Adverbs of Change and Dynamicity

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Abstract

This paper makes two contributions, one empirical and one theoretical. The empirical focus is "adverbs of change"—modifiers such as *quickly*, *slowly*, and *immediately*, which characterize the change described by the modified predicate as fast or slow. Based on *quickly* as the most versatile exemplar, the paper develops a semantic account that is uniform both across and within such adverbs. Specifically, I argue that adverbs of change share a common semantic core which selects for dynamic predicates and measures out event duration. I further argue that individual adverbs are not lexically ambiguous, despite their ability to take on different readings—namely rate, extent, narrative, or illocutionary. Instead, these different readings arise through interaction with aspectual and discourse structure, and are further restricted by idiosyncratic scope possibilities. The proposed account of adverbs of change has theoretical implications for the aspectual notion of dynamicity, suggesting that dynamicity is built directly into the mereological structure of events. More concretely, dynamic predicates are claimed to refer to "transitions", a kind of complex events which label the change that has occurred. Overall, the paper aims to lay the groundwork for a general theory of verbal change that correctly predicts the implication relations between key aspectual features such as dynamicity, telicity, and durativity.

Keywords: adverbs of change, dynamicity, lexical aspect, event mereology, event measurement

1 Introduction

Change is a fundamental part of the human experience and, unsurprisingly, it is abundantly represented in natural language. The most direct way of expressing change in language is through the use of "dynamic" predicates (Vendler 1957; Comrie 1976: ch.2; Dowty 1979; Smith 1997; Kearns 2000: ch.9; Rothstein 2004; a.o.). Essentially, these are verbal predicates that are drawn from the aspectual classes of activities (e.g., *run* or *push a cart*), accomplishments (e.g., *paint a picture* or *deliver a sermon*), and achievements (e.g., *spot the plane*

or *reach the summit*). Notably, dynamic predicates exclude statives (like *believe* or *love*), which—as their name suggests—are static and do not convey change.

There is a class of verbal modifiers that characterize the change described by dynamic predicates as fast (e.g., *quickly*, *rapidly*, *swiftly*, *immediately*, *instantly*) or slow (e.g., *slowly*, *sluggishly*, *glacially*). I dub such modifiers "adverbs of change", partially falling in line with prior labels such as "motion adverbs" (Cresswell 1978), "celerative adverb" (Cinque 1999), "rate adverbs" (Tenny 2000; Kearns 2007), "aspect-manner adverbs" (Ernst 2004), or "adverbs of time and change" (Rawlins 2013). In this paper, I will focus on *quickly* and explicitly compare its interpretational properties to those of *slowly* and *immediately*. These three modifiers were chosen deliberately to highlight key commonalities and differences that exist across adverbs of change, particularly concerning their interaction with the aspectual notion of dynamicity.

The starting observation is that adverbs of change presuppose dynamicity. This is most evident with *quickly*, the most versatile example of such adverbs. The basic pattern is that *quickly* is incompatible with stative predicates but can co-occur with predicates from all other major aspectual classes (activities, accomplishments, and achievements), arguably because it selects for dynamic predicates. This is illustrated in (1).

(1) a. #Justin loved Selena quickly. (state)
b. Selena ran quickly. (activity)
c. Selena ran to the park quickly. (accomplishment)
d. The boy quickly spotted the plane. (achievement)

Note that while (1a) is marked as unacceptable, there are instances where *quickly* can felicitously combine with stative predicates. However, in such combinations the stative predicate is coerced into conveying an inchoative reading (e.g., *Justin went to bed and quickly was asleep* $\approx$ 'Justin went to bed and soon fell asleep'). That is, the modified predicate no longer refers to a proper state because the described situation is bounded by a starting point. The formal mechanism responsible for coercing atelic predicates (statives or activities) into conveying an inchoative meaning will be made explicit in Sect. 4.5.

Since adverbs of change can characterize rates, they have often been classified as a kind of manner adverbs (e.g., Jackendoff 1972: ch.3; Parsons 1990: ch.4; Ernst 2004: ch.2; Maienborn and Schäfer 2011; Morzycki 2016: ch.5). However, these adverbs display a wide variety of seemingly unrelated readings and should be better viewed as constituting a class in their own right. For example, *quickly* can measure the rate of change, the duration of the entire described event, the narrative time spanning the period between the described event and some prior event, or the illocutionary time between asking and answering a question. This is illustrated in (2).

(2) a. Selena ran quickly. (rate)
b. Harry read the book quickly. (extent)
c. The professor walked in and the student quickly noticed her. (narrative)
d. Quickly, what is the capital of Uganda? (illocutionary)

Despite this apparent polysemy, I will argue that adverbs of change are not lexically ambiguous. Instead, such adverbs consistently measure event duration, with the different readings hinging on the kind of event being targeted.[1]

As a benchmark for other adverbs of change, I will propose that *quickly* singles out the short events that fall under the base predicate. More specifically, *quickly* composes with dynamic predicates and distributes over event structure, stating that every minimal event that falls under the base predicate is of relatively short duration (see Sect. 4.2 for details; cf. Cresswell 1978; Rawlins 2013). Given this proposal, here is a preliminary sketch of how the four readings in (2) will be derived (Sect. 4.3–4.6 fill in the details). The extent reading in (2b) constitutes the most straightforward case. A common assumption in the aspectual literature is that telic predicates (accomplishments and achievements) denote events which lack proper subparts that fall under the same predicate (Krifka 1989). Due to this property, only maximal events fall under the modified predicate, leading *quickly* to characterize as short the entire described event. Deriving the readings in (2c) and (2d) requires an extrapolation of this same idea to covert predicates that refer to abstract events. That is, in (2c) *quickly* characterizes a narrative event, one that spans the time between the described event and some previously mentioned event (Rawlins 2013). In turn, (2d) has *quickly* modifying an illocutionary event of the addressee reacting to the prior question move. Example (2a) is the only case where the distribution over event structure does some real semantic work. That is, it is typically assumed that the denotation of activities contains not just maximal events but also subevents of a certain size, making the relevant denotation "divisible" down to minimal parts (cf. Bennett and Partee 1972; Dowty 1979; Bach 1981; Krifka 1989; Landman and Rothstein 2012a, 2012b; Champollion 2017). This assumption forces *quickly* to distribute over the minimal meaningful parts of the described process, implying that each such part is of relatively short duration and giving rise to the intuition of a fast rate.

The specific semantic analysis of *quickly* will serve as a foundation for characterizing the entire class of adverbs of change as selecting dynamic predicates and measuring out event duration. At the same time, this analysis offers insight into the dimensions along which other adverbs of change are expected to vary (see Sect. 5). First, note that *quickly* and *slowly* are grammatically gradable, whereas *immediately* seems to lack this property (cf. *more quickly/slowly than* vs. **more immediately than*, *very quickly/slowly* vs. **very immediately*). While grammatically gradable, *quickly* and *slowly* differ in scale direction, with *quickly* requiring the event to meet a standard for short events of the relevant kind, and *slowly* requiring it to meet a standard for long events. These two differences will be attributed to the presence or absence of a degree argument and the type of measure lexicalized by specific adverbs, respectively. Finally, not all readings are available for all adverbs. For example, *slowly* seems able to convey a rate reading only, and *immediately* is always interpreted narratively. Since the inaccessibility of specific readings is unexpected under the minimal semantics assumed for all adverbs of change, I will suggest—without putting forward a concrete analysis—that such gaps follow from idiosyncratic restrictions on accessible scopal sites for individual adverbs.

The proposed semantics for adverbs of change warrants a uniform yet fine-grained notion of dynamicity, along with a basic understanding of its interaction with other fundamental

[1] In line with the neo-Davidsonian tradition, I am assuming that verbal constituents refer to events. Since adverbs of change modify verbal constituents, it follows that they measure events rather than time intervals directly.

aspectual notions, like telicity and durativity. To formally articulate this notion, I will propose that dynamicity is built directly into the mereological structure of events, where the term "event" is used for an eventuality of any kind (cf. Bach 1986). More concretely, I will claim that dynamic predicates refer to "transitions", i.e., complex events labeled by a description of the change that has occurred (cf. von Wright 1963: ch.2; Szabolcsi 1982; Landman 1991: ch.5; Pustejovsky 1991; Naumann 2001; Beavers 2013; Krifka 2014). The technical innovation that I will introduce to represent transition events is the "arrow" operator $\rightarrow$. This operator takes a prior event e, a successor event e' and an event description Q, and creates the transition $e \xrightarrow{Q} e'$, intended to capture the intuition that Q (and no other unrelated change) comes about between e and e'. This is achieved formally by requiring that e and e' are two temporally contiguous events which differ only with respect to Q (and anything entailed by it), such that Q does not hold of e but Q holds of e'. For example, if s is the state of being outside the room, s' is the state of being inside the room, and Q is the property of being in the room, then the transition $s \xrightarrow{Q} s'$ may represent the event of entering the room. This idea of modeling instantaneous change will be extended to entire processes, which will be analyzed as chains of instantaneous changes.

The arrow constructor is specifically designed to apply to events and enriches classical mereology, which may apply to entities of any kind (Leonard and Goodman 1940; Link 1983, 1991; Simons 1987; Krifka 1989, 1998; Champollion and Krifka 2016; Varzi 2016; Champollion 2017: ch.2; a.o.). Classical mereology employs the "sum" operator $\oplus$ (sometimes called "fusion" or "join") as its primary tool for constructing wholes from parts. That is, if e and e' are events, $e \oplus e'$ is their sum, or the minimal event that contains e and e'. Against this background, the additional expressive power conferred by the arrow constructor is necessary for at least two reasons. First, there are certain empirical benefits from explicitly representing the structure of transitions. For example, simple transition events create the meaningful minimal parts needed for distribution over mereological structure to produce the rate reading of adverbs of change (Sect. 4.3). Additionally, proper parts of transition events may be targeted by covert aspectual operators, such as inchoative operators (Sect. 4.5). Second, spelling out transition events broadens our understanding of the logical relationships that hold between dynamicity and other key aspectual notions, such as telicity and durativity. As discussed in Sect. 3.3, standard aspectual classifications demonstrate that telicity is a subcase of dynamicity, and punctuality is a subcase of telicity—and, by extension, of dynamicity. In the absence of a clearly articulated notion of dynamicity, these dependencies would remain obscure.

The rest of the paper is structured as follows. Sect. 2 discusses the semantic distribution of *quickly*, emphasizing the important role of the aspectual profile of the modified predicate. Sect. 3 introduces an enriched mereology that includes transition events. It also spells out the aspectual notion of dynamicity and discusses its links to telicity and durativity. Sect. 4 presents the main proposal about *quickly*, making a crucial use of our explicit assumptions regarding event type and aspectual class. Sect. 5 is devoted to variation within the class of adverbs of change, briefly comparing *quickly* to *slowly* and *immediately*. Sect. 6 discusses two previous accounts of adverbs of change, and Sect. 7 is the conclusion.

2 Data on *quickly*

This section presents the main data on *quickly*, examining its compatibility with predicates from different aspectual classes and cataloging the resulting interpretations.

The empirical properties of *quickly* have been previously discussed in Cresswell (1978), Pustejovsky (1991), Tenny (2000), Thompson (2006), Kearns (2007), Rawlins (2013), and Wellwood (2019: 6.3.3), a.o. *Quickly* turns out to be the most flexible of all adverbs of change, combining with various dynamic predicates (activities, accomplishments, achievements) and yielding four different interpretations: "rate", "extent", "narrative", and "illocutionary".[2] These interpretations are typically linked to the aspectual properties of the modified expression, as demonstrated below.

A rate reading for *quickly* arises with activities and entails that the described action progresses rapidly. For example, (3) entails that Selena moved through space at a faster rate than the standard rate for a running event of this kind.[3]

(3) Selena ran quickly.

The extent reading of *quickly* arises with accomplishment predicates and measures the temporal extent of the entire described event. For example, (4a) describes the temporal extent of the book-reading event as being short relative to some appropriate standard. The same kind of reading seems to arise with achievement predicates, specifically with culminations.[4] This is illustrated by the web-inspired example in (4b), where what is described as relatively short is the event of winning the race.

(4) a. Elaine read the book quickly.

b. Southerland won the race against Perez quickly and decisively.

Note that while achievement predicates are punctual in aspectual terms, an extent reading of *quickly* with such predicates is unsurprising. This is because, on the current account, all events take time, irrespective of whether they are denoted by durative or punctual predicates. In Sect. 3.3, punctual predicates will be characterized as those that refer to events constituting a direct transition (i.e., have a certain mereological structure that highlights the change), not as those that refer to events without temporal extent (no such events will be assumed to exist).

Cresswell (1978)—followed by Pustejovsky (1991), Shaer (1998), Thompson (2006), and Rawlins (2013)—claims that when modifying accomplishments, *quickly* is actually ambiguous between an extent and a rate reading. As mentioned earlier, the extent reading in such cases describes the duration of the whole event. In turn, a rate reading should modify the intensity of the underlying process. For example, in Cresswell's own words, the extent reading of (5) says that John's walking was a quick walking to the station, while the rate reading of (5) says that John walked quickly and that his walking was to the station.

