broadly Davidsonian" account of how direct quotation works, using interpreted logical forms. An interesting part of the account is an attempt to separate the principle of compositionality from the issue of substitutivity. In doing this, interpreted logical forms are ordered pairs of a linguistic form with its (Fregean-like) sense.

Reimer, Marga. "Quotation Marks: Demonstratives or Demonstrations?" *Analysis* **56** (1996): 131-141.

Argues that the best theory of quotation will combine the Fregean identity theory with the Davidsonian paratactic/demonstrative theory. Frege is seen as correct in viewing the referring expression as the quotationally-embedded expression; Davidson is seen as correct in thinking that the referring expression was a demonstrative expression. (But Davidson wrongly identified the referring expression with the quotation marks.)

Washington, Corey. "The Identity Theory of Quotation" *Journal of Philosophy* **89** (1992): 582-605.

The (Fregean) identity theory of quotation alleges that the correlation between expressions used and the expressions thereby mentioned is rule-governed. Washington contrasts this with views of Quine, Geach, and Davidson who take quotation as either a kind of naming, or describing, or demonstrating. An interesting part of the view is that quotation marks are seen as neither mentioning expressions nor parts of mentioning expressions, but rather are punctuation.

Idioms

Idioms are often defined as phrases whose meaning can't be predicted from the words constituting them and the way those words are combined. This means that almost by definition they are non-compositional. Nonetheless, there are works that challenge this attitude toward idioms. Nunberg, Sag & Wasow 1994 claims that once we distinguish different varieties of idioms, we will find that the differing types each allow for a compositional treatment. Westerstahl 2002 argues that idioms can always be embedded in compositional languages, and proposes three different ways of doing so.

Nunberg, Geoff, Ivan Sag, & Tom Wasow "Idioms" *Language* **70** (1994): 491-538.

Argues that the usual feeling that idiomaticity entails non-compositionality is due to a failure to distinguish several dimensions of idiomaticity, such as conventionality and figuration. Authors distinguish "idiomatically combining expressions" (which have conventional meanings in their parts) from "idiomatic phrases" (which do not distribute their meanings to their components).

Dag Westerstahl (2002) "On the Compositionality of Idioms: An Abstract Approach", in D. Barker-Plummer, D. Beaver, J. van Benthem, P. Scotto di Luzio (eds), *Words, Proofs and Diagrams* (Stanford: CSLI Press) pp. 241-272.

Possible compositional methods of treating idioms: (i) extend the atomic expressions by a holophrastic reading of the idiom, (ii) extend the syntax so that literal and idiomatic readings of an idiom become outcomes of different syntactic operations, (iii) make syntactic parts of the idiom be homonyms of their occurrences in its literal reading and add them to the set of atomic expressions.

Relative Clauses

A question of the 1970s was whether relative clauses should be analyzed as N+S or as NP+S. That is, should the analysis be [_{NP}the [_Nman [_{rel}who is in the corner]]]? Or should it be [_{NP}the [_Nman]] [_{rel}who is in the corner]? Considerations of compositionality led Partee 1975 to prefer the N+S solution. von Stechow 1980 worries that it is quite difficult to make the N+S solution work correctly, but thinks that there are other advantages to it. Bach & Cooper 1978 are concerned that the N+S solution seems to work only for a certain type of language.

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Bach, Emmon and Robin Cooper. "The NP-S Analysis of Relative Clauses and Compositional Semantics" *Linguistics and Philosophy* 2 (1978): 145-150.

Bach & Cooper are following up Partee's 1975 suggestions. But they find that other languages, such as Hittite that they investigate here, do not have the same sort of structures as English. This seems to throw into question the entire procedure of allowing considerations of compositionality to guide syntactic analyses. But a generalized quantifier analysis can allow for the NP-S analysis to be compositional.

Partee, Barbara H. "Montague Grammar and Transformational Grammar" *Linguistic Inquiry* 6 (1975): 203-300.

Partee was the first to use the consideration of semantic compositionality as a constraint on syntactic analyses. And the N+S vs. NP+S was a test case mentioned in this article.

Arnim von Stechow (1980) "Modification of Noun Phrases: A Challenge for Compositional Semantics" *Theoretical Linguistics* 7: 57-110.

This early work that uses the tool of compositionality to favor the Noun-Sentence analysis of relative clauses vs. the Noun Phrase-Sentence analysis. But much work is needed for it to come out right. However, side benefits are supposed to be that the restrictive vs. non-restrictive relative clause distinction comes out as a semantic distinction, with no syntactic correlate, and that there is a unified semantics for *and*.

Works that Discuss Many Linguistic Constructions

The works in this section each discuss a number of the linguistic constructions that have been implicated in non-compositionality (including those mentioned individually in *Anti-Arguments*). Partee 1984 discusses generics, adjectives, adjuncts, compounds and genitives; Partee 1995 discusses also the topics of context-dependence and point of view. Pelletier 2004 contains a discussion of generics, superlatives, quantifier scope, ambiguity, and other constructions. Pagin & Westerståhl 2010 discuss the more general issues of ambiguity, synonymy, idioms, and quotation.

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Dowty, David. "Compositionality as an Empirical Problem." In *Direct Compositionality*. Edited by C. Barker and P. Jacobson, 23-101. Oxford: Oxford University Press, 2007.

