

Building Verb Meanings

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Much research on the syntax-lexical semantics interface in the eighties took as its starting point the hypothesis that many aspects of the syntactic structure of a sentence—in particular, the syntactic realization of arguments—are projected from the lexical properties of the verbs and other predicators in it (see Wasow 1985). This hypothesis is made explicit, for example, in the GB framework's Projection Principle (Chomsky 1981, 1986). On this approach, the lexical property of a verb that is taken to determine its syntactic behavior is its meaning (e.g., Levin 1993; Levin and Rappaport Hovav 1995; Pinker 1989). Much effort was therefore devoted to developing lexical semantic representations which could serve as a basis for the perspicuous formulation of rules—often called linking rules—which determine the realization of arguments in syntax.

Close scrutiny of possible argument expression options reveals that many verbs exhibit a range of argument expressions, a phenomenon which has more recently been the focus of attention in work on argument expression. Some illustrations of this variation are given below, using the verbs *sweep*, *whistle*, and *run*.

- (1)
 - a. Terry swept.
 - b. Terry swept the floor.
 - c. Terry swept the crumbs into the corner.
 - d. Terry swept the leaves off the sidewalk.
 - e. Terry swept the floor clean.

We have presented this research in a number of different forums and would like to thank the audiences for their questions and contributions. We are also grateful to Mari Olsen, Grace Song, and two reviewers for their comments on an earlier version of this paper. This research was supported by NSF grant DBS-9221993 to Levin.

The Projection of Arguments: Lexical and Compositional Factors.
 Miriam Butt and Wilhelm Geuder (eds.).
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- (2) f. Terry swept the leaves into a pile.
 a. Kim whistled.
 b. Kim whistled at the dog.
 c. Kim whistled a tune.
 d. Kim whistled a warning.
 e. Kim whistled me a warning.
 f. Kim whistled her appreciation.
 g. Kim whistled to the dog to come.
 h. The bullet whistled through the air.
 i. The air whistled with bullets.
- (3) a. Pat ran.
 b. Pat ran to the beach.
 c. Pat ran herself ragged.
 d. Pat ran her shoes to shreds.
 e. Pat ran clear of the falling rocks.
 f. The coach ran the athletes around the track.

This variation involves not only the number and syntactic type of complements that a verb can take, but also the allowable combinations of these complements. For instance, although *sweep* may simply take a direct object as in (1b), the NP *the crumbs* is possible as a direct object of *sweep* only if followed by a PP complement; thus, the acceptable (1c) contrasts with the unacceptable **Terry swept the crumbs*. Moreover, the variation in syntactic context correlates with variation in meaning. Consider the verb *sweep* again. Sentence (1a) shows the properties of an activity, while (1c)–(1f) show properties of accomplishments. More specifically, (1c) and (1d) describe the bringing about of a change of location, (1e) describes the bringing about of a change of state, and (1f) describes the creation of an artifact. A second example reinforces this point: the verb *run* can be found in contexts describing an activity as in (3a), directed motion to a goal as in (3b), a caused change of state as in (3c) or (3d), or a caused change of location as in (3f).

Such variation poses a serious problem for theories of argument expression. On an approach which takes argument expression to be determined from a lexical semantic representation via linking rules, verbs with multiple options for the expression of arguments have to have multiple lexical semantic representations. If such variation is the rule rather than the exception—and recent studies show that the phenomenon is indeed widespread—then the lexicon must contain a vast number of verbs with multiple lexical entries. This result is undesirable, however, if only that it seems counterintuitive to have to posit that, for example, in sentences (1)–(3), we are dealing with six different

verbs *sweep*, nine different verbs *whistle*, and six different verbs *run*. Clearly, what is needed is a theory which will predict the range of argument expressions and meanings a particular verb can be associated with. Then the different lexical entries for individual verbs could be generated from general principles which determine the range of meanings a verb can have, and the existence of these multiple lexical entries would be accounted for in a principled way.

Although a first glance at examples such as (1)–(3) might give the impression that a verb's meaning¹ can vary in almost unlimited ways, a closer look at the attested variations in meaning reveals that this is not so. There are several striking properties of such variation which suggest that there are linguistic principles governing the range of meanings associated with a verb. First, the variation illustrated in (1)–(3) is not associated with individual verbs, but rather with entire semantic classes of verbs and thus may be considered an instance of what Apresjan (1973) calls "regular polysemy." For example, the behavior of *sweep* is typical of verbs of surface contact through motion; thus, the verb of surface contact *wipe* is found in the same range of contexts as *sweep*, as illustrated below.

- (4) a. Terry wiped.
 b. Terry wiped the table.
 c. Terry wiped the crumbs into the sink.
 d. Terry wiped the crumbs off the table.
 e. Terry wiped the slate clean.
 f. Terry wiped the crumbs into a pile.

Similarly, the verb *run* shows a pattern of behavior characteristic of all verbs of manner of motion, while the range of contexts available to *whistle* is typical of verbs of sound emission (for a discussion of the latter, see Levin 1991). Thus, verbs naming similar concepts appear in the same range of syntactic contexts, with verbs in each class showing a unique pattern of behavior. The fact that the range of meanings available to a verb seems to be determined by its semantic class membership

¹In our presentation of this phenomenon we attribute the variation in meaning in examples such as (1)–(3) to the verb, characterizing it as verbal polysemy; others attribute the variation in meaning to the construction the verb is found in. We discuss these two perspectives in the appendix, where we point out that both face the problem of accounting for the variation in meaning. We also argue that the two approaches incorporate similar assumptions about the nature of verb meaning, and as a consequence the insights that we present in this paper into the nature of the variation in meaning carry over in large part to the constructional approach, even though we will describe the problem in terms of verbal polysemy in the body of the paper.

suggests that there are principles which govern variation in verb meaning. Furthermore, as illustrated in detail by Slobin (1987, 1996), Talmy (1975, 1985, 1991), Wienold (1995), and others, the range of meanings available to members of a particular verb class in one language may not be available to the members of the corresponding class in another language, with systematic differences attested. The existence of cross-linguistic variation suggests that the principles governing possible verb meanings are linguistic in nature and given to parametric variation. Finally, and perhaps most importantly, not all English verbs allow the same range of flexibility in meaning and argument expression, and again this property is correlated with a verb's semantic class. For example, as we illustrate extensively in section 1 of this paper, verbs of change of state such as *break* do not permit anything like the range of argument expressions that verbs of surface contact such as *sweep* show.

A prerequisite to the development of an explanatory theory of possible variation in verb meaning is the documentation of allowable variations and, more important, the constraints on such variation.² To that end, we present a case study of the two verbs *break* and *sweep*, each a representative of a well-established semantic class: verbs of externally caused change of state and verbs of surface contact through motion, respectively. We choose these verbs because they serve to illustrate a dichotomy in the English verb lexicon that turns out to be central to understanding the nature of the elasticity of verb meaning. As we show in section 1, these two verbs show a striking contrast in the range of meanings available to them. First, we carefully review the argument expression options available to each; then, we identify a fundamental difference in their meaning. In section 2 we use this difference as a clue to the nature of the process which gives rise to variation in verb meaning. In section 3 we sketch the rudiments of a theory which will predict the exact range of meanings and syntactic contexts which individual verbs may be associated with. In section 4 we show how this theory accounts for the difference between the two verbs under study.

1 Manner versus Result Verbs

It is striking that the verbs whose impressive elasticity in meaning is illustrated in (1)–(3) all lexically specify or “lexicalize” the manner in which the action denoted by the verb is carried out. These verbs contrast with verbs such as *break* and *open* which lexicalize the result of the action denoted by the verb, but not the manner. We therefore

refer to verbs like *sweep* and *run* as “manner verbs” and to verbs such as *break* and *open* as “result verbs.”³ After clarifying the nature of the intended semantic distinction, we demonstrate a correlation between it and the range of syntactic and semantic variation available to a verb: result verbs show a much narrower range of variation in meaning and syntactic context than manner verbs.

As noted above, the verb *sweep* exhibits behavior that is representative of that of other verbs of surface contact, including *rub* and *wipe*. These three verbs are distinguished from each other in the manner of surface contact they specify, but none of these verbs, in its most basic use, entails a resulting change in the contacted surface. Thus, although a floor is typically swept in order to remove dirt and debris, a floor that is swept need not end up being clean. Although a hearer will infer that a swept floor is a clean floor because the conventional goal of sweeping is to clean a floor, there is nothing contradictory in saying *Tracy just swept the floor, but there are still crumbs on it*. Verbs of manner of motion such as *run*, *skip*, and *jog* are distinguished from each other with respect to the manner of motion each specifies; however, no achieved location (a kind of result) is entailed by such verbs unless an explicit goal phrase is added. For example, the sentence *Pat runs* simply states that Pat is moving in a particular way. Typically, we assume that Pat is also undergoing some displacement, but in the absence of a goal phrase this displacement need not be oriented towards a particular goal, and in fact there need not be any displacement at all (*Pat run in place*). The verb *whistle* shows the behavior typical of verbs of sound emission; such verbs lexicalize the manner in which a sound is emitted (and perhaps properties of the sound emitted) and differ from each other with respect to manner of sound emission. Thus, a whistle is emitted by forcing air through pursed lips, while a grunt involves the vocal tract.

