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Verbal argument structure: Events and participants

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Abstract

The generative enterprise in linguistics is roughly 50 years old, and it is reasonable to ask what progress the field has made in certain areas over the past five decades. This article will address the study of verbal argument structure. Research in generative linguistics without question has productively explored verbal argument structure within a general structuralist framework familiar from anthropology and the humanities, uncovering patterns and correlations across languages in the syntactic distribution and behavior of verbal arguments identified by their semantic roles, and providing structured explanations that capture these patterns in a compact and intuitively explanatory way. But this article will ask whether progress has been made in a different sense – toward a scientific understanding of language. In other words, has the generative enterprise made good on its promise to break from the structuralist anthropological tradition (Sapir, 1921; Bloomfield, 1933) and provide an account of argument structure within a general account of knowledge of language. If such progress has been made, we could argue that researchers in human psychology and neuroscience must take note of the latest theory of argument structure to inform their experiments, not just any account that traffics in thematic roles, word order, and case marking.

Keywords: Argument structure; Theta roles; Event structure

1. Autonomy of structure vs. demands of specific verbs

In this paper we will sketch how linguistics has in fact made considerable progress toward understanding the connection between the meanings of arguments (e.g., subjects and objects) in the linguistic coding of events and their structural expressions in sentences. As one might expect from a scientific enterprise, progress here has involved a transformation of the questions asked, as the proper account of verbal argument structure no longer hinges directly on the mapping between thematic roles and their expression nor on the role of verb words in mediating the connection between the semantics and syntax of arguments. Two lines of research come together in contemporary accounts of argument structure. First, it has been observed that general constraints on syntactic structure transcend the particularities of the demands of individual verbs. For example, no verb in English takes three obligatory ''internal arguments'' (ignoring the subject), and no verb may be followed by three ''bare'' noun phrases (without prepositions). Related to this observation, the connection between syntactic structure – in the shallow sense of word order and morphological marking – and meaning, while varied within a language, also transcends individual verbs, such that we can productively talk about verbs choosing frames relating form and meaning from a small finite set, rather than about each verb constructing a particular form/meaning connection. Second, despite ambitious attempts to describe how verbs might systematically appear in a variety of syntactic structures depending on their semantic category (see in

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particular Levin, 1993), the flexibility of verbs to appear within the various set of frames relating form and meaning has defied these efforts to regulate apparent alternations in argument structure through the classification of verbs. These two lines of research have shifted discussion away from verb classes and verb-centered argument structures to the detailed analysis of the way that structure is used to convey meaning in languages, with verbs being integrated into the structure/meaning relations by contributing semantic content, mainly associated with their roots, to subparts of a structured meaning representation.

I will sketch below some of the new understanding of argument structure that we can attribute to this current line of research. However, at the outset it is crucial to understand both the relationship between current research and past proposals about argument structure and the basis for the claim that current research is not just part of a never-ending cycle of proposals that provide insight but no real closure. From the outset of generative grammar (undoubtedly reflecting insights from previous work on language), two general ideas about argument structure (in the sense relevant here) can be identified. On the one hand, we can point to Fillmore's ''Case for Case'' (1967) as a landmark in the development of the idea that the mapping from verbal argument structure to syntax is mediated by the semantic roles of arguments. On this view, a hierarchy of roles such as ''agent'' and ''patient'' form the basis of an explanation of the distribution of phrases said to bear these roles in a linguistically described event. Work through the decades on the contribution of a thematic hierarchy to the organization of arguments in syntax follow this tradition, along with research into the possibility of universal principles aligning thematic roles with grammatical relations or positions (as in the Universal Alignment Hypothesis of Relational Grammar (see, e.g., Perlmutter, 1983), adopted by Baker (1988) as the UTAH or Uniformity of Theta Assignment Hypothesis). On the other hand, we can identify work in Generative Semantics (e.g., Postal, 1970) as key in the development of the idea that syntax is a reflection of a structured representation of meaning, with semantic predicate argument structures serving to yield syntactic hierarchical structure and syntactic asymmetries. On this view, relations between events (paraphrased in terms such as ''cause'' and ''become'') anchor an explanation of the syntactic distribution of arguments, rather than the roles of the arguments associated with the events.[1]

Contemporary linguists incorporate the insights of both these lines of research in their accounts of argument structure and structure/meaning correspondences. For example, current treatments of the external argument of a verb phrase (often the agent) rely on insights from theta theory, which traces its history at least to Fillmore, while the syntactic decomposition of event structure in current theories continues ways of thinking from Generative Semantics. We can claim progress from the proposals of the 1960s and 70s toward the goal of a theory of the knowledge of language precisely because the goal has been consistent over the history of generative grammar, with a developing understanding of the requirements for descriptive and explanatory adequacy for a theory. That is, the progress to be described below is progress from – built on – the discoveries of previous approaches, and new research on these topics should build on our present understanding. At the moment, our current best understanding of argument structure resembles the Generative Semantics view more than the ''Case for Case'' approach; this is because the syntax has been shown to reflect relationships between events such as causation and change of state as much as the relationship between entities and events described by thematic roles, and the relationship between entities and events must be projected onto a basic structure reflecting the events and their relations. But the current theory involves a radical reconception of the basic assumptions and principles of Generative Semantics. A linguist today pushing a new theory more reliant on a mapping from theta roles to syntax would certainly need a reconceptualization of theta roles designed to capture facts explained by the sort of event-structure decomposition of verb meanings to be described below. In describing our current understanding of argument structure through the lens of current theory, we will attempt to emphasize the deep generalizations captured by the current theory that will need to be ''saved'' in any revision of the theory aimed at answering currently open questions about the way language works.

The structure of this article is as follows. In section 2 we sketch the outlines of current theory in which we may couch an overview of progress in the field on understanding argument structure. This section will emphasize the separation of the identity of the verb, as indexed by its pronounced root, from verbal argument structure and the crucial role of syntax in capturing generalizations about the behavior of arguments. Section 3 will briefly visit topics in argument structure organized according to categories familiar from the linguistics literature: unaccusativity, causatives, and psychological predicates. Section 4 will conclude by emphasizing the relevance of progress within linguistics in the area of argument structure to neighboring disciplines studying linguistic behavior and language in the brain.

[1] Crucially important to the contemporary move from theta roles to event structure was the work of Jackendoff (e.g., 1987), who identified theta roles with positions in the primitive predicates into which verb meanings would decompose, and Hale and Keyser (e.g., 1993), who ''syntacticized'' the event structures that Jackendoff identified as lexical properties. The Hale & Keyser approach proved perhaps the most influential for current research on argument structure.

2. The syntax of argument structure

Current understanding of argument structure within linguistics has incorporated the results of various lines of exploration into what have come recently to be called the lexicalist and constructivist traditions. The lexicalist tradition traces its origins to Chomsky's ''Remarks on Nominalization'' (Chomsky, 1970, but see Marantz, 1997 for a revisionist interpretation of the thrust of this article) and emphasizes the role of verbs in projecting syntactic structure from argument structure information stored with the verbs. The constructivist approach,[2] often linked to the work of Ken Hale and Jay Keyser (e.g., 1993, 2002), emphasizes the role of syntax in constructing the meanings traditionally attributed to argument structure. These approaches interweave through the literature and have contributed to a dynamic consensus on many issues, to be described here. Particularly in the 1980s, work on the semantics of events was connected with a line of syntactic research more rooted in the Chomskyan tradition, research associated with Hale and Keyser (1993, 2002) as well as with Rappaport Hovav's explorations in lexical semantics (e.g., Levin and Rappaport Hovav, 1995). Gillian Ramchand (2008) provides a recent synthesis of this research, which has come also to touch base with insights from Jane Grimshaw's work of the 1980s (Grimshaw, 1990).