In Section 2 of this article, Dowty confronts a *very* wide range of "trouble cases" for a compositional analysis, arising in quite different areas of the syntax. This is probably the most thorough discussion of the topic of compositionality within syntax, and Dowty canvasses a range of solutions in quite a few variants of Montague and Categorical grammars.

Pagin, Peter and Dag Westerståhl. "Compositionality II: Arguments and Problems" *Philosophy Compass* 5 (2010): 265-282.

The final section of this second part of their two-part article discusses the issues of ambiguity, synonymy, idioms, and quotation.

Partee, Barbara H. "Compositionality" Reprinted in *Compositionality in Formal Semantics: Selected Papers of Barbara Partee* Edited by Barbara Partee, 153-181. Oxford: Blackwell, 2004.

In this broad-ranging article, Partee considers challenges to compositionality from a variety linguistic constructions: generics, dependent plurals, *any*, adjectives, *occasional*,

free adjuncts, compounds, and some genitives. Originally printed in F. Landman and F. Veltman (Eds.), *Varieties of Formal Semantics* (Dordrecht: Foris) pp. 281–312, 1984.

Partee, Barbara H. "Lexical Semantics and Compositionality." In (eds.) *An Invitation to Cognitive Science, 2nd Ed., Vol. 1*. Edited by D. Osherson and M. Liberman, 311–360. Cambridge, MA: MIT Press, 1995.

Discusses "ambiguous" adjective forms: a 'compound pattern' vs. a 'modifier pattern'; similarly adjectives that incorporate either a restrictive vs. a non-restrictive relative clause meaning. Also discusses the case of adjectives, of vagueness, context-dependence, point-of-view, compounds vs. modifiers, etc. Emphasizes that the correct analysis of any linguistic (semantic) phenomenon requires evaluating hypotheses about lexical meanings, about syntactic structure, and about modes of semantic composition.

Pelletier, Francis Jeffry "The Principle of Semantic Compositionality" (Reprinted, with additions, in *Semantics: A Reader*. Edited by S. Davis and B. Gillon, 133–156. Oxford: Oxford University Press, 2004.)

In addition to its discussion of synonymy and ambiguity as problematic for compositionality, it also discusses a number of claims in the literature that were supposed to be counterexamples to compositionality, such as generics, 'displaced' superlatives, adjectives, quantifier scope, non-restrictive relative clauses, and others. Originally printed in *Topoi* **13** (1994): 11–24.

NOUN-NOUN COMPOUNDS

Noun-Noun compounds like *child prodigy* and *child murderer* and *axe murderer* present the challenge to compositionality that, while it seems that there is but one syntactic rule to form the any of these complexes, there is more than one semantic rule that is being employed. It should be noted that this is quite similar to the challenge that Adjectives pose to compositionality (as mentioned elsewhere in this bibliography). It is also quite similar to some of the work discussed under the heading Genitives, also elsewhere in this bibliography. Levi 1978 and Ryder 1994 provide linguistic resources to the area, each from a distinctively different point of view. Weiskopf 2007 argues for a way of treating such compounding as "context sensitive", while Sainsbury 2001 argues for a "context *invariant*" meaning for them. Wisniewski & Wu 2012 on the other hand presents evidence that such combinations *are* in fact failures of compositionality. Finally, Downing 1977 argues that there is no finite list of interpretations of the semantic force of N-N compounding, thereby implicitly arguing that they form an inescapable counterexample to semantic compositionality.

Downing, Pamela. "On the Creation and Use of English Compound Nouns" *Language* **53** (1977): 810–842.

Downing uses a number of experimental tasks in which subjects are asked to create or interpret novel N-N compounds. Her main conclusion is that there is no finite number of interpretations for the ways that nouns can be compounded. Along the way there are a number of important observations made about ways of distinguishing compounds from modifications.

Levi, Judith. *The Syntax and Semantics of Complex Nominals*. New York: Academic Press, 1978.

Levi writes in a generative-semantics framework; nonetheless, the solution(s) canvassed are strikingly similar to the ones that are currently debated in other frameworks. The basic position Levi promotes is that N-N structures are ambiguous, and their ambiguity is accounted for by their being derived from twelve underlying logical structures, each of which contains a different specific relationship between head and modifier.

Ryder, Mary. (1994) *Ordered Chaos: The Interpretation of English Noun-Noun Compounds* (Berkeley: Univ. California Press).

Ryder writes in a Cognitive Grammar framework, but has an extensive summary of previous treatments. She separates speaker from hearer strategies: a speaker chooses a head noun and then a modifying noun so as to highlight a particular feature. The hearer attends to the form chosen by the speaker. The result is said to be a number of “schemas” Reported experiments claim to substantiate this model.

Sainsbury, Mark. “Two Ways to Smoke a Cigarette” *Ratio* 14 (2001): 386-406.

Sainsbury gives a “unified compositional account” of a number of different types of counterexamples to compositionality, of which N-N compounding is one. The general thrust of the unified account is that expressions will have a context-invariant “unspecific meaning”, which does not supply any information as to how the compounds are related. This unspecific meaning can be instantiated in many different ways.

Weiskopf, Daniel. “Compound Nominals, Context, and Compositionality” *Synthese* 156 (2007): 161-204.

