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## Introduction

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### 1.1 The terrain

It routinely baffles me that so many people have found so many insightful things to say about events. Trying to conduct research on events seems misguided in the same way as trying to conduct research on things: the notion of ‘event’, like the notion of ‘thing’, is so basic that it is not obvious that we can study it in any meaningful way. I occasionally tell people that I have spent years trying to figure out how to count events, and haven’t really got anywhere. This tends to provoke a kind of pitying laughter. I add: ‘You try. It’s harder than it seems.’ The laughter stops.

Things are hard to count in the same way as events are: easy enough in some artificial examples, but as I write this in my living room, I cannot even decide how many things are on the sofa. There are four pieces of paper which jointly constitute a manuscript. One thing, or four? Certainly not five, but why not? This is precisely the same problem that we encounter with counting events: when a drummer counts ‘One, two, three, four’, did one event take place, or four? Certainly not five, but why not?

Luckily, the topic of this handbook is not how to count events. We can agree that there are events, and that there are things, and also that it is not easy to say how many. If it is hard to count events, or things, that may indicate that recognizing eventhood or thinghood is part of a process of perceptual organization in something like the sense of Gestalt psychology, and that the world does not come intrinsically organized into clear-cut events and things.

Something like this notion of ‘event’ is used in different ways in different research communities. To cognitive scientists, events are perceptual units; to artificial intelligence researchers, they are objects that can be reasoned with. Both of those perspectives are important in the study of event structure. But I think it is fair to say that event structure is first and foremost a linguistic concern, and this handbook is organized to reflect that claim. Many sentences describe events, in a sense which will be made precise shortly. But more interestingly, and less obviously, there are systematic relationships between

properties of events and aspects of sentence structure. Either events are grammatical objects, or they are intimately related to grammatical objects.

To put it another way, we *talk as if there are events*. The study of event structure in this sense constitutes part of the programme of **natural language metaphysics**, articulated by Emmon Bach (1986*b*: 573) as follows:

Metaphysics I take to be the study of how things are. It deals with questions like these:

What is there?

What kinds of things are there and how are they related?

Weighty questions, indeed, but no concern of mine as a linguist trying to understand natural language. Nevertheless, anyone who deals with the semantics of natural language is driven to ask question that mimic those just given:

What do people talk as if there is?

What kinds of things and relations among them does one need in order to exhibit the structure of meanings that natural languages seem to have?

Events as grammatical objects stand in close correspondence to events as perceptual objects (see Wolff 2003 *et seq.* for experimental evidence). This means that we can gain significant insight into the nature of events by focusing on the linguistics of event descriptions. That is what we will do, in this introduction and in the bulk of this handbook.

The claim that we talk as if there are events is canonically associated with Davidson (1967). Davidson claimed that events are formally similar to individuals, among other reasons because they can provide antecedents for personal pronouns. His 1967 paper begins as follows:

‘Strange goings on! Jones did it slowly, deliberately, in the bathroom, with a knife, at midnight. What he did was butter a piece of toast. We are too familiar with the language of action to notice at first an anomaly: the ‘it’ of ‘Jones did it slowly, deliberately,...’ seems to refer to some entity, presumably an action, that is then characterized in a number of ways.’

(Davidson 1967: 81)

Davidson (1967) develops a logical analysis of the notion that sentences describe events. Sentences describe events because they existentially quantify

over event variables.<sup>1</sup> Although it is not universally accepted, that analysis is now part of the landscape, taken for granted by many researchers rather than explicitly argued for.

In fact, though, it is only one of at least three core ideas which jointly delimit the linguistic landscape covered by the term ‘event structure’. The others, roughly contemporaneous with Davidson’s, are that events may be usefully classified according to their internal temporal structure (an idea primarily associated with Vendler 1957), and that verbs (the event descriptions *par excellence*) are internally syntactically and semantically complex, even if they look monomorphemic (**lexical decomposition**, initially explored by generative semanticists like Lakoff 1965 and McCawley 1968). In Section 1.2, we will discuss these three ideas individually, and their subsequent synthesis and expansion. This is intended as an overview of the development of the field, to ground the following chapters. The chapters themselves are then discussed in Section 1.3.

## 1.2 The three big ideas

### 1.2.1 Events are like individuals

Although Davidson begins his essay in the memorable way repeated above, the core of his argument lies elsewhere. His analysis is so persuasive, and has been so widely adopted, because it solves the problem of **variable polyadicity**, attributed by Davidson to Kenny (1963).<sup>2</sup> Consider again (1).

- (1) Jones buttered the toast in the bathroom, with a knife, at midnight.

On a classical approach, where verbs denote relations between individuals and other objects, it is tempting to take *butter* in (1) as denoting a 5-place predicate like (2a), where *a* is the butterer, *b* is the object buttered, *c* is a location, *d* is an instrument, and *e* is a time. The logical form of (1) would then be roughly like (2b).

<sup>1</sup> Although Davidson talks only of ‘an action’, his conclusion that there is reference to ‘some entity’ is now typically taken to apply more broadly—see Maienborn’s chapter in this volume for discussion.

<sup>2</sup> Davidson (1967) draws attention to, but only partially solves, a second problem, of identity among events under different descriptions. This problem was discussed further in Davidson (1969), and extensively in later work such as Pietroski (2000).

- (2) a.  $\lambda a \lambda b \lambda c \lambda d \lambda e. \text{butter}'(a, b, c, d, e)$   
 b.  $\text{butter}'(j, t, b, k, m)$

The problem is that *butter* doesn't just denote a 5-place predicate: it can also denote a 6-place predicate (on this line of analysis) in (3a), or an 8-place predicate in (3b).

- (3) a. Jones buttered the toast in the bathroom, with a knife, at midnight, by holding it between the toes of his left foot.  
 b. Jones buttered the toast slowly, deliberately, in the bathroom, with a knife, at midnight, by holding it between the toes of his left foot.

It is not clear whether there is an upper bound on the number of arguments that *butter* could take on such an analysis. If there were a principled limit on the number of arguments or modifiers of a verb, we could state that *butter* denotes an  $n$ -place predicate, for a fixed  $n$ , with existential closure over 'unused' argument slots.<sup>3</sup> For instance, if we knew that the only modifiers of a sentence described location, instrument, and time, then we could safely represent *butter* as a 5-place predicate like (2a). *Jones buttered the toast*, with no explicit indication of location, instrument, or time, could then be represented as in (4), with existential closure over unused 'argument' positions.

- (4) Jones buttered the toast:  $\exists c, d, e. \text{butter}'(j, t, c, d, e)$

But this will not work, precisely because we know that there are other parameters of the buttering event, such as manner, that can also be specified.

An alternative would be to claim that *butter* is lexically ambiguous, denoting a range of 2-, 3-, ...,  $n$ -place predicates, each admitting a different set of modifiers. However, this raises a problem concerning modification and entailment. Assume that *butter* denotes a 2-place predicate (call it  $\text{butter}'_2$ ) in (4); an 8-place predicate  $\text{butter}'_8$  in (3b), and so on. The problem here is these are logically unrelated predicates, however similar their names look. This analysis therefore does not capture the fact that, for any fixed set of arguments,

<sup>3</sup> This is not as theoretically outlandish as it may seem: it is predicted by the syntactic architecture of Cinque (1999), with a fixed, finite clausal functional sequence and an analysis of adjuncts as specifiers of functional heads. If there are  $n$  heads in the functional sequence, a verb could take maximally  $n + 1$  arguments ( $n$  specifiers, plus the complement of the lowest head). However, as  $n$  becomes very large, this prediction becomes impossible to test, given speakers' very limited patience for sentences containing 40 modifiers. We assume that there is no upper bound, although I am unaware of a watertight argument.

$butter'_8$  entails  $butter'_2$ : if Jones buttered the toast in the bathroom, with a knife, etc.; then Jones buttered the toast. The previous analysis could capture this, as (5a) entails (5b). But (6a) does not automatically entail (6b).

- (5) a.  $butter'(a, b, c, d, e)$   
 b.  $\exists x, y, z. butter'(a, b, x, y, z)$
- (6) a.  $butter'_5(a, b, c, d, e)$   
 b.  $butter'_2(a, b)$

A similar fate befalls an analysis of modifiers as higher-order predicates: if *in the bathroom* denotes a function from propositions to propositions (or from predicates to predicates), then we have no guarantee that the output proposition (7a) entails (7b).