Recent work resulting from these approaches to argument structure has organized understanding of argument structure around the grammatical architectures of the Minimalist Program (MP) in syntax (Chomsky, 1995) and Distributed Morphology in morphology (e.g., Halle and Marantz, 1993). Crucially from the Minimalist Program comes the assumption that syntax is the sole generative engine of the grammar, in the sense of the component that builds structures from morphemes. This assumption implies that the semantic and phonological representations of sentences, although subject to their own constraints and principles and constructed with units appropriate to the interfaces with meaning and sound, nevertheless are dependent on syntax for their hierarchical and compositional structure. In addition, structures are interpreted cyclically, within small syntactic domains called phases. From Distributed Morphology (DM) comes the assumption of ''late insertion,'' i.e., that the phonological identity of morphemes is determined after the syntax via a process of vocabulary insertion. On this view, units identified by their phonological form are not the building blocks of words or sentences, contrary to claims associated with a lexicalist approach to morphology. The appeal of an approach melding the MP with DM is that it allows one to connect work in phonology, in particular on the relationship between morphological structure and allomorphy, to work on the syntax/semantics interface, particularly on the relationship between structure and locality domains for compositional semantics (see Embick and Marantz, 2008; Embick, 2010 for some discussion on these points). While this paper supports the basic assumptions and basic architecture of a MP/DM theoretical marriage, progress in the understanding of argument structure transcends particular theoretical details of these frameworks. The main conclusions about the syntactic construction of meaning and the relative independence of argument structure from the meaning contributions of verbs can be stated in, and are connected to, work within a variety of theoretical frameworks cutting across the lexicalist/constructivist divide and uniting the MP with other competing frameworks; we could include here such theoretically diverse work as Borer (2005), Goldberg (1995), Levin and Rappaport Hovav (2005), Ramchand (2008) and Schäfer (2008).

A cartoon history of the analysis of argument structure since the early 1960s might serve to emphasize the core of our current understanding. Within a Generative Semanticist approach to argument structure, the semantically interpreted structures (deep structures) were generated independent of the demands of particular lexical items. In fact, deep structures lacked lexical items in the usual sense. Lexical verbs were inserted as the realization of complex syntactic structures, where the syntactic structures displayed the meaning of the verbs. So the lexical verb ''kill'' might be inserted for the structure, ''CAUSE to DIE'' (see the discussion in Fodor, 1970). In the move to Interpretive Semantics (e.g., Jackendoff, 1972) from *Aspects of the Theory of Syntax* (Chomsky, 1965) through the Government and Binding theory (Chomsky, 1981), a shift placed the power to determine syntax, and thus semantics (since semantics interpreted the syntax), in the hands of individual lexical items, specifically through subcategorization frames, which determined what structures were consistent with the appearance of each verb. Although initially in the development of generative theory, phrase-structure rules determined the space of possible syntactic structures independent of the subcategorization frames of individual verbs, the fact that verb phrase structure could be predicted by summing over verbal subcategorization frames led in the Government and Binding framework to an underspecified X-bar theory of phrase structure, without rules specifying specific structural possibilities. Actual verb phrase structure was demanded by the subcategorization frames of verbs, such that lexical information could be said to ''project'' phrase structure.

[2] The ''constructivist'' approach to argument structure is set in opposition to the ''projectionist'' approach associated with the ''projection principle'' within Government and Binding theory. On a projectionist view, argument structures are properties of verbs that are ''projected'' into the syntax via theta-role assignment and subcategorization features. The linguistic constructivist approach to argument structure within generative grammar should not be confused with ''Neoconstructivism'' (Johnson, 2010) within cognitive science more generally, although there are intellectual ties between constructivism in Construction Grammar and Neocontructivist views of language acquisition.

Subcategorization frames, like one specifying that a verb must occur with a direct object in the verb phrase, explicitly subcategorized the general category of verb into subcategories identified by the syntactic argument structure of a verb. So verbs that, in what became common parlance, ''subcategorized for'' a direct object were verbs of the subcategory of verbs that appeared before a NP (noun phrase) within a verb phrase. If we identify a verb by its pronunciation and general meaning, we find that verbs often fall into more than one subcategory. For example, verbs in English that describe changes of state, such as ''open,'' often fall into both the transitive (''John opened the door'') and intransitive (''The door opened'') subcategories. To the extent that one could identify generalizations about the predictable ''alternations'' verbs exhibit between subcategorization frames, one could propose lexical rules that relate subcategorization features for a verb.

Recent work on a number of fronts has swung the pendulum back in the direction of Generative Semantics from the Government and Binding approach of projecting the syntactic structure from verbal information, suggesting that the interpreted syntactic structures are generated independent of lexical demands, with verb-specific information determining the distribution of (pronounced) verbal roots in these independently generated structures. Over the last decade or so, the majority of work on verbal argument structure has endorsed the general approach of Hale & Keyser, Ramchand, Borer and others: the basic principles relating verbal meanings to syntactic structure transcend the idiosyncrasies of individual lexical items identified by their phonology. That is, whatever we might find about the syntactic behavior of a verb like ''walk'' in English the possibilities for the syntax/semantics connections for this verb will fall into a set of possibilities available independent of specific verbs. The various uses of ''walk'' in (1), for example, illustrate connections between syntax and semantics that are generally available for English (reflecting language-particular choices and constraints from a parameter space of universal options). What we know about the semantics of the root of this verb should help account for the availability of these structures for ''walk,'' but the verb itself in no way projects these structures or is responsible for the semantic interpretation of the structures themselves.[3]

(1) a. John walks (every day).
b. John walks his dog (every day).
c. John walked his way to a slimmer self (this year).
d. John walked his shoes ragged.

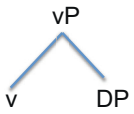
The failed hope for a strongly verb-based approach to argument structure, found most explicitly in references to Beth Levin's book on verb classes (1993), was that we might be able to divide verbs themselves into sets that predict the various syntax/semantics structures in which they may appear. For example, identifying a verb as a member of the ''change of state'' class might predict its appearance in intransitive (''The door opened'') and transitive (''I opened the door'') frames, and its non-appearance in ''*there* insertion'' contexts (''*There opened a door''). The insight of the recent work that decomposes verbs into roots and verbalizing heads is that the meanings conveyed by verbal roots – which correspond to the phonology of the stem of the verb – are not the meanings associated with the syntactic frames in which verbs appear. That is, for example, what meaning we might associate with a verb root like ''open'' is not ''change of state,'' which is a meaning that requires syntactic structure to express, but at most ''state.'' The flexibility in appearance of verbal roots in different syntactic/semantic frames is partially predictable from the meanings associated with the roots (so, other verbal roots naming states *might* parallel ''open'' in syntactic behavior), but the idiosyncrasies in use of verbal roots must be separated from the general, non-idiosyncratic connections between structure and meaning, both in a language and universally. That is, the syntactically representable meanings exist independent of any particular verbs, and idiosyncratic semantic requirements of verbs must make use of these syntactically available meanings.

The picture that emerges from recent work identifies the core structure of a verb phrase as implicating a verbal head, conventionally a ''little v,'' and a root. The little v semantically introduces an eventuality, either an activity or a state, and

[3] There are significant technical differences among the approaches lumped together here that nevertheless do not contradict the generalizations expressed in this section. For example, Ramchand's approach to indexing verbs for their appearance in verb phrase structures can be seen as having verbs ''project'' the structure in a manner similar to the way in which subcategorization frames of Government and Binding theory projected the syntax of verb phrases. Consistent with the class of theories being discussed in this section, however, Ramchand's system includes a small ontology of semantically interpreted heads that combine to create a limited range of verb phrase structures, which individual verbs then choose among. As with the other theories under discussion, within Ramchand's theory idiosyncrasy associated with verbs is constrained by an independent theory of possible verb phrase structures, where these structures directly determine verb phrase meanings.

