Achievements, durativity and scales

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vorgelegt von

Zsófia Gyarmathy

aus
Budapest, Ungarn

Betreuerin: Univ.-Prof. Dr. Hana Filip

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Abstract

The goal of this dissertation is to provide a novel formal semantic analysis of achievement predicates (in Vendler's sense) in the scope of the progressive. The focus is on the single-event progressive interpretations of two subtypes of achievements, namely, culminations and happenings (in the sense of Bach 1986): *i)* a "preliminary process" interpretation characteristic of culminations, as in *John is arriving*, and *ii)* a "slow-motion camera" interpretation characteristic of happenings, as in *The bomb is exploding*. Given the differences in the interpretation of culminations and happenings in the progressive, I subscribe to this distinction among Vendler's achievements, following authors like Carlson (1981), Bach (1986), Filip (1993/99), Piñón (1997). I offer a characterisation of these and other aspectual classes in a scale-based framework for aspect. On my account, the scale-based characterisation of these predicates then interacts with a scale-based semantics of the progressive to derive the correct truth-conditions.

The analysis of a "slow-motion camera" interpretation of happenings presupposes that we do away with an absolute notion of the temporal trace function and relativise it to a granularity parameter, based on the independently proposed notion of *granularity functions* over degrees of scales (Sauerland and Stateva 2007, 2011). The distinct advantage of this new proposal is that it allows us to exploit the same set of tools in approaching several independent issues in the domain of aspectual classes: namely, the minimal parts problem of activities and the vagueness of the temporal boundaries of events.

My analysis of "preliminary process" progressives exploits the notion of a *scale of change* and a dual characterisation of culminations as being associated with two kinds of scales. The concept of the scale of change I employ is an amalgam of the scale of change concept of Beavers (2008, 2013) that captures the change associated with a predicate and Asher's (1992) concept of a perspective that captures the contextually relevant properties of an eventuality. The proposed framework is a generalization of scale-based accounts of aspectual classes in that the scale-based approach is general-

ized to nearly all verbal predicates. As a further departure from earlier scale-based approaches, and in particular, Beavers (2008, 2013), I argue that culmination predicates are associated with both two-valued scales of change characterising events in their extension, and the multi-valued scales of change characterising events of gradual change that I call their "cover events". Informally, the cover events of a culmination-achievement (e.g., *arrive at the station*) are events (e.g., walking to the station-events, driving to the station-events etc.) whose culminations belong to the extension of the culmination-achievement.

I propose that the semantics of the progressive operator involves partitivity over scales of change rather than events or event runtimes, and since culmination-achievements (in contrast to happenings) are associated with *both* two-valued and multi-valued scales of change, their combination with the progressive is predicted. At the same time, since only culmination-achievements, but not accomplishments are associated with two-point scales, the difference between these two classes is upheld.

Thus, a scale-based framework for both aspectual classes (aka situation aspect) and grammatical aspect (aka viewpoint aspect) can be used to capture the difference between accomplishments, culminations and happenings and predict the interpretations of the progressive for different aspectual classes by appealing to scales of change over and above temporal and mereological relations in the domain of eventualities. Through employing scales of change and granularity functions as a means of accounting for the use of achievements in the progressive, the dissertation contributes to the growing work on scale-based approaches to verbal phenomena.

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Glossing conventions

ABL	ablative
ACC	accusative
ERG	ergative
IMPF	imperfective
PAST	past
PFV	perfective
PROG	progressive
PRT	preverbal particle
SUBL	sublative

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INTRODUCTION

> *[B]eginnings start from somewhere (which is where whatever it is begins), and becomings turn Thing One into Thing Two by pushing it across a clearly defined boundary (the tooth was not carved, but now it is; the spider was not dead, but now it is). Unfortunately the universe doesn't work in such a simple-minded manner...*
>
> Terry Pratchett, Ian Stewart and Jack Cohen: *The Science of Discworld*

1.1 Aspectual classes

This dissertation is about achievements and an account of their interpretations in the progressive, as well as a novel representation of the difference between accomplishments and different kinds of achievements. Talking meaningfully about such questions presupposes fixing an ontology and terminology of aspectual classes. I will therefore first clarify where I stand with respect to the different schools of thought in the work on aspectual classification before presenting the core topic discussed and main proposals put forth in my thesis.

1.1.1 Aspectual classifications

This dissertation focuses on the categorization of achievements, and existing classifications differ as to i) whether achievements form a class different from accomplishments, and ii) whether achievements themselves have distinct subclasses. I first review aspectual classifications in general before turning to point i) in Section 1.1.2 and point ii) in Section 1.1.3.

The number of different classifications of verbal predicates into aspectual classes is immense. Nevertheless, since the work of Vendler (1957), mostly the same features

recur as criteria for these classifications, with some small differences in their interpretation. Arguably the three most basic aspectual features of verbal predicates are the following (with one test of each feature given in parentheses for English):

- A basic distinction is between *statives* and *dynamic* predicates.
  - *States* are stative (they are admissible in the simple present on an episodic interpretation).
  - *Activities, accomplishments and achievements* are dynamic (they typically do not receive an episodic interpretation in the simple present).
- A second basic feature is *durativity*, distinguishing between predicates that are true at non-degenerate intervals and those which are true at instants.
  - *Accomplishments and activities* are durative (they typically do not combine with time point adverbials).
  - *Achievements* (and for many authors, *states*)[1] are instantaneous (they can combine with time point adverbials).
- The third distinction is between *telic* and *atelic* predicates, depending on whether or they are associated with a "natural endpoint".
  - *States and activities* are atelic (they can combine with a *for*-adverbial).
  - *Accomplishments and achievements* are telic[2] (they typically cannot combine with a *for*-adverbial unless it measures out their result state).

Table 1.1 summarizes some of the most influential (or for our purposes relevant) aspectual classifications, with the columns delineating sets of predicates that can be best equated across the classifications. Although many classifications draw on Vendler's (1957), it is important to be aware of their differences.[3] Of course, it is impossible to provide an exhaustive list of such categorizations, or even do justice to those mentioned here and present the nuances thereof.

[1] For instance, Vendler (1957) and Taylor (1977) regard states as true at instants, or more precisely, true at all instants of some interval, Comrie (1976) regards them as strictly durative, and Rothstein (2004) regards states as being true at both intervals and at instants of intervals at which they hold. von Stechow (2009b) holds that states are true only at instants, and there is usually a covert "throughout" adverb in sentences expressing that a state holds at an interval.

[2] Though, for instance, Comrie (1976) does not regard even archetypical achievements like *reach* as telic (cf. Comrie 1976, p. 47).

[3] For instance, the revised classification of Dowty (1979, Ch. 3) deviates much from Vendler's (1957) categorization, since "both accomplishments and achievements can be found in each of the four categories [of change of state predicates]" (p. 183). (Only two, instead of four, change of state categories are shown in Table 1.1, as I here disregard Dowty's (1979) agentive/non-agentive distinction that cross-cuts all his classes.)

Vendler (1957)	state	activity	accomplishment	achievement		
Kenny (1963)	state	activity	performance			
Comrie (1976)	state	activity	accomplishment	achievement	semelfactive	
Taylor (1977)	State-verbs	Energeia-verbs	Kinesis-verbs			
Mourelatos (1978)	state	process	event			
			development	punctual occurrence		
Dowty (1979, Ch. 3)	states	activity	complex change of state	single change of state		
	interval ¦ moment.					
Carlson (1981)	dynamic ¦ stative	activity	accomplishment	achievement	momentaneous	
Bach (1981)	state	process	event			
			protracted	instantaneous		
Bach (1986)	state	process	event			
	dynamic ¦ static		protracted	momentaneous		
				culmination	happening	
Moens and Steedman (1988)	state	event				
		process	culminated process	culmination	point	
Verkuyl (1989)	state	process	event			
Parsons (1990)	state	process	event			
			accomplishment	achievement		
Pustejovsky (1991)	state	process	transition			
Smith (1991)	state	activity	accomplishment	achievement	semelfactive	
example	*sit, own*	*walk, push a cart*	*walk to Boston*	*reach the top*	*recognise*	*flash*

Table 1.1: Aspectual classifications. Columns delineate the closest counterparts across classifications, though the exact boundaries among predicates differ (hence the dashed separator ¦).

At this point, I want to stress that in this dissertation, I will focus on the differentiation between accomplishments and different subtypes of Vendler's achievements, but will disregard the details and complications relating to other aspectual classes. For example, I will mostly ignore the difference between interval (aka dynamic) states like *sit*, stage-level states like *be asleep* and object-level states like *be a mammal* (in the terminology of Dowty 1979, Ch. 3) — even though these distinctions among statives are as much relevant for semantics as the distinction between different kinds of telic predicates. Throughout the dissertation the term "state" will, unless indicated otherwise, be used refer to temporary states (dynamic and stage-level states), which are those that can combine with a time point adverbial like *at noon* (these are the *1-state predicates* of Klein 1994).

