Chapter 5
Force Dynamics and Directed Change in Event Lexicalization and Argument Realization

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5.1 Introduction

Two theories of event lexicalization and argument realization are currently widely proposed: aspectual and causal (Levin and Rappaport Hovav 2005, henceforth AR). The aspectual theory originates in the classification of events (and the predicates that lexicalize them) according to how the event unfolds over time. The most influential version of this classification is that of Vendler (1967): his four-way division of events into states, activities, achievements, and accomplishments is widely used, despite acknowledgments of its deficiencies (see § 5.3). However, it is unclear whether the aspectual theory actually can contribute to an understanding of the semantic basis of argument realization—choice of subject, object, and oblique form for argument phrases—as well as event lexicalization. Levin and Rappaport Hovav note that "current aspectually driven theories of argument realization typically focus on the relation between choice and morphosyntactic expression of the direct object and notions such as telicity, measure and incremental theme" (AR, 98). While there is much that is valid in this analysis (see § 5.5), it is too limited as a comprehensive theory of argument realization that would account for the realization of other event participants as subjects or as various types of oblique phrases, as Levin and Rappaport Hovav note (AR, 111–112).

The second theory, the causal theory, is not widely found in generative and formal semantic approaches to event lexicalization and argument realization (with one caveat to be discussed in the next paragraph), but is widespread in cognitive semantics, beginning with Talmy (1976, 1985/2000) and followed by DeLancey (1985) and Langacker (1987) as well as myself (Croft 1991, 1993, 1994, 1998a, b, 2009, 2012). The causal approach is characterized by conceptualizing events as a causal chain linking participants in the event in terms of the transmission of force from one participant

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to another. In addition to providing a model of event lexicalization—predicates lexicalize segments of the causal chain—it also provides a model of argument realization, articulated in greatest detail in Croft (1991, 2012) and described briefly in § 5.2.

Causal structure does play a role in generative approaches to event lexicalization, namely in theories that exploit event decomposition. Early generative analyses decomposed events into subevents such as CAUSE, DO, BECOME, and (result) STATE. These approaches have been elaborated by many researchers, including Pinker (1989), Jackendoff (1990), Rappaport Hovav and Levin (1998), and Van Valin (Foley and Van Valin 1984; Van Valin and LaPolla 1997). These subevents are causal (CAUSE) as well as aspectual (BECOME), while subevents such as DO appear to be both causal and aspectual, involving both agency and process.

The theories cited in the preceding paragraph represent a particular type of event decomposition: one that includes causal, aspectual, and other subevents, and also nests the subevents in a representation such as [CAUSE [x, [BECOME [FLAT y]]], where the CAUSE subevent relates a causer argument to the caused subevent, or [[x ACT] CAUSE [BECOME [FLAT y]]], where the CAUSE predicate links two subevents. The causal theory found in cognitive semantic approaches also decomposes an event into subevents, but purely in terms of transmission of force, and linearly rather than in terms of a nested structure.

The theories proposed for event lexicalization and argument realization, and the evidence put forward to support those theories, suggest that both causal and aspectual structure of events play a role in their lexicalization as predicates and in the syntactic realization of their arguments. The real question, then, is what is the distinct contribution that each makes to lexical and grammatical realization of clauses? In this chapter, I will argue that the contributions of causal and aspectual structure can be most clearly identified by using a representation of event structure that includes both causal and aspectual structure but clearly distinguishes the two.

Section 5.2 reviews the evidence supporting the hypothesis that the causal (force dynamic) structure of events is the primary determinant of argument realization, given a particular lexicalization of an event. Section 5.3 presents a fine-grained analysis of aspectual structure (Croft 2009, 2012), and introduces the category of directed change, which is the aspectual category that appears to play the most important role in understanding event lexicalization. Section 5.4 introduces the combined causal–aspectual representation, and Sect. 5.5 proposes that directed change plays a central role in understanding constraints on event lexicalization.

5.2 Force Dynamics in Event Lexicalization and Argument Realization

Most, if not all, theories of argument realization have the following theoretical constructs (Croft 1998a, pp. 21–23; compare the organization of AR):

(a) Event structure: a representation of the semantic structure of events that is relevant to syntax. This is where event lexicalization enters into theories of argument realization (cf. AR, Chap. 4).
(b) Participant roles: a way of defining participant roles, usually based at least in principle on properties of event structure (cf. AR, Chap. 2).
(c) Ranking of participant roles: some way of ordering participant roles, such as a thematic role hierarchy or force-dynamic ordering, which is used in argument realization (cf. AR, Chap. 6).
(d) Role designation: some way to designate a special status for certain participant roles that generally links them to subject or object grammatical roles, to account for voice and argument structure alternations that cannot be accounted for by the ranking of participant roles in (c) (cf. AR, Chap. 3). Examples of role designation are macro-roles, proto-roles, underlying syntactic relations, and event profiling (see below).
(e) Mapping rules: rules that map the participant roles into grammatical roles such as subject and object, based on properties defined in (a)–(d) (cf. AR, Chap. 5).

AR provides a detailed critical survey of theories of argument realization; a critique of some of the more common theories is found in Croft (1998a). In this section, I review briefly the causal (force dynamic) theory of argument realization found in Croft (1991, 1998a, b, 2009, 2012), the evidence supporting it, and the shortcomings of its representation in my earlier publications (those before 2000).

The event structure that is proposed in the causal theory of argument realization is a linear causal chain defined by the transmission of force from one participant to another. For example, example (1) illustrates the casual chain structure of the event.

(1) *Sue broke the coconut for Greg with a hammer.*

The representation in (1) provides a semantic structure that achieves (a)–(d) in the argument realization model given above. First, the event structure itself is the causal or force-dynamic chain. Causation is defined in broad terms, to include a variety of causal relations. These involve not only physical causation but also an intentional being either initiating an action (volition or agency) or having one's mental state altered as a result of an action (what Talmy (1976) calls affective causation). They also involve not just "billiard-ball" causation but also "letting causation" (as in *I dropped the ball*) and maintaining a static situation (as in *I was holding the ball*), as described in Talmy's (1988/2000) force-dynamic model. (Noncausal relations will be discussed below.)

Participant roles can be defined in terms of the position of the participant in the causal chain. In fact, as many have noted, participant roles defined in absolute terms appear to play little role in argument realization. Instead, the ranking of participant roles is far more significant. In many theories, the ranking of participant roles is independent of event structure: properties of event structure are not used to define

the ranking, and participant roles from different kinds of events are lumped together in a single thematic role hierarchy. In the causal theory, the ranking is defined solely within an event, and is defined as the relative ordering of the participants in the event. In particular, subject is antecedent to the object in the causal chain.

