Article

FIRST LANGUAGE

First Language
32(1-2) 116–136

DOI: 10.1177/0142723711403879
fla.sagepub.com
SAGE

The lexical interface in L1 acquisition: What children have to say about radical concept nativism

David Stringer
Indiana University, USA

Abstract
In the ongoing philosophical debate over the origins and nature of lexical concepts stemming from the work of Fodor (1970, 1998, 2000, 2008), the potential of first language acquisition studies as a source of evidence has been somewhat overlooked. At the lexical interface with syntax, a restricted set of lexical conceptual elements can be shown to play a pivotal role in the generation of syntactic representations, and patterns of syntactic development can elucidate the nature of such elements. An experiment is described which reveals mature knowledge of interface principles in this domain in early syntactic production. It is argued that first language research of this type can provide much-needed observable evidence for lexical semantic decomposition and against radical concept nativism.

Keywords
conceptual atomism, lexical semantics, locative verbs, mapping principles, semantic decomposition

Introduction

The current philosophical debate concerning the internal nature of lexical concepts (e.g., Fodor, 1998, 2000, 2008; Landau, 2000; Laurence & Margolis, 2002; Pinker, 2007; Pulman, 2005) has generally not drawn on evidence from first language acquisition. However, developmental patterns in the acquisition of argument structure have the

Corresponding author:
David Stringer, Department of Second Language Studies, Indiana University, Memorial Hall 310, 1021 E. Third Street, Bloomington, IN 47405, USA.
Email: ds6@indiana.edu

potential to shed light on the nature of lexical concepts, as changing syntactic patterns are arguably due to shifts in the internal structure of concepts over the course of development. It is well known that the acquisition of argument structure is delayed compared to other areas of syntax. For example, Bowerman (1982) notes that both of her daughters had persistent errors with the syntax of 'theme-oriented' verbs (e.g., *put*, *pour*, and *spill*) and 'location-oriented' verbs (e.g., *touch*, *cover*, and *hit*) until around their seventh birthdays, and Pinker (1989) reports that children generally appear to have problems with the acquisition of argument structure until at least 8 or 9 years old. It is here argued that such delays are not due to tardy instantiation of the relevant syntactic principles, but rather a gradual convergence on appropriate lexical representations. That the requisite syntax is in place very early in development is shown in an experiment partially replicating the one reported in Gropen, Pinker, Hollander, and Goldberg (1991), extending the age range down to 2;10, and with different test materials and procedures used to confirm the original hypotheses. The early syntactic accuracy of children revealed by experimental manipulation of lexical semantic components supports the assertion that lexical concepts are acquired piecemeal, and therefore must be compositional in nature.

Such findings contradict the view taken by Jerry Fodor and his colleagues, who have long argued that lexical concepts are not compositional (Fodor, 1970, 1975, 1981; Fodor, Fodor, & Garrett, 1975; Fodor, Garrett, Walker, & Parkes, 1980). This position has its clearest statement in Fodor's (1998) manifesto of conceptual atomism, according to which lexical concepts are indivisible, unlearnable, and innate.[1] This extreme view has since been consistently defended (Fodor, 2000, 2008; Fodor & Lepore, 1998; Fodor & Lepore, forthcoming) in the face of resistance and disbelief from the cognitive science community at large (e.g., Churchland, 1986; Hampton, 2000; Keil & Wilson, 2000; Landau, 2000; Peacocke, 2000; Pinker, 2005, 2007; Pulman, 2005; Pustejovsky, 1998; Putnam, 1988). However, despite a range of interesting conceptual arguments on both sides, there is a general absence of empirical evidence brought to bear on this fundamental question of human cognition. The prevailing wisdom seems to side with Pulman (2005), when he states with some regret that although lexical decomposition is necessary in order to capture the nature of inferences, there is no tangible evidence for it: to posit 'abstract semantic entities of some kind' is inadequate because there is 'no empirically or philosophically satisfactory account of what these entities are' (Pulman, 2005, p. 155). In response to this assertion, it is argued here that research on acquisition at the interface between the lexicon and syntax provides robust empirical evidence against atomism, and support for the existence of grammatically relevant lexical semantic components.

In the next section, an outline is given of the two main arguments for conceptual atomism and radical nativism: first, that there is no adequate theory of definitions; and second, that in the absence of definitions, the acquisition of lexical concepts is impossible, therefore all concepts must be innate. It is argued that while the former is true, the latter does not necessarily follow. The general backlash against conceptual atomism is also discussed, as well as the need to address the logic of argumentation rather than simply dismiss the disagreeable conclusion. The third section shows how lexical semantic theory is able to propose word-internal semantic components without regarding such components as definitional. As such, arguments against a definitional theory of meaning do not constitute arguments against semantic decomposition. In the fourth section,

an experiment is discussed which shows that children split the lexical atom as they acquire verbal predicates. The findings constitute strong support for the hypothesis that lexicon–syntax mappings are innate, and that persistent errors in argument structure stem from non-targetlike conflation of lexical components. Crucially, the semantic components hypothesized are not primitives invoked to compute definitions of the type attacked by Fodor (1998), but are those elements of meaning which have observable (and predictable) effects in syntax. It is argued that first language acquisition provides an ideal testing ground for theories of conceptual semantics, as lexical representations are subject to developmental change.

The path to extreme nativism

No definitions: Arguments for atomism

The first step in Fodor's (1998) argument concerning the impossibility of lexical semantic decomposition is the observation that words cannot be defined in terms of other words; that is, lexical concepts cannot be defined in terms of other lexical concepts. This is not a radical move, but rather an uncontroversial assumption in modern theories of concepts, in opposition to what is sometimes referred to as the 'classical view' of categorization developed by empiricist philosophers such as Locke (1690/1964) and Hume (1739/1978). It is now recognized that definitions of lexical items are elusive, and perhaps impossible. To cite one of Wittgenstein's (1958) more famous examples, the concept *game* is indefinable because no one characteristic is common to all games. He asks us to consider the many types of board games, ball games, and children's dancing games, and to consider also whether there is in each case winning or losing, skill or luck, competition or enjoyment. In summary, while there are some properties common to all games (e.g., being events), no list of these provides necessary and sufficient conditions for being a game (Wittgenstein, 1958, p. 66). He invokes the idea of 'family resemblance' to characterize same-set concepts: not all members of a family share the same facial features, expressions, body shape, etc., but distinctive qualities may be common to subsets of the family. A further development in this direction was made by Putnam (1962), who posited the notion of 'cluster concepts': while no single semantic component is necessary for category membership, there may be a set of semantic components such that some proportion of them is sufficient for category membership. This work served as a precursor to Rosch's (1975, 1978) Prototype Theory, which also attempts to define word meaning probabilistically, eschewing classical definitions.

In linguistics, there have been several decompositional theories that attempt to split the inherent semantics of both verbs and nouns into constituent concepts, not to formulate definitions, but to identify which conceptual elements within lexical items are relevant to linguistic computation. One objective of such proposals is to capture entailments: if we know that John killed Bill, we also know that Bill died, and that John was the cause of Bill's death, which appears easy to explain if the verb *kill* is semantically represented as CAUSE TO DIE. Similarly, if we know that Kim is a bachelor, we also know that Kim is male and that he is unmarried, which follows if the noun *bachelor* is represented as UNMARRIED MALE (Lakoff, 1965).