It is also important to note here that there are multiple lexical and grammatical factors contributing to the aspectual properties of a verb phrase (or sentence), most importantly, besides a verb's inherent meaning, the verb's arguments, such as the subject, the object and/or prepositional arguments. But over and above these, the aspectual class of a predicate can also be *shifted* in different contexts. As ter Meulen (1983, p. 178) put it, "we can stretch the standard use of just about any verb in a specific context". It was noted already in the seventies (cf. e.g., Comrie 1976, Steedman 1977, Dowty 1979), for instance, that all atelic verbs can receive a telic interpretation given a suitable context. "Thus if I know (and the addressee knows) that John is in the habit of swimming a specific distance every day (to prepare himself for a swimming race perhaps), then I can assert that today *John swam in an hour*" (Dowty 1979, p. 61), that is, *swim* here is used as an accomplishment rather than an activity.

1.1.2 Accomplishments and achievements

As can be seen from Table 1.1, accomplishments and achievements are collated by Taylor (1977) in his Kinesis-verbs, by Pustejovsky (1991) in his transitions, and also by Kenny (1963) in his performances.[4] Verkuyl (1972, 1989, 1993) argued explicitly that achievements are a subset of accomplishments: namely ones with a process stage so short as to be negligible. One cornerstone of Verkuyl's argumentation is the dual-faced behaviour of achievements, i.e., that the same predicate may be instantaneous and durative, as well, given the right context. For instance, the predicate *draw a circle*

[4]However, as Mourelatos (1978) pointed out, Kenny's categorization is dubious inasmuch as the criterion Kenny proposes for performances, namely, "finish/not finish V-ing", only works for accomplishments, but not for achievements.

may be durative given a human agent, but it may also be instantaneous if the agent is a computer.

Pustejovsky (1991) also argued that given the right kind of context, achievements behave like an accomplishment in their temporal properties (for instance, when modified with a *for*-adverbial). However, Pustejovsky places the distinguishing feature between what are customarily accomplishments and achievements not in their temporal properties (i.e., the length of the preliminary process), but in agentivity:

> we will argue that there is no further distinction necessary in terms of event structure for classifying these two aspectual types. Rather, achievements and accomplishments can be distinguished solely in terms of an agentive/non-agentive distinction. (p. 42)

Using agentivity as a distinguishing feature between achievements and accomplishments might not be fortunate, though: Dowty (1979, Ch. 3) already pointed out that agentivity is orthogonal to aspectual classes, arguing that there are in fact agentive and non-agentive predicates in all aspectual classes. Pustejovsky (1991) himself notes that there are sentences with achievements that seem to involve agents, such as *Mary arrived at the party*. But Pustejovsky argued that "agency is not intrinsically part of the [achievement] verb's meaning" (p. 43) based on sentences like *The package arrived at the office* and based on the infelicitousness of sentences in which intentional adverbials like *deliberately* modify achievement predicates like **Mary won the race deliberately*. However, I still regard it as a problem for Pustejovsky's (1991) proposal that there certainly are also non-agentive accomplishments, such as *The ball rolled off the table*, which indicates that agentivity is irrelevant for the accomplishment/achievement distinction. Pustejovsky's (1998) alternative distinction between achievements and accomplishments as boiling down to a difference in their focus on the initial or final subevent of the transition (in particular, a difference in what he calls *event headedness*) appears to me more compelling.

I argue that although there might be arguments (their felicitousness in the progressive and/or slow-motion readings) for regarding some or all of Vendler's achievements as accomplishments, the distinction between durative and non-durative telic predicates can and should be retained. The goal of my dissertation is to show how some typical durative uses of achievements can be explained in model-theoretic semantics.

1.1.3 Previous classifications of Vendler's achievements

There is no consensus regarding the ontology of non-durative predicates and the terminology used to refer to subclasses of these predicates. The term *achievement* was originally coined by Ryle (1949), whose classification, however, was not based on temporal/aspectual properties, and this term, in particular, did not correspond Vendler's (1957) class of achievements. Comrie (1976) and Smith (1991) use the term *achievement* for those of Vendler's achievements that are not semelfactives. Carlson (1981) and Dini and Bertinetto (1995) use the term *achievement* for those of Vendler's achievements which can naturally occur in the progressive without any shift (including an iterative shift) in their meaning — these correspond to what Bach (1986), who builds his ontology on Carlson's (1981), calls *culminations*. In contrast to Bach, Moens and Steedman (1988) use the term the *culminations* for those achievements of Vendler (1957) that are not semelfactives. The term *culmination* is, in addition, widely used to designate a culmination *point* rather than an aspectual class.

In Table 1.2, I compare some of the most important or for our purposes relevant subclassifications of the class of Vendler's achievements.[5] The table is divided into three parts: the first part includes Vendler (1957) who assumed a single class of those predicates that can be characterised as non-durative and telic, using modern terminology.[6] The second part includes authors who focused primarily on what can be called the semelfactive/non-semelfactive distinction, and the third part includes those who focussed primarily on what can be called the happening/culmination distinction.

The class of Vendler's achievements that is often assigned a category of its own is that of *semelfactives* (cf., e.g., Moens and Steedman 1988, Kearns 1991, Smith 1991).[7] As for their characterisation, a widely (though not uniformly, cf. Filip 2011a for a discussion) accepted view today is that of Smith (1991) who regards *achievements* as telic, and *semelfactives* as atelic. This is an approach shared in essence by Moens and Steedman (1988), too, for whom the difference between different punctual eventuality predicates lies in whether or not they have a consequent state. The difference Comrie (1976) made

[5] Just as the general survey of aspectual classifications in Table 1.1 is not exhaustive, so in this case, many authors have been omitted. For instance, Mori et al. 1992 also argue for several distinctions within the class of Japanese non-durative predicates.

[6] Vendler (1957) did not use the term *telic*, yet. But for ease of exposition, I will continue to refer to received terminology even in the case of authors who did not use the relevant terms; e.g., I will use "non-semelfactive happenings of Bach (1986)", even though he never employed the term *semelfactive*.

[7] Comrie (1976) was the one to make the term widely known in aspectual discourse, borrowing it from Slavic linguistics, and he reserved the term for single-event uses of predicates like *cough*, while he used the term *iterative* for a series of coughs.

CLASSES	FEATURES	EXAMPLES
(Vendler 1957)		
achievements	−durative, defin. time (= +telic)	*reach, recognise, knock*
(Comrie 1976)		
achievements	(strictly non-extended)	*reach*
semelfactives	(may be extended)	*knock*
(Smith 1991)		
achievements	+telic	*reach, recognise*
semelfactives	−telic	*knock*
(Moens and Steedman 1988)		
culminations	+conseq. (= +telic)	*reach, recognise*
points	−conseq. (= −telic)	*knock*
(Carlson 1981)		
achievements	+point, +extended	*reach*
momentaneous	+point, −extended	*knock, recognise*
(Bach 1986)		
culminations	momentaneous culmination	*reach*
happenings	momentaneous happening	*knock, recognise*
(Filip 1993/99, Altshuler and Filip 2013)		
culminations	+temporal extent	*reach*
happenings	−temporal extent	
semelfactives	full-cycle resettable	*knock*
(other happenings)		*recognise*
(Dini and Bertinetto 1995)		
achievements	+telic	*reach*
punctuals	−telic	
event-punctuals		*knock, explode*
state-punctuals		*recognise*
(Piñón 1997)		
right-boundary achievements	culmination	*reach*
left-boundary achievements	inception	*recognise*
(semelfactives?)		*knock*

Table 1.2: Classifications and ascribed properties of achievements

between semelfactives and a predicate like *reach* is that the former describes events that are not strictly speaking punctual and may be construed as durative, while the events described by *reach* are strictly punctual. As Comrie's (1976) focus lies else-

where, it is not clear if this difference is intended to be a characterisation of semelfactives, but this distinction is not suitable for this classificatory purpose, as achievements like *recognise* or *explode* also have slow-motion durative uses like semelfactives (cf. e.g., Dini and Bertinetto 1995).

Carlson (1981), Bach (1986), Filip (1993/99) and Piñón (1997) focus on a different division among Vendler's achievements, namely, a division between those which are associated with a preliminary activity like *reach the top, die, win*, and those which are not, like *notice, recognise, explode, knock*: the former, but not the latter are natural in the progressive without any shift. Carlson (1981), Filip (1993/99) and Altshuler and Filip (2013) assume that the former (*culminations*), but not the latter, are *both* momentaneous *and* extended; Dini and Bertinetto (1995) assume that the former, but not the latter, are telic; while Piñón (1997) assumes that the former, but not the latter describe the right boundary of an extended event, namely, one during which a gradual change is happening. I myself will draw on the proposals of both Carlson (1981), Filip (1993/99) and Altshuler and Filip (2013) and assume that *culminations* like *arrive, die, win* are characterised by *both* gradual (extended) and non-gradual (instantaneous) change, and also on that of Piñón (1997), and assume that culminations are true of events that do not include gradual change, but are *preceded* by events of gradual change.