Since Noun-Noun combination is quite productive, they present a serious challenge to the learnability/understandability arguments for compositionality. Weiskopf develops a theory that treats such compounds as fully compositional, but context-sensitive—in that there is a “hidden” indexical element. (In this, Weiskopf is [consciously] following Szabo’s 2001 treatment of adjectives in *Adjectives in Context*.)

Wisniewski, Edward and Jing Wu. (2012) “Emergency!!!! Challenges to a Compositional Understanding of Noun-Noun Combinations” in Werning, Hinzen, Machery (eds.) *The Oxford Handbook of Compositionality*.

Presents evidence that people interpret novel noun-noun combinations in ways that are not a straightforward function of the meanings of their constituents, but rather arise from an interaction of the meanings of its constituents, resulting in an “emergent feature” that is not represented in either constituent. (One might say that this notion of [failure of] compositionality is the “ontological sense” mentioned in *Introduction*.)

CONCEPTUAL COMBINATION

The linguistic phenomena characterized as *Noun-Noun Compounds* are matched by a more psychological way of describing it—which goes under the name of “conceptual combination”—the concept PET FISH seems not to be compositionally generated from the component concepts, PET and FISH. The psychology literature on this latter matter is massive and will not be delineated here: only a few articles of that sort will be mentioned. Ran and Duimering 2010 evaluates ten of the major efforts by psychologists to understand how conceptual combination works. Although this is done from the “cognitive grammar” point of view, and a research direction gets a strike against it if it does not fit well into cognitive grammar, it is still a nice resource for discovery of the breadth of the field. Gagné and Shoben 1997 discusses one of the major models for this, and in

Gagné 2002 the model got a lot more of its empirical backing together with a model for its employment. A different model is advocated by Hampton 1991. Wisniewski 1996 argues against all these "relational" models on the grounds that there "is more to combination" than just finding a relation that links constituents.

Gagné, Christina, and E. Shoben. "Influence of Thematic Relations on the Comprehension of Modifier-Noun Combinations" *Journal of Experimental Psychology: Learning, Memory, and Cognition* **23**(1997): 71-87.

The CARIN model places emphasis on selection of a combination relation during conceptual combination. This requires knowledge about the relations used by the modifier during conceptual combination and the ease of interpreting a combination. A number of works by Gagné and her collaborators have investigated and classified the sorts of relations that can be employed.

Gagné, Christina. "Lexical and Relational Influences on the Processing of Novel Compounds" *Brain and Language* **81** (2002): 723-735.

The general picture advocated in the CARIN model was employed. Here the goal was to examine the role of lexical and relation information, by preceding the combinations with some different types of semantic priming materials. Even though the modifier and head noun are both retrieved independently before they are combined, only information associated with the modifier affects the availability of a particular relation.

Hampton, James. "The Combination of Prototype Concepts." In *The Psychology of Word Meanings*, 91-116. Edited by P. Schwanenflugel. Hillsdale, NJ: Lawrence Erlbaum Associates, 1991.

Hampton proposes the "composite prototype model", which assumes that concepts are represented schematically as sets of attributes connected by theory-driven relations. Attributes are assumed to have a "definingness degree" called Importance. The proposal is that a conjunctive concept is represented semantically by a composite prototype that is formed as the union of the sets of attributes from both parent concepts.

Ran, Bing, and Robert Duimering. "Conceptual Combination: Models, Theories and Controversies". *International Journal of Cognitive Linguistics* **1** (2010): 65-90.

This overview article provides a critical review of ten major models, and evaluates them along four dimensions: the causal role of (Cognitive Grammar) schemata in the model, the role of "cognitive harmony and consistency" in the model, the "pragmatic orientation" in the model, and the explanatory scope of the model.

Wisniewski, Edward. "Construal and Similarity in Conceptual Combination." *Journal of Memory and Language*, **35** (1996): 424-453.

Wisniewski argues against interpreting novel phrases by linking one constituent to another via a relation. Experiments show that there are some relation-linkings going on, but there are also other ways that novel combinations are interpreted and Wisniewski proposes a two-part model of "comparison process".

PROTOTYPES

The notion of conceptual combination mentioned in the section which has that name presumes some notion of a concept as meaning of a linguistic item (or correlated with the meaning); and that concept is quite often seen to be a prototype. (Separating works on "conceptual combination" from works on prototypes is rather arbitrary.) It might be mentioned that one difference between the linguistic and conceptual areas seems to be that the conceptual realm employs the "metaphysical compositionality" sense of the term while the linguistic realm employs the "functional compositionality" sense. The seminal work in conceptual combination and compositionality was Osherson & Smith 1981. Crucially their work involved the mental construct of a prototype. Following work has discussed this along two dimensions: one involves refinements or changes to the notion of a prototype, while the other argues that prototypes are not *concepts*—interpreting concepts as the meaning of linguistic items. If prototypes don't combine compositionally, it is argued, this is not a difficulty for semantic compositionality if prototypes are not meanings. Along the first arm of this dichotomy is Braisby 1998 arguing that prototypes need to be understood "relationally", Jylkkä 2011 distinguishing "extensional" from "intensional" understandings of prototypes, and Prinz 2012 who argues in favor of a "possibilist" understanding of prototypes". One detail in implementing the employment of prototypes involves describing a way to tell whether or not something in fact manifests the prototype. Kamp and Partee 1995 proposes to replace the traditional fuzzy logic as a measure of the degree to which something manifests the property that a prototype names with supervaluation theory. This involves a discussion of the notion of vagueness in the degree of manifestation. Osherson and Smith 1997 replies to this aspect of their definition of prototypes. Along the other dimension of discussion, where prototypes are argued not to be concepts (that is, argued not to be meanings of linguistic items) are Fodor and Lepore 1996 and Gleitman, Connolly & Armstrong 2012.