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[2] While these labels are largely my own, they align conceptually with existing descriptions of these readings in the literature.

[3] The rate reading of *quickly* is sometimes characterized as a "manner" reading (Cresswell 1978; Pustejovsky 1991; Thompson 2006) or even contrasted with such a reading (Tenny 2000). On the former view, the difference is purely terminological and requires no further scrutiny. However, on the latter view, the two readings are expected to be logically independent. For example, in (3) a manner reading would presumably describe not the speed with which Selena traversed space, but the way Selena moved her body parts. However, it seems difficult to isolate an independent manner reading in the absence of a concomitant rate reading (cf. *?Selena ran quickly but moved forward slowly*), suggesting that the former reading is some sort of pragmatic implication of the latter reading. Furthermore, a distinct manner reading cannot be consistently identified for all activity predicates (e.g., *drive his car quickly*). Therefore, I will set aside the possibility of a contrasting manner reading for *quickly*.

[4] I leave it open whether an extent reading for *quickly* is also possible or salient in combinations with happenings, as in *quickly hit the ground* or *quickly notice the sound*.

(5) John walked quickly to the station. (Cresswell 1978: 181)

Rawlins (2013: 154) additionally argues that the extent versus rate readings of *quickly* with accomplishments can be distinguished by the distribution of measure phrases inside comparative forms. As empirical support, he cites the examples in (6) (the judgment marking in (6b) is mine).

(6) a. Alfonso ran to the park 2 minutes more quickly than Joanna. (extent)
b. %Alfonso ran to the park 2 miles per hour more quickly than Joanna. (rate)

According to Rawlins, in (6a) *2 minutes* measures the difference in temporal extent between the two running events, whereas in (6b) *2 miles per hour* measures the difference in rate between these two events. However, while (6a) is uncontroversial, some English speakers find (6b) unacceptable, perhaps due to the technical nature of the concept "miles per hour". Notice also that when the extent reading is explicitly denied in a follow-up clause, as in (7), the rate reading is not easily accessible.

(7) ?Alfonso ran to the park quickly, but it took him a long time to get there (he picked the longer path).

What is important here is that the semantic proposal in Sect. 4 is compatible, though it does not mandate, a rate reading for *quickly* with accomplishment predicates. That is, whether or not *quickly* has this reading will be a matter of scope site. Here I will tentatively assume that—at least for some speakers—such a reading is accessible.

The rate and extent readings of *quickly* are purely semantic, meaning that both comment on the event denoted by the modified expression. In this respect, they differ from the narrative and illocutionary readings, which are in some sense pragmatic. Intuitively, what is measured in the latter two readings is the temporal distance between two different events, such as two narrative events or two utterance events. Starting with the narrative reading, it most obviously arises with achievements. As illustrated below, *quickly* appears to measure the distance between the prior walking-in event and the ensuing noticing event in (8a), and the distance between the event of taking a lead and the event of winning the race in (8b).

(8) a. The professor walked in and the student quickly noticed her.
b. Harry took an early lead and quickly won the race.

A narrative reading seems also possible with other telic predicates, i.e., accomplishments. Two examples are cited in (9) (the second example is from COCA; Davies 2008).

(9) a. A low sound came from the direction of the bed and Kazuko quickly moved to the window.
b. When war broke out, they quickly built a false wall in one of their barns and hid the truck.

In both (8) and (9), it may be difficult to tell apart the claimed narrative reading from a more regular extent reading. Although I will not offer an empirical diagnostic to differentiate between these two readings of *quickly* with telic predicates, it is worth noting that the possibility of a narrative reading is in line with the common assumption in the literature on narrative discourse (e.g., Kamp and Rohrer 1983) that telic predicates move the "reference time" forward, thus creating some temporal distance between the described event and a previously

introduced event, which can be modified by adverbs of change (see Sect. 4.5 for analytical details).[5] Conversely, one might wonder whether the claimed extent reading in (4) actually conceals the narrative reading of *quickly*. However, this seems implausible, given that these sentences can be interpreted outside narrative discourse.

Finally, the illocutionary reading of *quickly* stands out because it is not sensitive to the aspectual properties of the modified form. For example, it also arises with stative predicates, which are generally incompatible with adverbs of change (see (1)). One context where the illocutionary reading pops up is in root interrogatives, where intuitively *quickly* restricts the time between the speaker's utterance event and the projected reaction to that utterance, i.e., the anticipated event of the addressee answering the question. An example of this case is given in (10a). Another appropriate context for the illocutionary reading is in imperatives, where *quickly* measures the time between the utterance event and the projected event of complying with the command. This is illustrated in (10b).

(10) a. Quickly, what were the main causes of the Russian Revolution? (Shaer 1998: 13)
b. Quickly, talk to Alfonso. (Rawlins 2013: 174)

More generally, the illocutionary reading seems to be restricted to sentences with a non-assertive force, including interrogatives and imperatives.

Before closing this section, note that *quickly* is generally unacceptable with non-dynamic predicates, at least out of the blue, see (11a). However, in the right context, such combinations can be coerced into an inchoative achievement-like reading, as demonstrated in (11b). This coercion really amounts to a narrative reading, where *quickly* measures the temporal distance between the beginning of the described event (the realization that something is wrong) and a previous salient event (the client's calling back).

(11) a. #Justin slept quickly.
b. The client called back and the operator quickly knew something was wrong.

In summary, *quickly* proves to be compatible with all kinds of dynamic predicates, generating a set of readings largely determined by the aspectual properties of the modified expression. It is thus important to keep track of which reading is compatible with which aspectual class and to explore the implications for the selectional restrictions of adverbs of change concerning the features of dynamicity, telicity, and durativity. Table 1 lists the available combinations of readings for *quickly* with major aspectual classes. Specifically, a rate reading requires predicates that are dynamic and durative, an extent reading requires predicates that are telic (and thus dynamic; see Sect. 3.3), a narrative reading requires telic predicates once again, and an illocutionary reading imposes no aspectual restrictions on the base predicate. In Sect. 4, I will argue that some of these aspectual restrictions emerge naturally from the lexical semantics of *quickly* and need not be explicitly encoded, while at the same time additional restrictions can be introduced through covert aspectual or discourse operators.

Before proceeding to the formal account, I will propose a new treatment of event structure, focusing on the notion of dynamicity. Once this new treatment is independently motivated and made formally precise, its core concepts can be employed in the analysis of *quickly* and other adverbs of change.

[5] In contrast, atelic predicates operate on the currently available reference time.

reading	aspectual class	features
rate	activity, accomplishment	dynamic + durative
extent	accomplishment, achievement	telic
narrative	accomplishment, achievement, inchoative state/activity	telic
illocutionary	(any)	(none)

Table 1 Compatibility of different readings for *quickly* with major aspectual classes and features.

3 Dynamicity and lexical aspect

This section develops a new theoretical framework intended to serve as a basis for the proper semantic analysis of adverbs of change. It proposes to recast standard event mereology so that dynamicity is directly built into the structure of events. Extending prior work, I provide explicit representations for different event types and formally define three key distinguishing features of aspectual class: dynamicity, telicity, and durativity. The proposed definitions of these features will not only play into the semantics of adverbs of change but will also turn out to predict the correct entailment patterns between major aspectual classes.

3.1 Recasting the event mereology

Formal treatments of lexical aspect typically draw a categorical ground-level distinction between events proper and states (e.g., Davidson 1967; Bach 1986; Parsons 1990; Kamp and Reyle 1993: ch.5; Rothstein 2004; Wellwood 2019). The guiding intuition behind this distinction is that events proper are dynamic and imply some sort of change, whereas states are static and do not imply any change. However, this way of proceeding obscures the key issue of what exactly aspectual change is, which hinders further the linguistic analysis of dynamicity. Since events proper are unanalyzed primitives, it becomes challenging to distinguish between different types of change, such as telic versus atelic or punctual versus durative (Comrie 1976: ch.2; Dowty 1979: 3.8.2; Beavers 2013).

To address the issue of aspectual change, I will reimagine the dualistic event–state picture just described and propose to incorporate change directly into the mereological structure of events. The reasoning process involves two major steps. As a first step, I borrow from von Wright (1963) the idea that instantaneous change includes two successive states, where the change itself is constituted by the transition from the prior state to the follow-up state. Von Wright illustrates this idea with the event of opening a window, which consists of a transition from the state of the window being closed to the state of the window being open. As a second step, I generalize this idea to gradual change by adopting what Landman calls the "filmstrip model" of change (Landman 1991: 212–213). This model is based on the metaphor of how moving pictures are created from the fast movement of static frames. That is, in traditional filmmaking each frame is flashed on a screen for a split second and then is immediately replaced by a slightly different frame. Since the persistence of vision blends the frames together, the viewer is left with the illusion of a moving picture. In a similar way, we can conceive of gradual change as a sequence of shifting states. For example, on this view, a

running event would consist of a chain of instantaneous events corresponding to some basic movements, such as individual steps or similar actions.[6]

In order to flesh out the filmstrip model of change, I assume that an event e can be one of two types: a state s or a transition t. Starting with states, these are the fundamental building blocks of all events and can be combined to form larger states. That is, any sum of prior states is also a state, as stipulated in (12).

(12) STATES

If s and s' are states, then their sum $s \oplus s'$ is also a state.

Transitions, on the other hand, are built from states and the arrow operator as follows. A simple transition is constructed through the arrow operator from two prior states and an event property. Furthermore, a complex transition is any event that contains a transition as one of its proper parts. This is formalized in (13).[7]

(13) TRANSITIONS

i. If s and s' are states and Q is an event property, then $s \xrightarrow{Q} s'$ is a transition.

ii. If t is a transition, e is an event, and Q is an event property, then any of the following is also a transition: $t \oplus e$, $e \oplus t$, $t \xrightarrow{Q} e$, or $e \xrightarrow{Q} t$.

To put it plainly, while all events may contain sums, whether an event is a state or a transition depends on the absence or presence of arrows in it, respectively. That is, states contain no arrows, whereas transitions contain at least one arrow. This distinction makes intuitive sense if we keep in mind that only transitions (but not states) are dynamic and that dynamicity is encoded by the arrow operator.[8]

The formal properties of the sum operator $\oplus$ are well known from prior work on mereology (e.g., Champollion and Krifka 2016), and I will adopt the usual assumptions without further discussion.[9] However, we also need to impose certain restrictions on the application of the arrow operator $\rightarrow$. This is done in (14), following related ideas outlined in von Wright (1963: ch.2), Szabolcsi (1982), Landman (1991: ch.5), Pustejovsky (1991), Naumann (2001), Beavers (2013), and Krifka (2014). Note that the symbol $\lhd$ marks the temporal adjacency ("abutment") relation between two events (Kamp and Reyle 1993: 573).

(14) ARROW

If e, e' are events and Q is a property of events, the transition $e \xrightarrow{Q} e'$ is the minimal event containing e and e' such that

i. $\neg Q(e)$ and $Q(e')$,

ii. for all event properties Q': if $Q \not\subseteq Q'$ then $Q'(e) \equiv Q'(e')$, and

iii. $e \lhd e'$.

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[6] Especially with predicates of motion (e.g., *rotate* or *move*), the gradual change described is typically presented as continuous. In the current model, this intuition can be explained if the atoms representing the instantaneous changes within the larger action are small enough to create the impression of a smooth process.

[7] The event property Q is more broadly construed than the lexical description of the entire event and, as evident from the second clause in (13), may hold true or false of state or transition components. See Sect. 3.2 for discussion and illustrations.

[8] Note that the definitions in (12) and (13) are purely syntactic, stipulating how states and transitions are constructed and allowing us to distinguish between these two event types in purely structural terms. It is the job of verbal predicates and general semantic restrictions on the application of constructors (see (14) below) to discriminate between combinations that are meaningful and those that are not.

[9] At a minimum, the sum operator is assumed to be commutative, associative, and idempotent.

Let me elaborate on the three conditions in (14). Starting with (14i), this is the central condition governing the application of the arrow operator. It enforces the intuition that Q "comes about" between e and e', meaning that Q is false of e but true of e'. (14ii) additionally imposes a minimality restriction on the expressed change, stating that e and e' are identical except with respect to Q and anything entailed by it.[10] Finally, (14iii) requires not just that e precede e', but also that these two events be temporally adjacent or "abut" each other, meaning that no third event occurs between them.[11] This is the sense in which, according to our model, change takes no time. There is no "moment of change" during which the change is partially but not fully realized (see Landman 1991: ch.5 for further discussion). While a given change may be preceded or followed by a long and complex process, the change itself occurs instantaneously.[12]

A brief comment on the "parthood" relation $\sqsubseteq$ is in order here. Note that, per the current proposal, events are constructed not only through the sum operator but also through the arrow operator. Therefore, two events may consist of the same parts yet count as distinct if constructed differently. It is thus important to clarify how events of different shapes are mereologically related. Based on the compositional procedure for constructing events in (12)–(13), we need to ensure that state components can be part of transitions or larger states, while transitions can be part of larger transitions but never part of states. These relationships follow directly from how the sum and the arrow operators are defined. That is, it is standard to define $e \oplus e'$ as the minimal event that includes both e and e' as subparts, and I adopt this definition here. Similarly, according to (14), $e \xrightarrow{Q} e'$ is the minimal event containing e and e' as subparts, provided that e and e' are temporally ordered in a certain way and are subject to specific restrictions imposed by Q.