As will be discussed in Section 2.1, the progressive in English offers support for a tripartite subdivision of Vendler's achievements (cf. also Carlson 1981, Filip 1993/99 and Engelberg 2000 on the fine-grained distinctions among Vendler's achievements that can be made on the basis of the progressive). It supports the *semelfactive/achievement* distinction of Smith (1991) inasmuch as the former but not the latter most easily receive an iterative interpretation without a plural or mass argument, as in *The light was flashing* (contrast this with *John was discovering crabgrass in his garden*). The progressive also supports the *culmination/happening* distinction of Bach (1986) inasmuch as the former, but not the latter, allow for a "preliminary process progressive", as in *John was arriving* (contrast this with the slow-motion interpretation of *The Challenger was exploding*).

1.1.4 Ontology and terminology to be assumed

1.1.4.1 Subtypes of Vendler's achievements

I assume that the following subclasses of Vendler's achievements should be distinguished minimally:[8]

- predicates like *reach* or *win*: these are the *culminations* of Bach (1986), the *achievements* of Dini and Bertinetto (1995) and the *right-boundary achievements* of Piñón (1997) — these are associated with a preceding gradual change and a result state;
- predicates like *recognise* or *explode*: these are those *happenings* of Bach (1986) that are not semelfactives, the *s(tate)-punctuals* along with some of the *e(vent)-punctuals* of Dini and Bertinetto (1995), and the *left-boundary achievements* of Piñón (1997) — these are associated with a preceding state and a result state;[9]

[8]Note that I do not preclude the existence of further classes. Indeed, there appear to be predicates which do not to fit into any of the standard aspectual classes. A case in point is *survive*, which generally behaves like a non-durative predicate, but — like semelfactives — does not imply any change from one state to another. Indeed, it implies the *absence* of an expected change (on its most basic reading, from not being dead to being dead), which is most perspicuous in cases when the argument of *survive* is some state, especially a state describing the absence of something:

(i) a. It's almost impossible for the human body to have survived the lack of oxygen and the cold temperature. (http://www.huffingtonpost.co.uk/2014/04/21/hawaii-flight-teen_n_5184645.html)

However, unlike semelfactives, but similar to achievements, *survive* is not naturally iterable:

(ii) ?John was surviving heart attacks on the operation table for hours.

Despite the absence of an iterative reading, it can have an activity interpretation like semelfactives:

(iii) a. This Guy Gave Up Food for Lent and Is Surviving On Beer Instead. (http://time.com/35534/man-gives-up-food-for-lent/)
b. She's surviving after the divorce. (http://dictionary.reference.com/browse/surviving)

A similar predicate is *break a promise*, as in *Rebecca broke the promise (by never giving Jamaal any flowers)* from Engelberg (2000), who noted that breaking a promise "probably does not refer to an event at all". Such predicates might thus not even denote sets of eventualities, but might instead be second-order predicates, i.e., predicates of eventuality predicates. I will ignore such cases and focus on the three classes delineated by the semelfactive/achievement and culmination/happening distinctions.

[9]Piñón's (1997) distinction of right- and left-boundaries, however, is not sensitive enough to actually classify, say, *reach* as describing right- and *recognise* as describing left-boundary events, since events in the extension of both are both left- and right-boundaries of some eventuality (one being an event/state boundary, the other a state/state one). "Left-boundary" is especially a misnomer for predicates like *recognise*, which just signal a change from some state $\neg\phi$ to ϕ, and it is arbitrary for us to say that it's a

- ♦ predicates like *knock*: these are those *happenings* of Bach (1986) that are semelfactives, the *points* of Moens and Steedman (1988), the *semelfactives* of Smith (1991), and most of the *e(vent)-punctuals* of Dini and Bertinetto (1995) — these are not boundaries (in the sense of Piñón 1997).[10]

1.1.4.2 Terminology

Table 1.3 provides an overview of the designation I use for subtypes of Vendler's achievements. Following Smith (1991), I will designate predicates of the first two types above as *achievements*, and predicates of the third type as *semelfactives*; following Bach (1986),[11] predicates of the second and third type will be called *happenings*, and predicates of the first type as *culminations*[12] or *culmination-achievements* (which I coined to be able to avoid the ambiguity that the term "culmination" introduces); combining Bach's and Smith's terminology, I call predicates of the second type (e.g., *explode*) as *non-semelfactive happenings*.

examples	*terms for the most specific classes*	*terms from Smith (1991)*	*terms from Bach (1986)*
arrive, die, win	culminations, or culmination-achievements	achievements	culminations
explode, recognise, notice	non-semelfactive happenings		happenings
knock, flash	semelfactives	semelfactives	

Table 1.3: Terms used in the dissertation for subtypes of Vendler's achievements.

boundary of ϕ, but not $\neg\phi$; indeed, language does appear to have achievement pairs "profiling" one or the other, such as *forget–recall*, *appear–disappear*, *kill–revive*. Although the term "left-boundary" does successfully emphasize that the state characterizing these predicates is their *result state*, such a result state is also associated with "right-boundary" achievements like *arrive* or *die*.

[10] Alternatively, we can say that semelfactives describe punctually conceived transitions from a preparatory state to a post-state such that the two states are (type-)identical, adopting the "full-cycle" view of Talmy (1985, 1988). I prefer to retain the idea of semelfactives not being boundaries, as such a conception will lend itself easily to a uniform "binary scale of change" approach to all non-durative predicates in Section 5.2.

[11] The reason I choose to follow the terminology of Bach (1986) rather than Piñón (1997), despite the fact that many modern-day scholars working on this distinction use Piñón's (1997) terms of left- and right-boundary achievements (cf. Heyde-Zybatow 2004, 2008, Malink 2008, Martin 2011), is that as noted in footnote 9, these latter designations might be misleading.

[12] Following Moens and Steedman (1988), the term "culmination" will also be used to refer to the pointlike change associated with an accomplishment or an achievement.

All non-durative predicates will be designated as *Vendler's achievements* or *achievements of Vendler*. I will use *temporal extendedness* and *durativity* interchangeably. Predicates and events that are not durative are designated as *non-durative*, *non-extended*, *punctual*, *instantaneous*, or *momentaneous* (that is, I will here use these terms interchangeably).[13] I regard *temporal extendedness* as a special case of *extendedness* along some dimension, which may be temporal, spatial, or any abstract property dimension such as weight or darkness.

An eventuality predicate is *durative* if eventualities in its extension are durative. An eventuality, in turn, is *durative* (or *temporally extended*) if its temporal trace is extended, that is, it is a non-degenerate interval (an interval that is not a single point). Extendedness and durativity, as properties of individuals, are used for the way the objective temporal extent of events is *conceptualised* in a given context unless indicated otherwise, rather than as properties of their objective temporal extent, because this construal, rather than objective temporal extent is what determines the durativity feature of *predicates*.

1.2 Issues and proposal

The goal of this dissertation is an analysis of progressive achievements using a uniform semantics for the progressive that can derive the different readings that arise when applying this aspectual operator to predicates belonging to different aspectual classes. Although most accounts of the progressive (e.g., Bennett and Partee 1972, Dowty 1979, Landman 1992, Portner 1998, Bonomi 1999, Gendler Szabó 2004, Varasdi 2014) tend to focus on durative predicates, and especially accomplishments, my primary focus is on achievements.

In particular, I concentrate on two different single-event interpretations a progressive achievement can have, namely, "preliminary process" readings like *The train is arriving* and "slow-motion (camera)" readings like *The Challenger is exploding*. I maintain that in order to explain these readings, we must break with the tradition of regarding "achievements" as a homogeneous class building on Vendler (1957) and instead follow authors like Carlson (1981), Bach (1986), Smith (1991), Filip (1993/99), Dini

[13] These terms are often used synonymously. For instance, Bach (1981) calls events described by Vendler's achievements *instantaneous* events, while in Bach (1986), he uses the term *momentaneous* events. However, for instance, Beavers (2002) uses the term *momentary* and *punctual* as not synonymous. *Momentary events*, for him, hold at a single instant (these are described by momentary state predicates), while *punctual events* hold at exactly two instants (these are described by achievement predicates).

and Bertinetto (1995), Piñón (1997) who make various categorial distinctions among predicates of punctual events. Preliminary process progressives are characteristic of predicates called *culminations* by Bach (1986), while slow-motion scenarios are typical for what he calls *happenings*. These readings, in turn, differ from the regular, "internal viewpoint" progressive interpretation of accomplishments and activities.

The progressive therefore offers support for the classification of Vendler's achievements into further subclasses, in line with proposals of Carlson (1981), Bach (1986), Moens and Steedman (1988), Smith (1991), Filip (1993/99), Dini and Bertinetto (1995), Piñón (1997), Heyde-Zybatow (2008), Altshuler and Filip (2013), a.o. The subclasses are delineated by two dichotomies proposed several decades ago: *i)* semelfactives (e.g., *flash, knock, cough*, which easily receive an iterative interpretation) *versus* non-semelfactives (e.g., *recognise, explode, arrive, win, die*, for which an iterative reading is less frequent) (cf. e.g., Comrie 1976, Moens and Steedman 1988, Smith 1991), and *ii)* culminations (e.g., *arrive, die, win*, whose progressive is true during their preliminary process) *versus* happenings (e.g., *flash, knock, cough, recognise, explode*, which are not normally felicitous in the progressive on a single-event reading, and require a slow-motion scenario to this end) (cf. e.g., Carlson 1981, Bach 1986, Filip 1993/99, Piñón 1997).