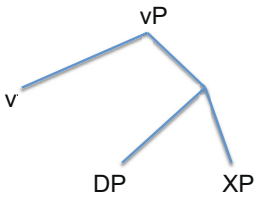
syntactically types the word heading the vP (verb phrase) as a verb. The v may take a single complement, perhaps because all structure building syntactically is binary ''merge,'' as in the Minimalist Program. A single noun phrase (DP, for Determiner Phrase) complement to a v head is canonically interpreted as expressing a change of state to the noun phrase, if the verbal head is interpreted as introducing a dynamic event. So, in a verb phrase like ''open the door,'' the little v is dynamic and the direct object is interpreted as undergoing a (caused) change of state. Alternatively, the verbal head might merge with a predicative complement, called a ''small clause,'' consisting of a noun phrase subject and predicate of various syntactic categories. This small clause gets generally the same interpretation with respect to the verbal head as a bare noun phrase complement – the subject of the small clause changes to the state of the predicate or is asserted to be in that state. So, in a verb phrase like ''put the book on the table,'' the little v is dynamic and the direct object – the subject of the small clause – is interpreted as undergoing a (caused) change of state to the state described by the predicate of the small clause. These basic structures are illustrated in (2a,b).

(2) a.



[$_{vP}$ open [the door]]

b.



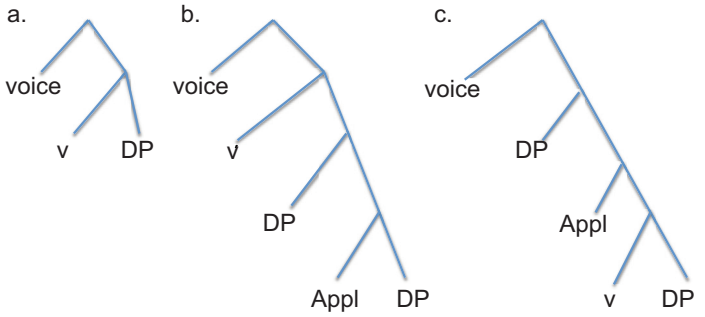
[$_{vP}$ put [[the book] [on the table]]]

On this view, there are two basic classes of direct objects, those that are the ''sole complement'' of the verb, as in (2a) and those that are the subjects of small clauses, as in (2b), where the predicate of the small clause complement serves as an additional obligatory argument of the verb phrase. The distinction between verb phrases with one vs. two obligatory complements as in (2a,b) has been discussed in a number of places; see in particular Levin and Rappaport (1986) for the ''Sole Complement Generalization'' as it relates to the formation of adjectival passives, Dowty (1979) on the connection between taking a single obligatory argument and ''lexical rules'' in general, and Postal (2011) for a classification of direct objects that also reflects this distinction between one and more than one obligatory complement.

Beyond the structures that project direct objects in (2a,b), additional arguments are introduced via particular syntactic heads, as summarized in Pylkkänen's (2008) *Introducing Arguments*. It is these additional arguments that may be said to bear thematic or theta roles, since the semantics of these arguments is that of constituents placed in a semantic relation to the event introduced by the v head. The so-called ''external argument'' of the verb phrase is one such additional argument, conventionally said to be introduced by a voice head that, syntactically, takes the vP as its complement (see Kratzer, 1996, the most influential work on the role of voice in introducing the external argument of a vP, and also Alexiadou et al., 2006). For expository purposes, we can divide the set of argument-introducing heads into voice and ''applicative'' heads on the one hand, and prepositional heads on the other (see the discussion in Wood, 2012). The voice and applicative types place the added argument syntactically above the phrase to which they add an argument (as in (3) below), so the external argument added by voice, for example, appears in the syntactic specifier position above the vP, while prepositions add an argument ''below'' the phrase to which they attach – see the discussion of ''cascade'' structures in Pesetsky (1996) and the literature that follows the insights there. We will not discuss further here the role of prepositional phrases in adding arguments to verb phrases; see in particular Svenonius (2007) for some recent considerations.

The position of voice and the external argument is shown in (3a). The structure in (3b) displays what Pylkkänen calls a low applicative, one that directly relates two arguments semantically, for example in a possession relation appropriate for the double object construction in English. If the direct object is interpreted as undergoing a change of state, for example, as the direct object of ''bake'' in ''John baked a cake,'' then (3b) would also be the structure for double object constructions in English in which the indirect object is interpreted as benefitting from the change of state event on the direct object. Although syntactically low (below the little v head), this is technically a ''high'' applicative in Pylkkänen's system, since semantically the argument added by the applicative head relates an argument, an indirect object, to an event, the change of state on the direct object (see Cuervo, 2003 for some discussion of the notion of a high low applicative). The structure in (3c) would be a canonical high applicative in Pylkkänen's sense, in which the event constructed by the vP is related to an argument, most commonly cross-linguistically an affected human argument (e.g., a benefactive). Pylkkänen argues that such structures are unavailable in English (among other languages) because they interrupt the direct relationship between voice and little v; many Bantu languages, among others, allow such an interruption and such constructions.

(3) a. b. c.



[$_{voice}$John opened the door] [$_{voice}$John gave $_{Appl}$[Mary a book]] *John held Mary a bag.

[$_{voice}$John baked $_{Appl}$[Mary a cake]] Not available in English

On the developing view of argument structure schematically illustrated in (2) and (3), verb phrases contain at most one core argument, the complement to little v, which might be a DP or a small clause, as in (2) (a dynamic vP without any core argument would be interpreted as an activity, as in (1a)). The small clause option yields two obligatory complements, the subject and predicate of the small clause. Additional arguments are introduced by heads that explicitly link an argument to the syntactic structure and are associated with particular semantic roles: agents and causers for the argument introduced by voice, for example, and benefactives and other affected roles for the argument introduced by an applicative head. From this perspective, to the extent that there is a ''theta theory'' that regulates the assignment of thematic roles within syntactic structures, themes and other semantic roles associated with the structures in (2) would stand outside theta theory, while arguments introduced by voice and by applicative heads (as well as prepositions) would feed such a theory.

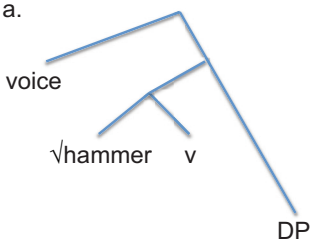
Severing the external argument from the verb (Kratzer, 1996) and connecting it to a voice head, as in (3) has contributed to a large literature explicating the syntactic behavior of, in particular, participles (e.g., passive and perfect participles; Kratzer, 2000; Embick, 2004) and nominalizations (e.g., Alexiadou, 2001) cross-linguistically. In addition to providing a general framework for analyzing constructions like those from Bantu languages in which the addition of an applicative morpheme to a verb correlates with the addition of a direct object to the structure (see Pylkkänen, 2008 for a literature review), the connection of additional (non-theme) arguments to an applicative construction like those in (3b,c) has inspired much recent work on the analysis of phrases referring to human participants in events, often marked in the dative case, that are interpreted as affected by the events described by the verb phrase. Cuervo (2003) provides an overview of such dative DPs in Spanish within a framework exploiting applicative heads, for example.[4]

So far, the discussion in this paper about verbal argument structure has omitted from the syntax any indication of the verbal roots that provide the identity of the particular verb associated with the structures under discussion. On the view in which particular verbs constrain the form and interpretation of the interpreted syntax but do not themselves project or generate structure, the roots of verbs must find their positions within the structures in (2) and (3), indicate any special demands they might impose on the structures associated with any idiosyncratic features they might have, and contribute some aspect of meaning to the interpretation of the structures. A restricted view of the semantic contribution of the root to the structures in (2) and (3) that is consistent with observations from the literature would suggest that roots may modify the event introduced by the little v, for example imposing a manner on an activity event (e.g., ''with a hammer as instrument/in the manner of using a hammer as an instrument,'' in ''hammer the nail''), or they may modify the state that is associated with a direct object of a change of state verb (e.g., ''be open'' in ''open the door'') (see the discussions in Harley, 2005; Mateu, 2002; McIntyre, 2004). If verbal roots may modify either the event introduced by v or the state associated with the complement to v, a question arises whether, empirically, a root can or cannot modify both the event and the end state of a change of state VP and whether, theoretically, the architecture of grammar prevents this; current research is investigating this issue.