- (7) a.  $in\_the\_bathroom'(butter'(a, b))$   
 b.  $butter'(a, b)$

Davidson’s analysis digs us out of this hole. The logical trick is simple once you have seen it: rather than admitting that an unbounded set of modifiers requires an unbounded set of argument positions in the verbal denotation, Davidson proposes a *finite* addition of a single argument position to the verbal denotation. This argument is typically existentially quantified, and modifiers appear as conjoined predicates of this extra argument, as in (8).

- (8)  $\exists e. butter'(a, b, e) \wedge in'(e, b) \wedge with'(e, k)$

As arbitrarily many predicates can take  $e$  as an argument, the problem of variable polyadicity is solved. Moreover, the entailment relations are as they should be: (8) entails (9) by virtue of conjunct elimination.

- (9)  $\exists e. butter'(a, b, e)$

Strictly speaking, Davidson’s logical argument does not show that verbs denote properties of events—the argument from anaphora reproduced in Section 1.1 is logically independent of the argument from variable polyadicity discussed here. However, the analysis of variable polyadicity does strongly suggest that verbs denote properties of *some* covert variable. Other analyses claiming that verbs denote properties of times (see Verkuyl’s chapter), or forces (Copley and Harley

2015), remain Davidsonian in this respect.<sup>4</sup> The discovery of that covert argument position is the first pillar on which event structure research rests.

### 1.2.2 *Aspectual classes*

Davidson called his paper ‘The logical form of *action* sentences’ (emphasis added), apparently because it was intended as a response to a prior literature on action and intention (in particular Ryle 1949 and Kenny 1963). Those works each contain fine taxonomies of predicates, particularly with respect to the beliefs, intentions, and feelings of the subject of those predicates. The categorization of predicates in this way is a venerable philosophical tradition, and Davidson was initially careful to circumscribe the scope of his claims. However, nowhere in Davidson (1967) is a restriction of event variables to action sentences argued for.

The fact that Davidson restricted his discussion to action sentences reflects an implicit awareness that different classes of predicate can have different logical forms, and that it is an empirical matter how far one can generalize any analysis. Moreover, the enumeration of these classes can be carried out strictly independently of the development of analyses based on the event argument.

Despite clear antecedents in the work of Aristotle, Ryle, and Kenny, the classification of predicates which has had most lasting impact was developed ten years prior to Davidson’s paper, by Vendler (1957). Vendler’s classification was based on two binary temporal distinctions: a distinction between ‘instants’ and ‘periods’, and a distinction between ‘definite’ and ‘indefinite’ temporal location (p.19—see also Mittwoch’s chapter). Each of these semantic distinctions can be diagnosed by a range of syntactic tests. For example, the progressive, as argued by Reichenbach (1947), requires noninstantaneous temporal reference, as the progressive of simple past and present verb forms locates the reference time properly within the runtime of the event, and this is impossible if the event is construed as an instant, rather than a time interval. The distribution of the

<sup>4</sup> Davidson himself discussed a broadly similar analysis by Reichenbach (1947, §48), concerning the relationship between sentences like *Amundsen flew to the North Pole in May 1926* and nominals like *Amundsen’s flight to the North Pole in May 1926*, or *Amundsen’s flight*. Reichenbach talks of ‘individuals . . . of the *thing type*’, and ‘individuals of another kind, which are of the *event type*’ (p.267), which clearly prefigures Davidson’s parallels between events and individuals, as well as later work by Link (e.g. 1983, 1987). However, Reichenbach’s logical forms for the different action nominals given above do not capture the entailment relations that Davidson was concerned with. This supports the reading that Davidson’s real innovation is not the metaphysical claims about events and individuals, but the compositional treatment of modification.

	<b>Telic</b>	<b>Atelic</b>
<b>Periods</b>	<b>Accomplishments</b> , e.g. <i>run a mile</i>	<b>Activities</b> , e.g. <i>push the cart</i>
<b>Instants</b>	<b>Achievements</b> , e.g. <i>spot the plane</i>	<b>States</b> , e.g. <i>know the answer</i>

TABLE 1.1 Aspectual classes in Vendler (1957).

progressive therefore reveals the distribution of noninstantaneous temporal reference.

- (10)
- a. I am running a mile (drawing a circle, building a house, ...)
  - b. I am running (writing, working, ...)
  - c. \*I am spotting the plane (appearing, blinking, ...)
  - d. \*I am knowing the answer (loving you, understanding French, ...)

Cross-cutting the progressive test, Vendler claims (see Verkuyl’s chapter for critical discussion) that PPs headed by *in* require a definite endpoint to an event, while *for* requires an indefinite endpoint. Such **frame adverbials** therefore diagnose the **telicity**, or inherent culmination, of an event.<sup>5</sup>

- (11)
- a. I ran a mile *in/#for* five minutes.
  - b. I ran *#in/for* five minutes.
  - c. I spotted the plane *in/#for* an instant.
  - d. I loved you *#in/for* a while.

This implies a  $2 \times 2$  classification of verbal predicates, as in Table 1.1.

Various alternatives to Vendler’s taxonomy exist. Firstly, many classes can be refined or subdivided: Kratzer (1995) and Maienborn (2007*b*) have each proposed, on quite different grounds, a bifurcation of the class of states into atemporal (‘Kimian’, in Maienborn’s terminology) and temporally bounded (‘Davidsonian’) subclasses. The evidence is Vendlerian in spirit: Kratzer notes, following remarks in Higginbotham (1983), that some predicates diagnosed as stative by the above tests nevertheless allow modifiers specifying spatial and/or temporal location (12), while Maienborn describes a class of predicates that

<sup>5</sup> Applying these diagnostics rarely leads to absolute infelicity, but rather triggers different **coerced** interpretations, of varying degrees of accessibility. This makes it necessary to apply these tests with some caution. See Moens and Steedman (1988), de Swart (1998), and the chapter by Mittwoch for further discussion.

describe states of affairs that resemble states in that they are temporally extended but not dynamic, but nevertheless allow progressive forms (13).

- (12) a. Consultants are available between 12 and 2pm.  
b. #Consultants are altruistic between 12 and 2pm.
- (13) John is lying in bed.

Similarly, there is a live debate about exactly how, or whether, to divide accomplishments from achievements. Smith (1991) introduced a further class of **semelfactives** such as *hiccup* or *blink*, defined as atelic achievements. However, this notion of an atelic achievement does not fit naturally into Vendler’s original classification: strictly speaking, for Vendler, an atelic achievement (a description of an atelic event not related to a period) should be a state. Nevertheless, the class of verbs that Smith aimed to describe is real enough: we can distinguish at least the following subtypes of ‘achievement’:

1. **Points** (see Moens and Steedman 1988): instantaneous and not easily iterated, e.g. *notice* (#*She was noticing the explosion* → she noticed the explosion several times → her noticing the explosion was imminent).
2. **Semelfactives**: instantaneous and easily iterated, e.g. *blink* (*She was blinking* → she blinked several times → her blinking was imminent).
3. **‘Other’ achievements**: instantaneous but with ‘prospective’ uses of the progressive (see Rothstein 2004), e.g. *die* (*She was dying* → she died several times → her death was imminent).

Such a fine-grained subdivision may seem a little profligate, but the question of which distinctions are linguistically significant cannot be decided *a priori*, and equally fine-grained divisions have been proposed elsewhere (for example, Dowty 1979 ultimately divided verbs into 11 classes, based on cross-classification of a slight refinement of Vendler’s taxonomy with notions such as agentivity). At the same time, an alternative approach to this issue (see Mourelatos 1978 and further discussion in Mittwoch’s chapter) collapses the accomplishment and achievement classes, leading to a three-way distinction between telic events, processes (activities), and states.

All of these options imply a second way of modifying Vendler’s approach: as originally presented, Vendler’s classification seems complete because every cell in the grid is filled and the criteria for assigning a verb phrase to a particular cell seem quite clear. As the divisions Vendler made are questioned, it is natural to wonder whether a binary, feature-based approach is the correct basis for the classification. Alternatives include the decision tree-like classification of Bach (1986a), according to which stative and eventive predicates are first separated,



then telic from atelic eventive predicates, and then further distinctions made among the telic predicates. Alternatively, Moens and Steedman (1988) view their aspectual classes (four classes of event, plus several types of state) as nodes in a transition network, with various interpretive effects often called ‘coercion’ (iteration, atelicization, resultativity, and so on) arising as a consequence of transitions between these nodes. Either of these approaches has the welcome effect of freeing us from the expectation that there should be  $2^n$  aspectual classes, for some  $n$ .