In early salvos against decomposition, both these specific examples were targeted by Fodor (1970) and Fodor et al. (1975). Fodor (1970) took issue with the fact that if lexical items decompose, then the truth of the first sentence below should entail the truth of the second, but this is not the case:

(1) a. John caused Bill to die on Sunday by stabbing him on Saturday.
b. ??John killed Bill on Sunday by stabbing him on Saturday.

It is worth noting that same argument can be made for alternating causative verbs such as *melt*, which keep the same form in transitive and intransitive uses:

(2) a. Fred caused the glass to melt on Sunday by heating it on Saturday.
b. ??Fred melted the glass on Sunday by heating it on Saturday.

Fodor et al. (1975) posited that lexically complex terms should increase processing time as compared to simple terms. Starting from the accepted observation that the inclusion of two negatives in a sentence increases processing difficulty, they hypothesized that if the noun *bachelor* really subsumed the elements NEGATIVE and MARRIED, then sentence (b) below would have a longer processing time than sentence (c):

(3) a. The bachelor married Sybil.
b. The bachelor did not marry Sybil.
c. The widow did not marry Sybil.

As no processing differences were found, Fodor et al. (1975) concluded that sublexical features are not accessed in language processing, and words are semantically represented whole.

The implications of these studies are less than straightforward. Even if the lexical item 'cause' were the same as the semantic component Cause (which is specifically denied by Jackendoff [1990] and Pinker [1989]), it is not clear that the entailment relations would be the same if there was conflation into a single predicate (indicating an single event) or if both elements were represented separately in syntax (arguably indicating two events). As for differences in processing time, it is not clear that the word *bachelor* (defined for the purposes of the experiment as 'a man who is not married') should take more time to process than *widow* ('a woman whose husband has died'). In addition, Jackendoff (1990, p. 38) points out that the relation between processing time and structure in general is likely to be more complex: subroutines may be created which, while having internal structure, function as units for processing, rather like musical scales and chords.

Such wranglings aside, one thing that virtually everyone agrees upon is that there are no necessary and sufficient conditions for category membership, and thus there are no classical definitions of concepts. Some posit probabilistic definitions (e.g., Putnam, 1962; Rosch, 1975, 1978), while the emphasis in linguistic studies such as Talmy (1985), Pinker (1989), Jackendoff (1990), and Levin (1993) has been to identify the nature and roles of those elements of meaning that are relevant to syntax, regardless of

whether or not such meaning components can serve as input to definitions. Indeed, the role of inference in determining meaning in context is well understood, and 'complete' definitions of lexical items in all their senses have never been on the agenda of mainstream linguistics.

No acquisition: Arguments for radical concept nativism

That there are no definitions is a fundamental part of the argument that all concepts are unlearnable. An early example of this line of thinking is found in Fodor (1975), in which he asks us to consider an experiment in which participants have to learn the meaning of a new word, *flurg*. They are asked to sort cards according to whether they are *flurg* or not, and are able to learn from feedback given by the experimenter after each trial. If there are circles and squares that are either green or red, and if green is the target concept, selection of a green circle will result in positive feedback, while selection of a red circle will result in negative feedback. Accordingly, they will eventually be able to identify which cards are *flurg*. Fodor's (1975) principal objection to this behaviorist approach to learning is that hypotheses can only be formulated and tested if participants already have the concepts they are supposed to be learning. In the above case, they must be able to represent the concept GREEN in the hypothesis and identify it in the supporting data. As such, they cannot be learning a new concept.

The only way to justify such hypothesis-testing models, according to Fodor (1975), is if the concept being acquired is complex, so that the learners may utilize evidence based on constituent concepts in order to acquire it. The problem with this, however, is that there are no definitions. It is important to understand that it is assumed that the only relevant kind of internal structure that a concept can have is definitional, which is tendentious. Fodor dismisses alternatives such as Prototype Theory and semantic structure theories. One argument presented against prototypes is that concepts cannot be prototypes because the latter cannot be composed to give us complex concepts: a pet fish is not the most typical pet (a dog?) plus the most typical fish (a cod?), nor is red hair the most typical instance of red (as in fire engines?) plus the most typical kind of hair, whatever that may be (see Fodor, 2000, Chs 4 & 5). As for semantic structure theories, they rely on abstract semantic elements which do not correspond to words, but remain somewhat vague because, well, they cannot be defined in words. Such semantic components are discussed in more detail later.

These considerations of the nature and learnability of concepts lead Fodor to the following reasoning (for a variant of the laying out of this logic, see Laurence & Margolis, 2002):

i. all concepts are either learned or innate
ii. if they are learned, they are learned by hypothesis testing
iii. if they are learned by hypothesis testing, they are structured
iv. but lexical concepts have no internal structure
v. so they cannot be learned by hypothesis testing
vi. so they cannot be learned
vii. therefore, all lexical concepts must be innate.

In the absence of lexical learning, Fodor (1998) maintains that concepts must be 'triggered' into existence in the mind once learners 'lock onto' examples in the world. This raises many questions, not least of which is how come the mind has, as Pinker (2007) puts it, 'fifty thousand innate concepts' to start with. (This number is extremely conservative, as it should include every entry in the largest dictionaries of all languages, all the words that have ever existed, and all the words that will ever exist, including things that toddlers make up on a daily basis.) Fodor finds support for the triggering approach to lexical acquisition from Piatelli-Palmerini (1986, 1989), who suggests a parallel with the immune system. It is now known that antibodies do not 'mold themselves' to the invading proteins carried by pathogens and parasites, thereby 'learning' about incoming antigens. Rather, the immune system generates millions of different antibodies, including ones that fit proteins our bodies have never experienced and will never experience. Thus an immune response consists of attempting to map one of millions of pre-existing antibodies onto the offending antigen. Piatelli-Palmerini (1986, 1989) considers that a similar triggering system may be in place for the generation of concepts.

More than any other aspect of Fodor's approach to concepts, it is this radical concept nativism that has provoked extreme reactions from the cognitive science community, particularly in the 10 years between its most extensive defense in Fodor (1998) and its restatement in Fodor (2008, Ch. 5). The nature of this backlash deserves its own brief commentary.

The backlash

A representative perception of Fodor's (1998) stance on radical concept nativism can be found in the review by Bach (2000, p. 627):

> . . . Fodor is an equal-opportunity annoyer. He sees no job for conceptual analysts, no hope for lexical semanticists, and no need for prototype theorists. When it comes to shedding light on concepts, these luminaries have delivered nothing but moonshine.

Bach (2000) went on to give a considered response to Fodor's argument, but perhaps the most common reaction has been to dismiss its absurd conclusion out of hand. Churchland (1986, p. 389) remarks that it is 'difficult to take such an idea seriously.' Putnam (1988, p. 15) typifies most people's reactions when he states:

> To have given us an innate stock of notions which includes *carburetor*, *bureaucrat*, *quantum potential*, etc., as required by Fodor's version of the Innateness Hypothesis, evolution would have had to be able to anticipate all the contingencies of future physical and cultural environments. Obviously it didn't and couldn't do this.