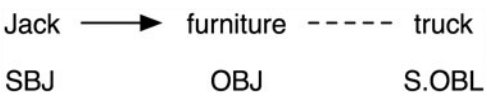
The relative position of participants in the causal chain accounts for the high degree of regularity in the mapping of the participants in transitive events to subject and object roles across languages. Where there is variation across languages (and within languages) in the choice of subject versus object, it can be attributed to indeterminacy in the ordering of participants in a causal chain. A clause construes an event as a single linear, asymmetric causal chain, but not all events are of this type. For example, in predicates involving mental states such as *see, know*, and *like*, there is substantial crosslinguistic variation in whether the experiencer or the stimulus is coded as subject or object (Croft 1993, 2012, pp. 233–236). This is illustrated by the well-known English argument realization patterns in (2)–(4):

(2) *I like Beethoven's Seventh Symphony*.
(3) *I am enjoying Beethoven's Seventh Symphony*.
(4) *Beethoven's Seventh Symphony pleases me*.

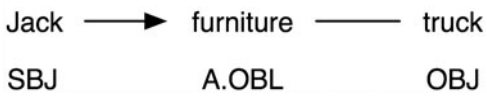
In mental events such as those expressed in (2)–(4), the force dynamics is bidirectional: the experiencer attends to the stimulus, and the stimulus causes a certain mental state in the experiencer. Hence, the variability. In fact, the variability is limited to examples like (2). Causative predicates that focus on the change of mental state always have the stimulus as subject, as in (4), because they describe the transmission of force from stimulus to experiencer. Activity verbs that describe how the experiencer is attending to the stimulus always have an experiencer subject as in (3), because they describe the transmission of force (in Talmy's broad sense of "force") from experiencer to stimulus. Sentence (2) denotes a state, and hence there is no transmission of force; it is these that are expressed variably across languages (for examples, see Croft 1993).

Role designation is not stipulated in the causal model, but is part of the semantic structure of the event. The solid arrows in example (1) represent the segment of the causal chain that is denoted, or profiled, by the predicate in the clause (in this case, *break*). I use the term "profile" here basically as it is used in cognitive grammar (Langacker 1987): it represents the concept denoted by a word against its semantic frame (Fillmore 1982, 1985), in this case the entire causal chain in example (1). Differences in verbal profile result in differences in argument realization. For example, in the classic locative alternation, different segments of the causal chain are profiled, as examples (5)–(6).

(5) *Jack loaded the furniture on the truck.*



(6) *Jack loaded the truck with the furniture*.



Examples (5)–(6) illustrate two further properties of the causal structure theory. The caused location event represented in examples (5)–(6) involves a noncausal relation: while the agent causes the change in spatial configuration, the spatial relation of figure (the furniture) to ground (the truck) is not causal. It turns out that, crosslinguistically, the figure is conceptualized or construed as antecedent to the ground in a "causal" chain; the noncausal relation is represented by a line without an arrowhead in examples (5)–(6). The theoretical notion of construal plays a major role in the analysis here. It is a central component of cognitive semantic theories (Croft and Cruse 2004, Chap. 3), but also occurs in generative and formal semantic theories, usually under the name of coercion (see Croft 2012, pp. 84–92, 358–393). I will use the term "construal" here.

The second property is the differentiation of oblique case marking (adposition or case affix) into two types, antecedent and subsequent. Antecedent obliques encode participants antecedent to the object in the causal chain; subsequent obliques encode participants subsequent to the object in the causal chain. Whether a participant is antecedent or subsequent depends of course on which participant in the causal chain is encoded as object, which in turn depends on which segments of the causal chain are profiled.

The division of obliques into antecedent and subsequent is a consequence of the causal theory (or predicted by it, if you prefer). It is supported by extensive crosslinguistic evidence, much of which is presented in Croft (1991, 2012). Case markings are often polysemous, used for multiple semantic roles; but they are generally polysemous only with antecedent roles (as in the case of English *with*) or only with subsequent roles (as with English *for*), as shown in a 40-language typological study (Croft 1991, p. 196). Croft (1991) gives numerous examples of argument structure alternations in a variety of languages in which antecedent and oblique case markings alternate as predicted. Croft (1998a, p. 40) presents developmental evidence that children learning English respect the antecedent/subsequent distinction in their argument realization patterns, even if they use the wrong preposition or an argument structure alternation that does not occur in the adult language.

The profiling of a segment of the causal chain introduces an important new element to the semantic representation of an event. What factors determine what segment of the causal chain is profiled? To some extent, a verbal profile, as reflected by the choice of subject and object, is simply a matter of lexicalization. However, the lexicalization patterns indicate some general principles that appear to govern the choice of the verbal profile. One important principle is that the prototypical simple verb profiles a highly individuated segment of the causal chain, that is, one that is the most "cut off" from the rest of the causal network. Thus, volitional agents are most likely to be subjects—initiators of the profiled segment—because they are construed as autonomous causes. Conversely, completely affected patients are most likely to be objects—end points of the profiled segment—because they are construed as not causing any further change

(see Croft 1994). This is just one general principle governing the choice of verbal profile; the rest of this chapter describes other principles governing the choice of verbal profile.

The examples given to illustrate how the causal theory of argument realization represents components (a)–(d) also illustrate (e), the mapping rules that govern the encoding of participants in syntactic roles. The mapping rules that accompany the causal event representation are small in number and simple in formulation (Croft 1998a, p. 24, 2012, p. 207):

1. Subject and object delimit the verbal profile.
2. Subject is antecedent to object in the causal chain (SBJ → OBJ).
3. Antecedent oblique is antecedent to the object in the causal chain; subsequent oblique is subsequent to the object in the causal chain (A.OBL → OBJ → S.OBL).
4. Incorporated arguments are between subject and object in the causal chain (SBJ → INCORP → OBJ).

The crosslinguistic evidence in support of the causal theory of argument linking has withstood the test of time, and causal theories are widely used in cognitive semantics. However, the representation that I presented in earlier publications, which attempted to combine causal structure with aspectual structure, is seriously inadequate (the changes introduced in Croft 1998a do not substantially improve it). Example (7) is the representation for the same sentence as in example (1) in the framework from Croft (1991).