Braisby, Nick. "Compositionality and the Modelling of Complex Concepts" *Minds and Machines* **8** (1998): 479-508.

Argues that a "Relational View of Concepts" can accommodate a range of complex concepts, including the cases that have been argued to be non-compositional. The idea is that the content of a concept varies systematically with perspective, so too compositionality should be considered to be sensitive to perspective.

Fodor, Jerry and Ernest Lepore. "The Red Herring and the Pet Fish: Why Concepts Aren't Prototypes" *Cognition* **58** (1996): 253-270.

Contrary to Kamp & Partee 1995 (and the view of Osherson & Smith 1981), these authors argue that the "standard argument" is correct: because of prototypes not being compositional, they cannot be concepts...which are the meaning of natural language items.

Gleitman, Lila, Andrew Connolly, and Sharon L. Armstrong. "Can Prototype Representations support Composition and Decomposition?" In *The Oxford Handbook of Compositionality*. Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

The authors try to undermine prototype theories by distinguishing 'having a prototype' from 'being a prototype'. (People think robins are more prototypical birds than penguins, but also think they are both birds.) Another attack on prototypes concerns lexical combinations: people do not think that a prototypical green apple is a prototypical apple that is prototypically green.

Jylkkä, Jussi. "Hybrid Extensional Prototype Compositionality" *Mind and Language*. (2011 forthcoming). [DOI 10.1007/s11023-010-9217-8]

Responds to the standard argument that prototypes can't compose by distinguishing an intensional vs. extensional approach to prototype compositionality. Both are argued to be faulty, but a hybrid extensional theory is advocated, according to which the extension of a complex concept is a function of what triggers its constituent prototypes.

Kamp, Hans and Barbara H. Partee. "Prototype Theory and Compositionality" *Cognition* **57** (1995): 129-191.

A very detailed attempt to replace fuzzy logic with supervaluation theory as an account of the way that prototypes can combine, and how they can be used to provide truth conditions for statements. In this paper they distinguish two different kinds of gradedness, typicality and membership [in a concept], and argue that many of the objections to prototypes has to do with conflation of these two types of "fuzziness".

Osherson, Daniel, and Edward Smith. "On the Adequacy of Prototype Theory as a Theory of Concepts" *Cognition* **9** (1981): 35-58.

This is the classic paper where the issue of compositionality in concept formation and prototypes was discussed, using *pet fish* as a leading example. The "standard objection" was brought forward: since prototypes are not compositional, and since meaning *is* compositional, prototypes can't be meanings.

Osherson, Daniel and Edward Smith. "On Typicality and Vagueness" *Cognition* **64** (1997): 189-206.

This is the response to Kamp/Partee 1995 and to Fodor/Lepore 1996 by the authors of the initial "standard argument" against prototypes being meanings. In this paper they agree with the two different kinds of gradedness, but argue that the typicality type is still not able to be captured. They accuse Fodor/Lepore of misunderstanding the aspect of prototypicality that they are concerned to elucidate.

Prinz, Jesse. "Regaining Composure: A Defense of Prototype Compositionality." In *The Oxford Handbook of Compositionality*. Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

Distinguishes between the view that concepts *necessarily* combine compositionally from the view that they *are capable* of combining compositionally, and claims that only the latter is plausible. Develops a theory that implements this idea.

MEANING HOLISM

To many theorists, the opposite view to semantic compositionality is meaning holism. The topic of meaning holism is *extremely* heavily populated in the philosophical literature. Until the publication of Fodor & Lepore 1991, it was probably the conscious or unconscious choice of most philosophers of language, due to its pedigree from many different sources: Quine, Wittgenstein, D.K. Lewis and other influential writers. That article sparked many outraged responses, but it was in the very next year, when it was incorporated into Fodor & Lepore 1992, that the outrage became a tsunami of protest. Their book occasioned very many author-meets-critics sessions at conferences and in the journals. The listing here hits only some of the very important contributions. Even a cursory look at the literature will uncover numerous others. Pagin's 1997 article gave expression to the technical feeling that if holism entailed that a word's meaning was

its contribution to all the sentences in which it occurred, then it would *have* to be compositional. Pelletier's 2012 article attempts to describe a notion of meaning holism that is *not* compatible with compositionality. Along the way it canvasses the standard objections that are leveled against meaning holism. (These objections can also be got from Fodor/Lepore 1992, although perhaps not so concisely stated.) Montminy 2005 argues that there is a style of meaning holism that can counter the standard arguments against such holism to the effect that it is unable to account for productivity and systematicity in language. Robert Brandom (Brandom 2001) is well-known for his view of "inferentialism", which is a type of meaning holism. Fodor & Lepore 2001 responds to this. Warfield's 1993 piece is an attempt to "sidestep" the argument by claiming that inferential roles do not have to *define* meaning (which appears to something assumed by Fodor & Lepore). One place where meaning holism has gained acceptance is in scientific theories: the meaning of any theoretical term is its role within the theory. Fodor & Lepore 1992 have many arguments against this view, but Schurz 2005 claims that a non-compositional theory can avoid all of them.