However, at the same time, all of these approaches remain distinctively Vendlerian: they rely on concrete grammatical phenomena to classify verbal predicates according to their temporal properties. This is the second pillar of event structure research.

### 1.2.3 Lexical decomposition

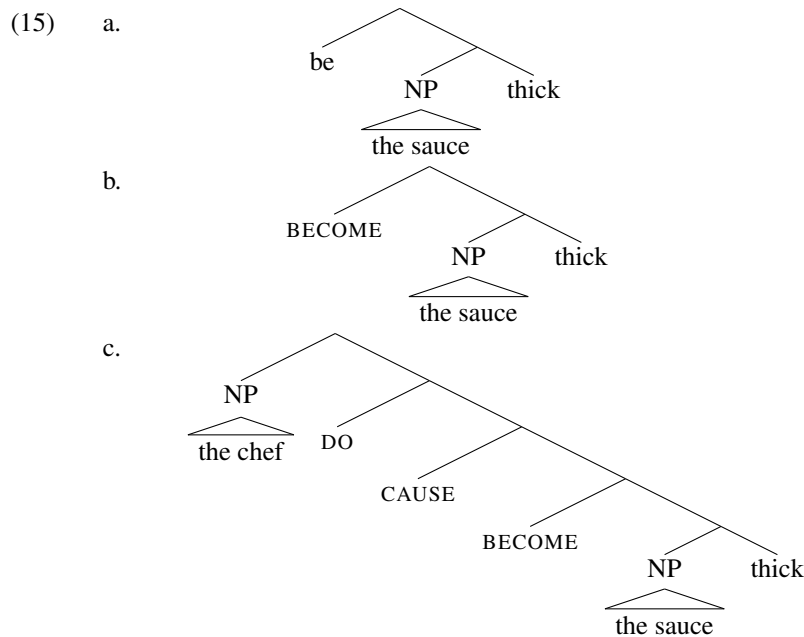
The division of predicates into aspectual classes is conceptually close to an originally distinct line of research originating with Lakoff (1965) and McCawley (1968). Together with other generative semanticists, Lakoff and McCawley had a wider project, namely the demonstration that Deep Structure as characterized in Chomsky (1965) was empirically untenable, and specifically that lexical insertion and semantic interpretation could not precede all transformations. Their evidence concerned triples like (14).

- (14) a. The sauce is thick.  
 b. The sauce thickened.  
 c. The chef thickened the sauce.

These examples suggest parallel increases in complexity in three domains: *thicken* in (14b–c) is morphologically more complex than *thick* in (14a); (14c) has a more complex argument structure than (14a–b); and there is an incremental increase in the semantic complexity of the predicate: (14a) describes a state; (14b) (leaving aside for now worries about the gradable nature of the predicate *thick*—see Dowty 1979, Hay *et al.* 1999, and Baglini and Kennedy’s chapter) describes the inchoation of that state (if the sauce thickened, then it became the case that the sauce is thick); and (14c) describes a causal relation between the actions of the chef and the sauce’s becoming thick. The core idea of the Generative Semantics approach to such triples is to take these three types of complexity to reflect aspects of a single syntactic structure.

Without going into the (now untenable) specifics of the early Generative Semantics analyses, the core of the analysis is three recurring predicates,

normally called CAUSE, BECOME, and DO.<sup>6</sup> BECOME embeds stative predicates, producing inchoative predicates; CAUSE embeds inchoative predicates and introduces an external argument; while DO distinguishes actions from other events. Underlying structures for (14) would then be approximately as in (15); as heads like CAUSE and BECOME could be expected to introduce their own morphological, argument-structural, and semantic material, the parallel increase in complexity across the three domains is predicted.



This approach implies that aspects of verb meaning are determined by rule-governed compositional processes outside the lexicon. The properties of transitive *thicken* do not just represent the properties of the root *thick*, but also the properties of CAUSE, BECOME, and DO: the verb meaning is **decomposed**. The fact that these operators recur across whole classes of verbs allows the possibility of capturing regularities across verb meanings, and of constructing an ‘aspectual calculus’, to use Dowty’s (1979) term.

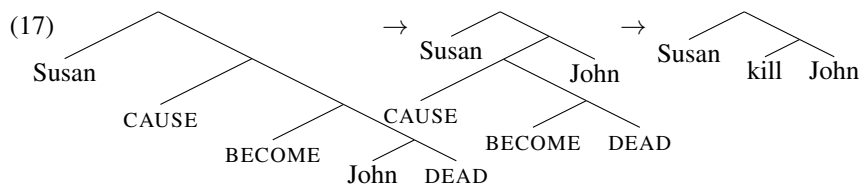
<sup>6</sup> On DO, less widely discussed than CAUSE and BECOME, see Ross (1972), Verkuyl (1972), and Dowty (1979). The difficulties that Dowty described in constructing a precise model-theoretic analysis of DO may have contributed to its relatively marginal role in subsequent discussion.

This leading idea remains one of the most influential in the literature on event structure: after largely disappearing from view in the late 1970s and early 1980s, the core insight was resurrected in work by Hale and Keyser (1993) on verbal morphology and argument structure. Hale and Keyser developed an articulated syntactic structure, which they call L-syntax (subsequent variants are sometimes called **first phase syntax**, following Ramchand 2008*b*), to explain argument structure alternations such as those in (14). It is now common to use these L-syntactic structures in the analysis of event-structural phenomena (see, for example, Travis 2000*a*, Borer 2005*b*, Ramchand 2008*b*), in part because phenomena including binding patterns, case assignment, idiom chunks, and others apparently unrelated to event structure (Larson 1988*b*, Chomsky 1995, Kratzer 1996, Marantz 1997), all point towards similar syntactic structures. However, some amount of controversy persists about the scope of these ideas (see Siloni’s chapter). The doubts fall broadly into two classes: cases where increases in morphological, argument-structural, and event-structural complexity do not map neatly onto each other, and restrictions on the productive use of CAUSE and BECOME.

The morphological relationship between the simpler and more complex forms is not always as straightforward as (14) would suggest. (16) shows a similar set of semantic relations to (14), but with suppletive morphological forms.

- (16) a. John is dead.  
 b. John died  
 c. Susan killed John.

The generative semanticists (see particularly McCawley 1968) were not only aware of this, but built their theory largely upon such triples, suggesting that such suppletive morphological forms indicated that lexical insertion followed the transformational derivation of a complex predicate, roughly as in (17).



Indeed, an assumption that such relations among syntactic structures could correspond to suppletive morphological relations broadened the scope of potential decompositional analyses: could *give* be treated as CAUSE + HAVE, for instance, or *have* as BE + a possessive element? The search for a set of semantic

primitives, in the sense of Wierzbicka (1972), inflected generative grammar (see Steedman’s chapter for review).

Even given the assumed opacity of the morphology–semantics mapping revealed by pairs like *kill* and *die*, it is clearly surprising on this decompositional approach that many languages morphologically mark the inchoative variant of a causative–inchoative pair, typically with a simple reflexive form such as French *se* or German *sich* (Haspelmath 1993, Reinhart 2002, Chierchia 2004).

- (18) a. *La fenêtre s’est cassée*  
 The window SE.is broken  
 ‘The window broke’  
 b. *Jean a cassé la fenêtre*  
 John has broken the window  
 ‘John broke the window’

Here, increased morphological complexity is dissociable from increased event- and argument-structural complexity: *se* appears to mark the presence of a valency-reducing operator, but such elements are not straightforward to integrate into a syntactic structure: how is it *se*’s business to remove another head’s arguments?

Similar worries arise with the productivity of CAUSE and BECOME. Lakoff was already aware of the limited applicability of these operators, and designed a system of ‘exception features’ to show where they could and couldn’t be applied. For example, *hard* is ambiguous: it can describe a physical state or a level of difficulty. Only the former participates in the causative–inchoative alternation.

- (19) a. The metal is hard.  
 b. The metal hardened.  
 c. The wizard hardened the metal.  
 (20) a. The problem is hard.  
 b. #The problem hardened [= the problem became harder]  
 c. #John hardened the problem [= John made the problem harder]

Moreover, related to the challenge illustrated in (18), Parsons (1990) claimed that if one member of the triple is missing, it is often the inchoative. Some examples (from Parsons 1990: 105) are in (21)–(22)

- (21) a. The burglar was alert.  
 b. #The burglar alerted.  
 c. The alarm alerted the burglar.