In summary, I have reimagined classical event mereology by introducing two key revisions. Classical event mereology relies on two qualitatively distinct kinds of entities, i.e., events proper and states, and utilizes the sum operator as its only tool for constructing wholes from parts. In contrast, I propose that all events are built from states, and that this is done by using not one but two operators: sum and arrow. The distinction in dynamicity between states and transitions now hinges on whether the arrow operator is present. States, being static, do not contain the arrow operator; transitions, which are dynamic, do.

3.2 Event types

With the revised event mereology in place, we can now flesh out intuitive contrasts between different event types. Ever since Vendler (1957), the aspectual literature has distinguished between four main event types: states, activities, accomplishments, and achievements (Kenny 1963: ch.8; Comrie 1976: ch.2; Taylor 1977; Mourelatos 1978; Dowty 1979; Bach 1986; Moens and Steedman 1988; Parsons 1990: ch.3; Pustejovsky 1991; Kamp and Reyle 1993: ch.5; Verkuyl 1993; Smith 1997; Kearns 2000: ch.9; Rothstein 2004; Beavers 2013; a.o.).[13] Differences in event type have reflexes in linguistic distribution and are assumed to result from

[10] Although other contingent changes may have occurred simultaneously, I submit that these are conceptualized as distinct transitions.

[11] More formally, where $<$ is the temporal precedence relation (a strict total order), $e \lhd e'$ iff $e < e'$ and there is no e'' such that $e < e''$ and $e'' < e'$.

[12] Conditions (14i) and (14iii) also entail that the arrow operator is anticommutative, meaning that if $e \xrightarrow{Q} e'$ is defined, it is never the case that $e' \xrightarrow{Q} e$ is defined as well. This captures the intuition that change is always "directed".

[13] Sometimes accomplishments and achievements are merged into a single category.

differences in internal composition. I will now demonstrate how the common-sense intuitions about these four event types can be explicitly represented.

Starting with states, these are the kind of things referred to by predicates like *know*, *love*, *be asleep*, and so on. States are assumed to be "divisible" in the sense that they consist of smaller states that are of the same kind (cf. Bach 1981; Krifka 1989; Landman and Rothstein 2012a, 2012b; Champollion and Krifka 2016).[14] While divisible, states do not express change, and so they must be constructed solely through the sum operator. This is schematized in (15).

(15) STATES: $s = s_1 \oplus \cdots \oplus s_n$

Moving on to achievements, these are the type of events referred to by predicates like *notice the plane* or *reach the top*. Although achievements always involve transitions, Bach (1986) distinguishes between two kinds: "happenings" and "culminations". Happenings, referred to by predicates like *notice the plane*, constitute simple transitions from a prior state to a follow-up state and require no preparation in order to occur. In contrast, culminations are described by predicates like *reach the top* and constitute complex transitions that are preceded by a preliminary process. These two structures are schematized in (16) (the details of the preliminary process in (16b) will be further specified in (18b) below).

(16) ACHIEVEMENTS (preliminary)

a. HAPPENINGS: $t = s \xrightarrow{Q} s'$

b. CULMINATIONS: $t = t' \xrightarrow{Q} s$

Note that a transition label, marked as Q in (16), need not coincide with the description of the entire event. In fact, since such labels apply to (follow-up) states, they will not be appropriate descriptions of the entire transition. Nonetheless, the two predicates are closely linked, as an achievement description will (contextually) entail the label predicate. For example, the achievement description *notice the plane* entails the label predicate 'be aware of the plane', where the former is dynamic and applies to the transition as a whole while the latter is non-dynamic and applies to the resulting state. Similar observations can be made about other types of transitions, such as activities and accomplishments, which will be discussed below.

Now let us consider activities. Activity events are described by predicates like *walk* or *drive a car*. Similar to states, activities are divisible into smaller parts that are of the same kind. However, unlike states, activities are not sums of smaller states; rather, they are sums of simple achievement-like transitions. Their structure is schematized in (17), which exemplifies a sum of simple transitions from s_0 to s_1, from s_1 to s_2, and so on up to s_n.

(17) ACTIVITIES: $t = (s_0 \xrightarrow{Q_1} s_1) \oplus (s_1 \xrightarrow{Q_2} s_2) \oplus \cdots \oplus (s_{n-1} \xrightarrow{Q_n} s_n)$

It is important to emphasize that the labels within any specific activity need not be the same. For example, in an activity described by *walk*, appropriate labels might include 'have taken one step', 'have taken two steps', and so on. Similar to achievements, these labels will be (contextually) entailed by the description of the entire activity, i.e., *walk*.

[14] I will set aside the issue of whether states are *infinitely* divisible. This issue is tied to the broader question of whether there is linguistic evidence for saying that event mereology is strictly atomic, strictly atomless, or perhaps a combination of both. Even if atomic, also relevant is how stable such atoms are, given the possibility of different individuation criteria (cf. Chierchia 2010).

Having outlined the structure of activities, we can now spell out the structure of culminations, which was left unspecified in (16). I will assume that the preliminary process for this kind of achievement is simply an activity, i.e., a sum of simple transitions. This is made explicit in (18).

(18) ACHIEVEMENTS (final)

a. HAPPENINGS: $t = s \xrightarrow{Q} s'$

b. CULMINATIONS: $t = ((s_0 \xrightarrow{Q_1} s_1) \oplus (s_1 \xrightarrow{Q_2} s_2) \oplus \cdots \oplus (s_{n-2} \xrightarrow{Q_{n-1}} s_{n-1})) \xrightarrow{Q_n} s_n$

Finally, accomplishments are typically conceived as activity-like processes that reach a certain point and are followed by a state. Often, their initial segment is called a "preparatory phase", their final segment is called a "consequent" (or "result") state, and the change itself is called a "culmination point" (cf. Moens and Steedman 1988; Kamp and Reyle 1993: 5.3.2). Despite this intuitive complexity, I will assume that accomplishments are just sums of simple transitions. This is illustrated in (19), where the preparatory phase corresponds to the chain of transitions from s_0 through s_{n-1}, the consequent state corresponds to s_n, and the culmination point corresponds to the final transition from s_{n-1} to s_n.

(19) ACCOMPLISHMENTS: $t = (s_0 \xrightarrow{Q_1} s_1) \oplus (s_1 \xrightarrow{Q_2} s_2) \oplus \cdots \oplus (s_{n-1} \xrightarrow{Q_n} s_n)$

Note that (19) displays the exact same structure as that proposed for activities in (17). One general motivation for this assumption is that the very same event can be felicitously described by both an activity predicate, such as *run*, and an accomplishment predicate, such as *run to the store*. More important for our purposes, in Sect. 2 we established that when *quickly* modifies accomplishment predicates, this adverb can describe the rate of the action, just like when *quickly* modifies activity predicates. Despite this internal similarity between accomplishment and activity events, one salient difference is that the former but not latter are felt to be oriented toward a goal, or to be telic. Following Krifka (1989) and much subsequent work, I take it that this contrast in telicity is encoded not at the level of individual events but rather in the way the denotation of the corresponding predicate is structured.[15] That is, the denotation of accomplishment predicates is "quantized", meaning that no event is a proper part of another event. In contrast, the denotation of activity predicates is "cumulative", i.e., the sum of any two events in the denotation is also included in the denotation. These formal notions will be made explicit in Sect. 3.3.

Comparing (19) with (18b), one might wonder why the significant structural difference between accomplishments and culmination achievements, given that these event types share some intuitive similarity. That is, both an accomplishment predicate like *run to the store* and a culmination predicate like *win the race* are felt to refer to events that start with a preliminary process, reach a culmination point, and end in a consequent state. However, despite this intuitive similarity, Bach (1986) points out that culminations are like happenings and unlike accomplishments in that they are punctual rather than durative. For example, only the former allow for modification by temporal point adverbials like *at 3:04 p.m.* (see Sect. 3.3). This aspectual difference in punctuality/durativity is one of the key reasons why culminations and accomplishments must be kept apart.[16]

[15] This also means that, strictly speaking, terms like "accomplishment" and "achievement" should only be applied to predicates (or their respective denotations). Nonetheless, here I follow common practice and use such terms to refer to individual events as well.

[16] The punctuality/durativity contrast captures the basic intuition that culmination predicates pick out the very moment of change while accomplishment predicates make salient the entire described event, including the preliminary process (Kamp and Reyle 1993:

We have demonstrated how our revised event mereology can represent different event types. According to this mereology, all events are constructed from the same basic building blocks. Event types differ only in the way they are constructed, i.e., in how the sum and the arrow operators combine simple states to form complex structures. This implies that event types are hierarchically structured, with more complex event types built from simpler event types. More specifically, states are composed of smaller states, happenings are transitions from one state to another, activities/accomplishments are sums of happening-like transitions, and culminations are complex transitions from activities/accomplishments to states. Moreover, states and activities/accomplishments are sums of smaller parts, while happenings and culminations have the arrow operator as their main connector. The emerging typology of events is represented in Figure 1.

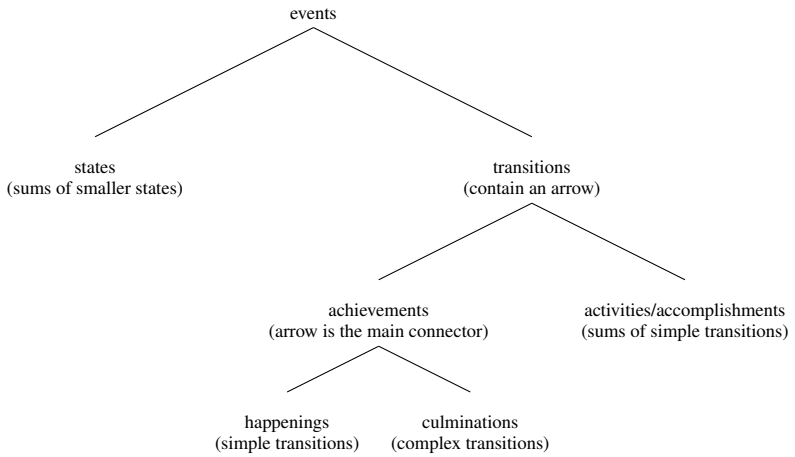

Fig. 1 Basic event typology predicted by the revised mereology.

3.3 Dynamicity, telicity, durativity

The internal structure of each event type projects certain properties that only partially determine its membership in a given aspectual class. The mapping from internal event structure to aspectual class is partial because the very same event may sometimes be viewed as belonging to different aspectual classes. For example, as mentioned in the previous subsection, a given running event may be conceptualized as either an activity or an accomplishment (cf. *run* vs. *run to the store*). This raises the question of what properties event predicates may have that are not encoded in individual events. More generally, what properties carve out the logical space in which aspectual classes reside?

Work on lexical aspect has traditionally relied on a small number of distinctive features that generalize attested commonalities and differences across aspectual classes. One very popular triad of features is that of dynamicity, telicity, and durativity (e.g., Comrie 1976:

5.3.2). For this reason, punctuality will be directly linked to the arrow being the main connector of the underlying event (see the following subsection).

ch.2; Mourelatos 1978; Smith 1997; Kearns 2000: ch.9; Rothstein 2008; Beavers 2013). I will adopt this triad as a basis for core aspectual classification. I will first rehearse the established empirical picture on how these three features describe the main aspectual classes, and then will go on to formally define dynamicity, telicity, and durativity. The proposed definitions are based on the event typology developed in the previous subsection and will play a crucial role in the analysis of adverbs of change in Sect. 4 and 5.

I start with the dynamicity feature. Dynamicity concerns the intuition that certain verbal predicates convey change. However, to the best of my knowledge, this intuition has not been supported by a clear empirical diagnostic. Typically, a host of diagnostics are employed to distinguish between stative predicates, on the one hand, and activity/accomplishment/achievement predicates, on the other hand; the latter class of predicates is then simply called "dynamic". Here I will take felicitous modification by adverbs of change as the primary diagnostic for dynamicity.[17] That is, among the four major aspectual classes, only stative predicates reject modification by adverbs of change (barring the possibility of a repair reading through aspectual coercion). This is demonstrated by the data in (20), which involves *quickly* and is repeated from (1) above.

(20) a. #Justin loved Selena quickly. (state)
b. Selena ran quickly. (activity)
c. Selena ran to the park quickly. (accomplishment)
d. The boy quickly spotted the plane. (achievement)

The reason why adverbs of change select for dynamic predicates is simple and will be discussed in detail in Sect. 4 and 5. In short, the lexical semantics of such adverbs presupposes that the modified predicate is dynamic and imposes further restrictions on the duration of the targeted events.

As for telicity, this feature captures the common-sense intuition that accomplishments and achievements are bounded by a goal and cannot progress beyond a given point in time. This contrasts with states and activities, which lack natural boundaries. A standard test used in the literature to diagnose telicity involves the contrast between temporal *in-* and *for*-adverbials, where telic predicates take *in*-adverbials and atelic predicates take *for*-adverbials. This is shown in (21).