A more careful response is found in Laurence and Margolis (2002), where they characterize such rapid-fire rejections as 'intellectually philistine' (p. 33), because they reject the conclusion without considering the logic of the argument; they do not show where Fodor's argument goes wrong, and leave the important questions unanswered. Laurence and Margolis (2002, p. 33) suggest that the radical nativist argument should be treated as a philosophical puzzle, henceforth Fodor's Puzzle, on a par with the paradoxes of Zeno:

> The point of these puzzles is that they seem to embody deep difficulties that infect our total theory of the world, puzzles about how we understand space and time, justification, ontology, meaning, etc. The value of such puzzles is exactly that they capture these difficulties, while providing a focused point of reflection. To simply side-step the problems they raise is to opt out of doing philosophy.

Others have been less impressed with the beauty of the puzzle. After all, classical paradoxes such as Achilles and the Tortoise or Zeno's Arrow involve a *reductio ad absurdum* which carries us gently from stage to stage of the argument, with each step totally plausible and uncontestable. However, the premises of Fodor's Puzzle are wide open to question. Stage (ii) – the assertion that concepts are invariably learned by hypothesis testing – is highly controversial. Samet and Flanagan (1989) argue that not all learning involves hypothesis testing, and cast doubt on whether lexical learning can be so characterized. Keil and Wilson (2000) note *inter alia* that many concepts are learned that never lock onto things in the world. Laurence and Margolis (2002) themselves wonder if Fodor does not do empiricist thought an injustice in his characterization of this trial-and-error kind of concept acquisition. For example, Hume's (1739/1978, p. 10) treatment of the acquisition of concepts such as 'winged horses, fiery dragons and monstrous giants' is not so simplistic.

Other objections have been raised with regard to Stage (iv) – the claim that lexical concepts have no internal structure, which is rejected by all working lexical semanticists. Although Jackendoff (1989) endorses the logic of Fodor's argument 'unconditionally' (p. 98), he disputes the validity of the claim concerning internal structure, without which, of course, the argument falls to pieces. Another line of attack on Stage (iv) comes from Hampton (2000), who feels strongly that Fodor has misrepresented Prototype Theory, to the point of not citing the most important developments in the literature. Hampton (2000) argues not only that concepts have internal structure, but that previous work has revealed how complex concepts can be composed of prototypes (*contra* Fodor's discussion of pet fish and red hair). In Prototype Theory, conceptual features are never necessary conditions, so that for example, it doesn't follow that a pet bird would be assumed to live in a tree. Rather, people appear to compose lists of attributes likely to be generated by both categories, and when attributes seem incompatible, they elaborate the complex concept to make it more coherent. For example, if asked to describe something that is both fruit and furniture, participants invent hybrids such as chairs carved out of giant pineapples or watermelons used as bean bags. Then they attempt to resolve design problems by chipping away at the original prototypes: fruit rots, and furniture is durable, giving rise to hybrids such as disposable furniture or genetically modified fruit (Hampton, 1996; Kunda, Miller, & Clare, 1990).

The 'triggering' account of lexical acquisition has stimulated its own set of criticisms. Landau (2000) points out that the notion that all concepts are innately available, awaiting an experiential trigger, implies that all concepts are 'public' – that is, they are shared, not only by the linguistic community, but by all human beings. Landau (2000) observes that not all adults have the same concept of what GEOMETRY entails, and children change their understanding of concepts such as FISH over the course of development (applying it to whales and dolphins for a time). Pinker (2007) highlights a separate problem with the triggering account, concerning the analogy with the immune system. The immune

system and the conceptual system face very different pressures. The more antibodies, the better, as we are constantly under attack from 'the innumerable, rapidly evolving, and malevolent microorganisms that surround us' (p. 96). However, concepts must be constrained so that in the course of acquisition, children can home in only on those that are relevant. Word learning constitutes a tremendous induction problem, because most of the generalizations one could make are wrong (for an idea of the extent of this problem, see Bloom, 2000).

Landau's (2000) point concerning over- and undergeneralization in language development is a serious problem for Fodor, but the situation is even worse when one compares lexical concepts across languages. Natural language lexicons are characterized by extreme lexical relativity, such that pairs of equivalent terms are virtually non-existent (Stringer, 2008, 2010). Even the most intuitively universal terms resist cross-linguistic equivalence: the English verb *drink* is used only of liquids; in Turkish, the analogous verb may be used of smoke; in Japanese, of medicinal pills, even if swallowed dry. The English noun *television* has no exact equivalent in German: *der Fernseher* refers to the machine, while *das Fernsehen* refers to the medium. Following this through, if analogues for an English verb such as *put* are slightly different in every known language, which is a plausible hypothesis, then the number of concepts conveyed just by this set of analogues will be at least the number of known languages. The option of making this problem more tractable by reference to shared semantic components is not available in the theory of conceptual atomism.

Fodor is quite explicit about one aspect of cross-linguistic variation. He claims that a concept expressed as a word in one language cannot be expressed by a phrase in another language: 'Since . . . most words are undefinable – not just undefinable in the language that contains them, but undefinable *tout court* – I'm committed to claiming that this sort of case can't arise. . . . The issue is of course empirical' (Fodor, 1998, p. 42, fn. 2). However, as most linguists will recognize, such cases arise with well-documented frequency. As discussed by Pinker (2007, p. 98), while English has pairs of words such as *see* and *show*, *come* and *bring*, and *write* and *dictate*, Hebrew expresses *show* as *cause-to-see*, *bring* as *cause-to-come*, and *dictate* as *cause-to-write*. It is not difficult to multiply such examples.

A more positive response to Fodor's Puzzle has been to acknowledge the fact that this provocative, well-argued thesis with its absurd conclusion has at least forced philosophers, lexical semanticists, and acquisitionists to re-examine their assumptions with renewed intellectual rigor. As Daniel Dennett puts it:

> Most philosophers are like old beds: you jump on them and sink deep into qualifications, revisions, addenda. But Fodor is like a trampoline: you jump on him and he springs back, presenting claims twice as trenchant and outrageous. If some of us can see further, it's from jumping on Jerry. (cited in Loewer & Rey, 1991, p. xi)

Decomposition without definitions

If there are no classical definitions, then the question arises of how lexical semanticists view constituent concepts. The goal of identifying semantic components in contemporary lexical semantic theory is not to arrive at a complete definition of any lexical item,

but is much more restrictive: to reveal those aspects of meaning that play a role in grammar. Colors (e.g., *red*) and temperatures (e.g., *hot*) may or may not be represented in particular lexical concepts (e.g., *blood*, *fire*), but they play no role in the grammar of any known language, and so are outside the scope of inquiry for those investigating the role of meaning in argument structure.