- (22) a. The order is random.  
 b. #The order randomized.  
 c. The script randomized the order.

We therefore have a dilemma of a slightly different form to that raised by taxonomies of aspectual classes: the idea here is clearly attractive and rich in explanatory potential, but we run into the issue **nonproductive schemas** (Jackendoff 1975): relations which are apparently rule-governed, but limited in scope of application, and riddled with exceptions.

Nevertheless, two interrelated core ideas of lexical decomposition (that verbs can have internal semantic structure, and that aspects of verb meaning are determined compositionally) are now almost universally accepted, as a third pillar of event structure research. None of the challenges discussed above touch that finding. Instead, the major matter open for debate is the extent to which that internal structure is reflected in phrase structure, and the extent to which it is encapsulated within a semantic representation (at the opposite extreme to Generative Semantics, see Jackendoff 1976, 1990 for decompositional approaches to verb meaning where the internal semantic structure of verbs is largely invisible to morphosyntax).

#### 1.2.4 Subsequent developments

It is a slight exaggeration to say that the current field of research into event structure has developed from synthesis and development of these three leading ideas, but the three ideas have coalesced in the last couple of decades, and to the extent that there is a mature, cohesive body of event-structural research today, that research would be unrecognizable without the synthesis of these three ideas. This section will not attempt a comprehensive account of subsequent developments, but will outline the path that brought us from there to here.

**1.2.4.1 Verkuyl (1972) and Dowty (1979): Decomposition and lexical aspect** Written during the heyday of Generative Semantics research, Verkuyl (1972) made a series of seminal arguments that aspectual class was partly compositionally determined. Vendler’s (1957) paper had been called ‘*Verbs and times*’ (emphasis added);<sup>7</sup> one of Verkuyl’s contributions was to show that aspectual class had to be determined at least at the level of the verb *phrase*, and

<sup>7</sup> Although Verkuyl mentions Vendler briefly, he is primarily concerned with the analysis of related distinctions made in traditional Slavic grammars.

that in some cases the subject also contributes to the determination of aspectual class.

Verkuyl’s focus is on the activity/accomplishment distinction, and particularly triples like (23).<sup>8</sup>

- (23)
- a. *Ze dronken urenlang whisky.*  
They drank hours.long whisky  
‘They were drinking whisky for hours.’
  - b. \**Ze dronken urenlang een liter whisky.*  
They drank hours.long one litre whisky  
‘They were drinking a litre of whisky for hours.’
  - c. *Ze zagen urenlang een liter whisky.*  
They saw hours.long one litre whisky  
‘They saw a litre of whisky for hours.’
- (Verkuyl 1972: 21, 23)

A verb like *drinken* behaves like an activity, allowing durative adverbs like *urenlang*, when it does not take an object NP that denotes a **specified quantity** (Verkuyl’s phrase) of liquid. Otherwise, it behaves like an accomplishment. *Een liter whisky* denotes a specified quantity of whisky, leading to the accomplishment reading in (23b), while *whisky* denotes an unspecified quantity of whisky, yielding an activity in (23a). So denotational properties of the object NP partly determine aspectual class.

Other verbs do not work like this. Regardless of whether the object of *zien* denotes a specified or unspecified quantity, the result is an activity predicate. (23c) contrasts with (23b) in this respect. As the two sentences differ only in the choice of verb, we can conclude that the verb as well as the object NP contributes to the determination of aspectual class.<sup>9</sup>

Verkuyl calls the property that distinguishes *drinken* and *zien* ADD-TO, a property which he characterizes as follows: ‘If we say at some moment  $t_m$ , where  $t_i < t_m < t_j$ , that Katinka is constructing something, we could equally well say that she is adding something to what has been constructed during the interval  $(t_i, t_{m-1})$ ’ (Verkuyl 1972: 95). Verkuyl’s generalization then is that accomplishments arise from the combination of an ADD-TO verb with arguments denoting specified quantities.

<sup>8</sup> The asterisk on (23b) would today probably be considered not as a matter of ungrammaticality, but rather as a matter of a non-default interpretation, requiring coercion to a habitual or conative reading, for instance.

<sup>9</sup> Verkuyl goes through a similar demonstration that the subject affects aspectual class. We omit that here because of the complex quantificational issues that it raises. See Lohndal’s chapter for relevant discussion.

This represents the earliest demonstration, to my knowledge, that aspectual class is a matter of compositional, rather than just lexical, semantics. At the same time, though, it is incomplete in many respects. For one thing, it largely concentrates on activities and accomplishments, where aspectual composition is most clearly visible. More importantly, there is no model-theoretic treatment of SPECIFIED QUANTITY and ADD-TO. This is an important gap, because it is clear from Verkuyl’s prose that there is a semantic rationale for the compositional interactions, but at the level of the formal syntax that Verkuyl develops, that rationale is not reflected. The relevant features are just features, and the syntax doesn’t explain why this precise combination of features should yield an accomplishment reading.

This is not accidental. The Generative Semantics research of the late 60s and early 70s was developing largely in isolation from the model-theoretic compositional semantics being developed by Montague (especially 1973), and a framework with the formal precision of Montague’s is required to ground Verkuyl’s intuitive explanation of why these particular properties of noun phrases and verbs have these specific effects on aspectual class.

Dowty (1979) addressed both of these issues with Verkuyl (1972). Dowty developed an ‘aspectual calculus’ based on the CAUSE, BECOME, and DO operators discussed in the previous section, used this to expand Verkuyl’s work on the accomplishment–activity distinction into a complete decompositional analysis of the aspectual classes, and grounded all of this in a rigorously model-theoretic Montague Grammar fragment.<sup>10</sup>

In this fragment, telicity, as diagnosed by the *in/for*-tests, originates in BECOME, the progressive is related to DO, construed as a kind of dynamicity marker (Ross 1972); and accomplishments result from a CAUSE-relation between a DO-proposition and a BECOME-proposition. Representative structures for Vendler’s four classes are as follows.

- (24) a. **State:**  $\phi$   
 b. **Achievement:**  $\text{BECOME}(\phi)$   
 c. **Activity** (agentive):  $\text{DO}(x, \phi)$   
 d. **Accomplishment** (agentive):  $\text{CAUSE}(\text{DO}(x, \phi), \text{BECOME}(\psi))$

Of the three operators, the definition of BECOME is purely temporal:  $\text{BECOME}(\phi)$  holds at an interval  $i$  if  $i$  is a minimal interval such that  $\neg\phi$  holds at the start of  $i$  and  $\phi$  holds at the end of  $i$ . DO defied satisfactory model-theoretic

<sup>10</sup> Verkuyl subsequently developed his own model-theoretic treatments of many of the same issues, summarized in Verkuyl (1993) and later work, including his chapter in this volume.

analysis, in Dowty’s opinion, reducing to a notion of ‘control’ over an event which could not be reduced further. CAUSE was given a counterfactual treatment, following Lewis (1977):  $\phi$  causes  $\psi$  iff both propositions obtain, but  $\psi$  would not have obtained if  $\neg\phi$ , plus certain auxiliary assumptions. The result is a fairly complete model-theoretic syntactic and semantic implementation of both the lexical decomposition programme and Vendler’s aspectual classes, a huge unifying step forward.

Dowty’s work is explicitly presented as a synthesis: the title alone references ‘Montague Grammar,’ ‘Verbs and times’ (i.e., Vendler 1957), and ‘Generative Semantics’. However, so many new research questions emerged from this synthesis that Dowty (1979) is probably the indispensable reference for research on event structure. I won’t even try to list all of Dowty’s innovations here, but instead briefly summarize two, discussed at several junctures in this handbook. The remainder of this section discusses Dowty’s analysis of the progressive and related phenomena often discussed under the heading of the **imperfective paradox** (see chapters by Copley, Mittwoch, Travis, and Truswell), while the next section explores consequences of Dowty’s identification of a class of **degree achievements** (see particularly Baglini and Kennedy’s chapter).

The imperfective paradox concerns entailment relations between progressive sentences and their simple past counterparts. (25a), with an activity predicate, entails (25b), but (26a), with an accomplishment predicate, does not entail (26b), because the drawing of the circle may have been interrupted.