(21) a. John liked Mary $\left\{\begin{matrix}\text{\#in a year}\\ \text{for a year}\end{matrix}\right\}$. (state)
b. Pedro walked $\left\{\begin{matrix}\text{?in an hour}\\ \text{for an hour}\end{matrix}\right\}$. (activity)
c. Bertha painted a picture $\left\{\begin{matrix}\text{in an hour}\\ \text{?for an hour}\end{matrix}\right\}$. (accomplishment)
d. Kim won the race $\left\{\begin{matrix}\text{in a few minutes}\\ \text{\#for a few minutes}\end{matrix}\right\}$. (achievement)

Why do *in*-adverbials pair with telic predicates and *for*-adverbials pair with atelic predicates? The usual explanation is that *for*-adverbials distribute over event structure while *in*-adverbials

[17] Notice, though, that not all possible combinations between adverbs of change and dynamic predicates are felicitous. In Sect. 5, I will suggest that such semantic gaps arise from idiosyncratic restrictions on available scopal sites for individual adverbs.

modify maximal events (cf. Dowty 1979: ch.7; Landman and Rothstein 2012a, 2012b; Champollion 2017: ch.5). If only atelic predicates are assumed to make available event parts, the pattern in (21) falls out naturally.

Finally, the durativity feature reflects the intuition that states, activities and accomplishments are presented as taking time, while achievements are presented as punctual. This feature can be diagnosed by temporal *at*-adverbials, which single out achievements (happenings or culminations), as demonstrated in (22).[18]

(22) a. #John hated Mary at 3:04 p.m. (state)
b. #A man walked in the park at 3:04 p.m. (activity)
c. #Pat cleaned the house at 3:04 p.m. (accomplishment)
d. The gas main exploded at 3:04 p.m. (happening)
e. We reached the summit at 3:04 p.m. (culmination)

A natural explanation for the pattern observed in (22) is that *at*-adverbials refer to instants rather than temporal intervals (cf. Vendler 1957; Bennett and Partee 1972). If durative predicates are assumed to refer to events that span intervals, such predicates are expected to be incompatible with *at*-adverbials.

We have arrived at the commonly cited aspectual classification summarized in Table 2. The fact that not all possible combinations are represented suggests that there are interactions between the different features, such that the specifications of one feature may determine the specifications of another feature. Concretely, two important generalizations can be drawn regarding how dynamicity is linked to telicity and durativity, as stated in (23)–(23).

aspectual class	**dynamic**	**telic**	**durative**
states	−	−	+
activities	+	−	+
achievements	+	+	−
accomplishments	+	+	+

Table 2 Classification of aspectual classes in terms of dynamicity, telicity, and durativity.

(23) GENERALIZATION A

While dynamic predicates can be telic or atelic, all telic predicates are dynamic (cf. Rothstein 2008).

(24) GENERALIZATION B

A punctual predicate (i.e., an achievement) is always telic, and therefore—by Generalization A—also dynamic (see Comrie 1976: 50).

[18] Another common diagnostic involves inceptive and terminative operators, like *begin*/*start* or *finish*/*stop*. Barring the possibility of a habitual interpretation, these operators are only acceptable with durative predicates (Dowty 1979: 2.2; Smith 1997: ch.3).

These two generalizations are something that any theory of lexical aspect should be able to capture. Indeed, they will be accounted for by the analysis of dynamicity, telicity, and durativity presented at the end of this subsection.[19]

Notice that the aspectual classification developed here is not intended to be exhaustive. One class not mentioned above includes predicated like *watch TV*, *sleep*, or *wait*. I will call such predicates "stativities", as they seem to display the linguistic behavior of activities but are nonetheless static in the intended sense (Dowty 1979: 3.8; Bach 1986; Maienborn 2007; Copley and Harley 2015). Another class not included comprises predicates like *tap*, *knock*, or *flap*. On their "semelfactive" reading these predicates denote achievement-like events, while on their "iterative" reading they resemble activities (Comrie 1976: ch.2; Smith 1997; Rothstein 2008). Also absent from the above typology are degree achievements, i.e., deadjectival verbs like *widen* or *darken* (Dowty 1979: 2.3.5; Hay et al. 1999; Kennedy and Levin 2008; Piñón 2008; Rothstein 2008; Kennedy 2012). The class of stativities will feature in following discussions, mostly to exclude it from the class of dynamic predicates while also distinguishing it from classical statives like *know* or *be happy*. The latter two aspectual classes (semelfactives/iteratives and degree achievements) are generally compatible with adverbs of change, although they are ambivalent regarding their durativity or telicity properties. None of these more complex classes of predicates will be given an explicit analysis, and I leave it to future research to determine whether the proposed formalism can be fruitfully employed or extended to elucidate their properties as well.

Our final and most important task in this subsection is to provide model-theoretic definitions for the three aspectual features of dynamicity, telicity, and durativity. Dynamicity is the most crucial feature for our purposes because it is directly selected by adverbs of change. Dynamicity is typically analyzed in terms of heterogeneity (cf. Vendler 1957; a.o.), meaning that events referred to by a dynamic predicate are viewed as having parts that no longer fall under that predicate. For example, an event described by the activity predicate *waltz* may have parts—say, single steps—that are too small to still count as waltzing. Conversely, non-dynamic predicates (e.g., *believe*) are assumed to refer to homogenous events where all event parts, no matter how small, fall under the same predicate. The relevant formal property that characterizes homogeneity and contrasts it with heterogeneity is "divisibility" (Bennett and Partee 1972; Taylor 1977; Dowty 1979; Bach 1981; Krifka 1989; Landman and Rothstein 2012a, 2012b; Champollion and Krifka 2016). It is defined in (25).

(25) DIVISIBILITY

P is *divisible* iff for every two events e and e' such that $P(e)$ and $e' \sqsubset e$, it holds that $P(e')$.

However, characterizing non-dynamic predicates as divisible and dynamic predicates as non-divisible presents certain challenges, particularly when working with traditional event mereology where the sum operator is the only way to construct wholes from parts. For example, we predict that stativities (like *watch TV*, *sleep*, or *wait*) are divisible, whereas activities (like *drive a car* or *glide*) are non-divisible, which may seem counterintuitive or arbitrary if larger events are just sums of smaller events. Moreover, the divisibility property imposes

[19] Of course, if further empirical research uncovers feature combinations that contradict some of these generalizations, the theory itself would have to be revised.

strong ontological commitments on certain aspectual classes. For example, we need to stipulate that achievement predicates, while implying punctuality, refer to events with proper parts that do not fall under the same predicate. This is because, if achievement predicates refer to mereological atoms, they will vacuously satisfy the divisibility property in (25) and be incorrectly classified as non-dynamic.[20]

In contrast to these challenges, the event typology proposed in Sect. 3.2 is tailor-made to characterize dynamicity. We can simply say that dynamic predicates are those that apply to transition events as defined in (13), i.e., events that contain the arrow operator. This concept is stated in (26) and encompasses activities, accomplishments, and achievements.

(26) DYNAMICITY

P is *dynamic* iff *P* only applies to transition events.

Note that now non-divisibility directly falls out from dynamicity. That is, since transition events are fundamentally built from states, a dynamic predicate will always refer to events which have parts (i.e., states) that do not fall under said predicate.

Moving on to telicity, one straightforward way to characterize this feature is through the "quantization" property, which is about how a predicate's denotation is structured (Krifka 1989, 1992). A predicate counts as quantized when its denotation is exclusively comprised of complete events, i.e., the denotation does not include any two events such that one is a proper part of the other. This property is defined in (27).

(27) QUANTIZATION

P is *quantized* iff there are no events e and e' such that $P(e)$, $P(e')$, and $e \sqsubset e'$.

The characterization of telicity in terms of quantization has been relaxed in more recent work, typically due to concerns about how the intuition of a culmination point arises and the role of verbal objects in it (Krifka 1998; Kratzer 2004; Beavers 2012; a.o.). Here I will set aside these concerns and accept that quantization is a key part of the notion of telicity. Crucially, I point out that even the stricter quantization-based characterization in (27) does not link telicity with dynamicity tightly enough. That is, recalling Generalization A in (23), the quantization property alone provides no clue as to why telic predicates are dynamic. It allows for the possibility of telic predicates that are static, which is at odds with the basic intuition that telic predicates are inherently goal-oriented and necessarily convey change.[21] To address this issue, I will simply propose that telicity requires both quantization and dynamicity (cf. Verkuyl 1993: ch.1), where—intuitively speaking—quantization ensures event boundedness and dynamicity guarantees goal orientation. This is codified in (28).[22]

(28) TELICITY

P is *telic* iff *P* is both quantized and dynamic.

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[20] At a more basic level, it would also be unclear how mereological atoms manage to convey change.

[21] A reviewer brings up the interesting case of non-dynamic predicates bounded by *for*-measure phrases, such as *believe something for 20 years* or *sleep for five hours*, suggesting that they are telic. However, while such complex predicates may be quantized, they are not dynamic and therefore not telic in the sense discussed here. Moreover, standard tests for telicity (compatibility with *for/in*-temporal adverbials, modification by *almost*, modification by conjoined temporal location adverbials, entailments of the progressive form; see Dowty 1979: 2.2 and Verkuyl 1993: 2.3) either prove difficult to apply to such predicates or do not paint a clear picture (I omit the relevant data here for brevity). A more detailed study of such predicates is left for future work.

[22] Ultimately, we should aim for a definition of telicity that entails dynamicity not through stipulation but by providing additional explanatory value. If such a definition cannot be found, then telicity would merely serve as a descriptive label for the combination of quantization and dynamicity.

Since only accomplishment and achievement predicates have denotations that are both quantized and dynamic, this definition correctly identifies these two aspectual classes as telic.[23]

Finally, let us address the durativity feature. Two options for defining durativity—and its opposite, punctuality—are in terms of temporal instantaneity or event atomicity. However, neither option seems to lead to satisfactory results. Starting with the first idea, if predicates were punctual because they refer to events which only last for a moment, then the question of punctuality is merely shifted from the domain of events to the domain of times (cf. Freed 1979: 3.1; Engelberg 2000). And if predicates were punctual because they refer to events that are mereological atoms, it would be unclear why achievements (the only punctual predicate in our aspectual typology) can convey change at all (but see Piñón 1997).

Here I will take a different approach to punctuality, utilizing the filmstrip model of change presented in Sect. 3.1. Building on the intuition that minimal change happens instantaneously, I propose that punctual predicates are those that refer to "direct" transitions, i.e., events whose main connector is the arrow operator. Recalling the structure of different event types from Sect. 3.2, this correctly singles out achievements as the only type of punctual predicates. In turn, durative predicates are defined as being non-punctual, i.e., those that apply to events that do not have the arrow operator as a main connector, including states, activities, and accomplishments. The formal definitions are provided in (29).[24]

(29) PUNCTUALITY/DURATIVITY

i. P is *punctual* iff for every event e in P there are events e', e'' and an event property Q such that $e = e' \xrightarrow{Q} e''$.

ii. P is *durative* iff P is not punctual.

According to this definition, punctual predicates are necessarily dynamic as they refer to transition events. By making the standard assumption that the denotation of punctual predicates is quantized, we predict more specifically (following the definition in (28)) that such predicates are also telic. This derives Generalization B in (24), i.e., the fact that punctuality entails telicity.

3.4 Related approaches to dynamicity

There are several related formal approaches to lexical aspect that make predictions about dynamicity. This subsection provides a brief comparison of my proposal to three such approaches: a categorical state–event distinction, Dowty (1979)'s aspect calculus, and Copley and Harley (2015)'s force dynamics. I will highlight their key features and suggest that these approaches do not draw the desired contrasts in dynamicity.

[23] A reviewer wonders how the current proposal predicts that adding an object to an activity predicate may result in an accomplishment predicate, thereby enforcing a shift in telicity (e.g., *run* versus *run to the park*). The general issue of aspectual composition is complex and falls beyond the scope of this paper. However, I expect my proposal to be compatible with the approach developed in Krifka (1989, 1992, 1998). In this approach, the aspectual features of different verbal expressions are not explicitly represented but emerge as metaproperties of verbal denotations produced during the standard semantic composition. For example, while the dynamic verb *write* may denote both partial and complete writing events, given that the noun phrase *a letter* has quantized reference and the bare plural *letters* has cumulative reference, the combinations *write a letter* and *write letters* will yield telic or non-telic denotations, respectively.

[24] Beavers (2008, 2012, 2013) is one place in the literature where the notions of punctuality/durativity are directly linked to the mereological complexity of events. For Beavers, a punctual event consists of just two atoms (including a beginning and an end), while a durative event consists of more than two atoms (including a beginning, a middle part, and an end).

One popular assumption in the literature on lexical aspect, previously mentioned in Sect. 3.1, is that verbal predicates refer to one of two sorts of entities: events proper or states (e.g., Parsons 1990). At the core of this distinction lies the concept of dynamicity. That is, dynamic predicates—including (at least) activities, accomplishments, and achievements—are taken to refer to events proper, whereas non-dynamic predicates are taken to refer to states.