[4] For reasons of space, the discussion in this paper will focus almost exclusively on dynamic (non-stative) vPs that express an activity and/or a (caused) change of state. Current work on argument structure would use the same vP structures in (2), (3) and (4) to analyze stative verb phrases. Recent literature on stative constructions has in particular explored the varied ways that languages express possession, adjectival and prepositional predication, and psychological states. Progress has been made on understanding the relationship among the expressions of these various stative meanings within and across languages, focusing on the connections between *have* (in languages that use *have*) and *be* and on the connections between *have* and *be* and psychological verbs such as *fear* and *frighten*. See Harves and Kayne (2012) for discussion and pointers and section 3 for a guide to the literature on psychological predicates.

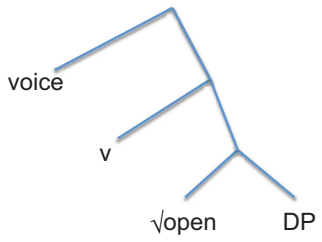
A straightforward and restrictive means of positioning verbal roots syntactically to allow them to do their syntactic, morphological and semantic work would be to adjoin the event-modifying roots to little v as in (4a) and the state (in change of state) modifying roots to the DP undergoing the change of state in structures like (2b), yielding (4b).[5]

(4) a.



hammer the nail

b.



open the door

Recent contemporary generative work separating the root from the verbal category head little v can perhaps be traced to Pesetsky (1996), who argued for a separation of the root, denoting a property or state, from the causal semantics of psychological predicates like ''amuse.'' Important recent literature developing this approach includes Borer (2005), Arad (2003) and Doron (2003).

Three questions arise immediately in connection with the structures in (4), and indeed those in (3) and (2) as well. First, how do the heads distributed through the syntactic trees – voice, v, Appl, and the verbal root – get together into a single phonological word? Here, there have been a variety of proposals that involve general considerations of the phonological realization of syntactic heads, often called the theory of head movement. Some important discussions of this issue can be found in Embick and Noyer (2001), Matushansky (2006) and Koopman (2005), and the references cited in these articles. Approaches like MP/DM that distribute heads in the syntax that may end up as affixes on a verb do not raise any special issues for the theory of grammar not already raised by considerations of how affixal material relates to syntax in general. If, instead of associating the features of voice, v and Appl with root-independent syntactic heads, we placed all these features on the verbal head of a VP, we still would need to explain the ways in which these features interact with their local syntactic and morphosyntactic environment; the theory of head movement within MP/DM is one approach to explaining these interactions.

Second, as should be obvious from the English examples provided so far, the crucial functional heads associated with the syntactic construction of argument structure – voice, v, and Appl heads – are often if not canonically phonological zeros (not pronounced). Cross-linguistically, overt realizations of these heads do occur; see below for a brief discussion of overt voice and overt v and above for mention of overt Appl heads in, e.g., Bantu languages (and see also work on ''complex predicates,'' where the little v seems to be pronounced as a light verb while the root appears in, for example, a nominal complement; Folli and Harley, 2012 provide a recent discussion). In particular, voice may be overt in unaccusative constructions contrasting with transitive constructions (see Schäfer, 2008) and v may be overt in transitive constructions (called ''lexical causatives'') contrasting with unaccusative (inchoative) constructions (see Miyagawa, 1998, 1999). Although these heads in the vP domain are not always zero, a general theory of functional heads must address this issue of pervasive non-pronunciation. In case one is tempted to believe that the ''abstractness'' of the account here is itself creating this issue, which would not arise within a theory that recognized only a verbal head anchored by the pronounced verb root, we should point out that moving away from a syntactic representation of voice, v and Appl in no way solves the problem. The feature of being a verb (connected to little v), having or not having an external argument (connected to voice), and having or not having an indirect object (connected to Appl) are syntactically relevant features of verb phrases and/or verbs. When and why these features lead to overt pronunciation would be an issue for any approach to argument structure, no matter how ''abstract'' in terms of the postulation of functional heads.

The third question associated with structures like (4) involves the possibility for roots to make demands on the functional heads within the vP. One side of this question, to be discussed below, involves the semantic flexibility of roots, as illustrated for example in (1). Although one finds corpus support for a wide range of latitude for the exploitation of verbal roots within the different argument structures generated by the functional heads for vPs, nevertheless, speaker intuitions

[5] While the approach to roots explored in this paper attaches roots to a single position in a syntactic tree, where they may locally interact with neighboring constituents, other recent approaches to verbal syntax assume that a root might exert an influence over a larger span of structure, whether via movement and feature checking or some other mechanism. See Ramchand (2008) for one such alternative.

would suggest that use of some roots in some frames is ungrammatical, in the usual sense of speakers' judgments of ungrammaticality. The examples in (5) illustrate such structures.

(5) a. *John catted Mary the ball. (√cat)
b. *John appeared Mary at the party. (√appear or ap-√pear)
c. *John put the book. (√put)

A general question about examples like (5), a question currently occupying linguists interested in argument structure, is whether information about the semantics of roots combined with the meanings associated with the syntactic structures in (2–4) is sufficient to account for speakers' intuitions concerning restrictions on the distribution of roots within these structures.

The flip side of this question about semantic selection – selection for semantically interpreted syntactic structure – by roots is one of selection for syntactic and morphological features. To the extent that voice, v and Appl have or are composed of features, can particular roots be marked to choose such features? Current investigations of this issue cannot escape the empirical conclusion that roots choose aspects of their local environment. Just as certain bound roots in English must always occur with a certain set of affixes (consider *-ceive*, for example; see Aronoff, 1976), roots cross-linguistically appear to demand to appear with certain features in v or voice. ''Deponent'' verbs – including inherent reflexive verbs in Romance languages – involve roots that appear to choose values of voice that lead to (overt) non-active morphology, and there are roots that appear to demand features on v that lead to overt causative realizations of this node (see Embick, 2000 and below). Whatever the ultimate account of selection by roots in these cases, the general picture is one in which roots are associated with a subset from a set of restricted options generated in the syntax. That is, the observed selectivity of roots here does not undermine the general approach of separating the interpreted syntax from the idiosyncratic properties of roots. What would cause problems for this approach would be roots creating their own syntax/semantics connection between vP structures and event semantics, not roots allowing only an apparently idiosyncratic subset of the connections made available by the language.

In addition to relying on verb-independent principles to connect syntactic and semantic structure, the current approach to argument structure situates the semantic contribution of the verbal root in modifying the semantic structure built by the syntax. Broadly speaking, roots provide the type of meanings classified as event, state and entity modifiers, although there is much disagreement about the exact nature of these classes and meanings. Roots that modify entities canonically attach to a little n nominal head (creating nouns); state modifiers canonically attach to a little a adjectival head (creating adjectives), and event modifiers canonically attach to little v (see Levinson, 2007, 2010 for discussion, and Borer, 2005 for an opposing view). On this view, there must be flexibility in the ways in which root meanings combine with the skeletal structures in (2) and (3), implicating polysemy for roots and/or semantic type shifting in which a canonical entity modifier, for example, is shifted to event modifier (say a manner). For example, an entity-modifying root like ''hammer'' can modify an event, leading to an instrumental interpretation for ''hammer'' as a verb. A root like ''open'' modifies states (i.e., is consistent with a subset of states), and in English can be used with an adjective head, which introduces states into a structure, as well as a verbal head, where the root modifies the end state of a change of state event.