Brandom, Robert. *Articulating Reasons: An Introduction to Inferentialism* (2001). Harvard University Press: Cambridge, MA.

Brandom recommends an inferentialist semantics, according to which there are performances that have a (semantic?) content that is thereby given derivatively to a sentence as its meaning. These contents are to consist of their inferential properties. The ability to know and understand a language is the practical ability to keep track of these inferential commitments and entitlements.

Fodor, Jerry and Ernest Lepore. "Why Meaning (Probably) Isn't Conceptual Role" *Language and Mind* **6** (1991): 328-343.

The first of the Fodor/Lepore contributions in this area. Officially, it finds an *internal* problem for (a class of) semantic theories, whereas it claims that holism and its problems are *external*. But the holism difficulties form a very strong background in the paper. The internal problem is that while meanings are compositional, inferential roles are not. Hence meanings cannot be due to inferential roles.

Fodor, Jerry and Ernest Lepore. (1992) *Holism: A Shopper's Guide*.

This is the locus classicus of argumentation against meaning holism. In this book the authors do not attempt to "prove" that natural language is compositional. Their purpose is rather merely to "sweep away" the alternative view.

Fodor, Jerry and Ernie Lepore. "Brandom's Burdens: Compositionality and Inferentialism." *Philosophy and Phenomenological Research* **63** (2001): 465-481.

This is a reply, much in the spirit of their 1992 book, to the influential view of Robert Brandom, called 'inferentialism', according to which meaning is elucidated in terms of the inferences that are justified.

Montminy, Martin. "A Non-Compositional Inferential Role Theory" *Erkenntnis* **62** (2005): 211-233.

Argues that a "dispositional inferential role theory" can account for the arguments concerning productivity and systematicity in language without assuming compositionality.

Pagin, Peter. "Is Compositionality Compatible with Holism?" *Mind and Language* **12** (1997): 11-33.

Gives both intuitive reasons and formal proof of the belief that (a certain kind of) meaning holism must be compatible with compositionality.

Pelletier, Francis Jeffry. "Holism and Compositionality." In *The Oxford Handbook of Compositionality*. Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

Gives an account of the standard notions of meaning holism together with a summary of the standard objections to them. It goes on to develop an account of semantic holism (based on ideas of Saussure) that is not compatible with holism.

Schurz, Gerhard. "Semantic Holism and (Non-)Compositionality in Scientific Theories." In *The Compositionality of Meaning and Content. Vol. 1: Foundational Issues*. Edited by M. Werning, E. Machery, and G. Schurz, 271-284. Frankfurt: Ontos Verlag, 2005.

Schurz considers meaning holism in the realm of scientific theories, where the meaning of a term is its inferential role in a theory. He identifies six problems with such holism; argues that a Ramsey-Carnap-Lewis view avoids five of them, but fails on the topic of compositionality. Schurz concludes that a theory can be holistic (thus non-compositional) and nonetheless avoid the other standard objections to holism.

Warfield, Ted. "On a Semantic Argument against Conceptual Role Semantics" *Analysis* 53 (1993): 298-304.

An early and influential paper complaining about the style of argument employed by Fodor/Lepore, especially in their basic 1991 paper. The claim is that the class of semantic theories under attack by Fodor/Lepore do not all think of inferential roles as *defining* meaning.

CONTEXT IN GENERAL

This is a huge topic that cannot be adequately surveyed here. We therefore give four examples that indicate different positions along a spectrum of positions that are outlined by Recanati 2004. Borg 2004 defines what semantic minimalism is: semantic content is exhausted by the contributions of the syntactic constituents and their mode of composition. There is no role for any contextual information (except for a short list of indexicals). Cappelen & Lepore 2005 also argue for minimalism, but by attacking all forms of contextualism. The most radical form of contextualism is that advocated by Travis 2008; Pagin & Pelletier 2007 define a method for giving an account of some forms of contextualism.

Cappelen, Herman, and Ernest Lepore. *Insensitive Semantics*. Oxford: Blackwell, 2005.

This very influential book defends minimalism in semantics by contrasting it with "rabid contextualism" of the Travis 2008 variety. The authors say that "no one" would believe rabid contextualism; but they proceed to argue that any so-called moderate contextualism inevitably slides into rabid contextualism. Hence only semantic minimalism is plausible.

Borg, Emma. *Minimal Semantics*. Oxford: Clarendon Press, 2004.

Minimalism provides an answer to two questions: (a) what counts as *semantic* content, and (b) what work does semantic content do. Semantic content is exhausted by syntactic constituents and their composition, so features of context cannot permeate semantic content unless there is an item in the syntax that dictates so. Semantic content guides pragmatic speech-act content, and helps in communication.