Manner verbs like *sweep*, *run*, and *whistle* can be contrasted with result verbs,⁴ which lexicalize a particular result, but more often than not are vague as to how the result is achieved. There are two types of result verbs: one type lexicalizes a resulting state and the other a resulting location. A verb of change of state, such as *break*, *dry*, or *widen*, as the name implies, lexicalizes a particular achieved state, and the verb denotes the bringing about of this state. But though the

³The manner/result verb distinction has also received independent support from studies in child language acquisition, including Behrend 1990, Gentner 1978, and Groppen et al. 1991.

⁴There are some verbs which lexically specify both manner and result; *cut* is probably such a verb.

²We are not concerning ourselves with variations in meaning that involve figurative or metaphorical uses of a verb (e.g., *cat* as in *The acid ate the metal*).

verb itself denotes the bringing about of this state, it leaves the nature of the causing activity involved unspecified; that is, such verbs do not lexicalize a manner. For example, clothes may be dried by putting them into a dryer or by putting them out in the sun; the verb *dry* may be used no matter how the dry state is brought about. Likewise, a vase may be broken in many ways; again the verb *break*'s own meaning contributes nothing to the specification of how the vase came to be broken. The verb *clean* also specifies a resulting state, while leaving open how it is achieved. In fact, how a clean state is obtained depends on the surface involved: floors are cleaned by sweeping or washing, while counters and tables are wiped. Verbs which lexicalize an achieved location are the second type of result verbs. These are verbs of directed motion such as *come*, *go*, and *arrive*, which lexicalize an achieved location (and usually also a direction), but not a manner of motion. For example, someone could arrive at the station by running, walking, driving, or bicycling. These verbs can be contrasted with manner of motion verbs such as *run*, *swim*, *jog*, or *walk*, which specify a manner of motion but no achieved location (or direction).

We now illustrate how the result verbs are much more constrained in their syntactic behavior than the manner verbs by presenting a variety of contrasting properties of the two verb types. First, two-argument manner verbs more readily allow the omission of their direct object than two-argument result verbs. Contrast the manner verb *sweep* and the result verb *break* in (5). Although *sweep* may occur without an object even in the absence of any context, *break* cannot, and it is even difficult to think of a context that would improve an example such as (5b).

- (5) a. Leslie swept.
b. *Kelly broke.

Second, manner verbs can readily appear with a wide range of "non-subcategorized" objects, whereas such objects are not available to result verbs. In (6a) *her fingers* is a nonsubcategorized object since it is not the surface that is being scrubbed. Although this sentence is understood to describe the scrubbing of a surface, the surface itself is not mentioned. Thus, the sentence means that Cinderella scrubbed something, perhaps the floor, until her fingers were raw; however, (6b) cannot have a parallel interpretation: the child broke many things, and as a result of handling the broken things his knuckles were hurt. An additional pair of examples contrasting manner and result verbs is given in (7).

- (6) a. Cinderella scrubbed her fingers to the bone.
b. *The clumsy child broke his knuckles to the bone.
(7) a. The child rubbed the tiredness out of his eyes.
b. *The clumsy child broke the beauty out of the vase.

Although *sweep* and other verbs of surface contact can be used as verbs of change of location, change of state, and creation as illustrated in (1), a verb of change of state like *break* cannot show such a range of uses, as illustrated in (8)–(10). In each pair, the (a) sentence with *break* cannot be assigned an interpretation to parallel the (b) sentence with a manner verb; the intended interpretation of each *break* sentence is given in parentheses.

- (8) a. *Kelly broke the dishes off the table.
(meaning: Kelly removed the dishes from the table by breaking the table)
b. Kelly swept the leaves off the sidewalk.
(9) a. *Kelly broke the dishes off the table.
(meaning: Kelly broke the dishes and as a result they went off the table.)
b. Kelly shoved the dishes off the table.
(10) a. *Kelly broke the dishes into a pile.
(meaning: Kelly broke the dishes and made a pile out of them)
b. Kelly swept the leaves into a pile.

A similar distinction is found among verbs of motion. Directed motion verbs are also rigid in their behavior: they do not exhibit the range of options available to verbs of manner of motion. Thus, the verb *go* is not found in the same range of contexts as *run*, as the attempt to insert it in contexts parallel to those in (3) shows.

- (11) a. The students went.
b. The students went to the beach.
c. *The jetsetters went themselves ragged.
d. *The runner went his shoes to shreds.
e. *The pedestrian went clear of the oncoming car.
f. *The coach went the athletes around the track.

In sum, the impressive flexibility of manner verbs with respect to argument expression contrasts with the relative rigidity of result verbs.

2 The Monotonicity of Verb Meaning Construction

In this section we provide an intuitive explanation for the distinctive behavior of manner and result verbs. Then, in the following section

we outline a theory of verb meaning and argument expression which derives the desired results.

As a first step towards understanding why the difference in type of meaning component lexicalized in the verb should be correlated with such a striking difference in verb behavior, we point out that manner verbs and result verbs have different lexical aspectual classifications: manner verbs are activities, whereas result verbs are either achievements (e.g., *arrive*) or accomplishments (e.g., transitive *break*). This last statement presupposes that verbs with multiple meanings, although associated with more than one lexical semantic representation, still have a basic semantic classification, and that the lexical aspectual classifications we just referred to are the basic classifications of manner and result verbs. For example, as illustrated in (1), the verb *sweep* has a variety of uses that qualify as accomplishments, as well as uses that qualify as activities; nonetheless, we assign this verb a basic classification as an activity verb because all its uses entail an activity involving a particular manner of surface contact, but only some of its uses entail a result. We assume that the basic classification of a verb is determined by the nature of the concept which the verb lexicalizes; see section 3.1.

Research on lexical aspect has brought out interrelationships between the various aspectual classes. These interrelationships have been captured in the predicate decompositions assigned to the members of the various aspectual classes by certain theories of lexical semantic representation. For instance, accomplishments are generally assigned a complex event structure. (For arguments in favor of such an event structure see Dowty 1979; Parsons 1990; Pustejovsky 1991, 1995; Van Valin 1993.)

- (12) $[[x \text{ ACT}] \text{ CAUSE } [\text{BECOME } [y < \text{STATE} >]]]$

Accomplishments are complex events composed of two subevents: the causing event—typically an activity—and the change of state it brings about. Thus, in the representation (12) the first subevent of an accomplishment has the representation also associated with activities, given in (13), while the second subevent has the representation also associated with achievements, given in (14).

- (13) $[x \text{ ACT}]$

- (14) $[\text{BECOME } [x < \text{STATE} >]]$

The possible variations in verb meaning illustrated in (1)–(3) all involve the “expansion” of an activity to yield various kinds of accomplishments. For example, if *sweep* is basically an activity verb, all the

extended meanings which the verb is associated with involve the addition of a resulting state: a change of location, a change of state, or the coming into existence of some artifact. In each instance, the addition of the resulting state is signalled by an element in the syntax. For example, in all the examples in (1), the verb *sweep* itself signals the activity part of the event structure, and in (1c)–(1f) the resulting state is signalled by some other element in the sentence. This pattern suggests that verb meaning is built up incrementally.

If we take this idea further and assume that verb meaning is built up in a monotonic fashion, in a way which precludes the elimination of any basic element of meaning, we have a natural explanation for the differential behavior of the result verbs and the manner verbs.⁵ If we assume that many of the result verbs are inherently classified as accomplishments, then the rigidity in their behavior can be attributed to the nature of the lexical representation of accomplishments: accomplishments have fully lexically-specified representations. They cannot take on activity readings without eliminating a lexically-specified component of verb meaning (the resulting state). Furthermore, we propose that no additional expansion of their representation is possible as the accomplishment representation is the most complex representation available. Consequently, if the accomplishment verb is one that specifies a change of state, no change of location can be added to the meaning of the verb, and vice versa.