As an example of this approach, Levin (1993) sorted 3000 English verbs into approximately 85 semantic classes based on shared syntactic environments. Thus for each verb, we have a list of semantic components that appear to play a role in determining syntactic possibilities. However, nowhere does Levin claim to have defined the totality of the meaning of any particular verb in terms of such components, and this is clearly not the object of the endeavor. She provides an influential example of how syntactic evidence can be used to identify semantic components. The verbs (a) *cut*, (b) *crack*, (c) *stroke*, and (d) *whack* may seem conceptually similar at first glance, but detailed analysis reveals that *crack* and *stroke* may not be used in the 'conative' construction (e.g., *Harry cut at the pastry*), *crack* may not be used in the 'body-part ascension' construction (e.g., *Sally cut Harry on the arm*), and *stroke* and *whack* may not be used in the 'middle' construction (e.g., *This surface cuts easily*), while *cut* is grammatical in all three environments (Levin, 1993, pp. 6–7). The semantic elements that appear relevant to this distribution appear to be conflated as follows:

(4) a. *cut*: [CAUSE, CHANGE OF STATE, CONTACT, MOTION]
b. *crack*: [CAUSE, CHANGE OF STATE]
c. *stroke*: [CONTACT]
d. *whack*: [CONTACT, MOTION]

If this analysis is correct, then predictions can be made as to the syntax of verbs that share the same semantic features. Such predictions are borne out with the syntactic distribution of (a) *cut*-type verbs (*scratch*, *hack, slash*, etc.); (b) *crack*-type verbs (*rip*, *break*, *snap*, etc.); (c) *stroke*-type verbs (*tickle*, *pat*, *touch*, etc.); and (d) *whack*-type verbs (*kick*, *hit*, *tap*, etc.), leading to the conclusion that lexical semantic features do play a determining role in the syntax of argument structure.

As another leading proponent of decomposition, Jackendoff (2002, pp. 334–339) recognizes that Fodor's (1998) arguments against classical definitions are sound, but he also maintains that conceptual semantics is a non-definitional form of decomposition. He draws a parallel with the phonology of a word, which is neither atomic nor innate, and may be decomposed into mostly language-specific syllables, then into partly language-specific phonemes, then further into a universal repertoire of distinctive features to which we have no conscious access. He also suggests that criticism of semantic feature theories as unconstrained and leading to infinite regress invites comparison with physics: decomposition of the elements from the atom to the nucleus to protons and neutrons to quarks and features of quarks (in each case, first in theory, then in fact) does not lead physicists to worry about hitting bottom. In lexical semantics, as in physics, 'every time a further decomposition emerges for elements previously thought to be primitive, it reveals further layers of generalization and explanation' (Jackendoff, 1990, p. 4).

Fodor (1998, p. 63ff.) states that arguments for lexical semantic components are not arguments for decomposition, as the identification of semantic features does not mean that concepts consist entirely of bundles of such features; however, this mischaracterizes decomposition as involving every aspect of conceptual meaning; it seems clear that in restricting the investigation to grammatically relevant components, and ignoring other aspects of meaning, lexical semantic theory does not view decomposition as a definitional endeavor. The guiding assumption appears to be in the spirit of *Gestalt* psychology: 'the whole is greater than the sum of the parts.'

Lexical concepts in language acquisition

Conspicuous by its absence in the current debate over the nature of concepts is empirical evidence from first language acquisition. This is somewhat surprising, given both the emphasis on conditions of learnability and the previous groundbreaking research on lexical acquisition conducted by several researchers caught up in the polemic, such as Landau (e.g., Landau & Gleitman, 1985) and Pinker (e.g., Gropen et al., 1991). Neither Landau (2000) nor Pinker (2007) cite acquisitional evidence in their critiques of conceptual atomism. However, the study of the acquisition of syntax is highly relevant to the question of lexical conceptual composition, as it can be shown that lexical semantic components affect grammar at all stages of development. As with several other interface phenomena, delays in acquisition are apparent when accurate performance in one module is dependent on appropriate input from an independent linguistic subsystem. This is potentially useful in helping us to understand the nature of lexical representations because a given representation may change over time, with predictions for the associated grammar. Such a scenario also allows for manipulations of lexical meaning, such that novel words can be coined and taught; subsequently elicited utterances may then be used to shed light on the role of hypothesized meaning components. In this section, I briefly discuss an exemplary study of this type, and describe a modified version of the experiment that is strongly supportive of a decompositional approach to lexical concepts.

Gropen et al. (1991) and the acquisition of locative verbs

The phenomenon in question is the locative alternation, sometimes known as the *spray/load* alternation. The following examples show how the verbs *dribble*, *encrust*, and *sprinkle* may all be used in events that involve a moving thing or substance (e.g., milk, gems, or glitter), henceforth the Figure, and a reference object in the form of a surface (e.g., the politician, the crown, the boy), henceforth the Ground. However, each verb has different argument structure possibilities. *Dribble* allows only the Figure as direct object, *encrust* allows only the Ground, while *sprinkle* allows either the Figure or the Ground in this position:

(5) The baby dribbled {milk all over the politician / *the politician with milk}.
(6) The silversmith encrusted {*gems onto the crown / the crown with gems}.
(7) The clown sprinkled {glitter onto the boy / the boy with glitter}.

Verbs like *dribble*, which select a Figure direct object, include *dump*, *pour*, and *spill*; verbs like *encrust*, which select a Ground direct object, include *cover*, *decorate*, and *fill*; and so-called 'alternating' verbs like *sprinkle*, which allow both variants, include *load*, *pack*, and *spray*. As mentioned in the introduction, children make mistakes with non-alternating verbs until they are 8 or 9 years old. While adults can only *pour water into a cup* or *fill a cup with water*, children have been known to **pour a cup with water* or **fill water into a cup* (for actual examples, see Bowerman, 1981, 1982; Pinker, 1989). The question remains as to whether such errors are due to a delay in syntactic principles governing the alternation or inappropriate lexical conceptual representations, such that the representation of the verb has a particular semantic component either inappropriately conflated or missing.

Gropen et al. (1991) set out to investigate whether mapping principles between lexical semantics and syntax were available at the early stages of acquisition, or whether they had to be learned. They hypothesized that causative motion verbs with a Manner component select the Figure as direct object (*He rolled the ball into the goal* / **He rolled the goal with the ball*), Change-of-State verbs select the Ground as direct object (*She covered her head with a veil* / **She covered a veil onto her head*), and verbs with both components allow alternating argument structure (*He smeared paint onto the canvas* / *He smeared the canvas with paint*). Nonce verbs were taught to children with rich environmental context, through the use of experimental props, and in the absence of syntactic context, through the introduction of the new word in the gerund (e.g., 'Look! This is *pilking*'). In the first experiment, two novel verbs were taught to three groups of children (16 aged 3;4–4;5; 16 aged 4;7–5;11; and 16 aged 6;5–8;6) and an adult control group. Pennies or marbles were made to move in a hopping manner to a cloth, which did not move when they landed (the Manner condition), or they were moved with no particular manner to the cloth, which then sagged (the Change condition). Participants were asked a Figure-bias question, such as 'Can you tell me what I'm doing with the *pennies*?', and a Ground-bias question, such as 'Can you tell me what I'm doing with the *cloth*?' The discourse context of the former makes the choice of a Figure as direct object more 'natural,' and the same is true, *mutatis mutandis*, for the Ground question. The expected response for the first condition was 'You're *pilking* the pennies onto the cloth' (Figure as direct object), and the expected response for the second condition was 'You're *pilking* the cloth with the pennies' (Ground as direct object).