- (25) a. John was pushing a cart.  
       b. John pushed a cart.
- (26) a. John was drawing a circle.  
       b. John drew a circle. (Dowty 1979: 133)

The challenge implied by (26) is sharpened because of the use of CAUSE for the representation of accomplishments in Dowty’s aspectual calculus. Tenseless *John draw a circle*, for Dowty, means approximately that some drawing action of John’s causes it to become the case that a representation of a circle exists. Whatever the progressive does, it has to interfere with the existential statement contained in that decomposition.

Dowty takes this as evidence that the progressive is a modal operator. A sentence like (26a) asserts that John drew a circle in each member of a set of **inertia worlds**, ‘in which the “natural course of events” takes place’ (p.148). The actual



world may or may not be in the set of inertia worlds pertaining to the drawing of the circle, so (26a) does not entail (26b).<sup>11</sup>

The imperfective paradox is now recognized as an example of the wider class of **non-culminating accomplishments**, where result states associated with accomplishment predicates do not obtain. As documented most fully in Travis’ chapter, the morphological marking of culmination and non-culmination can differ from language to language, and while for Dowty it was non-culmination which required additional explanation, a recent class of theories (particularly Copley and Harley 2015) predict non-culminating readings by default, with a culmination entailment requiring additional machinery.

1.2.4.2 **Degrees, scales, and aspectual composition** Dowty observed that **degree achievements** like (27) are compatible with both *in-* and *for-*PPs, suggesting a dual life as accomplishments and activities.<sup>12</sup>

- (27) a. The soup cooled *for/in* ten minutes.  
 b. The chef cooled the soup *for/in* ten minutes.

Dowty claims that this reflects the nature of the predicate *cool*. Although this is not precisely how Dowty expresses it, a common approach to this duality is to claim that *cool* in (27) means roughly ‘become cooler’ when used as an activity, and ‘become cool’ (where the limits of the extension of adjectival *cool* are vague) when used as an accomplishment.

Hay *et al.* (1999) refine this leading idea, and demonstrate that there is an intimate connection between scalar structure as seen in the denotations of adjectives like *cool(er)* and the temporal properties of deadjectival verbs. For instance, *long* relates to an open scale of length (there is no maximal or minimal degree of length), while *straight* relates to a closed scale of straightness (there is a maximal degree of straightness). This difference plays out in the aspectual behaviour of *lengthen* and *straighten*: *lengthen* is typically atelic, while *straighten* is typically telic. Although the *in/for*-test does not show this very clearly, there is a clear difference with respect to the imperfective paradox: (28a)

<sup>11</sup> The explanation for the entailment in (25) is more straightforward. Following Reichenbach, (25a) entails that John is in the middle of a period of cart-pushing. That means that some cart-pushing by John has already taken place, and that period of cart-pushing can be described by (25b). So (25a) entails (25b).

<sup>12</sup> Hay *et al.* (1999) and Mittwoch’s chapter note that the ‘achievement’ part of ‘degree achievement’ is clearly a misnomer, maintained for historical reasons.

entails (28b), as with the activity predicates discussed in Section 1.2.4.1, while (29a) does not entail (29b), as is typical of accomplishment predicates.<sup>13</sup>

- (28) a. Kim is lengthening the rope.  
 b. Kim has lengthened the rope.
- (29) a. Kim is straightening the rope.  
 b. Kim has straightened the rope. (Hay *et al.* 1999: 127)

This interaction between scalar predicates and aspectual class informs a broader debate over the nature of telicity. Dowty’s aspectual calculus located telicity in BECOME, the common component of accomplishments and achievements. However, this always sat somewhat uneasily with the kind of interaction documented by Verkuyl for his class of ADD-TO verbs, where telicity resulted from an interaction between verb meaning and NP meaning. Verkuyl’s analysis was developed further by Krifka (1989), Tenny (1987), Dowty (1991), Pustejovsky (1991), and Jackendoff (1996). In particular, Krifka defined the properties **mapping to object** and **mapping to event**, which describe homomorphisms between mereological relations among events and among objects. This provides a logical vocabulary for describing cases in which boundedness (**quantization** in Krifka’s terms) or unboundedness (**cumulativity**) of an object determines boundedness or unboundedness of an event. In the simplest cases, if a cheesecake is divided into eight slices, at the point at which John has made his way through one slice, he is  $\frac{1}{8}$  of his way through the cheesecake, and also  $\frac{1}{8}$  of his way through the event of eating the cheesecake.

The atelic VPs in (30a) contrast with the telic VPs in (30), just as the bounded objects contrast with the unbounded objects. Cheesecake, unlike a cheesecake, is cumulative. That is, the equation in (31a) holds, but the equation in (31b) does not, and the same goes for (32).

- (30) a. John wrote poems/ran marathons/ate cheesecake for/#in three days.  
 b. John wrote a poem/ran a marathon/ate a cheesecake in/#for three days.
- (31) a. cheesecake + cheesecake = cheesecake.  
 b. a cheesecake + a cheesecake  $\neq$  a cheesecake.

<sup>13</sup> Hay *et al.* also discuss the significant effect of context in determining aspectual class. *The soup cooled in ten minutes* is readily interpretable because of a conventional standard for the temperature of cool soup, but *#The lake cooled in ten minutes* is harder to make sense of, because of the absence of such a conventional standard.

- (32) a. eating cheesecake + eating cheesecake = eating cheesecake.  
 b. eating a cheesecake + eating a cheesecake  $\neq$  eating a cheesecake.

For a large class of predicates, the Verkuyl/Krifka approach derives telicity from a conception of a verb as a predicate of scalar change, together with properties of the relevant scale determined by the verb’s internal argument. This is a more subtle conception of change of state than Dowty’s BECOME, which can be construed as a special case, namely change on a 2-point scale ( $P(x) = 0$  or  $P(x) = 1$ ).

Hay *et al.*’s analysis of degree achievements shows that Krifka’s mapping to objects is itself a special case. The scale in scalar change can come from an NP object, but it does not need to. In other words, ‘mapping to objects’ in a case like eating a cheesecake is actually mapping to a scale transparently related to an object, which Hay *et al.* call ‘volume’. In other cases, the relationship between object, scale, and event may be less transparent. As discussed by Verkuyl in this volume, a novel is a bounded object, and writing a novel is a telic event, but the relevant scale is one of completeness, and there is no straightforward mapping between parts of the novel-writing event and parts of the novel. In short, the current state of affairs is that approaches to verb meaning based on both lexical decomposition and on mereological relations are widely and actively researched, but our understanding of the relationships between these two types of analysis is still incomplete.

#### 1.2.4.3 Higginbotham (1983, 1985): Compositional davidsonianism

Dowty’s framework was deliberately event-free: Dowty argued instead that verbs denote properties of intervals. An explicit compositional event-based semantics would have to wait until a series of papers by James Higginbotham in the early 1980s. In the first of these (Higginbotham 1983), Higginbotham argued that bare verbal complements of perception verbs (e.g. (33a)) denoted existentially quantified event descriptions, unlike clausal complements of the same verbs (e.g. (33b)).

- (33) a. Mary saw someone leave.  
 b. Mary saw that someone left.

Higginbotham’s analysis builds on observations by Barwise (1981) which argue against a reduction of (33a) to clausal complementation. For instance, the examples in (33) interact differently with quantifiers. Either of the examples in (33) imply that someone left, but only (34b) implies that no-one left. (34a) merely implies that anyone who left wasn’t seen by Mary.

- (34) a. Mary saw no-one leave.  
 b. Mary saw that no-one left.

Higginbotham argues that the bare verbal complements existentially quantify over events, so that (33a) asserts that there is an event of someone leaving, and Mary saw that event. In contrast, the (b) examples above assert that Mary stands in some epistemic relation to the propositions that someone left and that no-one left, respectively.

Higginbotham also argues that this analysis has empirical advantages over Barwise’s situation-theoretic analysis (according to which the complements in the (a) sentences denote scenes—visually perceived properties of, or relations between, individuals). In particular, there is a clear distinction in acceptability between (35a) and (35b). This distinction disappears in clausal complements, as in (36).

- (35) a. (i) Mary saw her drunk.  
           (ii) Mary saw her leave.  
 b. (i) #Mary saw her tall.  
      (ii) #Mary saw her own a house.
- (36) a. Mary saw that she was tall.  
 b. Mary saw that she owned a house.