(1) *Sue broke the coconut for Greg with a hammer.*

```
   CAUSE     CAUSE     CHG-ST       STATE      BENEF
 o -----> o -----> o ------> (o) ----- (o) -----> o
 **************break**********************+++for+++
Sue     hammer    coconut    (coconut)  (coconut)    Greg
Sbj      A.Obl                            Obj       S.Obl
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This representation suffers from several shortcomings. The arrow notation is applied to processes happening to a single participant (the coconut changing state) as well as to a causal chain (Sue acting on the hammer, the hammer acting on the coconut, etc.). This is in part due to the debt that the representation owes to the traditional event decomposition by McCawley, Gruber and Jackendoff and their successors, which mixes causal and aspectual structure in a single-event decomposition (see § 5.1). Second, the only aspectual distinction that is captured is state versus process—less than Vendler proposed, let alone the additional aspectual types introduced by Vendler's successors (see § 5.3). These shortcomings are the consequence of an unsuccessful integration of aspectual and causal structure in this representation.

The representation is problematic for the causal theory as well. There is reentrant (repeated) representation of participants, e.g., the coconut. The causal theory crucially depends on identifying the verbal profile, yet the representation is ambiguous as to the extent of the verbal profile, since the coconut is represented multiple times in the "causal" chain. Finally, the causal representation itself does not represent

events causing other events; it represents only participants acting on other participants. It could be argued that transmission of force is the only relevant model of causation for argument realization; nevertheless, the philosophical position is that causation relates one event to another, and some linguists using event decompositions (e.g., Rappaport Hovav and Levin) represent subevents causing other subevents, not participants acting on other participants.

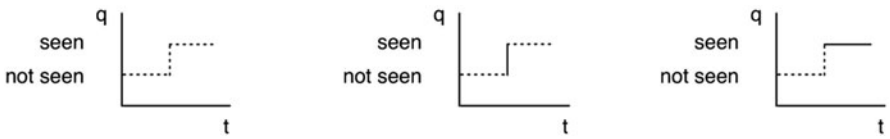
There is a solution to this representation problem: develop a more fine-grained model of aspectual structure (§ 5.3) and integrate it with a pure causal chain model (§ 5.4). The integrated model is used here to illustrate the role of an aspectual property, directed versus undirected change, in describing certain types of event structure constructions.

5.3 A Two-Dimensional Model of Aspect

The model of aspectual structure presented here is presented in greater detail in Croft (2012, Chaps. 2–4; see also Croft 2009). The aspectual structure of an event describes how the event unfolds over time. This definition implicitly requires two dimensions. The first, of course, is time. The second is what it means to say an event "unfolds." Unfolding characterizes the states and changes of state that take place over the time interval in which the event occurs. These are its phases.

A number of linguists have proposed phasal models of how an event unfolds, that is, a temporal decomposition of the event into discrete phases (see Croft 2009, pp. 149–151, 2012, pp. 45–52). The model presented here is also a phasal model, but unlike most previous proposals, it treats the qualitative states as points on a second dimension, and change as transitions from one state to another on that dimension. Example (8) illustrates the model for the perceptual event of seeing.

(8) *Aspectual contour:* *Achievement profile:* *State profile:*



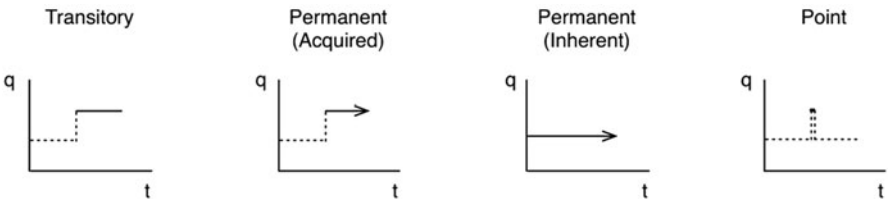
The *x* axis is the time dimension (*t*), and the *y* axis is the qualitative state dimension (*q*). The aspectual contour in example (8) is how the seeing event unfolds. Seeing has two defined states on *q*: not seeing something and seeing something. Seeing something is a transitory state, that is, one starts and stops seeing a particular object over one's lifetime. Seeing has at least three phases: not seeing something; the transition from not seeing something to seeing it, which is construed as an instantaneous jump from one state to the other and represented by a vertical line; and seeing that thing. The sequence of phases describes the aspectual contour of the event.

The English verb *see* in a particular usage profiles one phase of the event; a solid line indicates the profiled phase. Hence, the aspectual contour functions as the semantic frame for the profiled phase or phases of the event. The verb *see* may be construed as an achievement (the transition from not seeing something to seeing it) or as a state (the resulting state), as shown in example (8). Part of the challenge in analyzing aspect is the great flexibility of predicates in English to occur in different aspectual construals, without any morphological change in the verb form (Croft 2009, 2012). As will be seen in § 5.4, there are shifts in aspectual construal in argument structure alternations as well.

The two-dimensional *t/q* diagrams allow us to provide distinct representations of all of the aspectual types (or construals) that have been discussed in the aspectual literature, and to make sense of the bewildering variety of aspectual construals. These aspectual types go under different names as several of them have been discovered independently in different analytical traditions (generative, formal semantic, and cognitive semantic). Here I briefly describe the aspectual types and the *t/q* diagrams that represent them. There are ten aspectual types that are lexicalized by simple predicates, and their grouping under the four Vendler aspectual classes provides a framework for analyzing them.

There are three types of states, that is, events in which no change takes place, one of which has two subtypes, as illustrated in example (9):

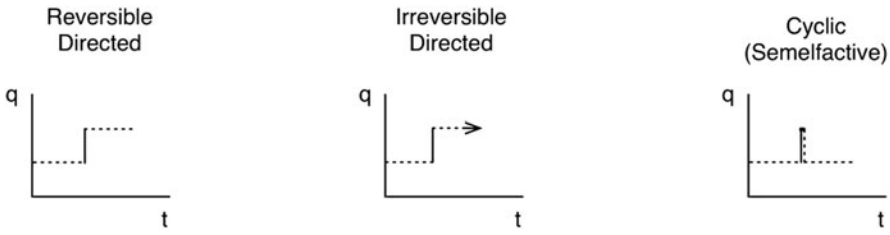
(9) *The door is open.* *The window is shattered.* *She is French.* *The sun is at its zenith.*



Transitory states are states that are not permanent; they correspond to (stative) stage-level predicates (Carlson 1979, pp. 56–57). Permanent states are represented by an arrow indicating that the state is permanent, i.e., continues for the lifetime of the entity (the time dimension is relative to the lifetime of the entity). Permanent states falls into two subtypes, acquired permanent states (a shattered window will never become whole, but it was whole before) and inherent permanent states (being French is an inherent property of a person, for that person's entire lifetime). Permanent states correspond to absolute states (Comrie 1976, p. 104) and object-level predicates (G. Carlson 1979, pp. 56–57). Finally, a little-known aspectual type are point states (Mittwoch 1988, p. 234), which describe a state that holds for only a point in time; hence, it entails that the point state no longer holds after that point in time, indicated on the *t/q* diagram by the unprofiled phases following the profiled point state.

Corresponding to these three types of states are three types of achievements, that is, instantaneous changes of state that profile the transition phase of the same aspectual contour. They are illustrated in example (10):

(10) *The door opened.* *The window shattered.* *The mouse squeaked.*