Needless to say, this kind of ontologically primitive binary divide provides no explanation for what makes one type of event dynamic and another type of event non-dynamic. This contrasts with my distinction between states and transitions, where the latter are derived from the former in a principled way, thus capturing core intuitions about the structure of different event types. Another challenge is that the state?event distinction seems too coarse-grained to make empirically correct contrasts, with stativities being the problematic case. Specifically, stativity predicates describe situations with spatiotemporal dimensions, thus meeting the individuation criteria for eventhood (cf. Davidson 1967). Such predicates also share core properties with activities; most notably, they are interpreted episodically in the progressive form and habitually in the simple present (cf. *Frida is sitting in the living room* versus *Frida sits in the living room*, respectively). While this would mean that stativities are dynamic, i.e., they refer to events proper, such predicates turn out to be rejected by adverbs of change (cf. **Jack waited quickly/slowly*). We seem to be in need of a further sortal distinction, perhaps within events proper, in order to differentiate between stativities and genuinely dynamic predicates.

A different approach to dynamicity is the well-known aspect calculus of Dowty (1979). The central claim of this approach is that the puzzling diversity of lexical aspects can be explained by combining stative predicates through a small number of sentential aspectual operators (i.e., BECOME, CAUSE, and DO). Most importantly, stative predicates are assumed to be conceptually simple and represented without the use of aspectual operators, whereas dynamic predicates are assumed to correspond to stative predicates embedded in complex formulas through one or several aspectual operators.

Dowty's aspect calculus is similar to the current system in that it builds lexical aspects in a combinatorial fashion. In fact, since this approach employs a number of aspectual operators, it achieves very broad empirical coverage. However, this diversity comes at a cost, as no single notion of dynamicity emerges.[25] This contrasts with my proposal, which employs an *atomic* notion of dynamicity based on the arrow operator. A related issue with the aspect calculus is that the dynamic/non-dynamic distinction is made at the level of logical representation and not at the level of meaning itself. This implies that aspectual operators represent a cluster of semantic properties rather than a uniform concept. As a result, it becomes difficult to understand how adverbs of change can select for dynamic predicates, assuming that linguistic selection is fundamentally a semantic process.

The approach to dynamicity that seems most closely aligned with my own proposal is that of Copley and Harley (2015). This approach draws on the notion of "force", intended to capture the energy inherent in a given situation. That is, Copley and Harley make a fundamental distinction between situations and forces: stative predicates denote properties of situations whereas dynamic predicates denote properties of forces (i.e., causal functions from an initial

[25] Specifically, BECOME conveys that a proposition holds in the current moment but did not hold in a previous moment; CAUSE encodes a logical dependence between two propositions; and DO centers around the notion of agentivity. However, it remains unclear that these operators are logically independent of each other and that they exhaustively characterize the intuitive notion of aspectual change.

situation to a final situation). Using these ideas, Copley and Harley apply their force-theoretic approach to derive familiar aspectual classes within a lexical-decomposition syntax.

On the face of it, the situation–force distinction is very similar to my state–transition distinction: transitions are derived from states just as forces are derived from situations. However, Copley and Harley view dynamicity in a much more physicalist way, treating it as encompassing the forces that accumulate in a given situation and may lead to a new situation, provided no outside force intervenes. Crucially, the authors explicitly argue that stativity predicates are "dynamic" in the sense of requiring a force that maintains the described situation, while also noting that such predicates do not convey change. This correctly identifies stativity predicates as sharing properties with activities while being incompatible with adverbs of change. In short, the notion of dynamicity employed by this approach is useful yet broader than the one carved out by adverbs of change.

3.5 Summary

We have developed a novel perspective on event mereology that defines and correctly predicts the logical relationships between the key aspectual features of dynamicity, telicity, and durativity. With this framework in place, we can now turn our attention to the semantics of adverbs of change, thereby illustrating the advantages of our more explicit model of lexical aspect.

4 Formal account: *Quickly*

This section develops a formal account for *quickly*, beginning with its gradability. It then goes on to demonstrate how the proposed semantics interacts with the aspectual properties of the target predicate to derive the four readings of *quickly* discussed in Sect. 2.

4.1 Gradability

Several linguistic analyses treat *quickly* as grammatically gradable (e.g., Heim 2006; Rawlins 2013; Wellwood 2019: 6.3.3). This is motivated by the observation that this adverb occurs in the comparative and accepts degree modifiers like *very*, as illustrated in (30).

(30) a. Jill ran to the park more quickly than Jack (did).
b. Jill ran to the park very quickly.

Within the degree-based approach to gradability (Cresswell 1976; a.o.), such data can be captured by the assumption that gradable expressions encode measure functions whose value is compared to some appropriate standard. Here I will adopt this approach, assuming more specifically that *quickly* measures out event duration. A preliminary lexical entry is stated in (31).

(31) $[\![\text{quickly}]\!] = \lambda d \lambda P \lambda e\,.\,P(e) \wedge d \preceq \mathbf{short}(e)$ (preliminary)

According to this entry, *quickly* carries over the meaning of the modified predicate (first conjunct) and compares the duration of the described event to some degree of length (second conjunct). More formally, *quickly* encodes the measure **short**, which maps events to degrees of temporal duration such that higher degrees on the scale correspond to shorter events.[26] This

[26]The measure **short** can be decomposed into Krifka (1989)'s "temporal trace"/"run time" function, which maps events to the intervals they occupy, plus the "temporal extent" function, which maps intervals to their temporal extent (see Rawlins 2013).

is evident from (30), where in the comparative sentence the main clause contains the shorter event, and degree intensification by *very* additionally reduces the duration of the measured event.

The degree argument made available by gradable expressions is manipulated by degree constructions or degree adverbs. In the case of *quickly*, this argument is manipulated by comparative morphemes like *more*, intensifiers like *very*, or—in the absence of overt degree morphology—by a covert POS modifier. Existing literature provides semantic accounts of adjectival versions of these elements (Cresswell 1976; Klein 1980; von Stechow 1984; Heim 1985; Kennedy 1999; Kennedy and McNally 2005; Morzycki 2016; Wellwood 2019; a.o.). Here I extend these accounts to include adverbial counterparts to the adjectival prototypes.

Kennedy and McNally (2005) define adjectival POS as in (32). According to this entry, POS takes a gradable adjective (like *tall*) and states that the degree to which the denoted property P (say, "tallness") applies to the relevant object x exceeds some standard value. This last value is selected by the standard function **std** on the basis of P (which determines the scale dimension) and a contextually supplied comparison class C^c of objects that are of the same kind as x.

(32) $[\![\text{POS}]\!]^c = \lambda P \lambda x . \exists d [P(d)(x) \wedge \mathbf{std}(P, C^c) \prec d]$

An adverbial counterpart POS_{Adv} is presented in (33a).[27] This entry differs from (32) mainly in that it introduces an extra argument A for the modified gradable adverb. This argument restricts the events that fall under the verbal property P (first conjunct) and also determines the dimension along which the events in the comparison class P^c are measured (second conjunct). The result of composing POS_{Adv} with *quickly* is shown in (33b). This meaning subsequently applies to verbal properties, requiring that the denoted events have a shorter duration than the standard duration for events of this kind.

(33) a. $[\![\text{POS}_{Adv}]\!]^c = \lambda A \lambda P \lambda e . \exists d [A(d)(P)(e) \wedge \mathbf{std}(A, P^c) \prec d]$

b. $[\![[\text{POS}_{Adv}\ \text{quickly}]]\!]^c$
$= \lambda P \lambda e . \exists d [P(e) \wedge d \preceq \mathbf{short}(e) \wedge \mathbf{std}([\![\text{quickly}]\!], P^c) \prec d]$
$= \lambda P \lambda e . P(e) \wedge \mathbf{std}([\![\text{quickly}]\!], P^c) \prec \mathbf{short}(e)$

Adverbial versions of *very* and *more* can be defined analogously.[28] For example, $very_{Adv}$ states that the modified adverbial applies to a degree that not just exceeds the standard but does so by a significant amount. This is formalized in (34), where $d \prec\!\prec^c d'$ indicates that d' exceeds d by some amount that counts as significantly large in the context c. Note that this is the same meaning as the one for POS_{Adv} in (33a), except for the intensification property enforced in the second conjunct.

(34) $[\![\text{very}_{Adv}]\!]^c = \lambda A \lambda P \lambda e . \exists d [A(d)(P)(e) \wedge \mathbf{std}(A, P^c) \prec\!\prec^c d]$

In turn, $more_{Adv}$ compares two degrees, asserting that the modified adverbial applies to the event described by the matrix clause to a higher degree than it applies to the event described by the comparative clause, as illustrated in (30b). This relationship is formalized in (35), where

[27] Notice that both versions of POS (adjectival and adverbial) only apply to "relative" gradable predicates, which have vague standards taken from the middle of the relevant scale, as opposed to "absolute" gradable predicates, which take as standards the scale minimum or the scale maximum (Rotstein and Winter 2004; Kennedy and McNally 2005; Burnett 2017). Since *quickly* is clearly a relative adverb, I will put absolute predicates aside.

[28] Their adjectival counterparts are not discussed here for reasons of space.

it is assumed that comparative clauses denote the maximal degree to which the contained gradable predicate applies (Heim 1985).

(35) $[\![\text{more}_{Adv}]\!] = \lambda A \lambda d' \lambda P \lambda e \,.\, \exists d\,[A(d)(P)(e) \wedge d' \prec d]$

In sum, the gradability properties of *quickly* naturally emerge from a conservative extension of a standard degree semantics originally developed for gradable adjectives. Following this tack provides the first step toward a realistic semantics for *quickly* and other gradable adverbs of change (see Sect. 5).

4.2 A semantics for *quickly*

Sect. 4.1 outlined a semantics for *quickly* that captures its core gradability properties. However, this semantics is lacking in two important respects. First, as discussed in Sect. 2, *quickly* typically imposes selectional restrictions on the aspectual profile of the modified predicate. Yet nothing said so far prevents this adverb from composing with predicates from any aspectual class. Second, per our preliminary semantics, *quickly* measures out event duration (on a shortness scale). While this analysis directly captures the extent reading, it remains unclear how the rate, narrative, and illocutionary readings are to be derived. The current subsection complicates the semantics for *quickly*, addressing the first issue and preparing the ground for tackling the second issue in the following subsections.

I propose to enrich the preliminary entry for *quickly* in (31) in two respects: by imposing restrictions on the aspectual profile of the modified predicate and by allowing the underlying measure to distribute over mereological structure. Starting with the first enrichment, Sect. 2 established that *quickly* selects for dynamic predicates.[29] I will thus impose dynamicity as a definedness condition on the lexical entry for *quickly*. The second enrichment is needed to derive the rate reading of *quickly* (see the next subsection). Following Cresswell (1978) and Rawlins (2013), I will assume that the measure encoded by *quickly* distributes over event structure, targeting the minimal event parts that still fall under the base predicate.

The final entry for *quickly* is stated in (36). To appreciate it, recall from (26) that dynamic predicates apply to transitions, i.e., events that contain the arrow operator, the bearer of aspectual change. Additionally, the set of P-atoms of an event e contains all minimal parts of e that fall under P. This set is defined in (37).[30]

(36) $[\![\text{quickly}]\!] = \lambda d \lambda P \lambda e : \mathbf{DYN}(P) \,.\, P(e) \wedge \forall e' \in \mathbf{atom}(e,P)\,[d \preceq \mathbf{short}(e')]$ (final)

(37) $\mathbf{atom}(e,P) = \{e' \in P \,|\, e' \sqsubseteq e \wedge \neg \exists e'' \in P\,[e'' \sqsubset e']\}$

I will now demonstrate how this semantics for *quickly* derives the attested readings (rate, extent, narrative, illocutionary). The core idea behind this analysis is that all readings involve measuring event duration, with differences in interpretation arising from the kind of events being targeted.

[29] While the illocutionary reading of *quickly* may seem like an exception as it does not restrict the aspect of the underlying lexical predicate, I will propose in Sect. 4.6 that this reading involves a covert linguistic layer which provides the required dynamicity.

[30] If P is quantized, none of the events it applies to will be proper parts of each other. In this case, the set of P-atoms of e will be the singleton $\{e\}$.

4.3 The rate reading

The rate reading of *quickly* implies that the described action evolves rapidly. This reading is derived for activity predicates in (38), where the bracketed part of (38a) results in the meaning in (38b).

(38) Selena ran quickly.

a. Selena [run [POS_{Adv} quickly]]

b. $\lambda e\,.\,run(e) \wedge \forall e' \in \mathbf{atom}(e, run)\,[\mathbf{std}([\![\text{quickly}]\!], run^c) \prec \mathbf{short}(e')]$

The resulting meaning states that the minimal parts of the relevant running event that still count as runnings are of a shorter duration than the standard duration for running events of this kind. Depending on the context, these atoms may correspond to short stretches of running, individual steps, or perhaps even smaller movements, giving rise to the intuition of an overall fast rate.