In accordance with theoretical predictions, participants in all age groups more frequently mapped the Figure onto the direct object when using the Manner verb than when using the Change verb, and more frequently mapped the Ground onto the direct object when using the Change verb than when using the Manner verb. However, despite the desired statistical significance, the results were not uncomplicated. Although predictions were borne out in a contrastive analysis of the two verbs, Figure-objects were chosen predominately for *both* Manner and Change verbs. In Manner verb responses, Figure-objects were preferred across both question types (mean 97% for Figure-bias question and Figure-object; mean 78% for Ground-bias question and Figure-object). In Change verb responses, Ground-objects were preferred only in responses to Ground-bias questions (mean 52% Ground-objects; mean 47% Figure-objects), while Figure-objects were preferred in responses to Figure questions (mean 81% Figure-objects;

mean 17% Ground-objects), so that the overall preference across question types was for Figure-objects (mean 66% Figure-objects; mean 32% Ground-objects).

This first set of results was almost certainly skewed due to a methodological flaw. Apparently, 'the experimenter often had to nudge the packet into the unsupported material in order to initiate the sagging' (Gropen et al., 1991, p. 171), making the Manner interpretation over-salient, when a neutral context was required. Participants may have interpreted the verb not as a pure Change verb but as an alternator with a similar representation to *stuff*, which would account for the high number of Figure-object responses in the Change condition. In a second experiment, designed to eliminate this flaw, the same teaching procedure was used with the same number and range of participants with a much clearer Change condition. A sponge or a cotton-ball was moved in a zig-zag path to a square cloth which did not change state (the Manner condition), or alternatively it was moved directly to the cloth causing a change in color, as either baking soda or lemon juice on the sponge came into contact with cabbage juice on the cloth (the Change condition). The results not only replicated the findings of Experiment 1 as regards the relative preference for Figure-objects with the Manner verb and Ground-objects with the Change verb, but this time the preference for Ground-objects when using the Change verb was evident across both Figure and Ground question types, and across all age groups. In this condition, Ground-objects were preferred not only in responses to Ground questions (mean 94% Ground-objects; mean 5% Figure-objects), but also in responses to Figure questions (mean 88% Ground-objects; mean 11% Figure-objects), so that the overall preference this time was for Ground-objects (mean 91% Ground-objects; mean 8% Figure-objects). These results indicate that when a change of state is salient enough, the Ground rather than the Figure will surface as the direct object, and they suggest that both forms of mapping are equally canonical. Thus neither of the following examples is a derived structure:

(8) The magician put the hat over the rabbit.
(Figure as canonical direct object)

(9) The magician covered the rabbit with the hat.
(Ground as canonical direct object)

This finding dovetails with the observation that in spontaneous production, children seem to acquire Figure- and Ground-oriented verbs at the same time and with equal ease (Bowerman, 1990; Pinker, 1989). The interface principle that ensures that the entity 'affected' by the verb is mapped to the direct object – the Figure in the case of Manner verbs and the Ground in the case of Change verbs – is plausibly part of Universal Grammar, and is available to children from the outset.

A partial replication study: Further evidence of canonical mapping from lexical semantics to syntax

The partial replication study adopted the overall methodological framework of Gropen et al. (1991), but with several important changes: different experimental materials to test the same phenomena, variations in protocol to reduce Figure or Ground bias, and other adjustments as discussed below.

Participants. Group A consisted of 12 children aged between 2;10 and 4;11 (mean: 4;2); Group B consisted of 12 children aged between 5;3 and 6;11 (mean: 6;4); and Group C consisted of 12 adult controls. All participants were tested in a quiet room, and sessions were tape-recorded.

Pretest. A pretest was administered in which full sentences with the Figure-oriented form of *stick* and Ground-oriented form of *decorate* were elicited. Participants were introduced to the materials: a collection of colorful, shiny tropical-fish stickers and a blank page. While the experimenter placed the fish onto the page, participants were asked, 'Using the word *sticking*, can you tell me what I'm doing?' Occasional prompting was necessary, and took the form of 'sticking . . .' or 'sticking the . . . .' The target response was 'You're sticking the fish onto the page,' and was often elicited first time. Other initial responses included 'You're sticking them on' (PB), 'sticking fishes on the book' (AMO), and 'sticking the fish' (DT). If a response did not include both a direct and an indirect object, the participants were asked to repeat the target response. The experimenter then continued placing fish onto the page, and participants were asked, 'Using the word *decorating*, can you tell me what I'm doing?' The target response was 'You're decorating the page with fish,' and again was often elicited with no further ado (even the youngest Group A participant – AM (2;10) – replied in this form with no prompting). Other answers included 'decorating the book with fish stickers' (SL), 'decorating the piece of paper' (JBR), and 'decorating the whole page with the fish' (AL). Three Group A participants initially used a Figure-object, thus making the *fill*-type error discussed previously. These responses were 'decorating fishes on' (AW), and [Prompt: decorating . . .] 'the fishes' (PH and HP). As before, when necessary, correct, complete forms were modeled and then elicited without difficulty.

Two novel verbs. The new verbs were both taught in the context of a Figure being moved to a Ground. The Figure-oriented verb *pook* was intended to specify a manner of motion. Participants were shown a small plastic Figure in the form of an amiable-looking, slightly disheveled, bespectacled professor, introduced to them as 'my friend, Dr. Doodle' (Figure 1). Several Group A participants said 'hello.' Inside the lower part of the Figure, above the plastic base, was a round magnet. Dr. Doodle acted as the Agent, while the Figure took the form of a round magnetic counter (introduced as 'a wheel'). The poles of the magnets in Dr. Doodle and the wheel were oriented so as to repel each other (one north-side-up, one north-side-down); in this way the professor appeared to cause the wheel to move without touching it. The Ground was provided by a hole cut into the cardboard surface of the upturned box on which the event took place, and the target response was, 'He's pooking the wheel into the hole.' The intended meaning of the novel Figure-oriented verb was thus a manner of motion, and whether interpreted as something paraphraseable as 'cause to move without touching' or 'cause to move magnetically,' or even 'cause to move magically' the manner of motion was intended to be the salient characteristic.

The materials used to teach the novel Ground-oriented Change verb included another toy character, named Charlie, and a 'magic' hat (Figures 2 and 3). Charlie's body was painted onto a small, upturned polystyrene cup, the narrow end of which was cut and

Figure 1. Dr. Doodle

lined with glue to accommodate the head. Charlie's head took the form of a table-tennis ball with a painted face, inside of which was an electrical circuit involving a miniature alarm system comprising a bulb, an oscillating bell and a battery. The circuit was broken, with the positive and negative terminals situated close together on the surface of the table-tennis ball (the back of Charlie's head). The terminals remained unseen by participants during the experiment. When the terminals were connected with a conductor (e.g., a finger), Charlie's head behaved with the characteristics of a miniature alarm, flashing red and beeping. The novel verb *zike* was coined to describe the causing of Charlie to enter such a state. The hat was made from a piece of egg carton cut to fit the head. It was covered inside and out with a layer of aluminum foil, and then decorated with shiny stickers. The foil acted as a conductor, so that it was possible to 'zike' Charlie by placing the hat on his head, thus connecting the circuit. The target response was, 'You're ziking Charlie / his head with the hat' (compare the real Change verb *cover*: 'You're covering his head with the hat / *You're covering the hat onto his head').