3 Components of the Theory

In this section we sketch the components of a theory intended to account for the possible meanings available to different types of verbs. This theory incorporates the insight of the previous section that verbs have basic classifications which can then be expanded in a monotonic fashion. In section 3.1 we introduce the representations of verb meaning we assume. Then in section 3.2 we present well-formedness conditions

⁵There are some types of meaning change that are not monotonic, but these appear to represent phenomena distinct from that under study in this paper. An example is the phenomenon sometimes referred to as “semantic bleaching,” which appears to involve the loss of some element of word meaning. Illustrations of semantic bleaching are the use of the verb *break* in *The news broke* or the use of the verb *fall* in *The baby fell asleep*. It is significant that semantic bleaching always involves the loss or weakening of the idiosyncratic aspect of verb meaning (what we call the “constant” in section 3.1), and to our knowledge, never involves removal of grammatically-relevant aspects of verb meaning (what we call the “template” in section 3.1). Furthermore, “semantic bleaching” is quite idiosyncratic, being associated with individual verbs rather than with grammatically-relevant semantic classes of verbs in the sense of Levin 1993. Both these properties set it apart from the type of variation in meaning represented by examples such as (1)–(3).

governing the association of a syntactic expression with the meaning representation.

3.1 The Basic Elements of Verb Meaning

Much recent work in lexical semantics either implicitly or explicitly recognizes a distinction between two aspects of verb meaning, which we term the "structural" and the "idiosyncratic." This distinction is also central to our theory of the representation of verb meaning. The structural part of a verb's meaning is that part which is relevant to determining the semantic classes of verbs that are grammatically relevant, while the idiosyncratic part of a verb's meaning distinguishes that verb from other members of the same class. The recognition of this subdivision in verb meaning is a major achievement of recent lexical semantic research, and it is assumed, although not necessarily made explicit, in the work of many researchers.⁶ For example, Grimshaw (1993) distinguishes between "semantic structure," roughly the structural component of meaning, and "semantic content," roughly the idiosyncratic component of meaning. Hale and Keyser (1993) associate fixed meanings with certain structural configurations which occur in the lexical representation of many verbs; these configurations correspond to the structural component of meaning. In their representations, the idiosyncratic aspect of meaning is represented by a "head" which is inserted into these structures and then undergoes Head Movement into an empty V position, thus integrating the idiosyncratic component into the structural component of verb meaning.

It is usually assumed that the structural component of verb meaning is that aspect which is grammatically relevant—for example, relevant to argument realization—and defines the grammatically-relevant semantic classes of verbs—that is, those semantic classes of verbs whose members share syntactically- and morphologically-salient properties. In fact, in most current theories, the aspects of meaning which are grammatically relevant usually are those which define the various ontological types of events, which correspond roughly to the recognized, Vendler-Dowty aspectual classes of verbs. It is for this reason, that the grammatically-relevant lexical semantic representation is often called an "event structure." In contrast, the idiosyncratic aspect of verb meaning serves to differentiate a verb from other verbs sharing the

⁶For more extensive discussion of this distinction and its consequences see Grimshaw 1993. For a presentation of the alternative point of view—that a verb's meaning cannot be carved up according to whether or not it is grammatically relevant—see Taylor 1996, and Jackendoff 1996 for a rejoinder.

same structural aspects of meaning; the idiosyncratic aspect is not relevant to the verb's grammatical behavior.

In many current theories, verbs are given an articulated lexical semantic representation taking the form of a predicate decomposition (Jackendoff 1990; Levin and Rappaport Hovav 1995; Pinker 1989; Rappaport Hovav and Levin in press; Van Valin 1993). A predicate decomposition is made up of two major types of components, primitive predicates and what have been called "constants." Specific combinations of primitive predicates represent the structural aspect of verb meaning, while the constants represent the idiosyncratic element of meaning. The various combinations of primitive predicates constitute the basic stock of lexical semantic templates of a language (the "thematic cores" of Pinker 1989). A verb's meaning consists of an association of a constant with a particular lexical semantic template. For example, causative change of state verbs share the lexical semantic template in (15a), with the various members of the class being derived by a particular instantiation of the constant representing the state, as illustrated by the representation of causative *dry* in (15b).

- (15) a. $\{ [x \text{ ACT}] \text{ CAUSE } [\text{BECOME } [y < \text{STATE} >]] \}$
 b. $\{ [x \text{ ACT}] \text{ CAUSE } [\text{BECOME } [y < \text{DRY} >]] \}$

As discussed in the introduction, verbs with multiple meanings are associated with multiple lexical semantic representations. These multiple meanings usually arise from the association of a single constant with more than one lexical semantic template. For example, some of the uses of the verb *sweep* illustrated in (1) can be derived by the association of the constant *<SWEEP>* with the three templates in (16); we present fully-instantiated representations that include the actual constant in section 4.

- (16) a. $\{ [x \text{ ACT}] \}$
 b. $\{ [[x \text{ ACT}] \text{ CAUSE } [\text{BECOME } [y < \text{STATE} >]]] \}$
 c. $\{ [[x \text{ ACT}] \text{ CAUSE } [\text{BECOME } [y < \text{PLACE} >]]] \}$

We assume that Universal Grammar provides an inventory of lexical semantic templates consisting of various combinations of primitive predicates, which correspond to a large degree to the generally acknowledged event types. For this reason, henceforth we refer to a lexical semantic template as an "event structure template." The inventory of event structure templates includes those listed below.⁷ (The

⁷The proposed activity event structure template has a single argument, although we recognize that there are two-argument activity verbs such as *sweep*; we discuss

italicized material in angle brackets represents the constant, which we discuss immediately below.)

[x ACT< <i>MANNER</i> >]	(activity)
[x < <i>STATE</i> >]	(state)
[BECOME [x < <i>STATE</i> >]]	(achievement)
[[x ACT< <i>MANNER</i> >] CAUSE [BECOME [y < <i>STATE</i> >]]]	(accomplishment)
[x CAUSE [BECOME [y < <i>STATE</i> >]]]	(accomplishment)

Although the set of event structure templates is fixed, we assume that the set of constants is open-ended. Each constant has an ontological categorization (Jackendoff 1990; Pinker 1989), drawn from a fixed set of types (e.g., state, thing, place, manner, etc.). Each constant is also associated with a name (i.e., a phonological string). As the discussion above suggests, we assume that the ontological type of a constant determines its basic association with a particular event structure template; these associations are specified via what we call "canonical realization rules," whose name is inspired by the canonical structural realizations of Grimshaw 1981. In addition, each constant also determines the basic number of participants in the event it is associated with.⁸ For example, although both running and sweeping are activities, an event of running minimally involves the runner, while an event of sweeping minimally includes a sweeper and a surface because of the nature of sweeping itself.

There are two ways in which constants are integrated into event structure templates: either they may be modifiers of predicates or they may serve as arguments of predicates, filling a particular argument slot in a template. A modifier constant is associated with the predicate in an event structure template that it modifies. For example, a constant categorized as a manner usually modifies an activity, and it is therefore associated with the predicate ACT in the activity event structure template. Likewise, an instrument constant modifies an activity (since it specifies the generic activity associated with using the instrument), so it too will be associated with the predicate ACT in an activity template.

The basic idea behind the canonical realization rules is that the treatment of the nonactor argument of two-argument activity verbs in sections 3.2 and 4.1.

⁸Goldberg (1995) and van Hout (1996) also propose that the idiosyncratic component of a verb's meaning, what we call the "constant," determines the basic number of participants in an event.

minimal elements of meaning encoded in the constants must be given syntactic expression. In this way, these rules also ensure the monotonicity of verb meaning. The fundamental canonical realization rules include those given below:⁹

- (17) manner → [x ACT<*MANNER*>]
(e.g., *jog, run, creak, whistle, ...*)
- (18) instrument → [x ACT<*INSTRUMENT*>]
(e.g., *brush, hammer, saw, shovel, ...*)
- (19) placeable object →
[x CAUSE [BECOME [y WITH <*THING*>]]]
(e.g., *butter, oil, paper, tile, wax, ...*)
- (20) place → [x CAUSE [BECOME [y <*PLACE*>]]]
(e.g., *bag, box, cage, crate, garage, pocket, ...*)
- (21) internally caused state → [x <*STATE*>]
(e.g., *bloom, blossom, decay, flower, rot, rust, sprout, ...*)
- (22) externally caused state →
[[x ACT] CAUSE [BECOME [y <*STATE*>]]]
(e.g., *break, dry, harden, melt, open, ...*)

Each rule pairs a constant of a particular ontological type, specified on the left of the arrow, with the event structure template to the right of the arrow. In these rules, the place of the constant in the associated event structure template is indicated in capital italics and placed between angle brackets. Argument constants appear in the appropriate argument position in the templates. Modifier constants appear as subscripts to the appropriate predicate in the event structure templates.