Since the progressive is most often assumed to be a partitive operator, and achievements are generally taken to lack non-trivial part structures (following the original suggestion in Vendler 1957), an analysis of "preliminary process" progressives typically assumes either a non-uniform semantics of the progressive operator (e.g., Kearns 2003), or type-shifted/coerced durative achievements in the scope of the progressive (e.g., Rothstein 2004). Given different problems faced by these and other strategies that I will discuss, I propose a new analysis within a scale-based framework.

I will work out and employ a scale-based framework on which all predicates (with the exception of individual-level predicates) are characterised on the basis of a scale of change that captures the change associated with events in the denotation of a predicate. Crucially, the concept of the scale of change is a more general one than is common in existing scale-based approaches to aspect (Hay et al. 1999, Kratzer 2004, Filip and Rothstein 2006, Kennedy and Levin 2008, Rappaport Hovav 2008, Piñón 2008a, Beavers 2013, a.o.), and is simply a series of state extensions. My notion of a scale of change is an integration of the scale of change concept of Beavers (2002, 2008, 2013), and Asher's (1992) notion of a *perspective* which is a set of propositions describing an aspect of a situation that is relevant in a given context. A scale of change on my account is a temporally decomposed version of Asher's perspective in that a scale of

change describes the contextually relevant aspects of *snapshots* of an event. This means that scales of change, just as Asher's (1992) perspectives, are primarily associated with events, and the scales of change associated with predicates are derived from these event-level scales: the scales of change of a predicate are the scales of change of all possible events of which the predicate holds.

A further radical departure from former scale-based approaches to aspect is that I will assume that some predicates can be associated with *two* kinds of scales of change. In particular, I will argue that culmination predicates like *arrive* are characterised by both binary and multi-valued scales of change. This is will be crucial for my account of preliminary process progressives. As noted by a number of researchers (Piñón 1997, Löbner 2002, Heyde-Zybatow 2008, Abusch 2010, Martin 2011, a.o.), culminations *presuppose* the occurrence of a prior gradual change: e.g., *arrive at the station* presupposes movement toward the station. This presupposed gradual change, I will argue, is of a special kind, namely, a gradual change that *elaborates* on the non-gradual change associated with the culmination (for *arrive at the station*, a change from not being at the station to being at the station). To represent this presupposition, I introduce the concept of a *secondary scale of change* associated with a culmination predicate like *arrive*, which characterises this special kind of gradual change that is presupposed by the culmination — while its primary scale of change characterises the non-gradual change whose occurrence is part of the asserted content of the predicate.

Secondary scales thus do not describe properties inherent in events in the extension of culmination predicates, but *relational* properties, namely, the properties of events that I call *cover events*, whose occurrence is presupposed by the predicate. Informally, the cover events of a culmination-achievement (e.g., *arrive at the station*) are events (e.g., walking to the station-events, driving to the station-events etc.) whose culminations belong to the extension of the culmination-achievement. The secondary scales of a culmination predicate like *arrive* are not the scales of the events in its extension, but the scales of all its cover events.

I will then propose a scale-based definition of the progressive that integrates the progressive theory of Varasdi (2014) into my scale-based framework. On his account, the progressive of a predicate P holds of an event just in case the event's properties are indicative of only P of a contextually relevant set of predicates, or more specifically, just in case the partial event can only be a part of a P-event out of the available alternatives based on its inherent properties. The crucial innovation of my account is that the progressive involves a partitive component over not events or event runtimes, but over scales of change: roughly, on my scale-based account, the progressive of a pred-

icate P holds of some event if the scale of change of the event is a non-final proper part of the scale of change of some (possible) P-event, and only a P-event out of a contextually given set of alternative predicates.

Given the change from partitivity over events (or event runtimes) to partitivity over scales, the applicability condition of the progressive also changes from a durative event predicate (that is, a predicate denoting a set of durative events) to a predicate with a multi-valued scale of change — that is, a progressive can only apply to a predicate P if P is associated with multi-valued scales. These two applicability conditions differ just in case the scales of change of predicates and events in the extension of predicates are teased apart, which is what I argue for in the case of culminations. Then, rather than coercing one aspectual type into another one, what happens in the case of progressive achievements is that instead of the *two-valued primary scale* associated with an achievement, the aspectual operator has access to a multi-valued scale.

Given the way the formal system is set up, a multi-valued scale can only be associated with a durative event — just as in Beavers (2002, 2008). Thus, the multi-valued scale satisfying the applicability condition of the progressive needs to be associated with a durative event. My proposal is that in the case of culmination achievements like *arrive*, this durative event is a cover event, while in the case of happenings like *explode*, this durative event is an event in the extension of the happening itself, viewed at a fine granularity. Figure 1.1 illustrates these two sources of a multi-valued scale in the case of different achievements.

Figure 1.1: Two sources of an event associated with a multi-valued scale of change.

In the case of culminations, the applicability condition of the progressive is satisfied by the scale associated with a cover event rather than the scale of an event in the extension of the culmination predicate: this results in a preliminary process reading, the account of which builds on the idea of culminations like *arrive* being characterised by both two-valued primary scales (describing the non-gradual change asserted by the predicate) and by multi-valued secondary scales (describing the gradual change pre-

supposed by the predicate). This dual characterisation encodes the observation made explicitly by Filip (1993/99) and Altshuler and Filip (2013) that some aspects of the linguistic behaviour of culmination predicates are similar to that of happenings and some other aspects of their behaviour are similar to that of accomplishments.

In the case of happenings like *explode*, the multi-valued scale is associated with an event in the extension of *explode* itself. This event may be conceived of as instantaneous in an everyday context, but is construed as durative in the "fine (temporal) granularity" discourse context of the progressive, in which minute temporal differences are conversationally relevant. This results in a slow-motion reading of the progressive. Several researchers have noted that an extended event in one context can count as instantaneous in another context, but so far, no formally precise analysis of this observation has been put forth, as Landman (1991, §3.3) remarked. I will offer such a formal analysis by employing and refining the framework of granularity functions of Sauerland and Stateva (2007, 2011) (who themselves build on Krifka 2007), developed originally for an account of a subset of the vague predicates. This analysis will be shown to have relevance and applicability outside of achievements, and opens up several lines of potential future research (for example, on the minimal parts problem and on vague event boundaries).

The aim of the dissertation is a comprehensive account of the set of observations that have been made about single-event progressive achievement readings in English. As such, its goal is theoretical rather than empirical, though some novel empirical observations will be made with respect to the behaviour of progressive culminations. But the line of investigation is not extended to a systematic survey of a wide range of different achievement predicates: instead, I restrict the discussion to those typical achievement predicates that have formed the centre of debate on progressive achievements.

An important idea inherent in the approach of the thesis is to take formal characterisations to their logical conclusion. The motivation behind this is that if the full strength of a formal tool introduced into semantics (e.g., scales) is not utilized in the analysis of language (e.g., only scales with an infinite number of degrees are used), then that formal tool might not be the ideal one for language modelling, because it overgenerates. I propose that we should exploit all that a given formal tool can give us, even extreme cases satisfying the formal definitions, and use the *extreme* cases to explain *extremely* different linguistic behaviour. For example, I will take the notion of a scale as a linearly ordered set quite seriously, which leads us to not only binary scales as in Beavers (2008, 2013), but to scales consisting of a single degree (and perhaps even

scales consisting of no degrees, as the emptyset $\emptyset$ is also a linearly ordered set), which satisfies the formal definition of a scale.

A consequence of this approach, however, is that we often arrive at results that at first sight may appear unintuitive given the typical use of the relevant concepts in semantic analysis. For example, state predicates will also be characterised by "scales of change" — but because these scales only contain a single degree, what is entailed is *no* change. Thus, the scale of change encodes the change profile of a predicate, including the difference between predicates which entail some change and those which do not. Perhaps it would be better to use a wholly different term for this scale of change concept, such as *change profile* or *temporal perspective*, but in doing so it would not be apparent that this concept is a generalization of the notion of a scale as used in previous scale-based aspectual works.

Despite the exploitation of extreme formal cases, virtually all components of the analysis I will propose have their predecessors in formal semantics, and I will aim to motivate the introduction of each component and link it to related ideas in the literature. Indeed, in the analysis of progressive achievements I propose, I aimed to incorporate the insights of researchers working in several different frameworks which I believe is necessary in order to account for the complex patterns of behaviour showed by achievements in the progressive.

1.3 Structure of the dissertation

The structure of the dissertation is as follows. In Chapter 2, I will review the main data that I aim to account for, and the previous accounts that I draw on. I first categorise the readings available to achievements in the progressive, and then review the proposed analyses of progressive achievements. I will pinpoint aspects of each previous account of progressive achievements that are problematic and those which are useful and should be incorporated into an account of these progressives. I conclude that many of the problems faced by earlier analyses are rooted in assuming that the progressive involves partitivity over events, and therefore is allowed to apply to durative predicates only. The final part of the chapter is a review of former scale-based approaches to aspectual phenomena, the goal of which is again the identification of those aspects of different proposals that will be incorporated in my own scale-based framework.