The meanings of roots involve world knowledge to a large extent, and the flexibility of roots to be used in different syntactic structures is governed somewhat by our experience and our imaginations. For example, both ''pile'' and ''braid'' are roots that modify things, and both can be used in/as nouns. One difference between the roots is that ''braid'' strongly implies an artifact, something intentionally created. So, in a verbal environment, where either ''braid'' or ''pile'' may be used to modify the end state of a change of state event (''Mary braided her hair/piled up the stones''), ''braid'' resists verb phrases that occur without agentive voice, whereas ''pile'' is consistent with a grouping of objects not intentionally caused to come together and may appear in a structure without agentive voice (''??The ropes braided in the wind,'' ''The stones piled up in the hurricane'').

By separating the root from the structure of the verb phrase corresponding to ''argument structure,'' we make some sense of the cross-linguistic diversity in the treatment of verbs. The morphophonological realization of roots within the vP is governed by the ways in which languages interpret structures phonologically. We find, then, that Semitic languages, which enforce strict morphophonological constraints on verbs in their interaction with inflection (''root and pattern'' morphology), employ a somewhat limited number of verbal roots, although the patterns of interaction of root meaning and verbal structure parallel those in Indo-European languages. Because the verbal root in Semitic is phonologically realized by two to four consonants, the root requires prosodic structure to be pronounced, and these prosodic ''templates'' are associated with features of v and voice (see e.g., Doron, 2003). In many languages, verbal roots do not become part of the inflected verb, either over a class of verbs (involving so-called ''light verbs,'' e.g., in Japanese and Korean; see Grimshaw and Mester, 1988) or over much of the language, as in languages described as having only a small handful of verbs (e.g., Jingulu; see Pensalfini, 1997). The contemporary generative approach to argument

structure predicts the same syntactic representation of events and arguments sketched above for languages that generally realize verbal roots with little v as for languages, like Jingulu, that do not have to.[6] The shift in emphasis from the lexical properties of verbs to the structures of verbal meanings, in which roots play a modificational, rather than a constructive, role, makes sense of the cross-linguistic variation observed here.

To follow the Generative Semantics tradition and construct the meanings of verbs syntactically involves claiming that syntax correctly explains aspects of the connection between sound and meaning in language. Cutting through much exploration of the architecture of syntactic theory in the recent literature, we might characterize the bare bones of syntax in terms of the hierarchical arrangement of morphemes, the minimal building blocks of grammar. Syntax describes an ordering or arrangement of morphemes, which themselves find interpretation in sound and meaning. Syntax displays for the so-called interpretive components, which assign sound and meaning to structures, two essential properties of this arrangement of morphemes: hierarchy (or asymmetry) among the syntactic pieces and locality of connections between these pieces. The general claim of syntactically grounded approaches to argument structure is that any apparent consequences of hierarchies among arguments or locality within argument structures are in fact mediated by reference to syntactic structures like those in (2–4) and in particular to the hierarchical and locality relations embodied in these structures. So, if agents appear to out-rank themes, for example, for purposes of explaining the relationship between anaphors and antecedents in a language, such a hierarchy would reflect the generation of agents in the specifier of voice and the theme within the vP, not some syntax-independent thematic hierarchy. Similarly, effects associated with co-arguments of verbs would be analyzed as locality effects within domains defined over structures like (2–4), perhaps with reference to the cyclic phases of the Minimalist Program (see, e.g., McGinnis, 2001).

Since syntactic structure is interpreted both semantically and phonologically, it is somewhat misleading to emphasize here the autonomy of syntax, and in particular the autonomy of hierarchy and locality from semantic (and phonological) factors. But crucially, hierarchy and locality can be seen to have consequences for language independent of their semantic (and phonological – e.g., word order) effects. For example, there are ways in which direct objects behave the same, independent of their semantic roles in sentences (see the brief discussion of Italian *ne* cliticization in section 3 for an example), where ''direct object'' can be understood in terms of a local hierarchical connection between a noun phrase (DP) and a verbal head (v) (see also Harley, 2005 for discussion of the distinction between ''direct objecthood'' and the semantic interpretation of ''measuring out,'' associated with only a subclass of objects). And the syntactic hierarchy of elements (often described in terms of ''c-command'') is implicated in explaining the distribution of reflexives, negative polarity items, case marking, agreement and many other phenomena.

To summarize the discussion in this section, contemporary theories of argument structure within the generative tradition place the construction of structured meanings at the interface between syntax and semantic interpretation, with the syntactic configurations determining event structure interpretations, modified by information associated with verbal roots. Although this approach argues for a tight relation between syntax and the types of meanings associated with verbs and verb phrases, it does not necessitate placing semantic heads, such as CAUSE, in the syntax nor does it require a transparent relationship between syntax and semantics in any obvious sense. To understand these points, we may quickly review the implications of an influential study by von Stechow (1996) on *again* (similar points are raised in the Generative Semantics tradition, and see Dowty, 1979). von Stechow points out that, in a sentence like (6a), *again* adds a presupposition to the meaning of the sentence that is ambiguous between a repetitive (John opened the door before) and a restitutive (the door was open before) reading. In preverbal position, *again* forces the repetitive reading, as in (6b).

(6) a. John opened the door again.
b. John again opened the door.

This type of test of adverbial modification has long been used to investigate how events are represented in syntactic structure. Adverbs generally modify only events with some syntactic representation, and the positioning of the adverb syntactically constrains which event the adverb might combine with. The data on the distribution and interpretation of *again*, and similar tests, have argued that English verb phrases can be bi-eventive even when headed by an apparently simple verb; in (6) the events are some activity initiated by John and also the end state of the door. Each (sub-)event can be separately modified, with syntactic structure helping to determine which event is modified by a particular adverbial.

[6] The observation that the structures in (2–4) underlie light verb constructions in which the root is realized independent of the v head does not immediately provide a complete account of such constructions. In particular, there is a sense in which the complement to the light verb in a language like Japanese, arguably a root, ''grows'' a DP structure, with case marking on the noun within the DP that is built on the root. These syntactic details in no way follow directly from the general approach described here.

Most intuitive semantic analyses of a transitive ''opening'' event would identify at least three components to the event decomposition: a causing event (suppose John pushes a button to open the door), a change of state (the door swings on its hinges from a closed state) and an end state (the door is open). However, there is no evidence that languages consistently (or perhaps ever) employ three syntactic heads corresponding to ''cause'', ''change'' (become), and ''be'', to express the meaning of a transitive verb like ''open.'' As von Stechow discusses, there is no direct evidence for separating ''cause'' and ''become'' syntactically in the representation of direct (also called lexical) causatives like *open*; the *again* test, for example, only argues for a separation of the cause/become event(s) on the one hand, and the end state on the other. Languages sometimes morphologically mark the distinction between inchoative (the door opened) and causative (John opened the door) events built on the same root via morphology apparently realizing the little v head – Japanese illustrates this option (Miyagawa, 1998, 1999). In such cases, the morphology points directly to an alternation between inchoative and causative, rather than to the semantic fact that the causative may add a causer and a causing event to an inchoative meaning. Other languages morphologically mark either the causative or the inchoative with morphology that is arguably associated with voice. For example, languages of the Balkans (Greek, Albanian, etc.; Alexiadou and Anagnostopoulou, 2000; Kallulli, 2007) use non-active morphology in some cases to mark the inchoative member of a causative/inchoative alternation, while Hebrew appears to mark the causative member of some alternations via prefixal morphology that is in complementary distribution with non-active morphology (used for middles and reflexives; see Doron, 2003). What languages do not do consistently is indicate the presence of cause and change for direct causatives like transitive ''open.''