Reversible directed achievements result in transitory, hence reversible, result states; Talmy (1985/2000, p. 68) describes them as resettable verbs. Irreversible directed achievements result in permanent, hence irreversible, result states; Talmy (ibid.) describes them as nonresettable verbs. Cyclic achievements result in point states, which then revert to the rest state. These correspond to semelfactive (Smith 1997, pp. 29–30) or momentaneous (Carlson 1981, p. 39) predicates.

There are two types of activities, that is, durative but unbounded processes, illustrated in example (11):

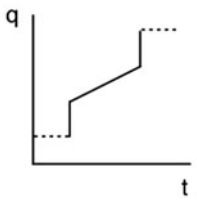
(11) *The soup cooled.* *The girls chanted.*

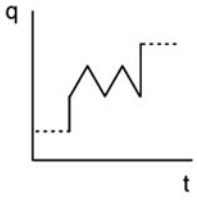
The first is a type of activity that involves an incremental change in a single direction on the *q* dimension. They are called directed activities here, following Hay et al. (1999, p. 132); they have also been called degree achievements (Dowty 1979, pp. 88–90), dynamic predicates (Carlson 1981, p. 39), and gradient verbs (Talmy 1985/2000, p. 68). The second is an undirected activity, the prototypical activity that Vendler seems to have had in mind. This type of activity essentially involves a process construed as repeated cyclic events of the same kind: talking is repeated sound emissions, dancing is repeated bodily motions, etc. For this reason, it is also described here as a cyclic activity, to emphasize its semantic relationship to cyclic achievements (semelfactives).

Finally, there are two types of performances or bounded processes, which correspond to the two kinds of activities, and are illustrated in example (12):

(12) *I ate an apple pancake.* *Harry repaired the computer.*

Incremental ccomplishments Nonincremental accomplishments





The first type is the prototypical Vendlerian accomplishment: an incremental change leading to a definite resulting state. An incremental accomplishment is temporally bounded, which is represented here, unsurprisingly, by profiling the inception and completion of the event. The resulting state is therefore entailed. (Actually, there are two subtypes of accomplishments, reversible and irreversible, depending on the nature of the result state; but this distinction plays no major role in what follows.)

The second type is called a nonincremental accomplishment (Croft 2012, pp. 62–63; it was called a run-up achievement in Croft 1998, p. 74). This aspectual type was recognized as an alternative construal of some directed achievements, such as *die* in *Help! He's dying!, reach the summit* in *They reached the summit in four hours*, and *fall asleep* as in *She is falling asleep* (Vendler 1967, p. 101, 104; Dowty 1991, p. 137). Rothstein (2004, pp. 98–99) identifies several predicates as having a default construal as what we call nonincremental accomplishments, including *repair X*. A nonincremental accomplishment describes an activity which will or may ultimately lead to a transition to a resulting state, but the activity cannot be described as incrementally accomplishing that resulting state. One can mow half the lawn (an incremental accomplishment), but if one is dying (nonincremental accomplishment), one is still alive until the point at which bodily functions ultimately fail.

It can be seen here that Vendler's examples of activity versus accomplishment conflate the directed/undirected distinction and the unbounded/bounded distinction: Vendler's activities are unbounded and undirected, while his accomplishments are bounded and directed. This may account for the fact that the two distinctions were not clearly separated at first (AR, 95).

The aspectual types illustrated in examples (9)–(12) represent all of the distinct aspectual types that I am aware of in the aspect literature. They also represent all the types with one phase profiled, and all of the bounded types (i.e., with inception and completion phases also profiled; in achievements, the inception and completion phases are one and the same). The only exception is a bounded state. A possible example of a bounded state might be the construal in *The movie starts in five minutes*: it could be argued that nothing is happening in the five-minute period, hence the container adverbial *in five minutes* is bounding a state between the present moment and the start of the movie (I am grateful to Paul Kay for this example). The two-dimensional model thus provides an account of why these are all the aspectual types

of simple predicates that have been identified (more complex aspectual contours and profiles can be obtained using complex predicates or certain adverbial expressions; see Croft 2012, pp. 101–110). It also provides a means to represent a variety of semantic relationships among aspectual types.

One of those relationships plays an important role in analyzing the phenomena that will be discussed in § 5.5. Directed achievements, directed activities, incremental accomplishments, and (arguably) nonincremental accomplishment form a coherent class, which will be called directed changes (Croft 2012, pp. 70–77; this category is essentially the same as Beavers' (2008, pp. 250–252) scalar changes; see also Wechsler 2005, pp. 262–268; Rappaport Hovav and Levin 2010, pp. 28–34). In all of these aspectual types, the end point of the profiled phase(s) is higher on the *q* dimension than the starting point of the profiled phase(s). For all of these types, except nonincremental accomplishment, every point in the profiled phase(s) is higher on the *q* dimension than every preceding point in the profiled phase(s).

Directed changes cut across the Vendler classification: they include only some achievements (not cyclic achievements) and some activities (not undirected/cyclic activities). Directed changes also cut across the commonly used semantic features that identify aspectual types: directed activities are incremental but unbounded, while directed achievements are bounded but not incremental. Yet there is further evidence that supports the concept of a directed change than just the semantic coherence of the category.

Directed changes include the aspectual type that contain incremental themes as defined by Dowty (1991). Dowty identified three types of incremental themes; Hay et al. (1999) add a fourth (see also references cited in Kennedy and McNally 2005, pp. 362–363). The types are illustrated in (13)–(16):

(13) Mereological incremental themes:
Bill mowed the lawn.

(14) Property incremental themes:
The balloon expanded.

(15) Holistic (path) incremental themes:
a. *They walked across the park*.
b. *He grew into an adult*.

(16) Representation-source themes:
Jane read/scanned War and Peace.

The classic type of incremental theme that Dowty presents can be characterized as mereological (Krifka 1989, Dowty 1991): the incremental progress of the action is manifested in the transformation of incremental parts of an argument (the incremental theme). Hay et al. (1999) identify another type of incremental theme, in which a gradual change in a property of the whole object defines the incremental progress of the action, as in expanding, cooling, etc. Dowty also identifies two other types of incremental themes in which the incremental progress of the action is indirectly associated with a particular argument of the predicate. With holistic themes, the incremental progress is change of location along a path (literal or metaphorical) which is not overtly expressed in the clause; the theme argument is the figure whose change