Figure 2. Charlie: Front

Figure 3. Charlie: Rear

Teaching procedure. In each case, the verbs were introduced in the gerund form, so that when participants used them for the first time they had had no exposure to associated argument structure, excluding the possibility of syntactic cueing of verb meaning; this also ensured that the resultant argument structure was derived from productive rule application. Participants were asked, 'Can you say *pooking*? . . . Say *pooking* . . . ,' after which they were told, 'Now I'm going to show you what *pooking* is.' They were then shown Dr. Doodle *pooking* the wheel into the hole, with no further commentary. Gropen et al. (1991) included additional descriptions, such as 'when I do this and it ends up over there, it's called . . .' (for the Manner verb), and 'when I do this and it ends up like that, it's called . . .' (for the Change verb), for which they do provide a rationale (p. 169, fn. 7), but it was decided that these descriptions might present potential cues for argument structure. Participants were then shown Dr. Doodle kicking the wheel into the hole and told, 'This is not *pooking*,' as an experimental means of reproducing the effect of cross-situational evidence. They were then asked, 'So now do you know what *pooking* is? Can you show me?' All the children and adults 'pooked' the counter into the hole (even if the younger ones had to stretch), indicating that the Ground was indeed considered a participant in the event described by the predicate. After they had demonstrated the event, they were asked to practice the new word by responding to some questions, while the event was repeated. The first question was invariably 'What am I doing?'; in this way, there was no bias from the input toward a Figure or a Ground as direct object. Gropen et al. (1991) used this form in their pretest but not when testing the novel verbs. The following two questions corresponded to Gropen et al.'s (1991) Figure-bias and Ground-bias questions. After a pause, participants were asked, 'Now, using the word *pooking*, and can you tell me what I'm doing with the counter?', which introduced a pragmatic bias for the Figure to surface as direct object (henceforth the 'Figure-question' type). After another pause, they were asked, 'Now, again using the word *pooking*, can you tell me what I'm doing with the hole?', which of course introduced a pragmatic bias for the Ground as direct object (henceforth the 'Ground-question' type). The order of these two questions was counterbalanced across participants, alternating for each successive participant. If they replied in the bare gerund form, or if they hesitated for 10 seconds or more, a prompting strategy was adopted. The first prompt was e.g., 'pooking . . .'; the second was 'pooking the . . .'; and the third was 'pooking what?'

As regards the form and order of the questions, exactly the same procedure was followed for the verb intended to specify a change-of-state. Participants were introduced to Charlie and asked if they could point out his feet and his hands, before pointing to his head. This was to raise awareness that the predicate could have something to do with the head and the hat, not just Charlie and the hat. Either Charlie or his head could serve as the Ground, but the third prompt, 'ziking what?' could be seen as a syntactic cue that the hat should be mapped onto direct object, while 'ziking who?' would indicate that Charlie should be the direct object. In the actual experiment, the prompt 'ziking what?' was used only twice and could refer to either the Figure or Ground. As an example of something that was not *ziking*, a second hat was used. It was made from the same egg carton and took the same form as the 'magic' hat. It was decorated in the same way, but was painted red rather than being covered in aluminum foil, so that it could not connect the circuit. After pointing out Charlie's head, participants were asked to point out which of the hats

Table 1. Experimental results: response percentages indicating the selection of Figure or Ground as the direct object of manner and endstate verbs

Age group Obj. argument	A (2;10–4;11)		B (5;3–6;11)		C (Adult)		Mean (across groups)	
	Figure	Ground	Figure	Ground	Figure	Ground	Figure	Ground
Manner verb								
Open Q	100	8.33*	100	0	100	0	100	2.77*
Figure Q	100	0	100	0	100	0	100	0
Ground Q	91.66	8.33	100	0	100	0	97.22	2.77
Mean (across Q types)	97.22	5.55*	100	0	100	0	99.07	1.85*
Endstate verb								
Open Q	8.33	91.66	25	75	0	100	11.11	88.88
Figure Q	8.33	91.66	25	75	0	100	11.11	88.88
Ground Q	0	100	16.66	83.33	0	100	5.55	94.44
Mean (across Q types)	5.55	94.44	22.22	77.77	0	100	9.25	90.74

*Figures marked by an asterisk are those which when combined with the Figure results do not add up to 100%. This is due to certain dual responses in which both Figure and Ground surfaced as direct objects, as discussed. Both forms of response were included in the calculations.

they thought was magic, so as not to focus attention solely on the Ground before testing. The Ground-oriented verb *zike* was introduced in the same fashion as the Figure-oriented *pook*. The results are shown in Table 1.

Results. The results replicate the patterns found by Gropen et al. (1991), with clearer distinctions between verb-types, especially with the younger children. A two-sided Fischer's exact test confirmed that participants were more likely to respond with Figure-object sentences in the Manner verb condition, and with Ground-object sentences in the Change verb condition, irrespective of age group and irrespective of question type (for all, $p < .001$).

In the Manner-verb condition, the Figure surfaced as direct object in 100% of responses to all three question types by Groups B and C. Group A had an almost identical response pattern, with Figure responses to the open question reaching 100%, to the Figure question also reaching 100%, and to the Ground question reaching 91.66%. These results are much clearer than those of Gropen et al.'s (1991) Experiment 2, in which mean response accuracy in the Manner condition was 53% for ages 3;4–4;5, 75% for ages 4;7–5;8, 75% for ages 6;7–8;5, and 66% for adults. This may be due to the creation of a purer nonce verb in the Manner condition; in the original study, moving in a zig-zag fashion could also possibly be interpreted as a Path verb. Turning to the exceptions in the current study, two Group A children selected the Ground as direct object in one out of three responses. SL did so in response to a Ground question, perhaps indicating pragmatic bias: [Ground question: 'can you tell me what he's doing with the hole?' Prompt: pooking . . .] 'pooking the hole.' PH responded in confused fashion to the first, open question: [Third prompt: pooking what?] 'the hole and the wheel' (PH). However, he

selected the Figure as direct object in his next two responses, despite the Ground bias in the final question ([Figure question: 'can you tell me what he's doing with the wheel?'] 'He's pooking it in the hole' (PH); [Ground question: 'can you tell me what he's doing with the hole?'] 'He's pooking the wheel into it' (PH)). The Ground question did make some participants hesitate, but the selection of Figure as direct object proved resilient.

In the endstate-verb condition, the mean response preferences of Groups A, B, and C for the Ground as direct object across question types were 97.22%, 77.77%, and 100% respectively, indicating a presumably canonical mapping between Ground and direct object position. These results corroborate the evidence from Gropen et al.'s (1991) Experiment 2, in which the mean rates of accuracy for the Change condition were 78% for ages 3;4–4;5, 100% for ages 4;7–5;8, 84% for ages 6;7–8;5, and 100% for adults. As for individual responses in the current study, only two children from Group A mapped the Figure onto the direct object, and each did so in only one out of three responses (AL after the open question: 'You're ziking the hat onto him'; and HP after the location question: 'You're ziking it on his head'). The overwhelming preference in Group A was to interpret the verb as a non-alternating change-of-state predicate, hence the selection of the Ground as direct object in 91.66% of responses to both open and Figure questions, and in 100% of responses to Ground questions. Typical responses include: 'You're ziking the head' (KM); and 'You're ziking Charlie' (DM). Group B responses were slightly less uniform, but the Ground still surfaced as direct object in 75% of responses to open and Figure questions and in 83.33% of responses to Ground questions. Two children (JBR and JW) consistently encoded the verb as Figure-oriented in all three responses, thus possibly categorizing the verb as a non-alternating Figure-oriented verb. A third child (AMO) responded in similar fashion to the open and Figure questions, but perhaps responded to pragmatic bias following the Ground question: 'ziking it . . . you're ziking the head' (AMO).