For purposes of guiding the semantic and morphophonological interpretations of syntactic structures, it is tempting to mark little v heads to indicate aspects of the event interpretation of the structures they head, yielding perhaps ''causative'' and ''inchoative,'' as well as ''stative'' little v heads (one might intuitively associate these with ''do,'' ''become'' and ''be'' respectively). There is much lively debate in the literature surrounding the proper way to implement this idea technically. The crucial point for present purposes is that the debate can be characterized as one about whether syntax recognizes ''flavors'' of little v in structures like (2–4) above (see Harley, 1995; Folli and Harley, 2005; Harley's research pioneered work on little v). The syntactic investigation of these issues has not led to strong arguments in favor of an elaboration of the structures in (2–4) to involve extra event heads in the syntax. Rather, these simple configurations are subject to a small variety of interpretations in the context of the elements inserted into the ''open'' slots in the structures, in particular in the context of particular roots and particular complements (e.g., DP or small clausal) to little v. Adding an additional little v to the structures to create a vP complement to a higher v yields the predictable consequence of creating a so-called ''syntactic causative,'' for which languages like English require an extra verb word (canonically ''make,'' as in, ''John made the door open'') but which in some languages can be realized via a causative suffix (e.g., in Japanese, see the discussion in Miyagawa, 1999). Verb meanings in the usual sense, then, involve only the structures in (2–4) despite their complex event structures as evidenced by, e.g., von Stechow's *again* data.

In short, then, syntax provides the morphemes and the structures that, through semantic interpretation, yield structured argument structures. Yet, unlike in Generative Semantics, the pieces and structures of syntax are not themselves the semantic units like CAUSE or BECOME. From the Hale & Keyser tradition, current approaches support the notion that a small number of canonical structures, illustrated in (2–4), provide the full range of distinctions for mapping out different argument structure possibilities, when supplemented by the contribution of root meanings, where roots may only select among the possibilities offered by the syntax and modify the resulting semantic structures in predictable ways. Despite structuring and determining the semantic interpretation in terms of event and argument structure, the syntactic representations are autonomous from semantics in the usual sense, and also structure and determine morphological and phonological interpretations.

3. Argument structure alternations and elaborations

Much discussion of verbal argument structure over the last half century has centered around certain semantic classes of verbs and certain alternations in the syntactic realization of a verb's arguments. The general approach outlined in section 2 provides a constrained framework for such discussions. Take for example the phenomenon of ''unaccusativity'': intransitive verbs have been argued to divide into two classes with syntactic repercussions, the unaccusative and the unergative, with certain types of presentational verbs (''arrive'') and change of state verbs (intransitive ''open'') illustrating the unaccusative class and intransitive activity verbs (''dance'') illustrating the unergative class. The syntactic approach to argument structure would demand that an unaccusativity/unergativity contrast be attributed to distinctions within and among the structures in (2–4), since all argument structure distinctions must be reflected in these structures. Similarly, consider the well-studied alternation between the transitive and intransitive use of a verb like ''open'' (John opened the door/The door opened). Each use of a verb in such alternations must correspond to a structure like those in (2–4), and the alternation itself must be explained or accounted for through reference to these structures. If unaccusativity or unergativity is associated with particular verbs, this must be

the result of choice by or affinity of a verbal root for a particular syntactic configuration of the sort described above. Similarly, alternations in argument structure associated with a verb must arise via the flexibility of the verb's root to appear in multiple structures like (2–4).

This section will survey some issues associated with argument structure contrasts, such as unaccusative vs. unergative, and argument structure alternations, such as the inchoative/causative alternation. A comprehensive survey would require at least an entire volume; here the discussion highlights examples that help illuminate the consequences of the framework outlined in section 2 and help guide the reader to the literature that reports progress in these areas.

Within the modern generative tradition, Relational Grammar is often credited with the insight behind the ''unaccusative hypothesis'' – the proposal that shared behavior between objects of some transitive verbs and subjects of some intransitives is to be explained by having the subjects of the relevant intransitives generated in the same syntactic position (broadly speaking) as objects of transitives (see e.g., Perlmutter, 1983). However, the detailed and compelling analysis of unaccusativity in Italian presented in Burzio (1986) within a Government and Binding theoretical approach made perhaps the most lasting impact on the field. The proposal for both Relational Grammar and for Burzio generalized the behavior of subjects of English-type passive sentences (''The wall was being smashed'') to the behavior of subjects of the subclass of intransitive verbs called the unaccusatives (''The wall was breaking''). Within a syntactic approach to argument structure (and consistent with the Relational Grammar and Government and Binding analyses of unaccusativity), the unaccusative subject is generated in one of the DP object positions in (2) in a structure whose voice head does not project or license an external argument in its specifier position. In English, where subjects are generally required in tensed sentences, the unaccusative object will move to subject position (except in the situation of *there* insertion, such as in, ''There arrived several children at the party,'' where the subject position is otherwise occupied). This movement yields intransitive sentences such as ''The door opened'' that superficially resemble sentences whose subjects are generated in the specifier of voice position, as in the unergative, ''The men danced.'' The predictions generated from the unaccusative hypothesis are that unaccusative vPs should share properties with transitive vPs, since both contain a DP object in the same structural position (if these properties rely on the DP being in this object position at some point in the derivation, rather than at the end of the derivation), and that unaccusative subjects should pattern with transitive objects and not with unergative subjects, when the relevant tests rely again on where the arguments are generated initially within syntactic structure.

Controversy over the unaccusative hypothesis highlights two observations. First, tests for unaccusativity in a language seemed often not to pick out a single set of verbs (see the literature on unaccusative mismatches, e.g., Levin and Rappaport, 1989). For example, in English secondary resultative predication (''black,'' in, ''The brownies burned black'') and *there* insertion (''There arrived several men at the party'') were proposed as tests for the unaccusativity of predicates, yet in general the class of intransitives that occur with the relevant resultative predication and the class of intransitives that allow *there* insertion is mutually exclusive (thus the ungrammaticality of, ''*There burned a brownie in the oven''). Second, unaccusative behavior did not seem to be consistent cross-linguistically (see, e.g., Rosen, 1984). That is, a semantic class of verbs identified by some test as unaccusative in one language may not group together on any syntactic diagnosis in the next language over.

The approach to argument structure outlined in section 2 helps provide insight into the problems with the unaccusative hypothesis while preserving the enormous insight of the initial proposal. On this view, verbs are not unaccusative; rather, there are unaccusative structures, ones in which the sole complement to a verbal head or the subject of a small clause complement to a verbal head appear in a construction in which no external argument is projected above the vP (no argument licensed in the specifier of voice). Whether or not members of this class of unaccusative objects so identified share properties with each other or share properties with direct objects of transitive verbal structures (where, for example, there is an external object in specifier of voice) depends on general facts about syntactic structure as well as particular properties of the language in question.

In English, for example, the resultative predicate test (as in, ''The brownies burned black'') seems to pick out the structure in (2a), with a bare DP complement, as well as requiring a particular type of change of state semantics. Adding a resultative predicate to a vP built with a small clause as in (2b) is not in general possible (''*John wiped the table clean white''). On the other hand, *there* insertion seems to require the structure in (2b), in which there is a vP internal predication between the underlying object and a constituent referring to a place of being or coming to be (see Moro, 1997, among others). Both the resultative predication and *there* insertion require an unaccusative vP (if the structure is intransitive), but they require different vP structures with different compositional meanings, and thus are compatible with different sets of verbs. Some examples of unaccusative mismatches in the literature yield to analyses of this sort, highlighting different ways that unaccusative structures might be generated (see Irwin, 2012 for a recent discussion).

Neither resultative predicates of the sort under discussion nor *there* insertion are universal, although they of course rely on and exploit possibilities that are universally available to languages. Thus we do not immediately predict that the class of verbs in English that allow the resultatives will translate into a class in another language that allow English-type resultatives or that necessarily share any particular behavior.

To emphasize both the importance and the limitations of the unaccusative insight, consider canonical examples like (7a,b) from Italian (from Sorace, 2004), where 'come' in (7a) is unaccusative and 'work' in (7b) is unergative.[7] The quantifier *molti* in both examples is the subject and is semantically associated with the preverbal genitive clitic *ne*.

(7) a. Ne sono venuti molti, di turisti.
of-them are come many, of tourists
'Many tourists came.'
b. *Ne hanno lavorato molti, di studenti, in questo ristorante.
of-them have worked many, of students, in this restaurant
'Many students worked in this restaurant.'