We call the pairing of a constant and an event structure template an "event structure." We consider the pairings of constants and event

⁹Instead of the event structure template in (19), the canonical realization rule for placeable objects might give rise to the template: [x CAUSE [BECOME [<*THING*> AT y]]]. There is some debate as to which template is the more appropriate one; see Hale and Keyser 1993 for discussion. We also leave it to further research to determine whether the templates in (19) and (20) should be of the form "event cause event" rather than the proposed "individual cause event."

Our representations for activities use the primitive predicate ACT modified by a manner constant; other representations for activities use a predicate DO taking a constant as an argument or, if not, take a form that is suggestive of this analysis, as in Hale and Keyser 1993. For example, our proposed analysis of *laugh* [x ACT<*LAUGH*>] could be contrasted with the following alternative analysis, [x DO <*LAUGH*>]. The representation in terms of DO appears to receive support from languages like Basque where the counterparts of English one-argument activity verbs are expressed by the verb *do* plus a noun (Levin 1989); however, this representation does not seem appropriate for two-argument activity verbs. Clearly, further investigation into the proper representation of activity verbs is necessary.

structure templates effected by the canonical realization rules to constitute a basic verb meaning; we return to derived meanings below. We assume that the "name" associated with a particular verb meaning is contributed by the constant (see Rappaport Hovav and Levin in press for discussion). A verb's lexical entry, then, consists of the name contributed by the constant together with the meaning, represented as an event structure. Since the constant specifies what is idiosyncratic to a particular verb—i.e., its "core" meaning—we will say that the verb lexicalizes the constant. To take an example, the verb *sweep* takes its name from a constant which specifies a certain manner of surface contact involving motion; due to the nature of this type of surface contact, this constant is basically associated with an activity event structure template by the canonical realization rule (17), and thus, the verb *sweep* is an activity verb.

We have just suggested that a simple verb meaning involves the association of a constant with an event structure template by a canonical realization rule to produce what we have called an event structure; however, there is more to "building" the basic event structure of a verb than filling the constant position in the event structure template with the constant. When a constant is associated with an event structure template by a canonical realization rule, the participants associated with the constant must be matched up, if possible, with appropriate variables in the event structure template. We assume that, as Goldberg (1995:50) puts it, "semantically compatible" participants are paired with each other.¹⁰ For example, consider the manner of motion verb *run*, which takes its name from a constant that specifies a certain manner of motion; this constant is associated with an event that involves a single participant, a runner. As a manner constant, this constant is associated by canonical realization rule (17) with an activity template; the single participant associated with the constant is semantically compatible with the single variable associated with the activity event structure template, so the two can be matched up.

There is, however, one complication in this process. In certain instances the constant has more associated participants than there are variables in the corresponding event structure template. In such instances, some participants are not paired with variables in the event structure template. This situation arises with two-argument activ-

¹⁰We do not spell out the details of the process that integrates the participants associated with the constant with the variables of the event structure template here, but see Goldberg 1995, particularly Chapter 2, for some relevant discussion, which though couched in terms of the constructional approach discussed in the appendix, can be translated into the perspective that we are taking here.

ity verbs, such as the verb *sweep*. We have suggested that the verb *sweep* is derived from a constant associated with two participants, although the activity event structure template this constant is associated with has only one variable. The actor participant is matched up with the variable of the activity template, but the nonactor argument is not matched up with a variable in the activity template and must be integrated into the resulting event structure in some other way. Its presence, we contend, is simply licensed by the constant.

As a result, we can distinguish between two types of participants in an event structure: those that are licensed by virtue of both the event structure template and the constant and those that are licensed by virtue of the constant alone. In fact, Grimshaw (1993) argues convincingly for making a dichotomy among arguments along roughly these lines based on differences in the behavior of the two types of arguments; she refers to them as "structure" and "content" arguments, respectively; we will refer to them as "structure" and "constant" participants.¹¹ We return to the differences in behavior in section 4.1, after proposing in section 3.2 that there are distinct conditions governing the syntactic realization of the two types of participants. In the event structures in the remainder of the paper, constant participants will be underlined to distinguish them from structure participants.

We have just described the construction of a basic verb meaning. The widespread variation in verb meaning indicates that many, if not most, verbs are also associated with derived verb meanings. We attribute much of the variation in verb meaning, specifically that variation which is monotonic in nature, to Template Augmentation, which allows more complex event structure templates to be built on simpler ones; however, Template Augmentation can only create meanings that are consistent with the basic inventory of lexical event structure templates.

- (23) **Template Augmentation:** Event structure templates may be freely augmented up to other possible templates in the basic inventory of event structure templates.

In order to show how Template Augmentation accounts for the range of semantic and syntactic variation exhibited by different verbs, we first need to make explicit the well-formedness conditions governing the syntactic realization of arguments and the predicates they are associated with.

¹¹We leave it for further study to determine whether the notion of structure argument might overlap with the notion of aspectual or event roles in the work of Ritter and Rosen (1996, this volume) and Tenny (1995).

3.2 Well-formedness Conditions on Syntactic Realization

We posit two well-formedness conditions on the syntactic realization of event structures. Their statement reflects assumptions common in the literature that elements in the semantic representation must be syntactically encoded and that the syntactic representation must be fully interpreted semantically. This idea has generally been instantiated with respect to the arguments of predicates, as in the Theta-Criterion of Chomsky 1981, but in the Subevent Identification Condition in (24) we extend this idea to the major components of the event structure, the subevents that constitute it.

- (24) **Subevent Identification Condition:** Each subevent in the event structure must be identified by a lexical head (e.g., a V, an A, or a P) in the syntax.

In most instances this identification comes about as a side effect of the association of the constant with an event structure template via one of the canonical realization rules: the verb takes its name from the constant, and we assume the verb also identifies any subevents in the event structure that results from the association of the constant with an event structure template by the relevant canonical realization rule. If Template Augmentation contributes another subevent to an event structure previously created via a canonical realization rule, then this additional subevent must be identified by another lexical head in the syntax for the Subevent Identification Condition to be met. As stated, the Subevent Identification Condition allows for a single verb in the syntax to identify more than one subevent when a canonical realization rule associates the constant with a complex event structure template; as we discuss in detail in section 4.1, externally caused change of state verbs, which are built using canonical realization rule (22) are a case in point.

The second well-formedness condition, the two-part Argument Realization Condition, involves the syntactic realization of the structure participants in the event structure.

(25) Argument Realization Condition:

- a. There must be an argument XP in the syntax for each structure participant in the event structure.
- b. Each argument XP in the syntax must be associated with an identified subevent in the event structure.

The first part is a reformulation of well-formedness conditions recently proposed in the work of Grimshaw and Vikner (1993) and van Hout (in press). Grimshaw and Vikner introduce their well-formedness condition to account for an obligatory adjunct requirement in some passives. Van Hout appeals to such a condition to account for the interaction between aspectual prefixes or particles and transitivity in Dutch and Russian. The second part of the Argument Realization Condition is reminiscent of a range of conditions in the literature that ensure that all constituents in the syntax are properly licensed, including GB's Theta-Criterion (Chomsky 1981, 1986) and LFG's Completeness and Coherence Conditions (Kaplan and Bresnan 1982).

The first Argument Realization Condition makes reference only to structure participants. Therefore, if an activity (sub)event includes both a structure participant and a constant participant, the Argument Realization Condition requires only that the former be realized in the syntax. Nevertheless, we suggest that there is a recoverability condition on constant participants, which in certain circumstances requires their realization. This recoverability condition is not a well-formedness condition on the syntactic realization of the event structure, since such constant participants are not essential to event structure (see also Grimshaw 1993), rather it simply requires that the content of a constant participant be recoverable. Their content is trivially recoverable when they are syntactically expressed, but such participants may sometimes also be recoverable when unexpressed from the context via pragmatic inferences; see section 4.1 for further discussion. Thus, the conditions on the syntactic realization of constant and structure participants differ.

Besides the well-formedness conditions, we assume the existence of a theory of linking that determines the specific syntactic expression of the participants in the event structure. We assume that this theory takes the form of a set of linking rules such as those in the work of Carter (1988), Jackendoff (1990), or Levin and Rappaport Hovav (1995). Such rules determine the precise syntactic expression of participants based on their function in the lexical semantic representation. Nothing, however, hinges on our use of linking rules, and we acknowledge that the best formulation of a linking theory is still a matter

of debate (see Levin and Rappaport Hovav to appear for discussion). Linking rules have been open to criticism since they refer to particular positions in lexical semantic representations. Some researchers have tried to avoid making such explicit statements, for instance, through the use of thematic hierarchies (Belletti and Rizzi 1988; Grimshaw 1990; among others) or even by taking linking to be a reflection of depth of embedding in a lexical semantic representation (Joppen and Wunderlich 1995; Wunderlich 1997; they adopt this idea from the work of Bierwisch).