Chapter 3 introduces the basic assumptions and considerations that I will use in my framework and analysis. I first review the relevant issues and insights relating to durativity and the moment of change. I conclude that although there may be reasons to suppose that there are no objectively instantaneous dynamic events, an event individual can be conceptualised as durative or instantaneous, and this conceptualisation affects whether a predicate used to describe the event is durative or not. I then discuss the existential presupposition about the occurrence of an activity that has been associated with culminations like *arrive* and *win*, and conclude that this presupposition is much weaker than generally assumed, but is highly important in the characterisation of this set of predicates. The chapter will be concluded by the presentation of the basic components of the model that I will use in my analysis. The special components of the formal semantic framework I use are a granularity and a context parameter of interpretation, and scales, for which I provide a detailed formal characterisation that aims to be as general as possible in order to be compatible with all previous scale-based approaches.

The main innovative contributions of the dissertation are in Chapters 4 and 5, containing an analysis of slow-motion and preliminary process readings, respectively.

Chapter 4 is dedicated to a formal analysis of how an achievement predicate in the sense of Vendler can be durative in a slow-motion scenario (and therefore, this chapter will focus primarily on the *happenings* of Bach 1986). I present first in detail the components necessary for analysing granularity-sensitive phenomena, building on the granularity function parameter of interpretation of Sauerland and Stateva (2007, 2011). I then show how changes in durativity (i.e., changes in the conceptualization of eventualities as instantaneous or durative), and in particular, slow-motion readings, can be accounted for by relativising the temporal trace function to a temporal granularity parameter (a granularity function over time as a scale). The results of this chapter can be directly exploited in event semantic frameworks with an event mereological approach to the progressive (since the proposed analysis only exploits the granularity parameter of the framework and so reference to scales of change are not necessary). Predictions and consequences of this account will be discussed, such as the link between durativity and vagueness, as well as the welcome theoretical gain in being able to model the vagueness of the temporal boundaries of events, and to approach the minimal parts question of activities within a more general framework of granularity.

In Chapter 5, I present a novel scale-based account of aspectual classes and the progressive in order to be able to account for not only slow-motion progressive readings, but also preliminary process interpretations. I first introduce a novel notion of a

scale of change, integrating ideas from Beavers (2008, 2013) and Asher (1992), and the novel notions of a cover event and secondary scales of change, building on the existential presupposition associated with culminations. Then I present a characterisation of predicates belonging to different aspectual classes based on their associated scale structure. I follow Beavers (2013) in having two properties of scales of change influence aspectual properties of their associated predicates: scale complexity determines durativity and specificity of the required change determines telicity. I concentrate mainly on durativity, and extend to states Beavers's (2008) idea of how scale complexity determines durativity by determining the gradualness of the associated change, and, more pertinently for the purposes of the dissertation, I characterise culminations with both two-valued and multi-valued scales.

I then formulate a scale-based definition of the progressive operator by adapting Varasdi's (2014) account to my scale-based framework. On my analysis, the input requirement of the progressive is a predicate associated with a multi-valued scale of change rather than a durative predicate (where a durative predicate is a predicate whose extension contains durative events). The chapter will be concluded by a brief look at aspect in some languages other than English to show that previous accounts of typological variations can be incorporated into the proposed scale-based framework. In addition, I will show that by changing another parameter specific to the scale-based definition of the progressive, namely, whether or not the progressive has access to secondary scales of change, we can account for a difference between the English and the more restricted Hungarian progressive.

In Appendix A, I give the notation and definition of the most important mathematical concepts I use. In Appendix B, I give a detailed characterisation of the scalar trace function that maps time intervals to parts of the scale of change of an eventuality — the formal details of this are not directly relevant to my analysis, but serves to ensure that the scale-based system works in the expected way formally.

The dissertation is organized around the following topics:

- *Culminations and preliminary process progressives* (which is the single-event progressive achievement reading discussed most frequently in former accounts): this forms the topic of Sections 2.1, 2.2 and 3.2 and Chapter 5.

  The analysis of these progressives is built on Gyarmathy (2011, 2012, 2014).

- *Durativity, granularity changes and slow-motion readings*: These are the focus of Section 3.1 and Chapter 4.

  The discussion in these chapters is built on Gyarmathy (2012, 2015).

- *A scale-based approach to aspectual phenomena*, and in particular, the characterisation of aspectual classes and the semantics of the progressive operator: this is the topic of Sections 2.3, 5.1, 5.2 and 5.3.

  The ideas in these parts are built on Gyarmathy (2011, 2014).

The overall encompassing theme of the dissertation is the exploitation of scale-based approaches to time and aspect in accounting for the behaviour of progressive achievements. The analysis of slow-motion readings in Chapter 4 relies on conceiving of time as a scale, while the analysis of preliminary progressives in Chapter 5 on conceiving of the change associated with all predicates as a scale.

Chapter 2

THE CORE DATA AND A REVIEW OF THE RELEVANT THEORIES

This chapter presents the data about progressive achievements that will serve as the object of study in the rest of the thesis. First, different uses of the progressive when applied to Vendler's achievements will be charted and the slow-motion and preliminary process interpretations isolated as specific to achievements. Second, I will review former accounts of progressive achievements with the aim of uncovering their respective weak points and advantages that I will incorporate in my own analysis. Finally, the chapter is concluded with an overview of different scale-based approaches to verb semantics with the aim of again selecting aspects of the various analyses to be incorporated in my own analysis.

2.1 Vendler's achievements in the scope of the progressive

2.1.1 The progressive as an aspectual operator

The imperfective, the progressive and the perfective, as well as the perfect according to some authors, is a so called *viewpoint aspect* (aka *grammatical aspect*), a perspective on states of affairs. They are often, though far from exclusively, signalled with morphosyntactic means; for instance, the English progressive is signalled with the auxiliary *be* plus the *-ing* morpheme. It is not at all trivial to compare aspectual operators and systems across different languages, as detailed by Dahl (1985) and Thieroff

(2000), a.o.[1] For instance, English, and, in fact, Germanic languages in general, are often argued not to have a perfective/imperfective distinction (cf. Dahl 1985, p. 167). Although the distinction between the simple past (or, in general, the non-progressive form) and the progressive in English is often analysed as a perfective/imperfective difference (Comrie 1976, p. 23), the English non-progressive form can be both perfective *and* imperfective (Comrie 1976, p. 25). Although the term "progressive" is often used in works on English aspect interchangeably with "imperfective", the two terms should be kept distinct even in an analysis of English. An example for an imperfective but not progressive sentence is *John is in the kitchen*, for instance.

Viewpoint aspect interacts with aspectual classes (aka *situation aspect*, or *lexical aspect*): viewpoint aspectual operators operate on an eventuality predicate to output another eventuality predicate.[2] The output of the progressive is an atelic predicate — a state according to, e.g., Vlach (1981), Bach (1981), Moens and Steedman (1988), or an activity according to, e.g., Mourelatos (1978), Kearns (1991). The semantics of the progressive should then ideally reflect the constraints on the aspectual class of its input predicate and account for the aspectual class of its output.

The most common approach to the semantics of the progressive, going back to at least Jespersen's (1931)'s idea of the progressive as describing an event that serves as a "temporal frame" encompassing another event, is that the progressive presents an eventuality "from within" (cf. e.g., Comrie 1976). This is reflected in analyses of the progressive as a partitive operator over time intervals (e.g., Bennett and Partee 1972, Dowty 1979) or events (e.g., Bach 1986, Krifka 1992, Filip 1993/99). Given this partitive view of the progressive and a view of Vendler's achievements as non-durative (both of which views can, and have been called into question, as we will see), an incompatibility of the progressive with Vendler's achievements is expected, since they denote events without proper parts, which cannot be "viewed from within". Whether this expectation is borne out is the topic of the following section.

[1] Despite problems of crosslinguistic identification of aspectual operators, it is customary to utilize the same terms in the description of the aspectual system of different languages, if only to account for semantic similarities. The basic aspectual distinction (originating from Slavic linguistics) is assumed to be the perfective/imperfective, and the progressive and the habitual are generally assumed to be a subtype of the imperfective (cf. e.g., Comrie 1976, Thieroff 2000), while the perfect is often regarded as a special type of the perfective (cf. e.g., Bertinetto et al. 2000).

[2] Of course, not all authors assume this view of viewpoint aspect, or even a distinction between viewpoint and situation aspect and/or viewpoint aspect and tense (cf. for instance the framework of Reichenbach 1947 who analysed both tense and viewpoint aspect as tenses), but a comparison of the various approaches is beyond our scope here.

2.1.2 Readings of the progressive of Vendler's achievements

Achievements, since the work of Vendler (1957), are often regarded as unacceptable in the progressive based on the infelicitousness of examples such as (2.1) from Dowty (1979).[3]

(2.1) ?(At this moment) John is noticing a stranger in the room.

At the same time, it is a well-known fact that many achievements do appear in the progressive, as the following examples from Dowty (1979) show:

(2.2) a. John was dying.
b. John is gradually realizing that you are right.
c. John has been discovering crabgrass in his yard for six weeks.