The examples here illustrate the generalization that post-verbal unaccusative subjects, arguably still in direct object position merged with the verb, allow for *ne* cliticization (the preverbal clitic 'of-them' connected to a quantified expression, here 'many') as in (7a) while post-verbal subjects of activity verbs, arguably in a position structurally adjoined to the verb phrase, i.e., outside vP, do not, as in (7b). These facts make sense based on general properties of languages and general properties of Italian: elements such as *ne* usually obey a structural constraint governing the connection between their surface position and their sources (the elements with which they are interpreted in this case), and in Italian one expects clitic *ne* to be interpreted with a vP-internal element it c-commands structurally, like the unaccusative subject, not an element outside the vP, like the unergative subject. One could of course try to tell a story about the contrast in (7) that hinges directly on the semantic contrast between agentive and non-agentive subjects of intransitives, but such a story would miss the syntactic generalizations obvious here. While the account of unaccusativity for these cases is relatively uncontroversial, one is not entitled to conclude from facts like this either that the notion of unaccusative subject is itself a predicate in grammatical theory, such that rules of grammar might refer to such a notion (for the purposes of *ne* cliticization, unaccusative subjects are crucially just objects, and it is their position c-commanded by the verb that is relevant for *ne*), nor (and related) would one necessarily expect Italian to show any other phenomena that make exactly the cut in (7) between unaccusative and unergative post-verbal subjects (but see footnote 3). In addition, since the roots of verbs may show flexibility in their occurrence in syntactic frames, depending on their semantic contribution to these frames, one might possibly find verbs whose subjects are sometimes agentive, appearing in unergative structures, but can also occur in the unaccusative construction.

Unaccusative change of state constructions with verbs like intransitive ''break'' (''The glass broke'') often alternate with transitive causative constructions (''John broke the glass''), as in the English examples with ''open'' discussed in the last section. As outlined above, this alternation between transitive – or lexical causative – and inchoative uses of a verb has been an important locus of investigation into argument structure. A growing consensus in the literature holds that there is no semantic or syntactic directionality to the alternation in any grammatically relevant sense – that is, neither the inchoative nor the causative verb is the syntactic or semantic base for the other such that the causative embeds the inchoative structurally and the inchoative structure is a subset of the causative. As summarized at the end of section 2, some languages mark the transitive member of such inchoative/causative alternations with an overt realization of a ''causative'' little v while other languages mark the intransitive member of the alternation with overt non-active morphology in voice, indicating the lack of an external argument. No language shows evidence arguing for two syntactic heads in the causative alternant, one for ''cause'' and one for ''become,'' but for only the ''become'' head in the inchoative. Nevertheless, the causative version of such alternations does implicate both a causal event and a causer associated with this event (often explicitly an animate agent) not implicated by the inchoative version.

These alternations illustrate the ways in which the semantics associated with the roots of verbs interacts with the general properties of language and the universal syntax/semantics connections outlined above. As summarized in Schäfer's (2008) work on ''marked unaccusatives,'' change of state events associated with verb roots may themselves hold greater or fewer implications for the existence of an external cause and causer for the change of state. Languages often use marked (i.e., overt) morphology associated with the voice system (either non-active voice, as in Greek, or a reflexive clitic arguably in the specifier of voice position, as in Romance languages) to indicate the lack of an expressed cause and causer when one is strongly implicated by the verbal root. On the other hand, languages like Japanese or Finnish can use a marked (overt) causative morpheme as a realization of the little v head to indicate a cause and a causer for an event that might not usually be associated with an external cause (e.g., Finnish tends to use an overt realization of v,

[7] Sorace (2004) includes an interesting discussion of the correlation between *ne* cliticization and the choice of auxiliary in Italian as unaccusative diagnostics; the examples in (7) show the canonical connection between unaccusative structures and the 'be' (here *sono*) auxiliary and between unergative structures and the 'have' (here *hanno*) auxiliary.

a causative suffix, with roots associated with a mental state to derive transitive psychological predicates with meanings like 'annoy').

Crucially, though, marked and unmarked inchoatives share syntactic and semantic behavior, as do marked and unmarked causatives. That is, the essentially interpreted syntax of an inchoative structure remains constant independent of morphological marking in v or in voice and independent of the semantic implications associated directly with the root, as does the interpreted syntax of a causative, although the overt morphology on a verb might be related to root properties including semantic implications. Moreover, the general structure of grammar allows for roots that appear only in a marked non-active verb form (so called deponent verbs, including inherently reflexive verbs in the Romance languages) and roots appearing only in a marked causative form (as in Bantu languages, e.g., Hyman, 2003, and in Finnish). This lexical idiosyncrasy in no way undermines the inherently non-lexical nature of the syntax/semantics interface for verbal argument structure. As in a system in which verbs are marked with subcategorization frames that guide their exploitation of independently generated syntactic structures, with independently determined structured meanings, here the syntactic structures and their interpretations are given independent of the verbal roots. The roots themselves contribute modificational meanings to the event structures, limit the syntactic frames among the options presented by the language in which the roots may appear, and help determine the allomorphy and morphological features of syntactic heads in the structures. So a root may be restricted to a particular frame with particular features, as for a deponent or inherently reflexive verb or an obligatorily causative one. Nevertheless, such roots do not demand or create structures not otherwise possible in the language, nor do they impose special structure/meaning relations.

Lexical causative constructions, like the structure for English transitive ''open,'' also serve as the basis for some expressions involving psychological states, such as English ''frighten.'' The analysis of psychological predicates has a long history within the generative linguistic tradition, with early emphasis on apparent alternations between constructions in which a human bearer of an emotion serves as the sentential subject, as in ''John fears porcupines,'' and constructions in which the experiencer serves as the direct object, as in ''Porcupines frighten John.'' As with transitive/inchoative alternations, the generative literature has converged on the conclusion that subject and object experiencer constructions are not related via a derivation such that one serves as the base for the other. Rather, different expressions of psychological predicates rely on manipulations of the general syntactic representation of event structures described in section 2. The different expressions of psychological predicates exploit different ways of viewing the having or getting of an emotion. Some English subject experiencer verbs, such as ''fear,'' seem to have the experiencer generated as an external argument. Dative-marked experiencer subjects in many languages seem to exploit structures used for the expression of possession relations (so the experiencer is represented as having an emotion) while other dative-marked experiencers seem to exploit applicative constructions that relate human event participants to eventualities (possession expressions themselves may exploit applicative heads in some languages).

The general conclusion from work in the Generative Semantics tradition through such important landmarks as Belletti and Rizzi (1988), Pesetsky (1996) and Landau (2009), is that psychological predicates exploit the universal as well as language particular general connections between syntactic structure and event meanings. There's an important sense in which the expression of psychological states is not a good or easy match for the universal structure/meaning correspondences of argument structure and thus languages exploit many options for the psychological predicates, leading to variability in expression of the ''same'' meanings cross-linguistically. The variability may be associated with the variability in the expression of possession cross-linguistically (see Harves and Kayne, 2012), as well as options for the expression of ''affected'' human participants in events. For example, an affected argument that in English might be expressed in a prepositional phrase, as in ''John's pet died on him,'' can, in Japanese, be expressed as the nominative subject of an ''adversative causative,'' with the verb marked as a ''lexical'' causative and what is the subject of the English sentence appearing as an accusative direct object. In many Indo-European languages, a similar ''affected'' meaning is associated with an apparent dative subject of the unaccusative verb. In some languages, the possessor is the nominative subject of a transitive verb like English 'have' while in others it appears in a prepositional phrase or an oblique case with a verb like 'be' – Harves and Kayne (2012) point to a generalization about the connection between this alternation in the expression of possession and the expression of the psychological state of ''needing.'' In no case, however, do psychological predicates seem to burst the bounds of universal grammar, requiring novel structures or novel syntax/semantics interface principles.