Although the performance of Group B in the endstate condition was not as clear-cut as that of Groups A and C, a two-sided Fischer's exact test revealed no significant differences between the groups at the level of individual question types. However, if the results for the three individual questions are collapsed, the difference between the means of Groups A and B approaches significance ($p = .085$) and a difference between Groups B and C emerges ($p = .005$). It is therefore possible that significant differences between groups might surface for each question type with a larger number of participants. The performance of Group B may indistinctly reflect one of two developmental processes that a larger study might illuminate. First, there might be a U-shaped developmental curve, by which children first get the mapping right, then make occasional errors, before converging on adultlike representations. This would be in line with general observations on the acquisition of argument structure by Bowerman (1982) and Pinker (1989). Second, these children may be exhibiting the purported bias of younger children to attend to Figures and manners of motion, rather than Grounds and endstates, as observed by Gentner (1978), Bowerman (1981, 1982), and Gropen et al. (1991). In this case, a larger study might also find such errors in the lower age group. However, given that the differences are down to the performance of just three Group B individuals, and that no such pattern emerged in Gropen et al.'s (1991) data, it is possible that such differences will disappear with a greater number of participants.

The fact remains that despite differences between groups in the Change condition, all groups still clearly distinguished between the Manner and Change verb conditions across question types, producing appropriate mappings at rates that were highly significant (for all question types, $p < .001$). The overall high levels of accuracy in the experiments were observable down to the youngest participant (AM: 2;10), who produced appropriate responses to all six questions, regardless of pragmatic response bias. These results constitute robust evidence that grammatically relevant concepts such as Manner and Change are conflated in larger lexical concepts corresponding to particular verbs. They also reveal that the mappings between lexical semantics and syntax are operative at a very early stage of syntactic development (at least following the two-word stage), and are plausibly part of the machinery of Universal Grammar. In addition, they support an account of delays in the acquisition of argument structure that places the burden of learnability not on syntactic principles, but on the gradual association of semantic components with particular lexical entries. As such, these experiments furnish empirical evidence against both lexical conceptual atomism and radical concept nativism.

Conclusion

These findings provide compelling evidence that the relevant mapping principles at the lexical interface are in place very early in acquisition, and are plausibly innate. Two- and three-year-old children *know* that causative motion verbs with a Manner component select the Figure as direct object and that Change verbs select the Ground as direct object. When lexical semantic components are controlled for, children reveal an adultlike knowledge of syntactic argument structure. Therefore, it seems plausible to assume that delays in syntactic accuracy with such verbs are due to the gradual nature of convergence on adultlike representations of the lexical semantics of predicates. If instances of pouring are assumed always to involve instances of filling, then *pour* will subsume a Change component, and it will alternate. If instances of filling are assumed always to involve instances of pouring, then *fill* will subsume a Manner component, and again, the alternation will be possible. How exactly children overcome such assumptions and change their lexical concepts remains a conundrum, despite Pinker's (1989) effort to solve the paradox, but this aspect of learnability is not of principal concern here. The issue is that both the reported experimental behavior and the associated delays in naturalistic acquisition cannot be explained on the assumptions of conceptual atomism or radical concept nativism.

Both the syntactic accuracy with nonce verbs shown by children in experimental conditions and the widely reported delays in the acquisition of the syntax of existing verbs can be explained on the assumption that semantic components such as Manner and Change have psychological reality. Despite the difficulties inherent in providing empirical confirmation of the existence of such abstract lexical semantic components, a decompositional approach is strongly supported by these experiments on the first language acquisition of locative verbs. More generally, the fact that the argument structure of verbs can change over the course of acquisition has the potential to inform us about lexical conceptual structure in different stages of development. It follows that first language acquisition is a largely untapped but potentially fruitful source of evidence bearing on theories of conceptual semantics.

Acknowledgments

This article grew out of a talk for the Cognitive Lunch Series at Indiana University in September 2008, and involves the elaboration of ideas born of empirical studies first reported in Stringer (2000), (2003), and (2006). Many thanks to Rob Goldstone, the director of the Cognitive Science Program, for making the talk possible, and to the participants for stimulating interdisciplinary discussion. I am also very grateful to the anonymous reviewers, whose comments were extremely useful.

Note

1. An anonymous reviewer strongly disagrees with this characterization of Fodor's approach to lexical concepts as 'indivisible, unlearnable and innate.' However, I respectfully maintain this interpretation, which is shared by the papers cited in the literature review. In a clarification of his position, Fodor (2001, p. 140) states: 'I hold that no concepts can be prototypes, hence that "most" concepts must be *unstructured*, hence that most concepts must be *unlearned*' [my italics]. He explains that 'most' is in quotation marks simply because many concepts are phrasal and therefore complex, such as 'A FRIEND OF MY AUNT.' Regarding innateness, he is more equivocal: 'I'm told from time to time that the thesis that DOORKNOB is innate is *prima facie* very implausible. . . . Actually, I do understand that it seems implausible that DOORKNOB is innate. The trouble is, I find it very hard to see what's wrong with the arguments that appear to require that conclusion' (p.110, fn. 9). As a possible alternative, he does elaborate an account by which our minds are innately driven to lock onto Lockean 'essences' of objects; after which statistical inferences allow for the creation of a prototype, eventually yielding a concept that is 'locked on' to an extension which includes all and only doorknobs (Fodor, 1998, Ch. 6; 2001; 2008, Ch. 5). However, this is still an argument that requires some quasi-mystical essence of objects to be innately retrievable. He concludes that 'Nativism is more or less right about the relation between the prototypes that one's experiences cause one to construct and the concepts that constructing the prototypes cause one to acquire. Anyhow, it's right enough to make concept acquisition a kind of triggering' (Fodor, 2001, p. 147). All this is clearly in opposition to the perspective advocated in this article: that acquisitional evidence supports a view of lexical concepts as decompositional, learnable, and dependent upon experience of the target language.

References

Bach, K. (2000). Review of Fodor (1998): Concepts: Where cognitive science went wrong. *Philosophical Review*, *109*, 627–632.

Bloom, P. (2000). *How children learn the meanings of words*. Cambridge, MA: MIT Press.

Bowerman, M. (1981). The child's expression of meaning: Expanding relationships among lexicon, syntax and morphology. In H. Winitz (Ed.), *Native language and foreign language acquisition* (pp. 172–189). New York: New York Academy of Science.

Bowerman, M. (1982). Reorganizational processes in lexical and syntactic development. In E. Wanner & L. R. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 319–346). Cambridge: Cambridge University Press.

Bowerman, M. (1990). Mapping thematic roles onto syntactic functions: Are children helped by innate 'linking rules'? *Journal of Linguistics*, *28*, 1253–1289.

Churchland, P. (1986). *Neurophilosophy*. Cambridge, MA: MIT Press.

Fodor, J. A. (1970). Three reasons for not deriving 'kill' from 'cause to die'. *Linguistic Inquiry*, *1*, 429–438.

Fodor, J. A. (1975). *The language of thought*. New York: Crowell.