The class of predicates in bare perception verbs complements consists of eventive VPs, plus the ‘stage-level’ states such as *drunk* argued by Kratzer (1995) to denote predicates of an event variable (see Maienborn’s chapter in this volume). Individual-level states as in (35b), whether denoted by a VP or any other category, do not make good bare complements. This implies that not just any situation can be perceived.<sup>14</sup>

This analysis strengthened Davidson’s original claims about event arguments, by arguing for a more direct role for events, not as mere compositional glue relating verbs to modifiers (a role which could be played equally well by a variable of another type), but as a class of objects which are actually perceived, and whose perception can be described with dedicated syntactic constructions. In Higginbotham (1985), Higginbotham developed this by giving a compositional event semantics for a GB syntax along the lines of Chomsky (1981).

Higginbotham’s implementation adds an event argument to the argument structure of the relevant verbal predicates, and provides a mechanism for binding

<sup>14</sup> In fact, a body of work, most notably by Kratzer herself, aims at a reconciliation of event semantics and situation semantics. See Kratzer (1998).

of the event argument by an inflectional head, parallel to a treatment of noun denotations as 1-place predicates, whose argument position is bound by a determiner.

A consequence of Higginbotham’s approach is that it becomes possible to replace many Montagovian higher-order predicates with series of conjoined first-order predicates. For instance, the standard Montague Grammar treatment of adverbial modifiers construed them as of type  $\langle \alpha, \alpha \rangle$ , where  $\alpha$  is the type of VP. In other words, modifiers were functors, taking their hosts as arguments. In contrast, for Higginbotham, VP contains an open event argument position, and adverbial modifiers can be analysed as 1-place predicates predicated of the event argument through Higginbotham’s mechanism of ‘ $\theta$ -identification’.

This possibility was developed further in Parsons (1990), the first in-depth compositional **Neodavidsonian** event semantic study.<sup>15</sup> The defining property of Neodavidsonianism is that not only modifiers, but also arguments, are treated as conjoined predicates of events, so a verbal denotation comes to consist of a 1-place predicate corresponding to the event variable, conjoined with a series of 2-place ‘thematic’ predicates relating the event to the arguments of the verb, as in (37). Parsons’ work can be seen as a Neodavidsonian, event-based reformulation of the ideas in Dowty (1979).

$$(37) \quad \lambda x \lambda y \lambda e. (\text{push}'(e) \wedge \text{THEME}(x, e) \wedge \text{AGENT}(y, e))$$

Finally, with Parsons (1990), then, the three founding ideas discussed in Sections 1.2.1–1.2.3 are unified, giving an event-based theory which uses lexical decomposition to provide an account of the behaviour of aspectual classes. The Neodavidsonian approach subsequently gained further support from a close analysis of various distributive readings of verbal predicates in Schein (1993), discussed in Lohndal’s chapter in this handbook.

#### 1.2.4.4 Talmy, Jackendoff, and Levin and Rappaport Hovav: Event perception and lexical conceptual structure

One of the remarkable successes of research into event structure has been the harmonious integration of findings from psychological research into event perception with research into the logical properties of event descriptions. The crucial point is that events are not given in the mind-external world, any more than individuals are. Ultimately, the logical study of event structure is the logical study of a perceptual system, and linguistic reflections thereof.

<sup>15</sup> Neodavidsonian analyses had already been envisaged in a commentary on Davidson (1967) by Castañeda (1967), but not really investigated until Parsons (1990).

The central psychological problem in event perception is parallel to that of object perception: the mind-external world does not contain determinate boundaries of objects or events, but rather is a spatiotemporal continuum, changing continually. We only rarely perceive those continua directly, if at all. Rather, we perceive discrete objects, often with determinate boundaries, which undergo determinate changes and interactions which themselves appear to have determinate beginnings and ends. This discretization of external stimuli is not inherent in those stimuli, but nevertheless properties of the stimuli condition the way they are discretized. This implies a range of questions about the heuristics employed to relate continuous ‘happenings’ to discrete events, parallel to questions about the relation of continuous matter to discrete individuals.

Both sets of questions preoccupied Gestalt psychologists in the first half of the 20th century. Wertheimer posed the problem as follows:

I stand at a window and see a house, trees, sky.

Theoretically I might say there were 327 brightnesses and nuances of colour. Do I *have* ‘327’? No. I have sky, house, and trees. It is impossible to achieve ‘327’ as such.

(Wertheimer 1923:71)

For Gestalt psychologists, the absence of ‘327’ implies that ‘perception is organization’ (Koffka 1935: 110): perception is an active, albeit largely unconscious, process of forming and maintaining perceptual units. This opens the door to study of the mechanisms underpinning that process, and factors influencing its operation.

Similar points can be made for segmentation of events, with the major difference being that events are, in some sense, more time-sensitive or dynamic. We expect a degree of permanence or atemporality from regular objects, while we expect events to be evanescent: as Miller and Johnson-Laird (1976) put it, ‘One can return to an object and examine it again for further information. One cannot return to a prior event unless photography has converted it into an object that can be revisited.’

For many linguists, the first point of contact with this branch of psychology was Leonard Talmy’s series of papers (1978, 1985*b*, 1988, among others) collected in Talmy (2000). Talmy demonstrated the relevance of a series of properties of perceptual organization of events (the figure/ground distinction, manner of motion vs. path, and the force-dynamic model of interaction among participants) to the description of *linguistic* phenomena. Jointly, these notions suggested a conceptual, or cognitive, template for event representations, relating principles of perceptual organization to linguistic expressions. Although the assumption of such a template is not new (being already implicit in Generative Semantics, in Gruber’s 1965 study of thematic roles, or in Fillmore’s 1968 Case Grammar),

the explicitly psychological orientation of Talmy’s proposals, as well as several empirical advances, brought a new dimension to event-structural research.

Talmy’s work opens up the possibility of cognitive constraints on word meaning, complementary to the logical analysis of aspectual classes and related issues initiated by Verkuyl (1972) and Dowty (1979). Talmy, and later research in a similar vein by Jackendoff (e.g. 1990) and Levin and Rappaport Hovav (e.g. 2005), contributed to the elaboration of the notion of **lexical conceptual structure**, a representation format suitable for statement of generalizations about verb meaning (see Levin and Rappaport Hovav’s chapter in this volume).

These generalizations can take a variety of forms. As a recent example, Rappaport Hovav and Levin (2010 *et seq.*) have argued that two components of lexical conceptual structure, MANNER and RESULT, cannot both be lexicalized by a single verb. In other words, while (38a) contains a verb, *wipe*, describing a manner, and an adjectival secondary predicate, *clean*, describing the result of the wiping, there is no single verb like *clean-wipe* in (38b) that describes the manner and result in a single lexical entry.

- (38) a. Max wiped the table clean.  
 b. \*Max clean-wiped the table.

A better-known example comes from Talmy’s (1985*b*) discussion of the realization of PATH in the world’s languages. Talmy observes that a **satellite-framed** language like English can describe a path using a satellite (in this case, a PP), rather than in the verb itself: (39a) has an interpretation on which the boat floated along a path which terminated under the bridge. **Verb-framed** languages like French do not have this option, so (39b) can only be interpreted as describing a static floating event, located under the bridge. To describe a path terminating under the bridge, French must use a motion verb like *aller* in (39c), and (if necessary) describe the manner using an adjunct.

- (39) a. The boat floated under the bridge.  
 b. *Le bateau a flotté sous le pont.*  
 the boat has floated under the bridge  
 ‘The boat floated under the bridge.’  
 c. *Le bateau est allé sous le pont en flottant.*  
 the boat is gone under the bridge in floating.  
 ‘The boat floated under the bridge.’

Rappaport Hovav and Levin’s generalization is a putative linguistic universal. Talmy’s is a putative lexicosemantic parameter, or locus of constrained crosslinguistic variation in word meaning. Neither would have been formulated

in the first place without the cognitive approach to event semantics to complement the logical approach.

Happily, ‘complement’ is the appropriate term here. The logical and cognitive approaches to event structure have become thoroughly, and quite harmoniously, intertwined. The work of Talmy, Jackendoff, and Levin and Rappaport Hovav have provided grist to the mill of Minimalist theorizing about verb phrase structure, from Hale and Keyser (1993) to Ramchand (2008*b*) and beyond, and various aspects of lexical conceptual structure have been incorporated into formal semantic treatments like Zwarts (2005) or Copley and Harley (2015). At the same time, work in cognitive linguistics has inspired further experimental cognitive science research on the perception of events (see in particular Wolff 2003 *et seq.*).