In general, then, although space will not allow a full demonstration of this conclusion here, the wide range of argument structures discussed in the recent literature, including those for unaccusatives and psychological predicates, and the range of argument structure alternations described there, including the inchoative/causative alternation, are profitably studied within the general set of assumptions outlined in section 2. In particular, the separation of verbal root from the structured representation of event structure and the emphasis on vP structures, rather than features of particular verbs, allows for an insightful separation of the contribution of syntax vs. morpheme (root) properties in describing and explaining the range of phenomena here.

4. Linguistics and cognitive neuroscience

The study of argument structure addresses certain specific questions about language within the general program of modern linguistics, exploring the way that language expresses certain meanings through (morpho)phonology. The contemporary understanding of the sound/meaning connection with respect to argument structure describes a relationship between events (including states) and event participants and their distribution and realization in sentences. Our current theories of argument structure place the emphasis on events and the connection between arguments and events, rather than on thematic roles, considered as an ordered set, or on properties of classes of verbs (where a verb is identified/distinguished by the phonological content of its stem or root). Although our current understanding obviously holds consequences for linguists, one might ask what the take-home message might be for those in related disciplines, such as psychology or cognitive neuroscience.

The understanding of argument structure as constructed within the syntax of a language independent of so-called lexical information, i.e., special instructions memorized with particular verbs, fits well within the growing understanding in cognitive science outside linguistics proper that explodes any strict dichotomy between the memorized and the constructed. The words vs. rules division, made familiar by Pinker (1991) and well-explored for, e.g., the English past-tense, has proved inadequate for understanding the way that learned, statistical information interacts with linguistic knowledge to explain behavior with language. In particular, ''memorized'' irregular forms show the consequences of being analyzed via decomposition/composition, while regular constructions show frequency and other effects indicating that they are ''memorized'' also, in some sense (see Embick and Marantz, 2005; Stockall and Marantz, 2006; Albright and Hayes, 2003; Solomyak and Marantz, 2010; Morris and Stockall, 2012 and references cited in these papers). In sentence comprehension, we use our experience with language to predict the upcoming linguistic units, and the relationship between these predictions and experience indicate that, if we use frequency effects as an indication of the stored or memorized in language, productive syntax is stored (see Roark et al., 2009 for recent discussion). One could take these effects of linguistic experience with morphologically complex words and multiword phrases on language use as evidence for expanding the linguistic concept of the ''lexicon'' beyond the storage of morphemes and their properties (as in Jackendoff's Parallel Architecture (2007)), but such a move by itself simply equates the lexicon with stored experience and does not solve any problems or provide any insight into the ways in which experience with language interacts with grammatical knowledge.

Once we move away from any simple stored vs. constructed or lexical vs. syntactic dichotomy, we can ask in a more general way how knowledge of the individual units of language (the morphemes) interacts with knowledge about the combination of units to predict properties of complex forms (whether newly encountered or experienced many times in the past). From this perspective, one should not look at the apparent variable use and polysemy of verbs as a nuisance in studying the systematic behavior of classes of verbs but rather as the expected consequence of a system in which the semantic dimensions appropriate for explaining root meanings interact with, but are not identical to, the semantics of syntactic heads that introduce events and construct phrases expressing causation, change of state, etc.

One may ask, then, in the case of verbal argument structure, is linguistics ready for primetime in the cognitive neurosciences? Here, we should start with a cautionary note. Linguistic theory, including the theory of argument structure, involves some level of complexity that cannot be ignored when the implications of the theory are investigated within cognitive neuroscience. For example, take the unaccusative hypothesis sketched above. An oversimplification of this hypothesis would involve a contrast between sets of unaccusative and unergative verbs. But as explained above, a verb is not unaccusative; rather, a structure is. A large part of our understanding of unaccusativity in fact revolves around alternating causative/inchoative verbs like ''open,'' verbs that appear both in unaccusative and in transitive structures. Experimental necessity might lead one to restrict attention to either alternating or non-alternating unaccusative verbs, but then one's experiment would not be about unaccusativity per se. Similarly, failure to recognize the implications behind the distinct behavior of English *arrive*-type unaccusatives and *break*-type unaccusatives, associated with different structures in (2), could lead to misleading conclusions about the mental and neural representations of unaccusative structures. Fortunately, many cognitive neuroscientists are well aware of the relevant linguistic literature, and unaccusativity is an area where such scientists have productively exploited progress in linguistics to reveal properties of the acquisition, mental representation, and neural processing of language (see in particular the work of Cynthia Thompson, e.g., Thompson, 2003; Thompson and Shapiro, 2007 and references therein, and of Naama Friedmann, e.g., Friedmann et al., 2008; Shetreet et al., 2010).

But assuming that one is careful to respect the linguistic literature from which one draws, with its various complexities, does not the history of work on argument structure point to an ever shifting set of hypotheses and assumptions, such that yesterday's theory du jour may be today's abandoned leftovers? In fact, the story of argument structure within the generative tradition is one of rather steady progress, albeit with the occasional wrong turn examined for a bit before being abandoned. The general assumptions about the nature of the data for linguistic theory and the relationship between data and the goals of descriptive and explanatory adequacy for a theory have remained relatively constant over the period of

development of generative grammar, and as a result theories must account for an ever-widening range of data and generalizations.[8] The observations of the Generative Semanticists about psychological predicates are carried through Belletti and Rizzi, Pesetsky, and Landau, for example, while each new study adds to the pool of patterns to be explained by an account of psychological verbs. To someone unfamiliar with the specifics of linguistic theory, works such as Hale & Keyser, with their syntactic approach to argument structure, must look completely at odds with, say, Larson (1988), in which argument structure is conceptualized as a list of theta roles. But it is clear from reading this literature that, for example, Larson is placing the burden of explaining generalizations that Hale & Keyser attribute to the syntax of argument structure elsewhere within the general theory. In retrospect, we can conclude that Larson was exploring a wrong hypothesis, particularly in his underestimation of the close connection between the specifics of event structure and the syntax of the verb phrase (see in particular Bruening, 2001, 2010 on this for double object constructions). But the whole of a Larson theory was not that different from the whole of a Hale & Keyser theory at the time of their publication, as each had to account for a similar set of data. Any cognitive science or neurolinguistic research at the time could have profited from relating either theory to an investigation of issues concerning the mental and neural representation of and computation over argument structures.

To conclude, linguistic investigation of argument structure within the generative tradition has made good on the excitement and promise evident in publications from the 1960s and 1970s. There remains, of course, much more to study and understand in this area, and future research may take the field in as yet unforeseen directions. However, such research will be built on a foundation of understanding surrounding the role of syntax in structuring event meanings and the relatively independent and constrained role of the verbal root (the obligatorily pronounced piece of a verb) in contributing to argument structure meanings. This understanding underlies current work within apparently conflicting frameworks, from Construction Grammar (Goldberg, 1995), through Lexicalist (Levin and Rappaport Hovav, 2005) and Exo-skeletal (Borer, 2003) approaches, to the Minimalist Program/Distributed Morphology framework assumed here. We owe the possibility of progress in this realm across this diversity of approaches to shared assumptions about the nature of linguistics and linguistic explanation developed by Chomsky at the outset of the generative era, and the extent of this progress is a tribute to the success of the generative enterprise.

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[8] We find occasional attacks on the standard data of linguistic work (see e.g., Gibson and Fedorenko, 2010a,b), but these have been shown to be misguided; proper analysis of the reliability of judgments used to support linguistic theories has demonstrated levels of reliability both for the sort of foundational data found in textbooks (Sprouse and Almeida, 2012) and for the sort of data found in major linguistics journals (Sprouse et al., 2011) that certainly meet the standards of cognitive psychology. While it is important to investigate the relationship between the data and the theory of generative linguistics (see Marantz (2005) on this), attacks on this relationship should not shake one's confidence in the sorts of results described here.

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