Pagin, Peter and Francis Jeffry Pelletier. "Content, Context and Composition." In *Context-Sensitivity and Semantic Minimalism: Essays on Semantics and Pragmatics*. Edited by G. Preyer and G. Peter, 25-62. Oxford: Oxford University Press. 2007.

This is an account of a way to accommodate, in a compositional manner, some of the contextual information alleged by Recanati (and Travis) to be contextual and non-semantic. In the terms of Cappelen & Lepore 2005, this counts as a moderate contextualism, but one that does not lead to "rabid contextualism", as Cappelen & Lepore claim any moderate view would.

Recanati, François. *Literal Meaning*. Oxford: Cambridge University Press, 2004.

This is a major work, offering a "truth-conditional pragmatic" account of the truth of utterances in a context. Among the other features of this discussion, a number of contextualist positions are described, which differ in "how much context" they allow in the interpretation of an utterance. Different stops along this spectrum give rise to different accounts of compositionality.

Travis, Charles. *Occasion-Sensitivity: Selected Essays*. Oxford: Oxford University Press, 2008.

Travis has emphasized the importance of context for meaning for over 20 years. A given linguistic form, even with its meaning fixed, may express an indefinite variety of thoughts. Travis falls on the "far contextual end" of the scale of contextuality that Recanati describes. He is often the "opponent" in discussions about the importance of semantics (and compositionality).

COMMUNICATION

Justifications of compositionality usually focus on understandability and on productivity. However, the requirement of compositionality is different in the two cases. The understander receives a sentence that can be broken into its structured parts, and then evaluated compositionally to determine the sentence's meaning. But the producer instead has knowledge what is desired to be conveyed, but needs to discover which words+structures will do this. This can't be done by straightforward compositionality. Pagin 2003 argues that it requires what he calls 'inverse compositionality'. Pagin 2005 applies the apparatus of compositionality applied to literal meaning to contextual meaning, claiming that with "unarticulated constituents" this can be made compositional also. Pagin 2012 considers the requirements of communication, arguing that compositionality by itself is not enough, and that communication requires that linguistic computation be of a certain "minimalistic" variety. Another aspect of compositionality and communication concerns the intuitive feeling that compositionality mandates a kind of "realism" about meanings that goes against indeterminacy of translation...which is seen as a feature of holistic theories instead. Werning 2004 argues for realism in semantics, claiming that Hodges' Theorem requires it. Leitgeb 2005 responds that Hodges' Theorem is neutral on that point.

Leitgeb, Hannes. (2005) "Hodges' Theorem Does Not Account for Determinacy of Translation: A Reply to Werning" *Erkenntnis* **62**: 411-425.

Argues against Werning's claim that Hodges' Theorem shows that indeterminacy of translation is wrong. Indeed the claim seems to be that there is *no* way to employ the Theorem so as to move away from a sort of indeterminacy of meaning of lexical items, since the Theorem is stated by *only up to isomorphism*...

Pagin, Peter. "Communication and Strong Compositionality." *Journal of Philosophical Logic* **32**

(2003): 287-322.

In order to account for both productivity *and* understandability, it is argued that the language must be not only compositional in the usual way, but *inverse* compositional (akin to Fodor's "reverse compositionality").

Pagin, Peter. "Compositionality and Context." In *Contextualism in Philosophy*. Edited by G. Preyer and G. Peter, 303-348. Oxford: Oxford University Press, 2005.

This is a discussion of how the concept of compositionality can be extended from context invariant to context dependent meaning, and of how the compositionality of natural language might conflict with context dependence. Presents a compositional theory of the unarticulated constituent variety.

Pagin, Peter. (2012) "Communication and the Complexity of Semantics." In *The Oxford Handbook of Compositionality*. Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

Justifies compositionality by means of computational needs for communication. Pagin defines a kind of "minimal complexity" computation that certain types of compositional systems have, and concludes that although it is not necessary to be compositional to be efficient, it is reasonable to conclude that natural language approximates this type of minimal complexity compositionality.

Werning, Markus. "Compositionality, Context, Categories and the Indeterminacy of Translation." *Erkenntnis* **60** (2004): 145-178.

Argues for "realism" in semantics, by claiming that the Hodges' Theorem shows that Quinean indeterminacy of translation is undermined by taking the observation sentences as stimulus meanings and showing that this meaning assignment is uniquely extendable to all the expressions that occur in observation statements.

CONTEXT AND CONTEXTUAL VARIABLES

Context – in the sense of the "real world circumstance" in which an utterance is made – is often seen as providing a challenge to compositionality, and numerous examples are brought forth to show that the intuitive meanings (and truth values) of a sentence differ depending on the context of utterance. Although indexicals ('I', 'you', 'now'...) are context dependent, but these are not normally seen as counterexamples to compositionality. Another class comes from such terms as 'local', 'enemy', 'foreigner', ... Often, there is the appearance of some indexical being "missing" from the sentence...such as in 'It is raining', when the location is where the speaker is. Perry 2001 rehearses his earlier "unarticulated constituents" solution to these problems. More telling are cases where context expands or restricts the meaning of terms that otherwise seem not to have any "hidden variable" (as 'foreigner' etc. arguably do). E.g., quantifier phrases can be seen as non-uniformly doing this: *All the beer is gone* might be true when said in one house, even though there is beer in a neighbor's house. Stanley 2000 proposed having a variable that got its value from context, but which was nonetheless in the logical form (semantics) of the sentence. This solution was a denial of the hidden indexical framework of Perry, since it had a variable in the syntax. His justification for placing it in the semantics became known as "the binding argument" because the value of the variable could change within the sentence on account of higher-level quantifiers that bound it. Stanley & Szabó 2000 investigated further the details of Stanley's proposal, arguing that the variables to be bound had to attach to lexical nouns. Pelletier 2003 argued that there were other options open for the invocation of variables, which, contra