Thus, the adage that achievements "lack progressive tenses" (Dowty 1979, p. 54) is well-known to be a simplified generalisation, as "there are at least occasional acceptable examples of achievements with progressives" (Dowty 1979, p. 137). A question that arises then is which achievement predicates can easily used in the progressive, and authors like Carlson (1981), Filip (1993/99), Dini and Bertinetto (1995) have argued that it is those achievements which are associated with an extended gradual change — *culminations* in the terminology of Bach (1986).

An important observation about progressive achievements is that "these exhibit the same failure of inference from progressive to simple tense as do accomplishments" (Dowty 1979, p. 137). In other words, achievements are generally assumed to display the *imperfective paradox* just like accomplishments. For example, (2.3b) does not follow from (2.3a).

(2.3) a. John was dying.
b. John died.

[3]Note that different authors take different sets of predicates to be achievements, which adds to the confusion surrounding progressive achievements. Many of the authors discussed here, including Moens and Steedman (1988), Piñón (1997), Rothstein (2004), Martin (2011) do not include semelfactives in their class of achievements, but may be in disagreement about less well-established distinctions, such as the status of predicates like *explode* or *kill*. I will continue to adhere to the current convention of using the term *achievement* for all event predicates which are generally non-durative in their behaviour except for semelfactives (without, however, wishing to commit to the assumption that these form a single, unified category).

Note that this generalisation is only valid only for the natural progressive interpretation of culmination predicates like *die* and *arrive*, but not if we take into account all of the progressive readings available to Vendler's achievements, which is what I will turn to now.

All of the readings I list below have been recognised and noted in previous works, but they have not, to my knowledge, been systematically categorised and characterised. Most researchers have tended to focus on the difference between the interpretation of the progressive when applied to accomplishments as opposed to culmination-achievements like *reach* (e.g., Kearns 2003, Rothstein 2004, Martin 2011). There is little attention given to other readings of progressive achievements, and apart from Filip (1993/99), Dini and Bertinetto (1995) and Engelberg (2000), researchers have given little or no attention to delineating subtypes of Vendler's achievements that give rise to one or another reading.

Building on observations of Carlson (1981), Filip (1993/99), Dini and Bertinetto (1995), Engelberg (2000), Kearns (2003) and Rothstein (2004), I propose that the main types of interpretation that are available to Vendler's achievements in the progressive in English are as follows,[4] with examples from, among others, Comrie (1976), Dowty (1979), Verkuyl (1989), Piñón (1997), Rothstein (2004).

1. **Preliminary process reading**

   This is the *preliminary stage*-focusing reading of Smith (1991), the *preliminary circumstance* reading of Kearns (2003), the *preparatory phase of result state* interpretation of Dini and Bertinetto (1995), and the most prominent use of progressive achievements as analysed by Piñón (1997), Rothstein (2004), Martin (2011).

   These sentences display the most typical use of the progressive in the case of the non-semelfactive achievements of Vendler. They often imply the imminency of the culmination[5] and display the imperfective paradox. Examples are as follows:

   (2.4) a. Rebecca was reaching the summit when it began to rain.
   b. Astrid was winning the race when we arrived.
   c. We visited the wounded soldier, who was dying.

[4] Here I only focus on aspectual-temporal uses of the progressive, and disregard, for example the "interpret(at)ive progressive" (cf. e.g. Bertinetto et al. 2000), which Kearns (2003)'s example, *In suddenly uncovering and seeing the key he was looking for, he was finding it*, shows is also available for achievements.

[5] The imminency meaning component of such progressives has been noted for English and several Romance languages, cf. Bertinetto (2000), as well as several Germanic languages, cf. Ebert (2000).

Not all achievements can be used in this sense, as witnessed by the unacceptability of the following sentence:

(2.5) #Anita was recognising Peter when I walked in.

I follow Carlson (1981), Filip (1993/99), Dini and Bertinetto (1995), Martin (2011) in maintaining that it is *culmination-achievements* that can appear on this progressive reading.

2. **Slow-motion (camera) reading**

   This is the *momentaneous progressive reading* of Dini and Bertinetto (1995), as well as the *slow-motion movie* reading noted by Filip (1993/99, pp. 18, 114), and the *slowed down* scenario mentioned by Comrie (1976, p. 43).

   On this reading, an event described by the achievement predicate, which by default is regarded as durationless, behaves like durative eventualities, that is, we "zoom in" to view it as an extended event. Then the predicate describing this event behaves like an accomplishment, and is therefore felicitous in the progressive, and displays the imperfective paradox. Examples include the following, with progressively more radical changes in granularity from an everyday context to an extreme scientific one:[6]

   (2.6) a. John is gradually realizing that you are right.
   b. Look at the screen, the Challenger is exploding now.
   c. And now the subject is coughing. [during a film in an anatomy lecture]

   As Comrie (1976, p. 43) argues, this reading is only available to those predicates which describe events that in reality are not instantaneous, but take (some small amount of) time — which is true of *happenings* (i.e., semelfactives and predicates like *recognise*). It is typically (though not by necessity) unavailable for predicates like *reach* (*culminations*), which, however much we "zoom in", could always be construed in a way that they refer to only the very final moment of some gradual change.

[6] (2.6a) is not strictly speaking a *slow-motion* reading, as it does not require an atypical, fine-grained context like (2.6b) or (2.6c). I include (2.6a) here to indicate that I believe all of these progressive sentences should be grouped together, the reason for which is that these are the cases in which an achievement predicate is genuinely used as an *accomplishment* predicate. (2.6a) will be analysed in detail in Section 5.4.1.

3. **Iterative reading**

The iterative reading of the progressive is a well-known, multi-event (i.e., *pluractional*, cf. Bertinetto and Lenci 2012) interpretation. Examples for this reading are as follows:

(2.7) a. The light was flashing.
b. John was coughing.

On the iterative reading, we typically do not find the imperfective paradox, that is, from *The light is flashing*, we can usually infer that *The light flashed*. As the examples show, this is the most natural progressive interpretation for *semelfactives*. This reading is not specific to this aspectual class,[7] but it is easy to explain why the iterative reading is most natural with semelfactives. An iterative interpretation is dependent on the *relative size* of two intervals: i) the size of the interval of evaluation and ii) the interval size which is the sum of the typical time an event of the relevant type takes and the time needed to "reset" the state of the affairs so that an event of the same type with the same participants can reoccur again (cf. Filip 1993/99, p. 114–5 and Vanden Wyngaerd 2001). Since, for example, a flash can reoccur as soon as one iteration is over, flashings easily fit multiple times into any reasonably-sized interval in everyday contexts.

This is reinforced by the fact that if the meaning of an achievement is shifted so that its result state is implied to hold for only a very short time, then an iterative reading becomes available to them, as in Beavers's (2008) example:

(2.8) [In a context of Nancy suffering from acute amnesia:] ?Sid's Mohawk will stun Nancy over and over again for five minutes.

But felicitous examples of an iterative reading of a non-semelfactive predicate in the progressive may also arise simply if the relative size of the interval of evaluation is great enough, as in (2.9a) from Vlach (1981) for the culmination predicate *win*, or as in (2.9b) (adapted from Vanden Wyngaerd 2001) for an accomplishment predicate.

(2.9) a. Max was winning for a year.
b. Fred has been swimming across the pool for the past 3 hours.

[7] Cf. Carlson (1981), Vlach (1981), Vanden Wyngaerd (2001). For example, (2.9b) exemplifies a progressive accomplishment that can have an iterative reading in a neutral context.

4. **Futurate progressive reading**

   In English (and in a number of other languages such as Icelandic and Judeo-Spanish, according to Bertinetto 2000), the progressive may take on a futurate meaning (e.g., *I am writing the letter to the dean tomorrow*) as opposed to a from-within-the-eventuality viewpoint. This is a reading that is, again, not specific to achievements, but is available to them, as (2.10) shows.

   (2.10) Mary's plane is arriving tomorrow morning.

   Although this reading is similar to the "preliminary process" reading in that it is a *prospective* interpretation, it is different from that reading. First, the futurate reading has *no* imminency implication, that is, (2.10) is not synonymous with (2.11).

   (2.11) Mary's plane is about to arrive.

   Second, as noted above, while the preliminary process reading is specific to achievements (for no progressive accomplishment or activity that is not modified with a time adverbial do we get an imminency implication), the futurate reading arises for other aspectual classes, as well (cf. *I am writing the letter to the dean tomorrow* for an accomplishment, or *I am running tomorrow morning* for an activity). Third, the futurate progressive, but not any other reading of the progressive, is known to imply that an eventuality of the relevant kind is planned or "predetermined" (as noted by, e.g., Dowty 1977, 1979). This predeterminancy meaning component explains why some predicates, semelfactives among them, are odd on the futurate reading in a neutral context, as (2.12) shows.[8]

   (2.12) ?The light is flashing tomorrow morning.

   Crucially, while the preliminary process reading is available to all culminations, the futurate reading is not naturally available for culminations like *win*, which, like semelfactives, are not generally compatible with their occurrence being predetermined:

   (2.13) ?John is winning the race tomorrow morning.

[8] Contrast (2.12) with *The light is flashing in a minute*, which appears to sound much better, arguably because a pattern of flashing in which individual flashes are separated by a few minutes, as opposed to days, is much easier to assume.