In the next section we show how the assumptions laid out in this section, along with the representations assumed for the various classes of verbs, account for the differences in behavior of manner and result verbs. To do this, we show how the multiple uses of *sweep* arise and how such multiple uses cannot arise for the verb *break*.

4 The Representation and Derivation of Verbs with Multiple Meanings

4.1 Simple Verb Meanings

Sweep is a manner verb which takes its name from a manner constant. Because of the nature of sweeping, this constant is associated with two participants: a sweeper and a surface. (We assume that the stuff that might be on the surface is not among the minimum set of participants since it is possible to sweep a surface without anything being on it.) This constant, which we represent as <SWEEP>, is associated with an activity event structure template by canonical realization rule (17). The single variable of the activity template will be matched up with the sweeper participant associated with the constant since they are semantically compatible. However, the constant is also associated with a second participant, the surface, and so this participant is licensed only by the constant, making it a constant participant, not a structure participant.¹² Thus, *sweep* has the basic event structure in (26).

(26) [x ACT<SWEEP> y]

There are two argument expressions that can be associated with *sweep*'s event structure; these are given in (27).

- (27) a. Phil swept the floor.
b. Phil swept.

In both there is a predicate in the syntax, the verb *sweep*, which by virtue of the canonical realization rule associating manner constants with activity templates, identifies the sole subevent in the event structure, ensuring that the Subevent Identification Condition is satisfied. Since only the actor is a structure participant, the first Argument Realization Condition, (25a), is met as long as the actor is expressed, as it is in both (27a) and (27b). Additionally, there is the requirement that the constant participant be recoverable. This requirement is met trivially in the transitive sentence, (27a); the acceptability of the intransitive use of *sweep* means that the constant participant is recoverable in (27b). We now elaborate on this condition.

While the appropriate formulation of the recoverability condition is a matter of debate, we adopt the condition proposed by Brisson (1994): a constant participant can be unexpressed if it is understood as "prototypical." We illustrate this condition by showing how it accounts for differences among verbs of surface contact with respect to unexpressed objects. The intransitive use of the verb *sweep* is felicitous since there is a prototypical surface associated with a sweeping event: a floor. The strong association between sweeping and floors means that no particular context needs to be specified with intransitive *sweep* to ensure the appropriate interpretation of the unexpressed participant. And in fact, when used in isolation (27b) cannot describe a situation in which anything other than a floor is swept. Other verbs of surface contact, such as *wipe* and *rub*, specify activities that are not associated with a particular surface; with such verbs an intransitive use is possible only if there is sufficient context available that the relevant surface can be determined. Thus, the intransitive sentence *Kim wiped* can be used felicitously in the context of dish-washing. The surface contact verb *rub* also cannot be used intransitively without context, and an even more elaborated context appears to be necessary with it than with *wipe*, if the intransitive use is to be felicitous.

Our analysis can account for the striking contrast in the behavior of verbs of surface contact such as *sweep* and externally caused verbs of change of state such as *break*; the latter, unlike the former, require a direct object no matter what the context. The account hinges on the difference in the event structures associated with these two types of verbs: *break*, unlike *sweep*, is basically associated with a complex event structure with two subevents. First, though, we review a subdivision

¹² The two arguments of two-argument activity verbs also receive distinct treatment within Role and Reference Grammar (Van Valin 1990, 1993). In the activity use of these verbs, only the actor argument is assigned a macrorole, while the other, nonactor argument is not; this assignment contrasts with two-argument accomplishment verbs, each of whose arguments is assigned a macrorole. Although the notion of macrorole is very different from the notion of structure argument, like the notion of structure argument, this notion has repercussions for syntactic realization.

among verbs of change of state which is relevant to determining *break*'s basic event structure.

In Levin and Rappaport Hovav 1994, 1995 we argue for two types of changes of state: those like *blossom*, *grow*, *rot*, and *wilt*, which are conceptualized as internally caused, and those like *break*, *open*, or *dry*, which are conceptualized as externally caused.¹³ As their names suggest, the source of an internally caused change of state is internal to the entity that changes state, while externally caused changes of state have a source outside the entity that changes state. The notion of external causation is reflected in the complex nature of the event structure template that the canonical realization rules associate with constants naming externally caused changes of state. Specifically, the externally caused change of state verb *break* has the event structure in (28).

(28) [[x ACT<MANNER>] CAUSE [BECOME [y <BROKEN>]]]

This event structure has two subevents: a causing activity and a change of state. This analysis is argued for by many, including Dowty (1979), Levin and Rappaport Hovav (1995), Parsons (1990), Pustejovsky (1991, 1995). In the case of *break*, the constant lexically specifies the change of state involved, but provides no information about the causing subevent beyond its existence. It is for this reason that *break* is a result verb and not a manner verb. While the nature of the causing subevent is not specified by the constant, the event structure associated with *break* must nonetheless include a representation of this causing subevent since the change of state *break* denotes is conceptualized as having an external cause and as not occurring spontaneously. Since the constant that gives its name to the verb *break* is paired directly with a complex event structure template by the relevant canonical realization rule, the verb *break* identifies both subevents in this complex event structure, ensuring that the Subevent Identification Condition is met.¹⁴

An important part of our analysis of verbs of surface contact was the difference between the number of participants associated with the

constant and the number of variables associated with the event structure template; however, a comparable discrepancy does not arise for externally caused verbs of change of state. The relevant constants are associated with two participants: the causer and the entity that changes state—what is typically referred to as the patient. These constants are paired with an event structure template with two variables, one in each subevent, and each of these two variables is semantically compatible with, and thus matched up with, one of the two constant-associated participants. Thus, there are no participants in the event structure whose presence is purely sanctioned by the constant; that is, both participants are structure participants.

With this background, we now look at the application of the Argument Realization Condition to the event structure of an externally caused change of state verb. This condition requires the obligatory expression of both the subject and the direct object of such verbs, a property of these verbs noted in section 1, since each realizes a structure participant, one associated with each subevent of the complex event structure of these verbs. Our analysis of this property adopts the central insight of the analyses proposed by Brisson (1994) and Grimshaw (1993), since it, like these two earlier analyses, also ties the obligatoriness of the verb's arguments to the licensing of its complex event structure. On our account, the causer argument realizes the structure participant of the first subevent and the patient argument realizes the structure participant of the second subevent.

Thus, both are obligatorily expressed. In fact, Brisson (1994) notes that no matter what the context, the direct object of *break* cannot be omitted, as shown in (29).

- (29) a. Tracy broke the dishes.
b. *Tracy broke.

Thus, the sharp contrast between *break* and *sweep* with respect to the obligatoriness of the direct object arises from the difference in their event structures.

The best-known property of externally caused verbs of change of state—and a property that sets them apart from internally caused verbs of change of state—is their participation in the causative alternation, illustrated in (30); that is, they allow transitive causative and intransitive noncausative uses.

- (30) a. Tracy broke the dishes.
b. The dishes broke.

In Levin and Rappaport Hovav 1995 we argue that even in the non-causative use such verbs are associated with the same complex event

¹³In Levin and Rappaport Hovav 1995 we support the distinction between the two kinds of changes of state and the difference in representation which we attribute to them with data concerning the morphological encoding of the relationship between the members of causative-noncausative pairs of both types of verbs cross-linguistically. We discuss the event structure template associated with internally caused change of state verbs in section 4.3.

¹⁴This description of the lexical semantic representation of externally caused verbs of change of state brings out an asymmetry in possible verb meanings: there are result verbs which imply the existence of a causing activity which is left unspecified, but there are no manner verbs implying an unspecified result. We leave an explanation of this asymmetry to future research.

structure that we associate with the causative use. That is, *break*, for example, would have the event structure in (28) whether it is transitive or intransitive. We also present several types of evidence for this analysis, which we do not repeat here. The question is how the well-formedness conditions on syntactic realization are met with non-causative *break*. We assume that the Subevent Identification Condition is met in the intransitive use in the same way it is met in the transitive use, since the constant is still the same, and the same canonical realization rule associates this constant with an event structure template. But the intransitive use of *break* appears to be problematic from the perspective of the Argument Realization Condition. Only a single argument is expressed, and yet the verb is associated with an event structure with two subevents, so that Argument Realization Condition (25a) appears not to be met. In most languages the causative alternation is indicated by some type of morphological marking, and in many of these languages, the intransitive use is morphologically more complex than the transitive use (see Haspelmath 1993; Nedjalkov 1969). Often the intransitive use involves a reflexive morpheme, as in the Romance and Slavic languages. We assume that it is this morpheme which serves to satisfy the Argument Realization Condition. English, on this account, is special in not having such a morpheme. Our analysis of intransitive *break*, then, is different from that of intransitive *wipe*, and in fact, as far as we know, unexpressed object intransitives are not typically morphologically marked cross-linguistically in accusative languages; nevertheless, this is an area requiring further study.