of location is being charted. With representation-source themes, the incremental progress is in the incrementation of the representation of the source (a mental or physical representation); the theme argument is the source whose representation is being created.

In all of these cases, there is a single argument that is associated with the incremental progress of the action, albeit indirectly so in the case of holistic and representation-source themes. Hay et al. analyze the incremental progress of the action as change on a scale that is (directly or indirectly) associated with the theme participant. But the four subtypes are not restricted to gradual directed changes. Directed achievement predicates describe the same four types of directed changes, but as instantaneous transitions rather than incremental progress. We can describe the relevant arguments of directed achievements as transition themes:

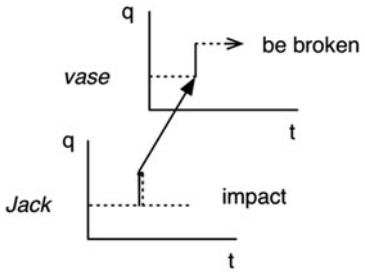
(17) Mereological transition themes:
Bill cut the rope.
(18) Property transition themes:
The light turned green.
(19) Transition holistic (path) themes:
a. *They reached the summit*.
b. *She became president of the company*.
(20) Transition representation-source themes:
I saw/photographed Mount Tamalpais.

The convergence in subtypes of themes for incremental themes—bounded (accomplishments) or unbounded (directed activities)—and directed achievements further supports the semantic relevance of the category of directed changes. Moreover, directed changes can be straightforwardly defined in the two-dimensional model as a monotonic function from t to q of the profiled phase(s) of the aspectual contour of the event. (This definition would have to be loosened to include nonincremental accomplishments, where only the initial and final profiled points represent a monotonic function; see § 5.5.) As we will see in § 5.5, after adding the causal dimension to the analysis in § 5.4, the category of directed change is useful for the analysis of constraints on event lexicalization.

5.4 The Three-Dimensional Model: Integrating Causal and Aspectual Structure

The solution I propose for integrating the fine-grained aspectual analysis in § 5.3 with the causal model for argument realization in § 5.2 is simply to add the causal chain as a third dimension to the two-dimensional aspectual representation (Croft 2009, pp. 161–164, 2012, Chaps. 5, 6), as in example (21).

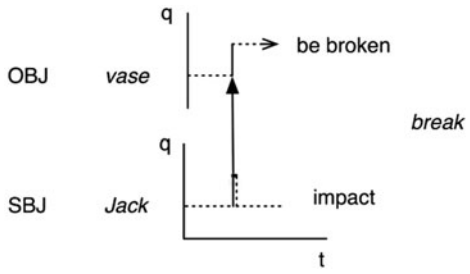
(21) *Jack broke the vase*.



The crucial feature of this representation is that each participant has its own subevent in the causal chain. The subevent is the aspectual profile/contour for that participant's activity in their role in the larger event. Informally, this can be thought of as what each individual participant does or undergoes during the course of the event. Each participant's subevent then stands in a causal relation to the subevent of the next participant in the causal chain (or a noncausal relation, e.g., a spatial relation as in the locative alternation).

Three-dimensional representations are of course difficult to apprehend on a two-dimensional page or screen. Hence, I have adopted the representation in example (22), which more or less collapses the causal and qualitative state dimensions onto the vertical dimension (Croft 2009, pp. 161–162, 2012, pp. 212–213).

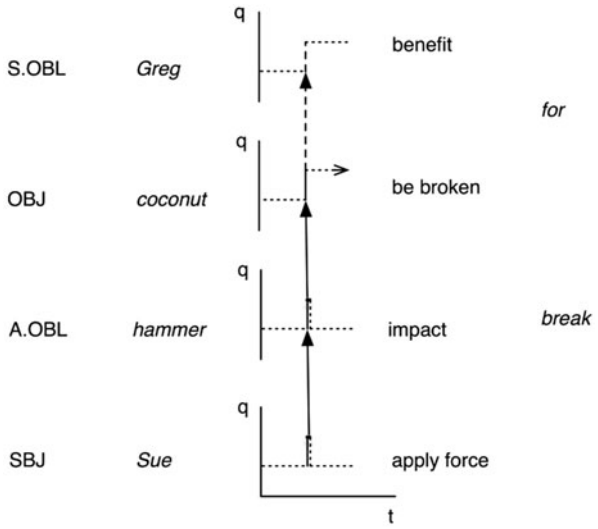
(22) *Jack broke the vase*.



The advantage of this way of reducing the three-dimensional representation onto two dimensions is that the temporal alignment of the subevents is clearly indicated. The qualitative state scales for each participant/subevent are kept separate, in order to remind the viewer that they actually belong on a third dimension.

Example (23) gives the new representation for the sentence in example (1) (Croft 2009, p. 163, 2012, p. 214)

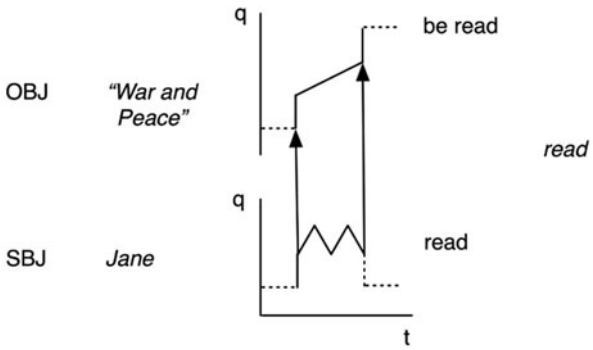
(23) *Sue broke the coconut for Greg with a hammer*.



Each participant has its own subevent: Sue applies force to the hammer, the hammer makes impact with the coconut, the coconut undergoes an irreversible change of state, and Greg comes to benefit from the outcome. All of the subevent profiles must be aligned temporally; the entire event is punctual. There is no longer any problem with defining the end point of the verbal profile: the coconut is involved in only one subevent.

Example (24) illustrates how a durative event is represented, namely *Jane read "War and Peace"*.

(24) *Jane read "War and Peace"*.



The transmission of force takes place for the profiled temporal phase of the event, but for convenience, it is only represented by the causal arrows at the beginning and the end of the profiled phase.

The event in example (24) contains two subevents: the one involving Jane is an undirected activity and the one involving *War and Peace* is an accomplishment. The overall event profiled by the verb is an accomplishment. In general, if the verb or predicate profile includes a directed change subevent, then the aspectual type of the predicate as a whole is a directed change of the relevant type (Croft 2012, pp. 286–288). There also appears to be another constraint on predicate profiles, at least for simple predicates: only one directed change subevent occurs in a predicate profile. This is the equivalent principle in the model presented here to Tenny's constraint on verbs (i.e., event lexicalizations): "there can be no more than one measuring out for any event described by a verb" (Tenny 1994, p. 11). (In fact, there is one significant exception to this generalization. If a recipient or beneficiary are involved in an event via a directed change, and if there is also a patient or theme undergoing a directed change in the same event, then there are two directed changes in overall event. Not coincidentally, the combination of patient/theme and beneficiary/recipient is the one most likely to be expressed with a double object construction such as the English ditransitive construction (Goldberg 1995), or an obligatory applicative construction, thereby realizing the beneficiary or recipient as a direct object and hence part of the verbal profile; see Croft 2012, pp. 286–288.)

The model presented here has several important advantages over the representation in Croft (1991) as well as the representations proposed by other authors (Croft 2012, pp. 216–217). First, it clearly distinguishes the aspectual and the causal structure of events. Besides the semantic cleanness of this feature, it also allows us to more clearly recognize the distinct contributions that aspectual structure and causal structure make to the grammar of predicates and arguments. Second, it allows us to employ the fine-grained aspectual analysis presented in § 5.3 along with the causal structure analysis presented in § 5.2. Third, it represents both types of causal structure, namely the transmission of force relation—participants acting on other participants—and the standard understanding of causation in terms of events causing other events. This is because of the principle that each participant has its own subevent in the causal structure of the overall event. As noted above, the causal subevents can be informally thought of as what each participant does or undergoes in the overall event. Finally, this model demonstrates that events can be decomposed in three distinct ways: temporally, in terms of temporal phases; qualitatively, in terms of the states defined on the q dimension for each participant's subevent; and causally, in terms of the segments of the causal chain.