It is worth pausing to comment on the nature of the atomic events measured by *quickly* in its rate reading. Typically, bringing atomic events into the analysis introduces the "minimal-parts problem", i.e., the issue of when event parts become too small to satisfy an atelic predicate (Taylor 1977; Dowty 1979: 7.3; Moltmann 1991; Vlach 1993; Landman and Rothstein 2012a, 2012b; Champollion 2017: ch.5; a.o.). However, since my account incorporates dynamicity directly into event structure, the minimal-parts problem does not really arise, at least not for activities. That is, recalling Sect. 3.2, activity predicates denote simple transitions of the form $s \xrightarrow{Q} s'$ and their sums. This means that the minimal parts are explicitly represented as simple transitions and distribution over them can readily apply. Moreover, although such simple transitions count as punctual in aspectual terms (as defined in Sect. 3.3), assigning temporal duration to them is quite unproblematic. This is because, in the current framework, the temporal notion of duration and the aspectual notion of punctuality/durativity are kept separate. That is, the former notion is about the temporal extent of an event, while the latter notion is about its mereological structure, i.e., whether or not the event has the arrow as it main connector. This distinction allows all events, punctual ones including, to have a positive temporal duration.

4.4 The extent reading

The extent reading of *quickly* is found with telic predicates and targets the temporal duration of the entire described event. To derive this reading, we need to ensure that *quickly* composes with the appropriate node of the interpreted structure that guarantees telicity (typically, the entire VP). Since the denotation of telic pedicates is quantized (it contains no incomplete events), the distribution over event structure is trivial and *quickly* ends up restricting the duration of the entire described event. This is illustrated in (39).

(39) Selena quickly ran to the park.

a. Selena [[POS_{Adv} quickly] [run to park]]

b. $\lambda e\,.\,run(e) \wedge \mathbf{goal}(e) = park \wedge$
$\quad \forall e' \in \mathbf{atom}(e, [\![\text{run to park}]\!])\,[\mathbf{std}([\![\text{quickly}]\!], [\![\text{run to park}]\!]^c) \prec \mathbf{short}(e')]$
$= \lambda e\,.\,run(e) \wedge \mathbf{goal}(e) = park \wedge \mathbf{std}([\![\text{quickly}]\!], [\![\text{run to park}]\!]^c) \prec \mathbf{short}(e)$

Recall from Sect. 2 that *quickly* with accomplishment predicates can also characterize the rate of the underlying process. In this case, it is essential to assume that *quickly* composes with the activity verb first, and then the resulting complex is composed with the object phrase. This is illustrated in (40), where the rate reading arises from distribution over the minimal running events of the underlying process, just as in (38).

(40) Selena ran quickly to the park.

a. Selena [[run [POS_{Adv} quickly]] to park]

b. $\lambda e\,.\,run(e) \wedge \forall e' \in \mathbf{atom}(e, [\![\text{run}]\!])\,[\mathbf{std}([\![\text{quickly}]\!], [\![\text{run}]\!]^c) \prec \mathbf{short}(e')] \wedge$
$\mathbf{goal}(e) = park$

Note that there are diverging claims in the literature regarding how the surface position of *quickly* in accomplishment sentences constraints available interpretations. While these claims are not entirely consistent with each other, the consensus seems to be that a postverbal position conveys a preference for the rate reading, whereas a preverbal position conveys a preference for the extent reading (e.g., Pustejovsky 1991; Thompson 2006; Kearns 2007). Here I will refrain from imposing concrete surface restrictions for different readings of *quickly*, leaving the detailed study to future work. The key point for my analysis is that the rate and the extent readings with accomplishment predicates are predicted under different scope configurations.

Finally, in Sect. 2 we established that a rate reading arises with dynamic predicates that are also durative. That is, it arises with activities or accomplishments but not with achievements, which are punctual. We now have an explanation for why that is. The reason is that only activities and accomplishments make available the atomic structure of the underlying process—although, in the case of accomplishments, an object may filter out non-maximal events, yielding a quantized denotation. In contrast, achievement predicates refer to direct transitions and their denotation remains quantized throughout the semantic composition. This means that the restriction of the rate reading to durative predicates need not be explicitly stated; it already follows from the distributivity of *quickly* and the way the denotation of achievement predicates is structured.

4.5 The narrative reading

The narrative reading of *quickly* arises with telic predicates (i.e., accomplishments or achievements). Intuitively, this reading regulates the temporal distance between the described event and some prior salient event. To capture this intuition, I will follow Rawlins (2013) in assuming that what is being measured here is the duration of a "narrative event", which functions as an eventive counterpart to "reference time" (Reichenbach 1947: §51). Reference time is a theoretical construct whose role is to fix the temporal relations between the events introduced in narrative discourse (Kamp and Rohrer 1983; Partee 1984; Dowty 1986; Hinrichs 1986; Kamp and Reyle 1993: ch.5; Parsons 2002; Bary and Haug 2011; Altshuler 2012; a.o.). Rawlins offers a novel implementation of this same idea, proposing instead that narrative discourse is chunked into narrative events, which bear analogous relations to described events as do reference times on the standard view. The justification for positing such events goes as follows: since adverbs of change target events in their more straightforward uses (such as rate and extent), it is plausible to assume that the narrative use involves abstract events of some sort.[31]

[31] A reviewer asks whether narrative events can be singled out in discourse, for example by anaphoric processes, thereby providing independent evidence for their existence. While I cannot offer conclusive proof, I present one suggestive example with *immediately*,

Developing Rawlins' proposal further, I will assume that narrative events are introduced by a covert NARR operator, inserted whenever needed to make the sentence temporally coherent. This operator does two things. It selects for telic predicates, as only such predicates are felt to advance the narration time. This operator also specifies that the narrative event it introduces contains the described event as a final segment. An entry for NARR is provided in (41), where e is a narrative event, e' is a described event, $<$ is the relation of strict temporal precedence over events, and $\mathbf{FIN}(e',e)$ says that e' is a final segment of e.

(41) a. $[\![\text{NARR}]\!] = \lambda P \lambda e : \mathbf{TEL}(P) . \exists e' [P(e') \wedge \mathbf{FIN}(e',e)]$

b. $\mathbf{FIN}(e',e)$ iff $e' \sqsubset e \wedge \neg \exists e'' [e'' \sqsubset e \wedge e' < e'']$

An illustration of the narrative reading of *quickly* is provided in (42). To derive this reading, two additional assumptions are necessary. The first assumption is that the property produced by application of NARR is quantized. If this is the case, distribution over it becomes trivial and *quickly* ends up characterizing the entire narrative event as having a short duration. The second assumption is that narrative events are temporally contiguous, following a similar assumption about reference times made in the literature on narrative discourse. Overall then, (42) entails that the narrative event—which contains the described event as a final segment and follows immediately upon a prior narrative event—has a shorter duration than the standard duration for typical narrative events of this kind. This derives the intuition that the event of Mark opening the door occurs shortly after the previously described event, whatever that might be.

(42) ... Mark quickly opened the door.

a. [[POS_{Adv} quickly] [NARR [Mark open door]]]

b. $\lambda e . \exists e' [mark.open.door(e') \wedge \mathbf{FIN}(e',e)] \wedge$
$\mathbf{std}([\![\text{quickly}]\!], [\![\text{NARR [Mark open door]}]\!]^c) \prec \mathbf{short}(e)$

Recall from Sect. 2 that, in the right context, a narrative reading may also arise with underlyingly atelic predicates (i.e., statives or activities). Such instances can plausibly be analyzed as involving aspectual coercion, where a shift is triggered by a covert operator in order to resolve an aspectual conflict (e.g., De Swart 1998).[32] For the case at hand, I assume that the narrative reading is facilitated by a covert inchoative operator INC. This operator transforms an atelic predicate into an achievement-like predicate by endowing the events in its denotation with a prior state, thus building change into their structure. A preliminary semantics for this operator is provided in (43).[33]

(43) $[\![\text{INC}]\!] = \lambda P \lambda e : \neg \mathbf{TEL}(P) . \exists s, e', Q [P(e') \wedge e = s \xrightarrow{Q} e']$ (preliminary)

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a specialized narrative adverb of change (see Sect. 5 for details). In (i), after A's initial utterance, B challenges the existence of the described event, while B′ can be taken to dispute the short duration of the presumed narrative event.

(i) A: We sat down and the door opened immediately.
B: It didn't happen—the door didn?t open.
B′: It didn't go like that—we waited for a while before the door opened.

[32] Here I remain agnostic regarding the conditions under which such aspectual shifts are licensed.

[33] The inchoative predicate that results from application of INC to an atelic predicate may be aptly called a "reverse culmination" (cf. Mourelatos 1978; Piñón 1997). That is, while both regular and reverse culminations refer to direct transitions (i.e., events of the form $e \xrightarrow{Q} e'$), the intuition about the former kind of events is that the moment of change completes the described episode, whereas the intuition about the latter kind of events is that the moment of change starts the described episode.

Given the possibility of coercing atelic predicates into telic ones in this manner, the narrative operator can apply as usual, resulting in a narrative interpretation for *quickly*. The structure in (44) provides an illustration and the semantic analysis mirrors that in (42).

(44) ... Quickly, Jill was asleep.

a. [[POS$_{Adv}$ quickly] [NARR [INC [Jill asleep]]]]

b. $\lambda e\,.\,\exists e', e'', s, Q\,[jill.asleep(e'') \wedge e' = s \xrightarrow{Q} e'' \wedge \mathbf{FIN}(e', e)] \wedge$
$\mathbf{std}(\llbracket \text{quickly} \rrbracket, \llbracket \text{NARR [INC [Jill asleep]]} \rrbracket^c) \prec \mathbf{short}(e)]$

When composing NARR and INC, as in (44), there are two additional facets that require further attention. The first one is that, while NARR selects for telic predicates (i.e., predicates that are both dynamic and quantized), INC as defined in (43) only ensures dynamicity (by building change into the underlying atelic predicate). To guarantee quantization as well, the coerced denotation must be based on the *maximal* events inside the underlying atelic denotation. For example, when coercing *be asleep* into meaning "start to sleep", we want to transform into direct transitions only complete sleeping events, excluding all their proper parts. This is achieved in (45) through the maximality operator **MAX**.

(45) a. $\llbracket \text{INC} \rrbracket = \lambda P \lambda e : \neg \mathbf{TEL}(P)\,.\,\exists s, e', Q\,[\mathbf{MAX}(e', P) \wedge e = s \xrightarrow{Q} e']$ (improved)

b. $\mathbf{MAX}(e', P)$ iff $P(e') \wedge \neg \exists e''\,[e' \sqsubset e'' \wedge P(e'')]$

The second facet concerns the extent to which the described event should be included in the narrative event. The entry for NARR in (41) specifies that the entire described event is included in the narrative event, serving as its final segment. This accords well with intuition for accomplishments and regular achievements (happenings or culminations), where the narrative reading of *quickly* characterizes as short the distance between *the end* of the described event and some prior event (cf. *They moved next door and quickly built a mill to grind corn*). However, with inchoative predicates, the default interpretation changes. What is typically measured by the narrative reading of *quickly* in this latter case is the distance between *the beginning* of the underlying event and some prior event. For example, in (44) Jill's state of being asleep may span over a longer period, but it would be sufficient for *quickly* to target only some initial segment of that state. To accommodate this intuition, I will further refine the semantics for INC, now requiring that the described event is only partially involved in determining the resulting inchoative event. The final version is presented in (46), where $\mathbf{INI}(e'', e')$ indicates that e'' is an initial segment of e'.[34]

(46) a. $\llbracket \text{INC} \rrbracket = \lambda P \lambda e : \neg \mathbf{TEL}(P)\,.\,\exists s, e', e'', Q\,[\mathbf{MAX}(e', P) \wedge \mathbf{INI}(e'', e') \wedge e = s \xrightarrow{Q} e'']$ (final)

b. $\mathbf{INI}(e'', e')$ iff $e'' \sqsubset e' \wedge \neg \exists e'''\,[e''' \sqsubset e' \wedge e''' < e'']$

Overt inchoative operators, like *begin* or *start*, yield similar coercion effects to these of INC and may be analyzed along similar lines.

[34] An appropriate instantiation of the transition label Q in (46), when applied to (44), would be 'have slept'. Note that the semantics leaves it to the context to determine how much of the underlying event is to be included in the coerced denotation. Generally, coercions of stage-level predicates (e.g., *quickly be asleep*) are likely to include a smaller initial segment compared to coercions of individual-level predicates (e.g., *quickly be happy with one's life*).

4.6 The illocutionary reading

Finally, I discuss the illocutionary reading of *quickly*, which arises in non-declarative utterances and imposes no restrictions on the aspectual properties of the underlying lexical predicate. In interrogatives, this reading pertains to the metalinguistic component of the question–answer dynamic and intuitively measures the time between two utterance events. To derive this reading, I adopt a similar approach as in the analysis of the narrative reading in the previous subsection. Specifically, I assume that discourse interaction is segmented into initiating and reacting events, such as asking and answering questions (cf. van Kuppevelt 1995; Ginzburg 1996, 2012; Büring 2003; Roberts 2012). I implement this idea by proposing that the illocutionary reading has *quickly* modifying a covert predicate called REACT, which characterizes the event of the addressee ($\mathbf{addr}^c$) reacting to the current discourse move ($\mathbf{move}^c$), as stated in (47a). Making the plausible assumption that this property is telic (i.e., dynamic and quantized), *quickly* can apply, although the distribution over event structure will be trivial and have no semantic effect. The resulting denotation is shown in (47b).