5. **Commentary reading**

   Kearns (1991) calls this use *anecdotal*, while Rothstein (2004) calls it a *slow-motion* or *film-commentary* reading.

   This reading is available, for instance, when the speaker is conveying the happenings in a movie to a hearer in the next room. An example for this reading is the following, which can be uttered closely before *or after* the time of Mary's actual spotting of her arch enemy:

   (2.14) Mary is spotting her arch enemy at the party at the moment.

   Importantly, Rothstein (2004) argued that this reading does not display the imperfective paradox. The reason for this is, intuitively, that this reading is used when "exactly timing the utterance is not important" (Kearns 1991, p. 168).

   This reading, again, appears not to be restricted to achievements: *Mary is pouring wine into the glass*, for instance, can be uttered even if, on the film that we describe, Mary has just finished pouring.

I have not included in the list above a further felicitous case of progressive achievements, namely, the case when the predicate has an argument that is a plural or a mass term. This is another multi-event, pluractional use (beside the iterative) on which achievement predicates are acceptable in the scope of the progressive, as noted by Dowty (1979) and Filip (1993/99), a.o. It is often not differentiated from the iterative reading, which it should be, because, as opposed to the iterative reading, this is not specific to semelfactives in the sense that a plural argument reading is *naturally* available for other types of Vendler's achievements, as well, without any special conditions. Examples include the following:

(2.15) a. Trains were arriving at the station the whole afternoon.
b. John has been discovering crabgrass in his yard for six weeks.

The reason I did not include this reading in the list above is that the input predicate of the progressive is here not in the same form as in the case of the other readings. In any case, just as the iterative reading, this progressive use is not specific to Vendler's achievements, cf. *John was building houses during the last months*.

What we see is that there are different ways in which Vendler's achievements can interact with the progressive, and their most natural progressive readings reveal cat-

egorial differences among them. Table 2.1 summarizes the most neutral use of the progressive as applied to different subtypes of Vendler's achievements.

CLASS	EXAMPLE	PROGRESSIVE READING
culminations	*reach, die*	preliminary process
non-semelfactive happenings	*recognise, explode*	slow-motion
semelfactives	*jump, flash*	iterative (also slow-motion)

Table 2.1: The most natural reading of the progressive for the three subtypes of Vendler's achievements

Most of the readings available to Vendler's achievements are not particular to this class and should thus be analysed within a broader theory of how these interpretations of the progressive arise. This leaves the first two readings (the preliminary process and slow-motion interpretations) as specific to this class, and these cases exhibit characteristics similar to progressive accomplishments, at least in displaying the imperfective paradox. At the same time, both these readings differ from the most natural reading of progressive accomplishments, which is what Kearns 2003 aptly calls the "component process" reading: a progressive accomplishment like *John is writing a letter* is true of the process part of a complete (possible) event of John writing the letter completely. A preliminary process progressive like *John is arriving* is true of a process that is not generally regarded to be a component part of an event of which the input predicate (*John arrive*$_{\emptyset}$) holds (though see Section 2.2.2 for a view on which it does). A slow-motion progressive like *The Challenger is exploding* does hold of a component process, but it requires a "fine granularity" discourse context which a progressive accomplishment does not. In the rest of the dissertation, it will be these two readings of the progressive of Vendler's achievements that I will focus on.

2.2 Previous analyses of progressive achievements

2.2.1 Charting existing approaches

An analysis of progressive achievements has both some differences and some similarities among aspectual classes to account for. First, it should ideally employ a semantics for the progressive that is invariant across aspectual classes (activities, accomplish-

ments, culminations, and happenings alike), the core of which is the "internal viewpoint" meaning component.

Second, the analysis should be able to capture and explain the difference between *culminations* and *accomplishments* in the progressive. Differences in behaviour involve (cf. e.g., Rothstein 2004, Martin 2011, and Chapter 5):

- infelicitous modification by adverbs of completion such as *halfway through*,
- non-acceptability as complements of aspectual verbs, such as *start*,
- different interpretation (imminency or fine granularity),
- non-implication to the existence of a "partial event" of the type denoted by the predicate input to the progressive.

Third, the analysis should also capture and explain the differences in the interpretation *across* groups of achievements in the progressive, as seen in Section 2.1.2, predicting the relevant single-event readings:

- preliminary process reading (*Rebecca was reaching the summit*);
- slow-motion reading (*The Challenger is exploding now*).

Most analyses of progressive achievements have focussed on the preliminary process reading characteristic of culmination-achievements, because this is the single-event progressive interpretation that is available for achievements in normal, everyday scenarios. Slow-motion readings like *Look at the screen, the Challenger is exploding* characteristic of happenings, in contrast, require fine-grained scenarios that are less common in everyday contexts.

And fourth, the analysis should account for the common meaning core within each of the above groups of progressive achievement.

There are several different approaches in previous works to satisfying some or all of the above desiderata. Existing accounts of progressive achievements can be categorised according to a handful of criteria which characterise the basic ontology and semantics they assume.

Progressive as a partitive operator. The first potential dividing line concerns the semantics of the progressive. In particular, theories could differ as to whether the semantics of the progressive involves partitivity (over the domain of time intervals or eventualities) or not.

1. To this question, most approaches have an affirmative answer, that is, the progressive is assumed to involve partitivity in Bennett and Partee (1972), Dowty

(1979), Moens and Steedman (1988), Landman (1992), Filip (1993/99), Portner (1998), Bonomi (1999), Kearns (2003), Deo (2009), Varasdi (2014), alike.

2. Exception to this strictly partitive account are Vlach (1981), Asher (1992) and Kamp and Reyle (1993), who put forth similar suggestions, namely, that the progressive is true during the process that *leads* to truth of its input predicate.

The analysis I will propose aims at a unification of the insights of both approaches: following the latter authors, I will assume that the progressive is not a partitive operator over time intervals or eventualities, but I will embrace the partitive approach in assuming that the progressive involves partitivity over *scales of change*. Such a move makes a difference just in case we tease apart scales of change and eventualities in the extension of a predicate, which is exactly what I will propose in the case of culminations.

Two progressives. A point of divergence among different approaches to progressive achievements is whether the semantics of the progressive is different when applied to accomplishments and (culmination-)achievements.

1. Some authors would like to retain a uniform semantics for the progressive and assume that the semantics of the operator is the same whatever predicate it applies to. This is the approach of Moens and Steedman (1988), Filip (1993/99) and Rothstein (2004). I myself will also endorse this view.

2. Some authors, on the other hand, posit different semantics of the progressive operator when applied to achievements and accomplishments. This is the view held by Kearns (2003) and Martin (2011). These authors assume that while the progressive refers to the component process of accomplishments (being a partitive operator by default), it refers to the preliminary process of culmination-achievements. Piñón (1997) should perhaps also be listed among these authors, though his case is unique in that the progressive operator itself does not have different semantics in different cases, but because he treats progressive achievements as complex lexicalized expressions, Piñón also does not derive the semantics thereof via a combination of the meaning of achievement predicates and the generic progressive operator.

Coercion. A third point of difference among theories of progressive achievements is whether or not a (culmination-)achievement is assumed to be coerced to describe durative events in the scope of the progressive.

1. Perhaps the most traditionally accepted view is that progressive achievements do involve coercion into a durative type. This is the view expounded by Moens and Steedman (1988), Rothstein (2004) and Martin (2011).

2. Some authors, however, do not assume an instantaneous to durative coercion in the case of progressive culminations. This is the view held by Filip (1993/99), Altshuler and Filip (2013) and Kearns (2003). Piñón (1997) is also an author to reject coercion in prohibiting the application of the progressive to achievements. I myself will likewise embrace the view that no instantaneous to durative coercion should be posited for culminations in the scope of the progressive.

Achievement types. A fourth point where approaches to progressive achievements (just as aspectual classifications, in general) differ is the distinctions they make among achievements, and, in particular, whether a distinction between culminations and happenings is assumed.

1. Approaches building on Vendler (1957) do not make such a fine-grained ontological distinction. Authors subscribing to this view are Dowty (1979), Moens and Steedman (1988), Kearns (2003), Rothstein (2004).

2. Most authors working on the aspectual characteristics of achievements, however, argue for a need for a distinction between culminations and happenings. Proponents of this view are Carlson (1981), Filip (1993/99), Piñón (1997), Martin (2011). I myself also endorse this view.

Durative input requirement. Based on these considerations, if one goes along with the most received semantics of the progressive as a partitive operator and of achievements as non-durative, then there are perhaps two basic approaches to resolving the clash between the non-durativity of achievements and the durativity requirement imposed on its input predicate by the progressive:

1. The progressive that applies to achievements has a special semantics, in which case it either does not involve partitivity, or it accesses the presupposed (rather than asserted) content.[9]

2. The achievement in the scope of the progressive is coerced to be durative.

Martin (2011) is an author who appears to endorse both solutions, that is, beside positing durative achievements, she also concludes that achievements are not compatible with the "standard progressive". The reason she subscribes to both assumptions is that she allows for durative achievements also outside the scope of a progressive operator, based on an inspection of (French) data with aspectual verbs and adverbs of completion, and so she needs to explain why progressive achievements have a preliminary process, rather than component process interpretation, meaning that they do not entail the partial realization of a (durative) achievement (e.g., no partial arrival is entailed by *be arriving*).