The three-dimensional geometrical representation constitutes the semantic structure of the linguistic representation. Outside of that representation are the morphosyntactic structures that are linked to the semantic structure. I use a constructional model of syntax here (Fillmore et al. 1988; Goldberg 1995, 2006; Croft 2001; Croft and Cruse 2004). The leftmost column, with syntactic roles in all capitals, indicates the syntax of the argument structure construction, which is associated with the semantics of the causal chain. The next column to the left of the semantic structure, in italic typeface, indicates the syntax of the argument phrases that instantiate the argument roles of the argument structure construction. They are associated with the individual causal subevents, which describe what each participant does or undergoes in the

event. The column to the right of the semantic structure, also in italic typeface, indicates the syntax of the predicate and satellite phrases that instantiate the predicate and satellite (if any) roles in the argument structure construction. They are associated with the participant's subevents that they each profile, including the causal (or noncausal) relations between the subevents that they also profile (indicated by the vertical links in the semantic structure).

A crucial, but incompletely analyzed, element in the semantic structure is the subevents themselves. The diagrams in examples (23) and (24) give suggestive labels for each participant's subevent. Unlike the linguistic forms in italics, these are part of the semantic structure, and are given in roman typeface. In fact, they are only suggestive labels. A proper description would be based on defining all the well-defined states on the qualitative dimension for each participant's subevent. This would be of course an analysis of what has been called the semantic root of a predicate (AR, 71–72).

In the next section of this chapter, I use this representation to provide an analysis of several phenomena that have been associated with a proposed contrast between manner and result predicates. I argue that the crucial semantic distinction between the two types of event structures is the distinction between directed change and undirected change.

5.5 Directed Change in Event Lexicalization

Levin and Rappaport Hovav (1991) address the question of what argument structure alternations are allowed for individual predicates in English. They observe that some predicates allow for many argument structure alternations, using the example of *wipe*.

(25) Transitive: *Kay wiped the counter.*
[surface contact meaning]
(26) Resultative: *Kay wiped the counter clean.*
[result from surface contact]
(27) Removal: *Kay wiped the fingerprints from the counter.*
[remove by means of surface contact]
(28) Application: *Kay wiped the polish onto the table.*
[apply by means of surface contact]

In contrast, other predicates such as *break* and *open* appear to allow very few argument structure alternations (Rappaport Hovav and Levin 1998, pp. 100–103).

Levin and Rappaport Hovav describe verbs of the *wipe* type as manner verbs, and verbs of the *break* type as result verbs. They treat this as a major distinction in event lexicalization patterns, and trace the distinction back to Fillmore (1970). Talmy (1988/2000) makes essentially the same distinction between verb-framing (result) and satellite-framing (manner) realizations of events.

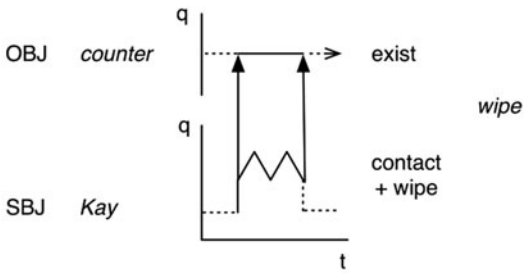
Rappaport Hovav and Levin (1998) propose an explanation in terms of the structural complexity of events (see also AR, 115–17). Manner verbs basically describe

simple events, consisting of one subevent in their representation. Further subevents can be combined with a simple manner subevent, leading to the argument structures found in (16)–(18). Result verbs, on the other hand, form complex subevents, including among other things the result state. For the most part, further subevents cannot be combined with a complex result event. As a consequence, result verbs do not allow for as many argument structure alternations.

Rappaport Hovav and Levin's (1998) explanation is based on a highly abstract property of event structure, namely its complexity in their event decomposition model, rather than on specific semantic properties of the event or any of its subevents. It is therefore highly sensitive to the way in which an event is decomposed in a semantic analysis. For example, in the model of event decomposition presented here, virtually every event is complex in at least one of the three dimensions (time, qualitative states, and causal chain). The only type of event that is simple (= consists of only one subevent on all dimensions) is a one-participant inherent permanent state. Thus, we must find a more specific semantic property of events that will distinguish manner and result verbs. That property appears to be directed change (Croft 2012, pp. 337–339).

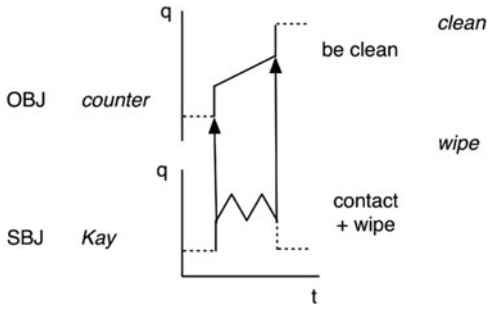
Manner verbs do not profile a directed change in their most "basic" or lowest valency construal. For example, the lowest valency construal for *wipe* is the transitive construction in example (25), repeated as example (29) (Croft 2012, p. 302):

(29) *Kay wiped the counter.*



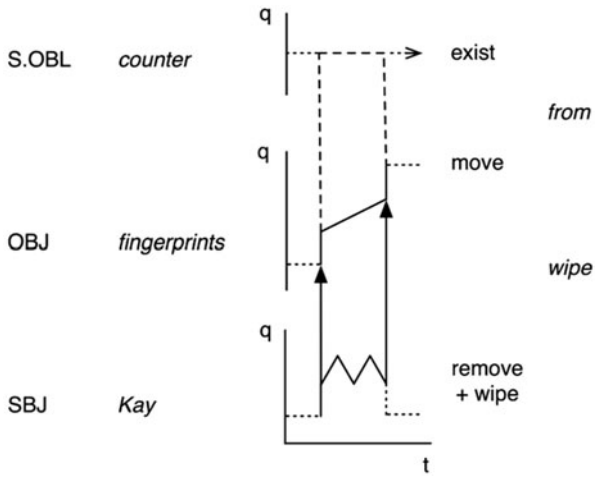
Higher valency constructions add a directed change to the verbal profile. Since there is no directed change in the lowest-valency profile, one can construe different types of directed changes for the manner event. A resultative construction for *wipe* as in (26), repeated as (30), construes the locus of surface contact as possessing a scalar property that is gradually brought about by the manner (Croft 2012, p. 338).

(30) *Kay wiped the counter clean.*



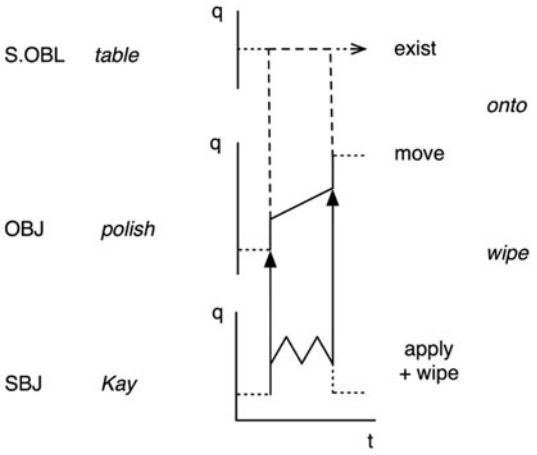
The removal construction in (27), repeated as example (31), construes the entity that is removed as a figure in a directed change of location.

(31) *Kay wiped the fingerprints from the counter.*



The application construction in (28), repeated as example (32), construes an applied entity as a figure in another kind of directed change of location (Croft 2012, pp. 338–339).

(32) *Kay wiped the polish onto the table.*



In contrast, a result verb profiles a directed change in its lowest valency form. Hence, it cannot occur in a construction that adds another directed change, because of the constraint allowing only one directed change subevent in a verbal profile.

The suggestive label for the undirected activity subevent in examples (29)–(32) is a combination that incorporates manner (wipe) and a second predicate that describes what is being done in that manner (contact, remove, apply). The manner semantic component is incorporated into a subevent which otherwise appears to describe a result of the manner activity: the wiping appears to cause contact, removal, or application in the examples. In a causal model, one might expect two separate subevents, which in this case would share the same participant.