(47) a. $[\![\text{REACT}]\!]^c = \lambda e\,.\,react(e, \mathbf{addr}^c, \mathbf{move}^c)$

b. $[\![\text{REACT } [\text{POS}_{Adv} \text{ quickly}]]\!]^c$
$= \lambda e\,.\,react(e, \mathbf{addr}^c, \mathbf{move}^c) \wedge \mathbf{std}([\![\text{quickly}]\!], [\![\text{REACT}]\!]^c) \prec \mathbf{short}(e)$

A remaining hurdle to the analysis is how to incorporate the illocutionary component in (47b) into the usual question partition (Hamblin 1973 and much subsequent work). I propose that this is mediated by ILLOC, as defined in (48). What this element does is place the illocutionary component in the presuppositional part and the partition component in the at-issue part of the question meaning.[35]

(48) $[\![\text{ILLOC}]\!] = \lambda Q \lambda P \lambda p \lambda e : P(e)\,.\,Q(p)$

The compositional analysis of a question with *quickly* is illustrated in (49). According to it, *quickly* restricts the answering event, indicating that this event is of a shorter duration than usual.

(49) Quickly, is it raining?

a. [[REACT [POS_{Adv} quickly]] [ILLOC [Q raining]]]

b. $\lambda p \lambda e : react(e, \mathbf{addr}^c, \mathbf{move}^c) \wedge \mathbf{std}([\![\text{quickly}]\!], [\![\text{REACT}]\!]^c) \prec \mathbf{short}(e)\,.$
$p = \lambda w.rain(w) \vee p = \lambda w.\neg rain(w)$

This analysis captures the sense of conversational urgency associated with the illocutionary reading of *quickly*. Specifically, (49) can be paraphrased as 'React quickly: Is it raining?'. This is because the question presupposes a quick reaction, and so the addressee commits themselves to this presupposition by virtue of accepting the question move. A slow answer, even if informative to the question, would therefore count as infelicitous. Moreover, since *quickly* targets the metalinguistic component rather than the descriptive content of the question, the analysis also captures the empirical observation from Sect. 2 that the illocutionary reading of *quickly* is blind to the aspectual properties of the underlying lexical predicate.

The illocutionary use of *quickly* is also found in imperative sentences. There are various ideas in the literature as to what directive force amounts to semantically: a necessity

[35] An alternative entry for ILLOC would merely conjoin the two meaning components. However, this would miss the intuition that a slow response to a question with *quickly*, while inappropriate, could still be informative.

modal carrying certain presuppositions (Kaufmann 2012), an individual property intended to update the addressee's To-Do List (Portner 2004), or a speaker's preference (Condoravdi and Lauer 2012). For ease of comparison and taking a cue from the last of these accounts, I will assume that imperative sentences are of the same semantic type as interrogatives, invoking propositional alternatives. However, unlike interrogatives, imperatives also convey a speaker's preference for the uttered alternative. With this much in place, the mechanism proposed for interrogatives can be extended to imperatives. For example, (50) intuitively reduces the time allowed to pass between issuing the directive and reacting to it. This intuition is captured by *quickly* appropriately constraining the reaction event introduced by REACT, as illustrated in (50) ($>_{\mathbf{sp}^c}$ conveys the speaker's current preference).

(50) Quickly, open the door!

a. [[REACT [POS_{Adv} quickly]] [ILLOC [IMP open door]]]

b. $\lambda p \lambda e : react(e, \mathbf{addr}^c, \mathbf{move}^c) \wedge \mathbf{std}(\llbracket \text{quickly} \rrbracket, \llbracket \text{REACT} \rrbracket^c) \prec \mathbf{short}(e)\,.$
$(p = \lambda w.open.door(w, \mathbf{addr}^c) \vee p = \lambda w.\neg open.door(w, \mathbf{addr}^c)) \wedge$
$\lambda w.open.door(w, \mathbf{addr}^c) >_{\mathbf{sp}^c} \lambda w.\neg open.door(w, \mathbf{addr}^c)$

4.7 Summary

We have derived the four attested readings (rate, extent, narrative, and illocutionary) from the same lexical content of *quickly*, thus preserving its semantic uniformity. We argued that the apparent ambivalence of this adverb arises from a combination of three factors: (i) the aspectual properties of the selected predicate, (ii) the possibility that *quickly* takes scope over different constituents in the interpreted structure, and (iii) interaction with covert aspectual and discourse operators.

5 Dimensions of variation: *Slowly* and *immediately*

The empirical discussion and the formal analysis thus far have centered on *quickly* as a prime example of an adverb that modifies aspectual change. Yet English contains a wealth of adverbs with similar properties. In this section, I will shift the focus to *slowly* and *immediately*, demonstrating how the meaning dimensions of *quickly* can be parameterized to produce the variation displayed by these two adverbs. While establishing a comprehensive semantic typology of adverbs of change is beyond the scope of this paper, I will also offer a few tentative observations regarding the broader empirical landscape.

I begin by examining variation in gradability. As established in Sect. 2, *quickly* is grammatically gradable, allowing occurrence in comparative constructions and intensification by *very*. The same holds for *slowly*. The data in (51) mirrors that in (30).

(51) a. Jill ran to the park more slowly than Jack (did).

b. Jill ran to the park very slowly.

Although both are gradable, *quickly* and *slowly* are antonyms, with the former characterizing the duration of the targeted events as being below standard and the latter characterizing this duration as being above standard.

Immediately shares with *quickly* the direction of comparison, characterizing the targeted events as having a relatively short duration. However, *immediately* differs from both *quickly* and *slowly* in that it does not seem to be grammatically gradable, as shown in (52).[36]

(52) a. *Selena left the room more immediately than Justin (did).

b. *Selena left the room very immediately.

Given the semantic analysis of *quickly* in (36), such points of variation are not unexpected and require only minor modifications. For *slowly*, I propose that it has a similar semantics to that of *quickly*, differing only in its measure function. That is, while *quickly* measures event duration on a "shortness" scale, *slowly* measures event duration on a "longness" scale, thus reversing the direction of comparison.[37] An entry for *slowly* is presented in (53).

(53) $[\![\text{slowly}]\!] = \lambda d \lambda P \lambda e : \textbf{DYN}(P) \,.\, P(e) \wedge \forall e' \in \textbf{atom}(e,P)\,[d \preceq \textbf{long}(e')]$

As for *immediately*, while maintaining the direction of comparison of *quickly*, its non-gradability suggests that this adverb lacks a degree argument and incorporates the relevant standard of comparison directly into its lexical meaning. This leads to (54) as one possible analysis (see (63) below for a simpler alternative).

(54) $[\![\text{immediately}]\!]$
$= \lambda P \lambda e : \textbf{DYN}(P) \,.\, P(e) \wedge \forall e' \in \textbf{atom}(e,P)\,[\textbf{std}(\mathit{immediately}, P^c) \preceq \textbf{short}(e')]$
(quantificational version)

Apart from gradability and direction of comparison, another major point of variation across adverbs of change concerns the range of available interpretations. Recall from Sect. 2 that *quickly* has four possible readings, being able to modify rate of change, event duration, narrative time, or illocutionary time. The proposed meaning in (53) makes *slowly* a perfect antonym to *quickly*, so—all other things being equal—it predicts no further variation. However, *slowly* turns out to only partially overlap in available readings with its antonym *quickly*. Like *quickly*, when modifying an activity predicate, *slowly* gives rise to a rate reading. For example, (55) states that Selena traversed space at a lower rate than the usual rate for comparable running events.

(55) Selena ran slowly.

Despite this similarity, *slowly* differs from *quickly* in that it lacks all remaining interpretations. As Pustejovsky (1991) points out, *slowly* appears unable to acquire an extent reading. This is illustrated for accomplishment predicates in (56), where only a rate reading seems available.

(56) Mary (slowly) walked to the store (slowly). (Pustejovsky 1991: 51)

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[36] The empirical evidence regarding the gradability of *immediately* is not entirely clear-cut. There are occasional naturalistic examples of this adverb occurring in the comparative or with *very*, as seen in (i) and (ii), both drawn from COCA (Davies 2008).

(i) The greatest challenge to both engineers and managers is that many corporate leaders feel pressure from stockholders and other stakeholders more immediately than they do the urgency of safety or engineering obligations.

(ii) Now, there is also a fair amount of funding being held up in Washington right now that the Egyptians need very immediately.

However, these examples seem to convey a shift in meaning, with (i) amounting to 'more directly' (or perhaps 'more strongly'), and (ii) amounting to 'very urgently'. This is why, without delving into the precise mechanism behind such meaning shifts, I will tentatively assume that *immediately* lacks a degree argument.

[37] In other words, $\textbf{short}(e) \prec \textbf{short}(e')$ just in case $\textbf{long}(e') \prec \textbf{long}(e)$.

Moreover, *slowly* does not give rise to a narrative reading either. For example, to the extent that it is interpretable, (57) appears to coerce an inherently punctual event into a durative, slow-motion-like event. Notably, in (57) *slowly* cannot receive a narrative interpretation in which the noticing event is punctual but occurs long after the walking-in event took place.

(57) (?)The professor walked in and Selena slowly noticed him.

Slowly also lacks a proper illocutionary reading. While the sentences in (58) are acceptable, in these cases *slowly* targets the desired rate of speech rather than the interval between asking and answering the question.[38] Similarly, in (59) *slowly* modifies the rate of the requested action rather than the temporal distance between the command and its compliance. These are just instances of the rate reading.[39]

(58) a. *A police officer who arrives on the scene of a car accident to one of the drivers:*
Slowly, what happened?
b. *A parent to their blubbering child:*
Slowly, why are you so upset?

(59) *A robber is pointing a gun at a victim:*
Slowly, hand in your wallet.

In short, *slowly* has a fairly impoverished semantic distribution. It shares with *quickly* the rate reading, yet it seems to lack all other readings available to *quickly*, i.e., extent, narrative, and illocutionary.

Turning now to *immediately*, the entry in (54) might lead us to expect that this adverb differs from *quickly* only in lacking a gradability component. However, *immediately* turns out to only give rise to a narrative reading. The examples in (60) illustrate this reading for the cases of happenings, culminations and accomplishments, respectively.

(60) a. I turned on the light and immediately noticed that something was wrong.
b. Kim took out her gun and the officer immediately exited his patrol car.
c. When Columbus arrived back in Spain, he immediately wrote a letter announcing his discoveries.

A rate reading for *immediately* with activity predicates is clearly unavailable. For example, (61a) cannot describe the running event as unfolding at a fast rate. Instead, such combinations are coerced into a narrative reading, where *immediately* characterizes as short the narrative time between the (onset of the) underlying event and some previously mentioned event, as illustrated in (61b).

(61) a. Valentina ran immediately.
b. We heard a noise and Valentina ran immediately toward the fire.

[38] I owe these examples to an anonimous reviewer.

[39] That being said, there seems to be an important difference between these data. In (59), the rate reading is unremarkable, as it is about the descriptive content of the sentence. However, in (58) the rate reading targets the illocutionary component, suggesting that here *slowly* attaches high. (This would mean that the illocutionary property introduced by the REACT operator in (47a) has non-trivial mereological structure over which *slowly* can distribute, contrary to our assumption in Sect. 4.6 that this property is telic.) I leave the more detailed study of cases like (58) for another occasion.

Immediately lacks an extent reading as well. For example, (60c) above does not characterize the letter-writing event itself as short. Rather, it indicates that upon returning to Spain, it did not take long for Columbus to write his grounbreaking letter, regardless of the speed of writing. Finally, an illocutionary reading for *immediately* appears to be absent as well, as seen in (62).

(62) ?Immediately, where is the key for the house?

In summary, *immediately* lacks rate, extent, and illocutionary readings, and appears to allow only a narrative reading.

How can we account for the observation that *slowly* and *immediately* display only a subset of the readings attested for *quickly*? One option is to complicate the lexical semantics so that each adverb becomes compatible with a very specific set of readings. However, there are reasons to suggest that such an approach might be difficult to defend. First, it is not immediately obvious how to tweak the entries for the adverbs discussed above in order to explain their limited semantic distribution. For example, given the availability of a rate reading, we adopted the semantics for *slowly* in (53). This entry is equivalent to the one for *quickly* in (36) except for the direction of comparison, thereby capturing the intuitive antonymy between these two adverbs. Assuming this much, what additional lexical property would prevent *slowly* from acquiring extent, narrative and illocutionary readings, in contrast to *quickly*? And what additional lexical property would make the entry for *immediately* in (54) (or (63), see below) accept only a narrative reading? Second, if we attribute the different readings to lexical factors, the versatile nature of *quickly* might start to look like a puzzle. The same issue extends to the entire class of adverbs of change, as a strictly lexical explanation for their reading variation might undermine their semantic uniformity by necessitating highly specialized semantic entries with very little overlap.