Fodor, J. A. (1981). The present status of the innateness controversy. In J. A. Fodor (Ed.), *Representations: Philosophical essays on the foundations of cognitive science* (pp. 257–316). Cambridge, MA: MIT Press.

Fodor, J. A. (1998). *Concepts: Where cognitive science went wrong*. Oxford: Clarendon Press.

Fodor, J. A. (2000). *In critical condition: Polemical essays on cognitive science and the philosophy of mind*. Cambridge, MA: MIT Press.

Fodor, J. A. (2001). Doing without what's within: Fiona Cowie's critique of nativism. *Mind*, *110*, 99–148.

Fodor, J. A. (2008). *LOT 2: The language of thought revisited*. Oxford: Oxford University Press.

Fodor, J. D., Fodor, J. A., & Garrett, M. (1975). The psychological unreality of semantic representations. *Linguistic Inquiry*, *6*, 515–531.

Fodor, J. A., Garrett, M. F., Walker, E., & Parkes, C. (1980). Against definitions. *Cognition*, *8*, 263–367.

Fodor, J. A., & Lepore, E. (1998). The emptiness of the lexicon: Reflections on James Pustejovsky's The Generative Lexicon. *Linguistic Inquiry*, *29*, 269–288.

Fodor, J. A., & Lepore, E. (forthcoming). *Morphemes matter*. RuCCS Tech Report, Rutgers University.

Gentner, D. (1978). On relational meaning: The acquisition of verb meaning. *Child Development*, *49*, 988–998.

Gropen, J., Pinker, S., Hollander, M., & Goldberg, R. (1991). Affectedness and direct objects: The role of lexical semantics in the acquisition of verb argument structure. *Cognition*, *41*, 153–195.

Hampton, J. A. (1996). Emergent attributes in conceptual combinations. In T. B. Ward, S. M. Smith, & J. Viad (Eds.), *Creative thought: An investigation of conceptual structures and processes* (pp. 83–110). Washington, DC: American Psychological Association Press.

Hampton, J. A. (2000). Concepts and prototypes. *Mind and Language*, *15*, 299–307.

Hume, D. (1978). *A treatise on human nature*. Oxford: Clarendon. (Original work published 1739).

Jackendoff, R. (1989). What is a concept, that a person may grasp it? *Mind and Language*, *4*, 68–102.

Jackendoff, R. (1990). *Semantic structures*. Cambridge, MA: MIT Press.

Jackendoff, R. (2002). *Foundations of language: Brain, meaning, grammar, evolution*. Oxford: Oxford University Press.

Keil, F. C., & Wilson, R. A. (2000). The concept concept: The wayward path of cognitive science. *Mind and Language*, *15*, 308–318.

Kunda, Z., Miller, D. T., & Clare, T. (1990). Combining social concepts: The role of causal reasoning. *Cognitive Science*, *14*, 551–578.

Lakoff, G. (1965). *On the nature of syntactic irregularity*. Doctoral dissertation, Indiana University.

Landau, B. (2000). Concepts, the lexicon and acquisition: Fodor's new challenge. *Mind and Language*, *15*, 319–326.

Landau, B., & Gleitman, L. R. (1985). *Language and experience: Evidence from the blind child*. Cambridge, MA: Harvard University Press.

Laurence, S., & Margolis, E. (2002). Radical concept nativism. *Cognition*, *86*, 25–55.

Levin, B. (1993). *English verb classes and alternations: A preliminary investigation*. Chicago, IL: University of Chicago Press.

Locke, J. (1964). *An essay concerning human understanding*. Cleveland: Meridian. (Original work published 1690).

Loewer, B., & Rey, B. (1991). *Meaning in mind: Fodor and his critics*. Malden, MA: Blackwell.

Peacocke, C. (2000). Fodor on concepts: Philosophical aspects. *Mind and Language*, *15*, 327–340.

Piattelli-Palmarini, M. (1986). The rise of selective theories: A case study and some lessons from immunology. In W. Demopoulos & A. Marras (Eds.), *Language learning and concept acquisition* (pp. 117–130). Norwood, NJ: Ablex.

Piattelli-Palmarini, M. (1989). Evolution, selection and cognition: From 'learning' to parameter setting in biology and in the study of language. *Cognition*, *31*, 1–44.

Pinker, S. (1989). *Learnability and cognition: The acquisition of argument structure*. Cambridge, MA: MIT Press.

Pinker, S. (2005). So how does the mind work? *Mind and Language*, *20*, 1–24.

Pinker, S. (2007). *The stuff of thought: Language as a window into human nature*. New York: Penguin.

Pulman, S. G. (2005). Lexical decomposition: For and against. In J. I. Tait (Ed.), *Charting a new course: Natural language processing and information retrieval: Essays in honour of Karen Spärck Jones* (pp. 155–174). Dordrecht: Kluwer.

Pustejovsky, J. (1998). Generativity and explanation in semantics: A reply to Fodor and Lepore. *Linguistic Inquiry*, *29*, 289–311.

Putnam, H. (1962). The analytic and the synthetic. In H. Feigh & G. Maxwell (Eds.), *Minnesota studies in the philosophy of science, Vol. 3: Scientific explanation, space, and time* (pp. 358–397). Minneapolis: University of Minnesota Press.

Putnam, H. (1988). *Representation and reality*. Cambridge, MA: MIT Press.

Rosch, E. (1975). Cognitive representations of semantic categories. *Journal of Experimental Psychology: General*, *104*, 192–233.

Rosch, E. (1978). Principles of categorization. In E. Rosch & B. Lloyd (Eds.), *Cognition and categorization* (pp. 27–48). Hillsdale, NJ: Lawrence Erlbaum.

Samet, J., & Flanagan, O. (1989). Innate representations. In S. Silvers (Ed.), *Rerepresentation* (pp. 189–210). New York: Kluwer Academic.

Stringer, D. (2000). 'Ground rules': Locative verbs in first language acquisition. *Newcastle and Durham Working Papers in Linguistics*, *6*, 145–157.

Stringer, D. (2003). Splitting the conceptual atom: Acquisitional evidence for semantic decomposition. *Durham Working Papers in Linguistics*, *9*, 81–94.

Stringer, D. (2006). The development of PATHS: Spatial complexity and the multiple predicate strategy. In S. Unsworth, T. Parodi, A. Sorace, & M. Young-Scholten (Eds.), *Paths of development in L1 and L2 acquisition* (pp. 135–160). Amsterdam: John Benjamins.

Stringer, D. (2008). What else transfers? In R. Slabakova, J. Rothman, P. Kempchinsky, & E. Gavruseva (Eds.), *GASLA 9: Proceedings of the 9th Generative Approaches to Second Language Acquisition Conference* (pp. 233–241). Somerville, MA: Cascadilla.

Stringer, D. (2010). The gloss trap. In Z-H. Han and T. Cadierno (Eds.), *Linguistic Relativity in SLA: Thinking for Speaking* (pp. 102–124). Clevedon: Multilingual Matters.

Talmy, L. (1985). Lexicalization patterns: Semantic structure in lexical forms. In T. Shopen (Ed.), *Language typology and syntactic description, Vol. 3: Grammatical categories and the lexicon* (pp. 57–149). Cambridge: Cambridge University Press.

Wittgenstein, L. (1958). *Philosophical investigations* (2nd ed.) Oxford: Blackwell.