Stanley & Szabó, did not imply non-compositionality. Rett 2006 claimed that Stanley's method can't both do domain restriction and also contextual effects in other parts of a sentence. Gauker 2010 argues against the Stanley 2000 "hidden variable" account and offers a slightly different "relational" account of lexical nouns. Recanati 2002 argues against Stanley and in favor of unarticulated constituents, giving Perry's account a fuller set of methods for interpreting these constituents. Recanati 2012 argues that many of these kinds of "semantic flexibility" are due to context effects that do not challenge compositionality. But he claims that other types of context effects do militate against compositionality.

Gauker, Christopher. "Global Domains versus Hidden Indexicals" *Journal of Semantics* **27** (2010): 243-270.

Gives an alternative compositional account from Stanley's 2000 of the logical form that is relevant to the way of getting contextual information into the representation of a sentence. Stanley had an account where nouns had a "hidden indexical". Gauker has nouns be relational, giving the same reading for the examples considered by Stanley. However they differ on such sentences as *Every student is happy and some student is not happy*.

Pelletier, Francis Jeffry. "Context Dependence and Compositionality" *Mind & Language* **18** (2003): 148-61.

Argues against Stanley & Szabó's 2002 claim that attaching contextual information directly to NP nodes of a logical-form tree is non-compositional. An evaluation of what the functional notion of compositionality allows for shows that this is a legitimate option.

Perry, John. *Reference and Reflexivity*. Stanford: CSLI Publications, 2001.

Perry is credited with introducing the notion of an unarticulated constituent in his 1986 "Thought without Representation", and having refined it through many iterations--here in the chapter "Unarticulated Constituents". An unarticulated constituent of a proposition is something that is just "too boring" to be vocalized by the sentence uttered in the context. Nonetheless, it is present in the proposition that was expressed.

Recanati, François "Unarticulated Constituents" *Linguistics and Philosophy*. **25** (2002): 299-345.

This is a major response to Stanley 2000. Stanley argued that there are no "unarticulated constituents", contrary to what 'truth-conditional pragmaticists' have claimed, but rather that all truth-conditional effects of context can be traced to logical form. Recanati claims that Stanley's argument is fallacious: that there *are* unarticulated constituents and truth-conditional pragmatics is correct. Much of Recanati's position relies on his accounts of "saturation", "enrichment" and "modulation" of semantic values.

François Recanati "Compositionality, Flexibility and Context-Dependence" In *The Oxford Handbook of Compositionality*. Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

Semantic flexibility is defined as the way a word's meaning can be affected by other words in the same sentence. Recanati argues that this flexibility amounts to a kind of context sensitivity which does not pose real problems for compositionality. However, another type of context sensitivity ("sense modulation") which does tell against compositionality.

Rett, Jessica. "Context, Compositionality and Calamity" *Mind and Language* **21** (2006): 541–552.

Explores a variety of issues with the proposal of Stanley 2000, especially those in which there is domain-restricting information elsewhere in the sentence (such as in a prepositional phrase). Rett's claim is that there is no coherent way that Stanley can make room for both context information and at the same time for domain-restricting information elsewhere in the sentence.

Stanley, Jason. "Context and Logical Form" *Linguistics and Philosophy* **23** (2000): 391–434.

In Stanley's account context assigns some value to words in a sentence. When there is no explicit item in the sentence, we need to have a variable attached to the some item that can accept the value put forth by context. Of interest is Stanley's demonstration that this variable must actually be in the sentence's representation, since it can be quantified over by explicit phrases in the sentence.

Stanley, Jason and Zoltán Szabó. "On Quantifier Domain Restriction" *Mind & Language* **15** (2000): 219–61.

This influential paper argues that "domain restrictions"—e.g., when a phrase like *All the students* is interpreted as *All the students in Linguistics 201 this year*—need be part of the *semantic* interpretation of the resulting sentence, and that the relevant restriction comes from associating a contextual variable with lexical nouns. Exhaustively surveying alternative accounts has left them with just one way to implement this idea.

NEURAL ISSUES

Many theorists feel that all mental activity, but in particular language-oriented processing, is a feature of the brain...and hence is neurally controlled. But then what should we say about the status of the principle of semantic compositionality? Is it also to be found in the neural substructure? Werning 2010 is concerned to accommodate compositionality in a neurally-plausible system. Werning 2012 discusses more the notions of information flow in a brain being compositional. Engel & Maye 2012 add the notion of temporal flow of information carried in language through the brain.

Werning, Markus. *The Compositional Brain: Neuronal Foundations of Conceptual Representation*. Paderborn: Mentis, 2010.