Depending on how you count, linguistic research into event structure is around 60 years old at this point. Those 60 years have been remarkably successful: it does not seem like hyperbole to claim that the trajectory sketched above contains some of the high points of syntactic and semantic theory, with deep and nonobvious empirical generalizations formalized, tested, and refined in an intellectual environment where researchers across the board, from theoretical syntacticians through formal semanticists to cognitive semanticists and cognitive scientists, listen to each other and learn from each other.

At this stage, the foundational ideas have more or less stabilized, but the field continues to develop, with greater sensitivity to comparative linguistic data and to experimental work on event perception. And so, we have a handbook. If it does its job well, it will show where we’ve come, and stimulate further research to help us move forward.

### 1.3 The structure of the handbook

The handbook is divided into four parts. Part 1 contains a series of chapters on the role of events and event structure in formal semantics, concentrating on the relations among events, and between events and other basic elements. This leads to a discussion in Part 2 of more narrowly linguistic phenomena: event structure in lexical representations and syntactic composition, as opposed to the logical foundations. Part 3 covers cross-linguistic perspectives on event-structural phenomena, an area where research is currently undergoing rapid development. Finally, Part 4 focuses on event structure from a broader cognitive and computational perspective.



### 1.3.1 Part I: Events and natural language metaphysics

We begin with a string of chapters exploring the three foundational ideas from Section 1.2. **Mittwoch**'s chapter reviews Vendler's notion of aspectual classes (see Section 1.2.2), describing some of the evidence for partitioning predicates into different aspectual classes, and remaining issues with such partitions, such as the number of divisions and their basis.

**Maienborn** focuses on the relationship between events and states, from a Davidsonian perspective. Although states are one of Vendler's four aspectual classes, it is frequently claimed that states are disjoint from events (one way of cashing out this claim logically is to hypothesize that the lexical representation of stative verbs does not include an event variable). Maienborn shows that this holds to different degrees of different classes of stative predicate, implying that the cluster of properties typically associated with the Davidsonian event variable can be dissociated to an extent, giving rise to a range of statelike objects.

**Truswell** explores a consequence of the Davidsonian hypothesis: that events are like individuals (see Section 1.2.1). He focuses particularly on internal composition of events, from logical and cognitive perspectives, across a range of different perceptual event types, investigating factors which support the perception of a series of occurrences as a single event, and linguistic consequences thereof.

**Thomason** makes a logical argument for causative constructions as describing relations between events, rather than propositions. He takes Dowty's (1979) propositional analysis of CAUSE as a starting point, and points out an unfortunate logical consequence of this event-free analysis. CAUSE is treated by Dowty as a relation among propositions: an individual  $x$  stands in a causal relation to a proposition  $\phi$  iff there is some property  $P$  such that  $\text{CAUSE}(P(x), \phi)$ . Thomason shows that there are too many such properties, and so this definition of CAUSE admits too many causers. Put simply, propositions have the wrong granularity to identify causal relations. Thomason's solution is to introduce events into the ontology, and redefine CAUSE as a relation among events. This chapter therefore serves as a critical evaluation of a distinctive ontological characteristic of Dowty's seminal work, namely his rejection of Davidson's event variable, as well as a philosophical investigation of one of the core components of decompositional accounts of verb meaning.

**Copley** describes the relationship between force dynamics and event structure. Although research into force dynamics was initially carried out by cognitive linguists like Talmy and Croft, recent syntheses with the formal Davidsonian tradition may be leading to a 'best-of-both-worlds' situation, where the empirical coverage of Davidsonian event semantics is increased by incorporation of forces, while maintaining its fundamental logical properties.

The major ontological innovation in Copley and Harley (2015), the most recent of these approaches, is that the ‘hidden’ Davidsonian argument is taken to range over forces, rather than events.

A different modification of Davidson’s logic comes from **Verkuyl**, who further develops his theory of temporal relations from Verkuyl (2008). For Verkuyl, verbs denote properties of temporal indices, and tense and aspectual phenomena emerge from three layered temporal operators organized into binary oppositions. The chapter is more thoroughly embedded in the post-Montague type-logical tradition than the rest of the handbook, including compositional derivations of examples of core aspectual phenomena.

As well as its ontological interest, Verkuyl’s chapter has interesting implications for the division between **inner** and **outer aspect**, or roughly speaking, lexically determined aspect and compositional manipulations thereof. Aspectual classes are prototypical inner aspectual phenomena; aspectual alternations such as the progressive are classically outer aspectual; but for Verkuyl, both types of opposition arise from the same basic mechanisms. Outer aspect is not a focus of this volume (see instead Chapters 26–31 of Binnick 2012), as it is frequently taken to be concerned with properties of times, rather than events. Verkuyl’s chapter reminds us that the line between inner and outer aspect is not yet clear, a position that is also echoed in later chapters by Kamp, Kehler, and Steedman.

**Gehrke**’s chapter develops the Davidsonian parallel between events and individuals in a different direction. Carlson (1977*b*) developed a distinction between ‘ordinary’ individuals and **kinds**, and showed that several expressions, including English bare plurals, could be analysed as referring to kinds. Gehrke describes recent work on a parallel distinction between ordinary events and event kinds, discussing constructions whose semantics makes reference to event kinds, and criteria for postulating an event kind.

### 1.3.2 *Part II: Events in morphosyntax and lexical semantics*

The chapters in Part I have mainly been concerned with motivations for, and alternatives to, the Davidsonian event variable. Part II focuses instead on the syntactic structures involved in compositional derivation of event descriptions, and the nature of the lexical representations that figure in those descriptions

**Gisborne and Donaldson** review approaches to a central architectural question, namely the relationship between event structure and argument structure. As they characterize it, we can take thematic roles as primitives and derive event descriptions from them, or we can take decompositional event structure as primitive and derive argument roles from that structure. Although both approaches are represented in this handbook, Gisborne and Donaldson favour

the latter, giving several arguments against treating thematic roles as primitives, the most straightforward of which is that no-one has yet proposed a reasonably complete and explicit list of primitive thematic roles. Moreover, following the architecture of Jackendoff (1990), Gisborne and Donaldson suggest that these event-structural representations need to be supplemented by a second layer, Jackendoff’s ‘action tier’, which represents force-dynamic relations of the sort discussed in Copley’s chapter.

**Levinson** discusses recent theories of lexical representation and the relationship between lexical and structural semantics, including Distributed Morphology (Marantz 1997 *et seq.*) and the ‘exoskeletal’ approach of Borer (2005*a,b*), and the consequences of those approaches for the syntactic representation of event variables. Although the terms of discussion in this chapter are different from those of much of the handbook, the thematic links are not far below the surface. Linguistic properties of event descriptions emerge from the interaction of lexical representations (e.g. predicates over event variables) and compositional semantics (e.g. aspectual composition phenomena as explored by Verkuyl 1972, Dowty 1979, and Krifka 1989). The division of labour between these two aspects of meaning is not given in advance, and indeed has been a recurring theme in event-structural research since the generative semanticists. For instance, on a classical Davidsonian approach, the association of a verb like *write* with an incremental theme argument is a lexical matter, but on many modern approaches, it is a matter of the compositional semantics, arising from the combination of a verbal root with functional structure (Borer’s ‘exoskeleton’). Various recent proposals, including L-syntax (Hale and Keyser 1993), first phase syntax (Ramchand 2008*b*), and some strands of Distributed Morphology (Marantz 2013*a*), describe intermediate positions, where the domain of lexical semantics overlaps to an extent with the domain of phrase structure. Levinson’s chapter explores the nature of that overlap.

Building on this, **Lohndal** describes the Neodavidsonian turn in event semantics (see discussion in Section 1.2.4.3), characterized by a treatment of thematic relations as 2-place predicates relating an event to an individual. Some of the most compelling evidence for a Neodavidsonian event semantics comes from patterns of quantification involving multiple events, which can form the basis of an argument (initially from Schein 1993) that arguments must be introduced by conjoined 2-place predicates like AGENT or THEME. A further question then concerns the extent to which this semantic Neodavidsonianism is reflected in the syntax by ‘severing’ of arguments from the lexical category, and introduction of arguments by distinct functional heads (e.g. Kratzer 1996, Pykkänen 2002).