However, this is not generally the case. For example, while the manner of motion causes the directed motion in (33), the manner of sound emission in (34) does not cause the directed motion, nor does the manner of sound emission in (35) cause the production of the linguistic utterance:

(33) *She swam to the other side.*
(34) *The car screeched around the corner.*
(35) *He growled his answer.*

Thus, it appears that "manner" here really is some sort of accompanying activity, and the verb in each of these argument structure constructions is being construed as (also) being a verb of contact, removal, or application (Croft 2012, pp. 301–302; see also Talmy 1985/2000, pp. 42–47). This characteristic of manner will be addressed again at the end of this section, when we discuss the contrast between manner and result verbs.

The directed change analysis of manner versus result verbs also appears to account for a broad difference between the possible types of resultatives in English and Japanese described by Washio (1997). Washio observes that the Japanese translation equivalents of the English resultatives in (36)–(37) are grammatical, but the Japanese equivalents of the English resultatives in (38)–(39) are ungrammatical:

(36) *I froze the ice cream solid.*
boku-wa aisu kuriimu katikati-ni koorase-ta.
(37) *He wiped the table clean.*
kare-wa teeburu-o kirei-ni hui-ta.
(38) *The horses dragged the logs smooth.*
**uma-ga maruta-o subesube-ni hikizut-ta.*
(39) *They ran the soles of their shoes threadbare.*
**karera-wa kutu-no soko-o boroboro-ni hasit-ta.*

Washio argues that the four examples represent four different semantic classes of predicates, and the semantic differences between them account for the differences in grammaticality between the English and Japanese resultative constructions. I propose a slightly different analysis (Croft 2012, pp. 339–341), which can be made more precise than Washio's thanks to the verbal semantic representation presented in this chapter.

Washio proposes that in the class represented by (36), *freeze X solid*, the verb specifies a change of state, hence the patient undergoes the change of state. The resulting state can therefore be expressed in the resultative construction in either English or Japanese. The alternative analysis here is that the verb in its lowest valency can only be construed as a directed activity. Putting a verb of this class into the resultative construction construes the directed change as an accomplishment; the resultative secondary predicate merely profiles the result state phase.

Washio proposes that in the class represented by (37), *wipe X clean*, the verb specifies that the patient is affected. A change of state is not necessary, but change is specified in a certain direction. The alternative analysis here is that the verb in its lowest valency can be construed as either a directed or an undirected activity. A sentence such as *Kay is wiping the table* can either describe an undirected wiping process or a gradual cleaning of the surface of the table that has not yet reached its end state. When such a verb is put into the resultative construction, it takes on the directed change construal and profiles an accomplishment, with the result phrase profiling the result state phase of the accomplishment.

The next two classes that Washio describes do not have equivalent resultative expressions in Japanese that are grammatical. Washio proposes that in the class represented by (38), *drag logs smooth*, the verb specifies that the patient is affected, but the change of state is not necessary, nor is it specified to occur in a certain direction. The alternative analysis here is that the verb in its lowest valency (*drag logs*) is construed only or chiefly as an undirected activity. There is no (easily) available construal as a directed activity. In English, it is possible to take such a verb and place it into a resultative construction. The outcome is a directed change, or more precisely the marginal member of that category, a nonincremental accomplishment. The reason that the Japanese counterpart is unacceptable is that Japanese does not allow such a radically different construal of the default aspectual type of the lowest valency version of the predicate, or that the Japanese resultative construction cannot denote a nonincremental accomplishment, or both.

Finally, Washio proposes that in the class represented by (39), *run soles threadbare*, the verb specifies neither a patient nor a change of state in any direction. The alternative analysis here is that the verb in its basic, lowest valency form is construed only or chiefly as an intransitive undirected activity. Placing such a verb in a resultative construction adds a participant as well as a resulting state. As with the class exemplified by (38), the event is construed as a nonincremental accomplishment. The reason that the Japanese translation equivalent is ungrammatical is basically the same.

In sum, the analysis presented here captures at least the spirit of Washio's explanation. But it dispenses with the need to make reference to a participant role such as patient, and it makes more precise the aspectual notion that Washio appeals to in the phrase "change of state in a certain direction."

The example of *run soles threadbare* illustrates what is sometimes called the "fake noun phrase (NP)" resultative in English. Rappaport Hovav and Levin (2001) present a semantic analysis of the contrast between a normal resultative on the one hand and a fake NP or fake reflexive resultative on the other. They give attested examples of the same verb occurring in both constructions; (40a–b) gives their examples for *wriggle*:

(40a) *One woman gets up to leave, but Red-Eyes grabs her roughly by the arm and pulls her into his lap.* ***She wriggles free****, but remains seated obediently beside him.* (The Ottawa Citizen, 30 Nov 1997, p. D10)

(40b) *Mr. Duggan became alarmed about being caught in the door of a lift which was about to begin its descent and* ***wriggled himself free****.* (The Irish Times, 2 Dec 1994, p. D11)

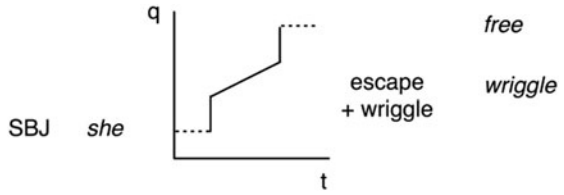
They argue that the semantic difference between the two is that in the normal resultative, the two subevents, wriggling and becoming free, unfold together, while in the reflexive resultative, the two subevents do not unfold together:

> A reflexive resultative is required whenever wiggling, wriggling, or kicking is used to bring about a state that is not incrementally brought about by moving in the designated manner since in such instances the events cannot unfold together. (Rappaport Hovav and Levin 2001, p. 778)

Rappaport Hovav and Levin describe unfolding together as temporal dependence (of one subevent on the other), and the lack thereof as temporal independence.

In the model presented in this chapter (see also Croft 2012, pp. 328–332), this is basically the same semantic contrast found between the English resultatives that have Japanese translation equivalents and those that do not. In temporal dependence, as in *She wriggles free* in (40a), repeated as example (41), the relevant participant is involved in only one subevent, which is a directed change.

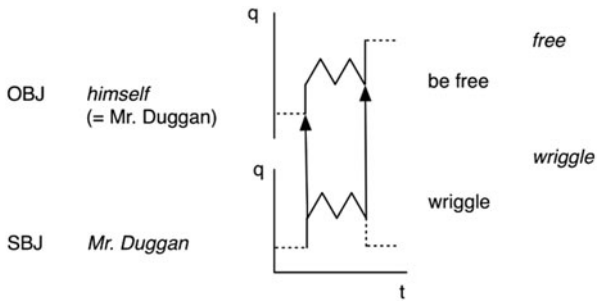
(41) *She wriggles free.*



In this analysis, like Rappaport Hovav and Levin's (Rappaport Hovav and Levin 2001, p. 780), there is just one (causal) subevent; the temporal dependence relationship follows by necessity.