4.2 The Effects of Template Augmentation

The multiple meanings of a verb like *sweep* can be derived via Template Augmentation on the basic event structure template associated with this verb, given in (26) and repeated in (31). As an activity template, this basic template is a subpart of several of the other possible event structure templates listed in section 3.1; thus, this template can be augmented to give these other templates as long as the resulting complex event structure meets the well-formedness conditions on syntactic realization. Specifically, their satisfaction will require a predicate in the syntax that can identify the second subevent introduced via Template Augmentation, as well as an argument in the syntax that is associated with this subevent. For example, one potential event structure that could be derived by applying Template Augmentation to (31) is (32). This event structure is associated with the resultative construction as in (33), where the head of the resultative phrase identifies the second subevent, ensuring the satisfaction of the Subevent Identification Con-

dition, and the NP *the floor* is an argument of this subevent, so that the Argument Realization Condition is also met.

- (31) [x ACT<SWEEP> y]
 (32) [[x ACT<SWEEP> y] CAUSE [BECOME [y <STATE>]]]
 (33) Phil swept the floor clean.

The event structure in (32) is that of an accomplishment, in contrast to the basic event structure, (31), which is that of an activity. There is evidence that sentences with the two uses of *sweep* do receive different aspectual classifications. For example, (33), like accomplishments in general, is incompatible with durative time adverbials, while (27a), like activities in general, is compatible with them.

- (34) a. Phil swept the floor for an hour.
 b. *Phil swept the floor clean for an hour.

The two uses of *sweep* show different interpretations with *almost* that are consistent with their distinct aspectual classifications. As illustrated in (35), the accomplishment use of *sweep* is ambiguous with *almost*, as expected of an accomplishment (Dowty 1979), while the activity use is not. Sentence (35a) can mean either that Phil was going to begin sweeping but did not, or that Phil began sweeping, but he stopped before he swept the whole floor clean; (35b) can only mean that Phil was going to begin the activity, but it cannot mean that he began the activity but did not carry it out to completion.¹⁵

- (35) a. Phil almost swept the floor clean.
 b. Phil almost swept the floor.

Sentence (33) meets the well-formedness requirements. The causing subevent is identified by the verb itself via the canonical realization rule pairing the constant with the activity template; the change of state subevent is identified by the adjective *clean*. The causing subevent is associated with the subject argument and the change of state subevent with the direct object. The direct object cannot be omitted, as shown in (36), since it is the realization of the structure participant of the second subevent.

- (36) *Phil swept clean.

¹⁵As Brisson (1994) points out, the simple transitive use of verbs like *sweep* can appear with telic time adverbials as in *Phil swept the floor in ten minutes*. However, we agree with her in assuming that this compatibility does not necessarily imply a complex event structure. As a consequence, not all instances of telicity can be represented with an event structure that embeds a state predicate, a position we defend in work in progress.

There are several other possible meanings of *sweep* that can arise via Template Augmentation. The added subevent may express an achieved location, another kind of result, as in (37), the representation associated with sentences like those in (38).

- (37) [[x ACT<SWEEP> y | CAUSE [BECOME [z <PLACE>]]]]
 (38) a. Phil swept the crumbs onto the floor.
 b. Phil swept the crumbs off the table.

In order to understand how the syntax of this pair of sentences is associated with the particular event structure we attribute to them, recall that we assume that the constant associated with *sweep* involves only two participants: the sweeper and the surface. These two participants are present in the basic event structure for *sweep*, and this event structure is the causing subevent in the more complex event structure also associated with this verb. In (38), unlike (33), the direct object is not one of the arguments of the causing subevent. The second argument of the causing subevent, the surface, need not be expressed since it is a constant participant. The second subevent, which is not identified by the verb itself, is identified by the preposition *onto* in the (a) sentence and *off* in the (b) sentence. Furthermore, there is an argument XP in the syntax associated with this subevent, *the crumbs*, as required by the Argument Realization Condition. Interestingly, in (38b) the surface argument is expressed within the XP headed by the preposition that identifies the second subevent, so that the constant participant is recoverable.

Contrasting with the acceptability of (38) is the ungrammaticality of (39). This sentence is ungrammatical for the same reason that (29b) above is, namely, that there is no argument XP in the syntax realizing the second structure participant, so that the Argument Realization Condition is violated.

- (39) *Phil swept onto the floor/off the table.

The PP cannot be omitted from (38a) or (38b) to give (40), which is intended to have the interpretation where the crumbs are the stuff that is swept up.

- (40) *Phil swept the crumbs.

Our account explains why this interpretation is impossible. There are two possible sources for this sentence, and neither involves a well-formed event structure. One possibility is that the sentence is associated with the same type of accomplishment event structure as (38a) or (38b). If so, its ungrammaticality follows because *the crumbs* is not a participant in the activity subevent in the event structure, (37), but

rather it is a participant in the second subevent; however, there is no predicate in the syntax to identify this second subevent. Alternatively, if we associate the verb in (40) simply with an activity event structure, then *the crumbs*, if it is interpreted as the stuff removed, would not be associated with the single subevent in this event structure, leading to a violation of the Argument Realization Condition (25b). In fact, the only interpretation that speakers are able to associate with (40) is the nonsensical one where the crumbs are the surface that is being swept. This reading is precisely the expected one if the sentence is associated with the activity event structure.¹⁶

We see, then, that activity verbs, typified by the verb *sweep*, have constants which are modifiers in an activity event structure, which can itself constitute the causing subevent of an accomplishment.¹⁷ Different accomplishment meanings arise depending on the element which licenses the second, resulting state, subevent. Each of these meanings is associated with a grammatically-relevant class of verbs. The second subevent can not only denote a change of state or a change of location, but it can also denote an artifact that comes into existence via the activity, as in *Terry swept the leaves into a pile*, in which a pile comes into existence as a result of the sweeping. English, but perhaps not all languages, allows the same "name" (derived from the constant) to be associated with all such templates (Rappaport Hovav and Levin in press). Because the name is derived from the activity of the causing subevent, the direct object is omissible when it is recoverable, and the syntactic direct object of the verb in the accomplishment uses of the

¹⁶This account also explains a contrast noted in Levin and Rappaport Hovav (1991). There we pointed out that when verbs like *sweep* are used as verbs of removal, they cannot express their arguments in exactly the same way as verbs such as *clear* or *clean*. *Clear* and *clean* enter into the construction illustrated in *Kim cleared the table of dishes*, but verbs like *sweep* do not: **Phil swept the floor of crumbs*. The reason for the contrast is that in the acceptable sentence *dishes* is a participant associated with the state constant <CLEAR>, which appears in the event structure of a verb like *clear* since it is an externally caused change of state verb. However, in the unacceptable sentence, *sweep*, being a manner verb, does not have a state constant in its basic event structure, so that *crumbs* has no subevent to be associated with. This situation can be altered by Template Augmentation, yielding *Phil swept the floor clean of crumbs*, where the adjective *clean* identifies the added change of state subevent.

¹⁷The directed motion use of verbs of manner of motion, as in *Pat ran to the beach*, also involves an activity-to-accomplishment shift; however, a causative analysis seems inappropriate for such derived accomplishments even though they also consist of a process and a result. If so, the account we present in this section of the accomplishment uses of verbs of surface contact may not extend to verbs of manner of motion. We leave the exact representation and derivation of the accomplishment uses of verbs of manner of motion as a topic for further research.

verb need not correspond to the "normal" direct object of the activity use (as in (38) above). This is because this causing subevent has only one structure participant which MUST correspond to an argument XP in the syntax, and it is what gives rise to the nonsubcategorized object examples in section 1.

We now show how the rigidity of externally caused change of state verbs with respect to argument expression arises from the interaction of Template Augmentation and the complex event structure templates associated with externally caused state constants. The patient argument of a change of state verb such as *break* is the sole participant of the second subevent in its event structure, and, as such, it is a structure participant and must be realized by an XP in syntax; the linking rules determine that the patient is expressed as a direct object. This requirement holds in general of verbs that are inherently associated with an accomplishment event structure template by the canonical realization rules. Consequently, verbs like *break* cannot be found in constructions such as (38) in which the direct object does not correspond to the "normal" direct object of the verb; that is, they cannot take nonsubcategorized objects. Thus, there is no sentence such as (41a) with the interpretation 'Kelly broke the table and as a result the dishes went off the table' that would be comparable to (41b).