**Ramchand** summarizes her own approach to the relationship between the lexicon and the syntax and semantics of verbal predicates, based on the ‘Post-Davidsonian’ postulation of a structured syntactic representation, aiming to derive Neodavidsonian representations from a decompositional model

of event structure broadly similar to the ideas discussed in Section 1.2.3. On this approach, classical ‘verb meaning’ is distributed over multiple syntactic terminals, which in turn inspires a model of lexical insertion which is not restricted to terminal nodes. Ramchand’s chapter serves as a point of contrast with the chapters of Gisborne and Donaldson, and Levin and Rappaport Hovav, which share a commitment to a reduction of thematic roles to event structure, but adopt a more rigid distinction between lexicon and syntax.

Event variables are primarily associated with verbs and their projections. However, the handbook contains two chapters which focus on the implications of predicates of other syntactic categories for event semantics. First, **Moltmann** describes event nominals and related constructions, relating different syntactic types of nominal to different semantic objects. A range of semantic analyses are considered. Most straightforwardly, a noun phrase like *John’s walk* could denote a definite John-walking event. In more complex cases, a range of ontological questions broadly similar to those in Maienborn’s chapter arise. No single semantic analysis is shown to be fully adequate across constructions, but a ‘truthmaker’ account avoids certain problems with the Davidsonian approach in the semantics of nominalizations and modifiers.

**Baglini and Kennedy** summarize recent research on adjectives and event structure. The key link here is the notion of **degree**: a major class of adjectives denote gradable predicates, which hold of an individual to a certain degree. Gradable predicates like *wide* relate morphologically and semantically to Dowty’s class of **degree achievements** like *widen*, discussed in Section 1.2.4.2. This insight has led to significant progress in the relationship of different scalar structures to aspectual phenomena, tackling similar issues to Verkuyl’s chapter from a different perspective.

Degree achievements are a class of deadjectival verbs. Baglini and Kennedy also discuss deverbal adjectives, and particularly adjectival passives, raising some points of contact with Gehrke’s chapter. Baglini and Kennedy end with a set of open questions for research on adjectives and states.

### 1.3.3 Part III: Crosslinguistic perspectives

Most of the material covered in Parts I–II is foundational and largely language-independent. In Part III, the focus is on the range of crosslinguistic variation in event semantics. Much current research in this area concerns debates over universality and variability in any ‘templatic’ representation of the internal structure, and the division of labour between syntax and semantics in accounting for those crosslinguistic patterns.

**Levin and Rappaport Hovav** begin by giving an introduction to the research programme that grew out of Talmy’s seminal work on crosslinguistic variation in lexicalization patterns (see Section 1.2.4.4). They discuss Talmy’s original typology and subsequent refinements, and syntactic and semantic explanations of the typology, before turning to their own recent work on manner/result complementarity, a proposed constraint on possible verb meanings that is a natural extension of one approach to Talmy’s typology.

Levin and Rappaport Hovav develop the theme that there are limits on the amount of information that can be expressed in a single verb. Whatever isn’t expressed by the verb can be expressed by several different types of modifier. **Rapoport** discusses a type of modifier called secondary predicates, canonically adjectives, which can appear to compose a single event description with a verb. Rapoport outlines the classical distinction between depictive and resultative secondary predicates, and demonstrates a range of syntactic, thematic, and semantic constraints on secondary predication. These latter are of particular interest to event-structural research: there are several interactions between the possibility of secondary predication and the aspectual class of the VP.

Although the bulk of Rapoport’s chapter is on English, we include it in this series of crosslinguistic studies for two reasons. First, Section 16.7 gives a brief review of a substantial comparative literature on secondary predication across languages. Second, secondary predicates are closely linked to the topics covered in Levin and Rappaport Hovav’s chapter: they are one example of Talmy’s class of ‘satellites,’ which in some languages express information about path and result not encoded by the verb.

**Siloni** offers a critical assessment of morphological, syntactic, and semantic evidence often adduced in favour of syntactic approaches to lexical decomposition such as those endorsed by Ramchand and Lohndal in this volume. Drawing on data from a range of languages, including French, Hebrew, Hungarian, and Japanese, Siloni shows that many pieces of evidence in favour of decomposition are either limited in scope or subject to exceptions. Moreover, as discussed above, in some cases, the opposite pattern is found to that which is expected: in causative–inchoative pairs, the causative variant is morphologically marked in some languages, while the inchoative variant is marked in others. The correlations predicted on post-GS approaches between argument-structural complexity and morphological complexity do not necessarily obtain. Many of the effects and counterexamples discussed here fit naturally within the more lexicalist approach to such alternations pioneered by Reinhart (2002).

**Travis** reviews recent work on crosslinguistic variation in inner aspect. Most seminal research on event structure, from Vendler to Dowty and Parsons, assumed an English-like set of aspectual classes, in which accomplishments, in particular, are characterized by a characteristic endpoint ‘which has to be

reached if the action is to be what it is claimed to be’ (Vendler 1957: 145). An event of sandcastle-building requires a sandcastle to be built, for instance, and exceptions to this (such as the progressive *Mary was building a sandcastle, but she didn’t get very far*) are to be treated as exceptions, requiring a possible-worlds semantics for Dowty (1979). Recently, there has been increased awareness that, across a range of languages, reaching the endpoint is an implicature, rather than an entailment, of an accomplishment predicate. In fact, it is no longer clear whether languages like English with a culmination entailment (at least in the simple past), or like Malagasy with an implicature, have more ‘basic’ entailments (see also discussion in Mittwoch and Truswell’s chapters). Travis offers perhaps the most thorough review yet of the crosslinguistic distribution of this phenomenon, and gives a range of possible analyses, which she evaluates according to morphophonological as well as syntactic and semantic criteria.

#### 1.3.4 Part IV: Events, cognition, and computation

The final part of this handbook is designed with the wider picture in mind. Events are not only the values of compositionally useful variables within sentence semantics. We perceive events, reason with events, and use event descriptions to structure discourses. Part IV is composed of surveys within this broader field of event-structural research.

**Kamp** gives an introduction to the analysis of tense and aspect within Discourse Representation Theory (DRT). A recurring concern in DRT and related formalisms is the analysis of patterns of anaphora and interactions with quantification, within and across sentences. Kamp demonstrates parallels between patterns of individual anaphora and event anaphora in this respect, motivating an event-based approach to model-theoretic analysis of the structure of narrative discourse and viewpoint aspect.

**Kehler**’s focus is on coherence relations, or the principles that govern our perception of associations between pieces of propositional information. Kehler summarizes a typology of coherence relations from Kehler (2002), based on Hume’s types of ‘connection among ideas’, and then goes on to show how various event-structural phenomena can condition the choice of coherence relation. In other words, although work on discourse coherence has classically paid little attention to events, Kehler’s chapter implies that a full treatment of the one must make reference to the other.

**Steedman** describes an ambitious attempt to automatically detect ‘hidden’ form-independent primitives of decomposed meaning representations, by recovering patterns of entailment from large amounts of text. The relevance to event structure comes with the use of aspectual oppositions to describe a

temporal (or causal) order, in the way outlined in Kamp’s chapter. For instance, if the president has arrived in Hawai’i, we can infer that the president is in Hawai’i, but if the president is arriving in Hawai’i, we can infer that he isn’t (yet) in Hawai’i. In this way, sensitivity to aspectual information increases the ability to detect these entailments.

Finally, **Cohn and Paczynski** review material on event perception from a cognitive neuroscience perspective. A focus of their chapter is similarities between the neurophysiology of processing of linguistic event descriptions, and nonlinguistic visual event stimuli, particularly with respect to the role of prediction within hierarchically organized models of events.

The first chapter of this handbook was originally meant to be on evidence for the event variable in semantic representations, written by James Higginbotham. Shortly after he had agreed to contribute to the volume, Prof. Higginbotham sadly died. We did not try to find a new author for the chapter, because few, if any, researchers could match his depth of understanding of the philosophical and linguistic issues surrounding event semantics. As reflected in the foregoing, many of the foundational works on event structure were written by philosophers, but the field has gained a new vitality from the involvement of generative linguists. That interdisciplinary connection was forged in no small part by Higginbotham: it was Higginbotham that coupled a GB syntax in the mould of Chomsky (1981) with a compositional semantics for variables ranging over individuals within noun phrases, and over events within sentences, building on emerging ideas about parallels between the functional structure of clauses and noun phrases, later developed by everyone from Abney (1987) to Borer (2005*a,b*). Even without his chapter, his ideas are ubiquitous in the volume.