Without putting forward an explicit proposal, I would like to suggest that the observed gaps in the semantic paradigm of a given adverb have to do not necessarily with its lexical meaning but rather with its scopal possibilities. That is, recall from Sect. 4 that different readings of *quickly* require different scopal sites—say, corresponding to V (rate), VP (extent), TP (narrative), and CP (illocutionary). If *slowly* can only attach to the specific position compatible with a rate reading, we can explain its lack of extent, narrative and illocutionary readings without modifying the proposed entry in (53). In the same vein, we can assume that *immediately* has the meaning in (54) but can only attach to the left-peripheral position designated for the narrative reading. More generally, given the various possibilities for scopal interaction, such structural restrictions are expected to constitute idiosyncratic properties of individual adverbs of change.

Notice that a scope explanation along these lines may seem to block a rate reading for *immediately* for the wrong reason. That is, while this adverb carries a quantificational component and could potentially distribute over event structure, this part of its meaning would never come to light as low attachment is generally unavailable. This suggests the simpler non-quantificational alternative for *immediately* in (63).

(63) $[\![\text{immediately}]\!] = \lambda P \lambda e : \mathbf{DYN}(P) \,.\, P(e) \wedge \mathbf{std}(\mathit{immediately}, P^c) \preceq \mathbf{short}(e)$
(non-quantificational version)

One argument in favor of the quantificational version in (54) is the idea of keeping the semantics of different adverbs of change as similar as possible. This would put the explanatory

burden for the missing rate reading of *immediately* solely on its scopal restrictions. Conversely, one might prefer the non-quantificational version in (63) for reasons of language economy. That is, it is difficult to argue for the presence of a quantificational component in the meaning of *immediately* if this component is never going to do any real semantic work for us. I will not make a choice between these two entries, here merely highlighting what the analytical options are.

I close this section with two more general points. The first point concerns the observation that adverbs of change seem to fall into several natural classes. One is the *quickly* class, which also includes synonyms like *rapidly*, *swiftly*, *hastily*, and *speedily*. These adverbs characterize the targeted event (or event parts) as being relatively short and share most of the readings of *quickly*. Another class, perhaps a subclass of the previous one, consists of adverbs like *immediately* and *instantly*, which only receive a narrative reading. Such adverbs should be distinguished from adverbs like *suddenly* or *abruptly*, which require not just dynamicity but also punctuality (cf. *The door suddenly opened* vs. *#The priest suddenly delivered a sermon*). Moreover, the adverbs in this last group do not produce a narrative interpretation (cf. *We sat down and waited for hours. Suddenly/#Immediately, the door opened*), instead conveying a sense of surprise. Yet another class is that of *slowly*, with additional members like *sluggishly* or *glacially*. These latter adverbs, just like *slowly*, imply a longer-than-usual event duration and only seem able to measure the rate of change. Finally, there is the *gradually* class, which includes apparent synonyms like *steadily*, *continuously*, *progressively*, and *incrementally*. Such adverbs stand out from all other classes in that they predominantly occur with degree achievements (e.g., *The river gradually widened*) and describe event developments that unfold in stages (Piñón 2000). In summary, while some of these classes of adverbs display very different properties from the prototypical case of *quickly*, they all interact with aspectual change in some form and should be studied in tandem.

The second point is that the current proposal analyzes the semantic distribution of change adverbs in terms of a selectional restriction, encoded as a lexical presupposition that the predicate they combine with is dynamic. However, as an anonymous reviewer points out, this proposal might be seen as non-explanatory because it offers no insight into why such a restriction should arise. An alternative analysis would remove the lexical presupposition entirely and instead claim that the dynamicity restriction associated with adverbs of change is somehow linked to the availability of the rate reading—or, more formally, to the distributive component in their at-issue semantics. Indeed, adverbs like *momentarily*, *briefly*, and *shortly* appear to share some of the non-rate readings of *quickly*, yet they are not restricted to dynamic predicates. I leave the detailed study of the origin of the dynamicity restriction associated with adverbs of change to future work.

6 Previous accounts of adverbs of change

This section critically evaluates two previous accounts of adverbs of change, i.e., Cresswell (1978) and Rawlins (2013), which anticipate several of the components of my own account. While there are other explicit proposals on the market (e.g., Heim 2006; Morzycki 2016: 5.4.1; Wellwood 2019: 6.3.3), the former two offer greater theoretical depth and make more specific predictions.

Cresswell (1978)'s seminal paper pioneered the idea that adverbs of change distribute over the minimal parts of the described action. Centering his analysis on *quickly*, Cresswell's main claim is that this adverb modifies motion predicates and compares the distance traveled by the agent during most minimal intervals to some average value. Cresswell thus takes the rate (or "manner") reading of *quickly* as fundamental, writing the following:

> The manner sense of *quickly* [when applied to *walk*] involves, I claim, not taking the distance of the whole walk and comparing it with the time taken, but rather taking the minimal subintervals of that interval which are intervals of walking and saying that the ratio of distance to time in most of them is above average for walkings occurring during intervals of that length. (Cresswell 1978: 180)

Cresswell's formalization of this idea is couched in the language of time intervals rather than event semantics. The proposed meaning for *quickly* is presented in a simplified form in (64), where the notion of a "minimal subinterval" is further specified in (65).

(64) If P is a motion property, a is an individual, and t is a time interval, then $[\![\text{quickly}]\!](P)(a)$ is true at t iff
   i. $P(a)$ is true at t, and
   ii. for most minimal subintervals t^* of t relative to $P(a)$: the distance covered by a during t^* while P-ing exceeds the average distance for P-ing during t^*.

(65) If a sentence ϕ is true at an interval t, then t^* is a *minimal subinterval* of t relative to ϕ iff
   i. t^* is a subinterval of t,
   ii. ϕ is true at t^*, and
   iii. there is no proper subinterval of t^* at which ϕ is true.

The main merit of Cresswell's account lies in its ability to derive the rate/extent contrast for *quickly* by considering the aspectual properties of the base predicate. The rate reading follows directly. For example, the account predicts that *John walked quickly* entails that John walked and that for most minimal subintervals of John's walking, John covered a longer distance than the average distance covered during walkings of such duration. The extent reading is also available as long as the base predicate is telic. For example, assuming VP-level scope for *quickly*, the sentence *John walked quickly to the station* entails that John walked to the station and that during most minimal subintervals of such walking, John covered more distance than the average distance covered by such walkings during such intervals. Crucially, since this distance is fixed by the telicity of the base predicate, the only way the above statement can be true is by virtue of the fact that the single interval of John's walking to the station was of a shorter duration than the relevant average. This is just the extent reading of *quickly*.

In addition to deriving the rate/extent contrast, Cresswell also touches on the narrative reading of *quickly*, suggesting that in this case *quickly* characterizes as short the interval over which the underlying sentence becomes true. Moreover, Cresswell recognizes the gradability of *quickly* and provides a simple extension of his core analysis to capture it. His account thus anticipates most major points surrounding the semantics of *quickly*.

Despite its virtues, Cresswell's account has some obvious limitations. It focuses solely on *quickly*, thus leaving out any variation within the broader class of adverbs of change. Furthermore, the account is confined to modification of predicates expressing physical motion,

which fails to capture the rich semantic distribution of *quickly*. As argued in Sect. 2 and 4, the relevant notion here is "dynamicity", which encompasses a much broader range of cases than just physical motion.

Rawlins (2013) translates Cresswell (1978)'s insights into a modern neo-Davidsonian semantics, while adding several new insights of his own. Specifically, Rawlins argues that adverbs of change denote degree functions that distribute over events proper (as opposed to states), thus generalizing Cresswell's motion-based account. Glossing over some technical complexities, the core proposal for e.g. *quickly* is that this adverb denotes a measure function of events on a scale of shortness, as stated in (66a).[40] The distribution over event structure is introduced by a covert distributivity operator D (cf. Landman 2000: ch.5), with its semantics as stated in (66b), where C_H is a contextually salient property of events that are homogeneous in some respect (see Rawlins 2013: 7.4.1.2 for details). The standard of comparison is introduced by POS_{Adv} and is based on C_C, a contextually salient comparison class of events, as shown in (66c). The composition of these elements yields the meaning in (67).

(66) a. $[\![\text{quickly}]\!] = \textbf{short}$

b. $[\![\text{D}]\!] = \lambda f \lambda P \lambda e . \forall e' \in \textbf{atom}(e, C_H)\,[f(P)(e')]$

c. $[\![\text{POS}_{Adv}]\!] = \lambda P \lambda e . \textbf{std}(P, C_C, e) \preceq P(e)$

(67) $[\![[\text{D POS}_{Adv}]\ \text{quickly}]\!] = \lambda e . \forall e' \in \textbf{atom}(e, C_H)\,[\textbf{std}([\![\text{quickly}]\!], C_C, e') \preceq \textbf{short}(e')]$

Rawlins' account provides explanations for the systematic interaction between adverbs of change and lexical aspect. It successfully derives the rate/extent reading ambiguity and offers a story about the narrative reading of adverbs of change, which I have built on in Sect. 4.5. It also recognizes the illocutionary reading of such adverbs, although it stops short of proposing an explicit analysis. Nonetheless, this account faces two main challenges: one related to the selection of the event classes generating the set of atoms and the standard of comparison, and another regarding how adverbs of change select for dynamicity. These two challenges are discussed below.

One feature of the semantics in (66)–(67) is that *quickly* denotes a property of events rather than functioning as a modifier of such a property, as per my proposal. This necessitates that the denotation of *quickly* be composed with the verbal meaning through the rule of Predicate Modification (roughly, set-theoretic intersection) rather than through Function Application. This seemingly minor technical detail has significant consequences for Rawlins' account. That is, the set of relevant atoms over which the measure of *quickly* distributes is no longer selected compositionally on the basis of the modified verbal predicate but is determined pragmatically (through C_H). In other words, the extent/rate reading ambiguity is not a matter of scopal interaction but rather a matter of contextual salience. This means that, in order to derive the ambiguity of *quickly* with accomplishment and culmination predicates, the account requires that either complete events or their atomic parts be contextually salient. Rawlins touts this feature as an improvement over Cresswell (1978) (and, by extension, over my own account), pointing out that the occurrence of *quickly* in the same surface position is often compatible with both a rate and an extent reading. However, this also makes the unrealistic prediction that, in the very same context, two sets of events can be salient simultaneously. Moreover, it is unclear how a pragmatic explanation of this sort could capture the attested

[40] See Kennedy (1999, 2007) for a comprehensive proposal that gradable expressions denote measure functions rather than relations between degrees, entities, and—in the case of adverbs—properties of such entities.

reading variation across different adverbs of change, as established in Sect. 5. The problem is that, without restricting the available scopal positions for specific adverbs, it remains unclear where such semantic variation originates—especially under the plausible assumption that the contextual salience of events depends mainly on the triggering verbal predicate and remains constant across adverbs.[41]

Viewed from my own proposal, a key challenge to Rawlins' account concerns the aspectual notion of dynamicity, which was argued to be crucial for correctly stating the selectional restrictions for adverbs of change. Rawlins' strategy here is to sortally restrict adverbs of change to events proper, thus excluding states. However, an attempt to use eventivity as a proxy for dynamicity was already criticized in Sect. 3.4 as being both theoretically and empirically unsatisfactory. That is, a basic ontological distinction like this lacks explanatory power. It is purely classificatory and does little to explain why events proper and states differ in dynamicity. Moreover, this distinction turns out to overgenerate, as adverbs of change are compatible with only a subset of eventive predicates (barring cases of inchoative aspectual coercion; see Sect. 2 and 4.5). One problematic class of predicates is that of stativitities. The issue with such predicates is that they refer to situations with spatiotemporal coordinates and also pattern with activities in key empirical respects, so they must be eventive. Nonetheless, stativities are incompatible with adverbs of change (cf. **Jill slept/watched TV/waited quickly/slowly*). Unlike such difficulties, a restriction like this is fully consistent with the current account. All we have to say is that stativity predicates are not dynamic in the relevant sense, i.e., they refer to events that do not incorporate transitions.[42]

7 Conclusion

Adverbs of change select for dynamic predicates and measure out the duration of the events referred to by such predicates. These adverbs give rise to a number of readings, being able to characterize the rate of change, the duration of the entire described event, the narrative time between the described event and some previously mentioned event, or the illocutionary time between two utterance events. Despite this apparent semantic diversity, adverbs of change are not lexically ambiguous. Instead, the different readings arise through external aspectual and discourse factors, and can be blocked by idiosyncratic restrictions on scopal interaction.

A predictive semantics for adverbs of change necessitates a detailed analysis of the aspectual notion of dynamicity, which is presupposed by such adverbs, as well as its logical relationships with telicity and durativity. One straightforward idea is that dynamicity is embedded directly within the mereological structure of events. This perspective affords us an analysis of dynamic predicates in terms of transitions, a type of complex event that explicitly represents and labels aspectual change.

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[41] Similar remarks apply to the selection of a comparison class (C_C), from which the standard for *quickly* is computed. Clearly, a comparison class must be closely tied to the modified verbal expression, typically delineating a specific subset of its denotation. For this reason, leaving the selection of this class to the pragmatic component invites unnecessary indeterminacy.

[42] I leave open the question of what distinguishes stativity predicates from stative predicates. Although the aspectual proposal presented in Sect. 3 does not make predictions on this matter, perhaps some version of Copley and Harley (2015) could be incorporated while keeping the desired notion of dynamicity intact.

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