- (41) a. *Kelly broke the dishes off the table.
b. Kelly wiped the crumbs off the table.

Furthermore, because the template associated with a verb like *break* cannot be augmented further, no other achieved state or location can be added to a sentence with *break*, even with the normal direct object. Thus, there are no sentences such as the (a) sentences in (42) and (43) with interpretations parallel to the (b) sentences. That is, the first (a) sentence cannot be used to express 'Kelly broke the dishes and as a result they went off the table', and the second cannot be used to express 'Kelly broke the dishes and as a result they were valueless'.

- (42) a. *Kelly broke the dishes off the table.
b. Kelly hit the ball across the field.
(43) a. *Kelly broke the dishes valueless.
b. Kelly wiped the table clean.

Occasionally, apparent resultative constructions with externally caused change of state verbs are cited, such as the one in (44); however, in such

examples the resultative phrase further specifies the change already lexicalized in the verb.¹⁸ No additional resulting state has been added.

- (44) Kelly broke the dishes to pieces.

Another possible way to vary the meaning of an externally caused change of state verb such as *break* would be to vary the causing subevent, just as the meaning of a verb of surface contact can be varied by varying the nature of the resulting state in the change of state subevent. In order to obtain such meanings there would have to be a lexical way of adding information about the causing subevent, but there does not seem to be one. In fact, we know of no verb that has multiple meanings that are differentiated in this way; for example, there is no verb that can mean both 'break with a sharp instrument' and 'break with the hand'. Unless it is lexicalized in the verb, the only way of specifying this information in English is periphrastically, for instance, through the use of a *by* clause.

Thus, the properties that distinguish the verb *break* from the verb *sweep* can be accounted for through the interaction of their event structure representations, the operation of Template Augmentation, and the well-formedness conditions.

Before closing this section we turn to an issue that we have been vague about: whether Template Augmentation is a lexical or interpretive operation. In principle, it could be implemented in either way, but in Rappaport Hovav and Levin 1996 we argue that at least some applications of Template Augmentation must be lexical because the results of its application show properties that are associated with basic lexical items. It is likely, as we suggest there, that some applications are lexical and others interpretive. See the appendix for further discussion.

4.3 Other Consequences

Achievements show the same rigidity in behavior as accomplishments. Like accomplishments, achievements are lexically associated with a specified resulting state. The state associated with the achievement verb *arrive* is a particular (deictically determined) location, while the state associated with *notice* is something like 'be aware'. Unlike accomplishments, achievements have a simple event structure given in (45), which lacks the causing subevent that characterizes accomplishments.

¹⁸ Examples such as *Kelly broke the brunch off the tree* require further consideration. As we discuss in Levin and Rappaport Hovav 1995, a salient property of all such examples is the part/whole relationship holding between the direct object NP and the NP in the directional PP. For further discussion of such examples see Rappaport Hovav and Levin 1996. We present a fuller analysis of such examples in work in preparation.

(45) [BECOME [x <STATE>]]

It might appear that Template Augmentation could be applied to the basic event structure template of achievements, adding a causing subevent and giving rise to an accomplishment event structure template. However, this possibility does not seem to be realized, and it is probably ruled out because there is no way to identify the added subevent. An achievement verb does not itself identify the causing subevent since it is not conceptualized as externally caused; furthermore, there appears to be no way to properly identify a causing subevent via the addition of another predicate. Because of this, verbs which are inherently classified as achievements do not have "causative" variants:

- (46) a. The train arrived.
 *The conductor arrived the train.
 b. The letter came.
 *The mailman came the letter.

When achievement verbs do have causative counterparts, the causative verb has a different name, as in the pair *come* and *bring*. We propose that this is because the causative verb denotes an externally caused change of location; the verb *bring*, for example, lexically specifies something about the causing subevent (i.e., that the agent accompanies the theme in its change of location), as well as the resulting location subevent. Furthermore, another imaginable application of Template Augmentation is also not an option for basic achievement verbs. Because there is already an achieved state specified in the event structure of an achievement verb, no other achieved states or locations can be added, just as with accomplishment verbs like *break*.

Achievements cannot assume activity readings for the same reason that accomplishments cannot: this would involve the elimination of the resulting state which is an inherent part of the meaning associated with achievement verbs. Activities, on the other hand, cannot be associated with achievement readings since there is no way to compositionally derive an achievement from an activity, there being no event structure templates of the form in (47).¹⁹

¹⁹This is not to say that there are no sentences describing the inchoation of an activity; there are after all sentences such as *Pat began to walk*; however, to our knowledge there are no simple verbs which lexicalize such an event type, a point also made by Dowty (1979:124). Presumably, there is no such event type in the basic inventory of event types. It is also true that achievements can sometimes assume certain properties of activities, such as when the verb *notice* is used duratively; we assume, however, that such shifts are not structurally represented in changes in the event structure template. We intend to elaborate on this point in future work.

(47) [BECOME [x ACT<MANNER>]]

Finally, we illustrate how the theory presented here accounts in a natural way for an interesting difference between verbs which denote internally caused changes of state and verbs which denote externally caused changes of state. As mentioned in section 4.1, verbs like *break*, although they lexicalize only a resulting state, involve states that are conceptualized as being externally caused; thus, they are basically associated with a complex event structure template which involves both a causing subevent and a change of state subevent. These verbs contrast with internally caused change of state verbs, which name states that come about naturally in an entity. These states are conceptualized as having their source internal to the entity that changes state, and consequently, the constants naming them cannot be associated with a complex event structure template that involves a causing subevent. Furthermore, Levin and Rappaport Hovav (1995) note that these verbs show a systematic ambiguity: allowing both a 'be-in-state' reading and a 'change-of-state' reading. The difference between the two readings is illustrated in (48).

- (48) a. The amaryllis blossomed for ten days.
 b. The tree blossomed in a day.

The atelic nature of (48a) is highlighted by the durative time adverbial. An interpretation involving iteration of telic events is excluded here since an amaryllis has only one flower. In contrast, (48b) has a telic interpretation, as indicated by its compatibility with the *in* time adverbial. This ambiguity is consistently absent from externally caused change of state verbs: verbs like *break* never have a 'be-in-state' reading; a sentence like *The vase broke* can never mean that the vase was in a state of being broken.

The difference in the behavior of the two types of change of state verbs can be accounted for if we assume that internally caused change of state verbs like *blossom* are basically associated with a state template, as in (49).

(49) [x <IN-BLOSSOM>]

That is, we assume the basic analysis of such verbs is as internally caused state verbs: they take their name from an internally caused state constant, which is associated with a state template by canonical realization rule, (21). The internally caused change of state interpretation, then, is the result of Template Augmentation, which derives an achievement template from the state template through the addition of the predicate BECOME, as in (50).

(50) [BECOME [x <IN-BLOSSOM>]]

Since no additional subevent is introduced, no additional argument XP need be added to identify the added predicate and no additional predicate is needed to meet the Subevent Identification Condition. In fact, it is a widespread phenomenon that stative verbs have achievement interpretations. In English, this phenomenon is particularly well-documented for verbs of perception and cognition such as *see*, *know*, and *understand* (Dowty 1979), but it extends into other verb classes. This ambiguity is not available to externally caused change of state verbs since they, by hypothesis, are basically associated with an accomplishment representation, and indeed it is not attested with externally caused change of state verbs.

5 Conclusion

The research reported in this paper is clearly just a start. For example, not all the diathesis alternations listed in Levin (1993) necessarily lend themselves to the analysis given above. The case study presented is a first attempt at making explicit how verb meanings are structured, how these meanings are expressed in syntax, and how verbs assume extended meanings. In this regard it is an attempt at a generative theory of verb meaning. Although a first glance at the range of meanings a verb can assume gives the impression that verb meanings can vary in almost unlimited ways, a closer look at the attested variations reveals that this is not so. As in the case of syntax, much is to be learned from the constraints on these phenomena. But these constraints can only be uncovered once the descriptive work of detailing the kinds of attested alternations is done. We hope that our work, built on the pioneering work of others, will provide a framework for doing just this. Furthermore, as in syntax, our understanding of the phenomenon under study can be greatly enriched by cross-linguistic comparison. It is well-known that verbs in English show a greater elasticity in meaning than verbs in other languages. For example, the manner of motion verbs which in English can appear with direction phrases, cannot do so in many other languages (Slobin 1987, 1996; Talmy 1975, 1985; Wienold 1995; among others). Presumably, the comparison of patterns attested in different languages will help lead to the development of more principled and predictive accounts of lexical phenomena.