Werning here attempts to meld the psycho-philosopho-linguistic conception of concepts as bearers of intentional content and meaning with a neural-oriented view of information flow in the brain. An underlying motif is to accommodate classical notions of compositionality within this framework.

Werning, Markus. "Non-Symbolic Compositional Representation and Its Neuronal Foundation: Towards an Emulative Semantics." In *The Oxford Handbook of Compositionality*. Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

A neurobiologically motivated theory of meaning as internal representation is developed that holds on to compositionality, but is non-symbolic, being implemented by recurrent neural networks. The semantics to be developed is structural analogous to model-theoretical semantics, but it regards meanings as set-theoretical constructions of the neural counterparts of denotations.

Engel, Andreas and Alexander Maye. "Neuronal Models of Compositionality" In *The Oxford Handbook of Compositionality*. Edited by M. Werning, W. Hinzen and E. Machery. Oxford: Oxford University Press, 2012.

The authors focus on models in which it is the temporal structure of activity that carries information, review the capability of such systems to develop compositional structures, and propose synchronization of neuronal activity as an underlying mechanism.

JERRY FODOR

Jerry Fodor is possibly the most famous scholar who makes unrelenting use of the notion of compositionality and its alleged features in philosophy of mind and psychologically-oriented works. It would be remiss not to have a special entry on Fodor, given his influence on the application of compositionality in the philosophy of mind. It should also be remarked that the original use of 'compositionality' comes from Katz & Fodor 1963, as indicated in the section of *Historical Antecedents*. Fodor has been concerned with the topic for most of his academic life. Much of his output on this topic has been in collaboration with Ernest Lepore. (A collection of their papers on compositionality is Fodor/Lepore 2002). Possibly their most basic paper is (Fodor/Lepore 1991—reprinted in the Fodor/Lepore 2002 book), the argument in which is generalized to cover a very wide range of views that all have the contention that the meaning of a term or phrase is the various connections it has with other terms/phrases in their (Fodor/Lepore 1992), and its workings are manifest in many of Fodor's other works. It is impossible to distinguish separate themes relevant to compositionality between pairs of the books, since they all seem to draw further and further conclusions from the presumed truth of compositionality. (Fodor, and Fodor & Lepore, are famous for claiming such things as "compositionality is, as they say in England, non-negotiable" and "so non-negotiable is compositionality that I'm not even going to tell you what it is.") Many topics that are in train with compositionality are also discussed in Fodor's works: in Fodor & Pylyshyn 1988, the topic of systematicity is introduced, in Fodor & Lepore 1992 the topic of holism is heavily discussed, in Fodor 1998 the topic of concept atomism is argued for, in Fodor 2001 the topic of "underived content" is discussed, and in Fodor 2008 the topic of reverse compositionality is under discussion.

Fodor, Jerry and Zenon Pylyshyn. "Connectionism and Cognitive Architecture: A Critical Analysis" *Cognition* 28 (1988): 3–71.

The famous "systematicity objection" to connectionist models of cognition is first brought out in this piece. The discussion sparked a vast literature throughout the 1990s concerning the role of representations within connectionism.

Fodor, Jerry and Ernest Lepore. "Why Meaning (Probably) Isn't Conceptual Role" *Language and Mind* 6 (1991): 328-343.

Describes inferential role semantics...the sort associated with "pragmatism" in philosophy of mind and language. Famously, it argues that while meanings are compositional, inferential roles are not. Hence meanings cannot be due to inferential roles.

Fodor, Jerry and Ernest Lepore. *Holism: A Shopper's Guide*. Oxford: Blackwell, 1992.

This is the locus classicus of argumentation against meaning holism. In this book the authors do not attempt to "prove" that natural language is compositional. Their purpose is rather merely to "sweep away" the alternative view of meaning holism.

Fodor, Jerry and Ernest Lepore. *The Compositionality Papers*. Oxford: Clarendon Press, 2002.

This collection of works by Fodor and Lepore has three parts: a section on the nature of compositionality, comprising four papers by Fodor & Lepore; a section on the meaning of terms in the mental lexicon, arguing for Fodor's semantic atomism and consisting of two papers; and finally three of their papers that critique two different versions of "meaning pragmatism"—Robert Brandom and Paul Churchland.

Fodor, Jerry. *Concepts: Where Cognitive Science Went Wrong*. Cambridge, MA: MIT Press, 1998.

In this book, Fodor argues for an atomistic theory of concepts. He claims that other accounts of concepts are committed to inferential role theory, and that falls prey to arguments that employ compositionality. In this account, concepts are argued not to be stereotypes, prototypes, abstractions from belief systems, and various psychologico-linguistic figures like Jackendoff and Pustejovsky.

Fodor, Jerry. "Language, Thought and Compositionality" *Mind & Language* **16** (2001): 1-15.

This is Fodor's "Millennial Paper". It discusses the issue of whether it is thought or language that has semantic content ("in the first instance"). Fodor's claims that it is thought, and that in fact language doesn't have content at all. He furthermore claims that this is an empirically-supported position.

Fodor, Jerry. *LOT2*. Oxford: Oxford University Press, 2008.

This book offers a more detailed account of the Language of Thought hypothesis that was started in Fodor's earlier works. The role of compositionality is re-emphasized as crucial for a representational theory of mind—most of what we know about concepts follows from the compositionality of thoughts.