The analysis of temporal independence, as in *Mr Duggan wriggled himself free* in (40b), repeated as example (42), is somewhat different from Rappaport Hovav and Levin's.

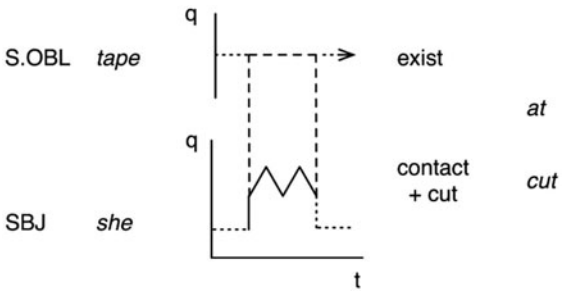
(42) *Mr Duggan wriggled himself free.*



There are two causal subevents in example (42), even though there is only one participant. This is of course manifested grammatically in the fake reflexive. In this respect, the analysis in (42) is the same as the analysis of temporally independent subevents by Rappaport Hovav and Levin (2001, p. 783). Temporal independence is possible when there are two subevents, but another crucial difference is that the aspectual type of the resultative subevent is different from that in example (41). In example (42), the aspectual type of the event is a nonincremental accomplishment, in which there is no directed change until the last instant of the event, when the result state is achieved. As a consequence, these events appear to be temporally independent because the achievement of the result state for the object (Mr. Duggan becoming free) does not occur until the end of the undirected wriggling activity; but that wriggling activity is also nonincremental progression towards the result state. The difference between the two types of English resultatives is basically the same as the difference in resultatives observed by Washio, and in this framework, the analysis is the same. This is not the only constraint governing the occurrence of reflexives. Boas (2003) points out a high degree of idiosyncrasy in resultative predicate choice; Wechsler (1988/2000) argues that the highly conventionalized and specialized reflexives are associated with directed change predicates.

A final manner–result question which the representation presented here may shed light on is the manner–result complementarity hypothesis. Levin and Rappaport Hovav propose that verbs lexicalize (contentful) manner or result, but not both (Levin and Rappaport Hovav 1991, pp. 144–145; Levin and Rappaport Hovav 2008; Rappaport Hovav and Levin 2010). Levin and Rappaport Hovav (2008) argue that some verbs which appear to lexicalize manner and result, such as *cut*, do not lexicalize manner and result simultaneously. Besides semantic intuition, the evidence they offer is that the manner *cut* and the result *cut* occur in different argument structure alternations. For example, manner *cut* occurs in the conative as in the attested example in (27) (from Levin and Rappaport Hovav 2008, ex. 15a, Rappaport Hovav and Levin 2010, p. 36; cf. the transitive *She was cutting the tape*).

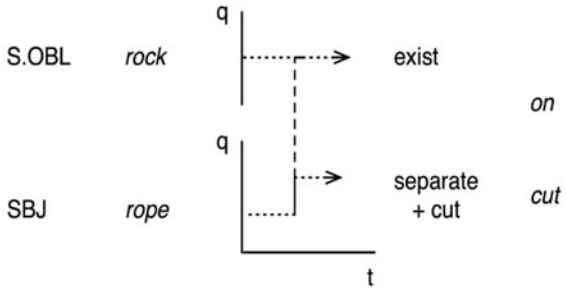
(43) *Finally, she got the blade pulled out and started* ***cutting at*** *the tape on Alex. . .*



This is the manner *cut*, according to Levin and Rappaport Hovav. As noted above, however, the cutting manner also incorporates the contact event that causally relates the woman and the tape.

On the other hand, result *cut* occurs in the lexical anticausative as in (44) (Levin and Rappaport Hovav 2008, ex. 19a; cf. *The rock cut the rope*):

(44) *. . . the rope* ***cut on*** *the rock releasing Rod on down the mountain.*



This is the result *cut*, according to Levin. If that is correct, then the label for the rope subevent would be only "separate," not "separate + cut." Does that subevent describe manner as well as result? It seems plausible. The fact of incorporation certainly makes it possible. Goldberg (2010, pp. 46–50) argues that certain motion verbs such

as *schuss* and *climb* simultaneously express manner and path/result, since certain types of manners of motion can only be performed in certain paths (e.g., downhill for *schuss*); she also mentions verbs of creation, idea formation, and cooking as verbs that denote both manner and result. Beavers and Koontz-Garboden (2012) argue that verbs of death such as *drown* or *asphyxiate* provide a clear case of result—the victim dies—and clearly different manners in which the result state comes about. So it appears that manner and result may not be complementary.

In fact, it is more complex than this. Manner and result may be combined in lexicalization in (at least) one other way. There are many examples in which a predicate profiles a complex event in which there is an undirected manner subevent and a directed result subevent, as in example (31) (*Kay wiped the fingerprints from the counter*). The overall verbal profile appears to combine manner and result in such events.

What is the difference between manner and result predicates? The analysis of event structure in this chapter suggests an answer. The definition of a result predicate is straightforward: a result predicate contains a directed change subevent in its profile. It is more difficult to define a manner predicate. A manner predicate could be defined as a verbal profile that is dynamic (not a state) but does not contain a directed change subevent in its profile. This definition would preserve complementarity (the definition of manner vs. result offered by Rappaport Hovav and Levin 2010, p. 33, is basically this definition). A manner predicate could also be defined as one that includes an undirected change in its profile—this would allow for complex events with both manner (undirected change) and result (directed change) subevents, as in examples (30)–(32) and (41). However, this definition still does not capture the incorporation of manner in a single subevent, as in example (44). Those subevents are directed changes. But manner is also incorporated in a single subevent with actions such as contact which are not directed changes and yet contrast in manner such as *tap the table, strike the gong, touch the painting*, etc. (see also example (29)). These examples indicate that manner may not be complementary to result (defined as directed change), but instead must be defined in terms of how specifically the qualitative states are characterized on the *q* dimension (so that they potentially contrast with other manner verbs of the same causal–aspectual type). A precise definition of manner will have to await a proper investigation of the qualitative state dimension of event structure.

5.6 Conclusion

The causal theory of event structure demonstrates that there is a simple conceptual basis for the choice of subject, object, and different types of oblique phrases to encode event participants. That work and a fine-grained aspectual analysis show that the aspectual structure of events and the causal structure of events are relevant to the grammar of verbs and clauses, but in different ways (see also the literature surveyed in AR, Chap. 4). This observation implies that the best representation of event structure should represent aspectual and causal structure independently, albeit

integrated into a single structure. The three-dimensional geometric representation of event structure presented here provides an efficient, easily visualized model of verbal semantics that can be used to analyze grammatical generalizations in semantic terms. In particular, I have argued that the category of directed change plays a major role in event lexicalization. The most pressing area for further research is in the qualitative dimension, which offers a means to analyze the seemingly unanalyzable verbal root.

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