Appendix: The Constructional Approach to Verbal Polysemy

The phenomenon of verbal polysemy treated in this paper has been discussed in the literature in the context of the problems which this phenomenon poses for the model of the syntax-semantics interface described in section 3.1, which we have elsewhere called the "projectionist model" (Levin and Rappaport Hovav to appear). As already mentioned, this model assumes that verbs have structured lexical semantic representations from which syntactic structures are projected (Chomsky 1981, 1986; Levin and Rappaport Hovav 1995; Pinker, 1989).²⁰ In this model, verbs with multiple meanings must have multiple lexical semantic representations, one for each meaning. These meanings, in turn, determine the various syntactic structures that the verb can be found in. Given the pervasiveness of verbal polysemy, the projectionist approach results in a significant proliferation of lexical representations associated with individual verbs, as mentioned in the introduction.

Many researchers have looked for an alternative approach that obviates the need for multiple lexical representations; these researchers (e.g., Borer 1994, in press; Erteschik-Shir and Rapoport 1995; Ghomeishi and Massam 1995; Goldberg 1995; Hoekstra 1992; Hoekstra and Mulder 1990; Ritter and Rosen 1996, this volume; among others) suggest that the phenomenon of verbal polysemy points instead to a model of the syntax-semantics interface which denies that verbs have structured lexical semantic representations from which syntactic structures are projected. Elsewhere we have termed this alternative approach the "constructional" approach.²¹ Proponents of the constructional ap-

²⁰The Projection Principle conflates two separate claims. One involves the idea that verbs have structured lexical entries which register the number and the types of their arguments. The second is that these properties are configurationally encoded at all levels of syntactic representation. LFG's Lexical Mapping Theory (Bresnan and Kanerva 1989) is also projectionist in the sense that the number and type of arguments is determined by the lexical entry of a verb; however, it denies the second claim of the Projection Principle, namely, that these properties are configurationally encoded at all levels of syntactic representation.

²¹Several researchers have adopted constructional approaches independently in recent years, most notably Goldberg (1995), Hoekstra (1992), and Borer (1994, in press). There are significant differences in the various instantiations of this approach, reflecting differences in the proponents' theoretical frameworks and goals. For example, Borer and Hoekstra assume more articulated syntactic representations than Goldberg. Goldberg clearly delineates the aspects of meaning which reside in the verb and those that are associated with each construction; she also investigates constructional polysemy, paying special attention to extended meanings which are found across constructions. Since our purpose is to contrast the constructional approach with the projectionist approach, we focus on the fundamental assumptions of the constructional approach, which the various instantiations share. However,

proach claim that only some aspects of meaning reside in verbs themselves. Certain syntactic constructions or syntactic positions are also associated with elements of meaning. One common proposal (Hoekstra 1992; Erteschik-Shir and Rapoport 1995) is that different constructions correspond to different event types in the Vendler-Dowty sense. A related proposal is presented by Borer (1994): certain syntactic positions assign the NPs occupying them a salient role in a particular event type. On the constructional approach, verbs name basic concepts, which are freely inserted into syntactic structures, whose meanings are then combined with the core meanings of the verbs. The meaning of a verb in a given use is determined compositionally from the meaning of the verb and the meaning of the construction. The major constraint on integrating a verb into a construction is the "compatibility" between the meaning of the verb and the meaning associated with the syntactic structures into which the verb is inserted.

The constructional approach assumes that verbs do not have multiple meanings; rather, a given verb names a concept which involves those aspects of meaning which are common to the verb in all its uses. Many verbs name concepts which are compatible with the meanings of more than one syntactic construction, and these verbs can be found in more than one syntactic context. The meaning of the verb, then, appears to vary according to the meaning of the various constructions it is found in. From the perspective of the constructional approach, the terms "verb meaning" and "verbal polysemy" are actually misnomers in the sense we have been using them in this paper.

To illustrate this point, we draw on the work of Hoekstra (1992). On his approach, the structure below in (51a) is associated with an activity interpretation, while that in (51b) is necessarily associated with an accomplishment interpretation, where PRED can represent either an achieved state or an achieved location. The concept named by the verb *sweep* is compatible with both an activity meaning and a variety of accomplishment meanings. Therefore, as shown in (1), a verb like *sweep* is compatible with either activity or accomplishment contexts and may be inserted into either syntactic structure. Thus, there is no need to give *sweep* distinct lexical entries. The distinct meanings arise from the distinct syntactic representations the verb can be inserted

we want to point out that there is no reason to assume that all alternations in argument expressions have a single source. In fact, Jackendoff (1990), among others, attributes some alternations in argument expression to the existence of multiple lexical entries for certain verbs (mediated by some kind of lexical rule) and others to the interaction between a verb's lexical entry and certain constructions, which themselves have associated meanings.

into. In fact, on Hoekstra's approach, the lexical entry for the verb *sweep* does not indicate the number of associated arguments; this is determined by the structure the verb is inserted into.

- (51) a. [NP V]
 b. [NP V [SC NP PRED]] (Hoekstra 1992)

It is not our intention in this appendix to choose between the constructional and projectionist approaches to the relation between the lexical representation of verbs and the syntactic expression of their arguments. Our main purpose is to point out that there are many elements shared by both approaches, that the challenges facing both are the same, and that the initial suggestions we have made in this paper concerning how to meet these challenges can be integrated into approaches of both sorts. Therefore, although proponents of the constructional approach have presented their approach as a significant departure from existing theories, we believe that the choice between the two approaches is not clear at this point, though we believe that a choice between them will ultimately be possible.

As already mentioned in section 3.1, most current lexical semantic theories recognize a dichotomy in verb meaning and distinguish what we have already referred to as the structural and the idiosyncratic aspects of verb meaning. We have shown that in the projectionist approach the structural aspect of meaning is usually encoded in some sort of skeletal event structure representation, while the idiosyncratic element of meaning is represented by the constant. The constructional approach recognizes the same distinction, although it is represented differently. In the constructional approach, the idiosyncratic component of meaning itself constitutes the lexical representation of the verb, while the structural aspects of meaning do not reside in the lexical entries of individual verbs, but rather are associated with certain basic syntactic structures, those which are associated with skeletal event interpretations. Since both projectionist and constructional approaches recognize this basic distinction among the elements of verb meaning, the major difference between the two concerns whether the association between the constant and the template is registered in the lexicon or not.

Both approaches to verb meanings are clearly capable of handling verbs with multiple meanings, but, as we have shown throughout this paper, the major challenge facing any effort to handle verbal polysemy is the delineation of the exact range of meanings available for any individual verb. Most current approaches to verb meanings have yet to take up this challenge. The constructional approach, as mentioned,

appeals to the compatibility between the verb and the construction, but this compatibility has not been explicated by most of its proponents.²²

Once the details of compatibility have been worked out, the theory of verb meaning that emerges might well resemble the one we have begun to articulate in this paper. In fact, although the theory presented in this paper has been cast in projectionist terms, the components of the theory can easily be incorporated into a nonprojectionist framework. Template Augmentation, the canonical realization rules, and the well-formedness conditions on argument realization, particularly the Subevent Identification Condition, can be seen as initial steps toward explicating what it means for constants to be compatible with the syntactic structures they appear in. That is, the major components of our theory can be adopted by a constructional approach if it is assumed that the event structure templates are not registered in lexical entries and the association between the constant and the template is not lexical, but rather is checked interpretively using appropriate reformulations of the rules and conditions we have articulated.²³

²²Goldberg's research (1995) is clearly in the spirit of the program we advocate in this paper. She presents a well-articulated theory of the representation of verb meaning and the ways in which verb meaning and constructional meanings are integrated, and we are in fact indebted to her work for an understanding of many of the issues involved in variation in verb meaning. It is not clear that Goldberg's theory as it stands accounts for the contrasts which we elaborate on in this paper, although there is nothing in principle which prevents these insights from being incorporated into it. We leave a fuller comparison of Goldberg's approach and ours for future work.

²³Some proponents of the constructional approach have claimed that the constraints on the syntactic structures which verbs can appear in can be reduced to well-known syntactic constraints (see, for example, Hale and Keyser 1993; Hoekstra 1992), although this claim is not necessary to the constructional approach since there are versions of this approach, such as Goldberg's (1995), which do not require the constraints to be syntactic. If it can be shown to be true in general that the constraints are syntactic, then there would be strong support for the particular syntactic version of the constructional approach. As should be clear, we have offered a nonsyntactic explanation for the constraints on verb polysemy which we have uncovered, but we have not yet dealt with the constraints discussed by Hale and Keyser. See Kiparsky in press for a critique of the syntactic explanation of the constraints which Hale and Keyser describe and see Rappaport Hovav and Levin 1995 for a discussion of certain problems with the syntactic explanation. Hoekstra offers for constraints of the sort which we discuss in this paper.

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