2.2.2 Culminations entailing a change with temporal extent

In contrast, Filip (1993/99) subscribes to neither of the above two assumptions. The reason she can do so is that she regards culminations as having *temporal extent*, just like accomplishments: "[p]rotracted events and culminations are extended in time" (Filip 1993/99, p. 111).

Filip does not belong with authors like Kenny (1963) or Verkuyl (1989, 1993), however, who deny any linguistically relevant difference between these classes. She differentiates culminations from accomplishments by saying that "[c]ulmination events differ from protracted events in that they have no expression in their semantic description associated with the process preceding the culmination (see Pustejovsky 1988:30ff.)" (*op. cit.*, p. 111). But if there is no expression of the processes preceding culminations in their semantic contents, then how is it encoded? If culmination events are extended in time, then the extended part must be encoded in some way, and, what is more, in a way that is different from the encoding of the extended process part in the case of accomplishments.

[9] Cf. the difference between the asserted content-manipulating imperfective operator IMPF needed for durative predicates and the presupposed content-manipulating IMPF-2 needed for achievements in Piñón (2008b), who made explicit the exact semantics of the imperfective operator that is needed by Malink (2008) in his account of *negated* achievements, and the same therefore applies to the account of progressive achievements in Heyde-Zybatow (2008) who employs the same framework as Malink (2008).

Pustejovsky himself presents various solutions to the achievement/accomplishment distinction. In Pustejovsky (1991), for instance, he locates this distinction in the specification of the "activity" part or lack thereof in their semantic description, but for him, this activity part is an agentive activity (rather than a generic process), and so the difference for him boils down to agentivity (accomplishments) *vs.* nonagentivity (achievements). He, of course, then may have problems differentiating non-agentive accomplishments (such as *the ball roll$_\emptyset$ to the bottom of the slope*) from achievements (cf. Section 1.1.2).

In what follows, I inspect three other possible options for differentiating culminations from accomplishments if we wish to retain the idea that culminations have temporal extent.

Solution 1: Presupposed activity part. One option open to Filip (1993/99) is to say that lack of the process part in the semantic description of achievements is related to the view accepted by many authors (e.g., Piñón 1997, Löbner 2002, Heyde-Zybatow 2008, Martin 2011) about the presupposed content of achievements. That is, we could say that although culminations are associated with a temporally extended *change*, the occurrence of the extended process associated with this change is *presupposed*, rather than part of their asserted content, and so they simply describe instantaneous change. Taking this view, however, would mean that we need to assume that the progressive of a culmination describes this presupposed process, and so it is either a culmination-specific progressive (accessing the presupposed process of its input, as the IMPF-2 imperfective operator in Piñón 2008b), or the culmination in its scope is coerced to include the process part in its semantic description.

One may wonder if a uniform, *disjunctive* semantics for the progressive cannot be given, after all. We could say that a progressive is a partitive operator over an event that is part of *either* the asserted, *or* the presupposed content. This definition of the progressive would lead to wrong results, however. For instance, *John managed to open the door* presupposes that John was *trying* to open the door, and so during the process of John trying to open the door — however small or non-existent chance John has of actually opening the door — (2.16) is predicted, incorrectly, to be true.

(2.16) John is managing to open the door.

Thus, a disjunctive, uniform semantics for the progressive is not tenable, and we are left with a culmination-specific definition.

Solution 2: Vague vs. sharp boundaries. Another way to potentially make a difference between culmination-achievements and accomplishments is to say that the former, but not the latter have a *sharp* (right) boundary. However, as noted by Altshuler and Filip (2013), some accomplishments, such as *write an email*, can also have a sharp boundary; e.g., as Altshuler and Filip (2013) put it, writing of an email can be "understood as culminating in the moment when the 'send' button is pressed".

Thus, having a sharp boundary is not specific to culminations, and is not suitable to distinguish culminations and accomplishments, because even accomplishments with a sharp boundary can be complements of aspectual verbs as in (2.17a), while the same is not true of culminations (Dowty 1979, Mittwoch 1991, Piñón 1997, Kearns 2003, Rothstein 2004, see Section 5.4.3), cf. (2.17b):[10]

(2.17) a. John started/finished writing an email.
b. *Mary started/finished arriving at the station.

It is a general issue with regarding culminations as extended that we need to resort to alternative methods and extra tools for explaining their *non-durative*-like behaviour (such as compatibility with temporal point adverbials like *at noon* and reduced compatibility with adverbs of completion like *halfway* or as arguments of aspectual verbs like *finish* and of *spend X time*). If culminations are extended, then it is surprising that a temporal frame adverbial such as *in a few minutes* only has an "after" reading when it modifies culminations, as in *John will arrive in a few minutes*, while it is ambiguous between an "after" and a "duration" reading when it modifies accomplishments, as in *John will build a house in two years* (cf. Vendler 1957, Dowty 1979, Kearns 2003, a.o.), where on an "after" reading, an eventuality happens *after* the given amount of time as measured from an event-independent reference time, and on a "duration" reading an eventuality itself takes the given amount of time.

Indeed, it appears that culminations only behave like a durative predicate with respect to the progressive, while in all other respects, they function as punctual pred-

[10] Also, given that *finish* arguably refers to the right boundary of an accomplishment, i.e., it results in a culmination predicate, it is unclear why *John finished building a house* is felicitous, if the culmination of *build a house*, as opposed to that of culmination-achievements (which is what *finish building a house* is), is vague. Of course, as will be discussed in Section 4.3.2, the precise location of the endpoint of events is, indeed underdefined, but this is not a point of difference for different aspectual classes. For instance, *Microsoft won the race for computer operating software in the 1990s* (from *Distribution Agreements Under the EC Competition Rules* by Valentine Korah & Denis O'Sullivan) is a culmination-achievement despite the fact that the exact point of the winning is vague, and even more so than the point when a house-building can be said to culminate.

icates (though see Chapter 5 for some exceptions). Importantly, their combinability and interpretations with *temporal adverbials* appears to display a strictly non-durative behaviour. It would be a welcome aspect of our semantics if it were able to explain why the durative behaviour of culminations is specific to a position in the scope of the progressive.

Solution 3: Salience. A third option for differentiating between accomplishments and temporally extended culminations is with reference to some kind of conceptual salience: we can say that the final punctual change is conceptually more salient in the case of culminations (but not in the case of accomplishments) than the process leading up to this punctual change. This solution captures the idea of Filip (1993/99) and Altshuler and Filip (2013) most closely. This proposal is highly compelling, but it is difficult to see how it can be incorporated in model-theoretic semantics. The analysis I will propose is an attempt at this incorporation and the formalization of Filip's (1993/99) idea of culmination-achievements sharing characteristics with both accomplishments and happenings.

It should be noted that a somewhat similar route taken by Pustejovsky (1998) who (instead of his agentivity-based distinction in Pustejovsky 1991) uses the notion of "event headedness". On his account, events in an event structure are ordered by relative prominence, and the head is the "most prominent subevent in the event structure of a predicate" (*op. cit.*, p. 72). Thus, Pustejovsky differentiates accomplishments like *build a house* and culminations like *arrive* by postulating that in the case of the former, the head is the initial subevent, while in the case of the latter, the head is the final subevent. But note that on Pustejovsky's (1998) account, the second part of the event structure of a transition (a telic predicate) is the result state, rather than the culmination point. This specific theory therefore introduces a distinction between accomplishments and achievements with respect to the importance of their result state, which might be potentially unwanted.

2.2.3 A lexicalization approach

A different solution is presented by Piñón (1997), the proposal of whom is worth discussing here, because although Piñón discusses progressive achievements only very briefly, he is the only one, as far as I am aware, who is explicitly committed to the route that is perhaps the most natural one for accounts disallowing progressive achievements. In particular, Piñón (1997) argues that progressive achievements are marginal

and always involve an "unpredictable meaning shift" and so they are always *lexicalized* cases. His most general argument for a lexicalization approach is that the progressive in these cases does not mean that the eventuality described by the predicate itself is in progress:

> In [*Rebecca was reaching the summit when it began to rain*], *was reaching* may be paraphrased as 'was approaching': it is not the actual attainment of the summit that was in progress. In [*Astrid was winning the race when we arrived.*], *was winning the race* has 'was ahead in the race' as a paraphrase—the winning itself was clearly not in progress. The question in [*Are you finding everything okay*] may be rephrased as 'Is your search for what you are looking for going well?'. Again, it is not the eventuality described by the achievement (here: a finding) that is in progress. Finally, *was dying* in [*We visited the wounded soldier, who was dying*] may be paraphrased as 'was suffering and on the verge of death': the death itself was not in progress. (p. 279)

Piñón's problem with having progressive achievements derived through a compositional mechanism of interpretation combining the meaning of the progressive and of the relevant achievement thus appears to be that it is the *preliminary process*, rather than the *component process* that the progressive describes in their case, much as authors like Smith (1991), Kearns (2003) and Martin (2011) maintain. So what Piñón (1997), like these authors, holds is that the progressive cannot have the same semantics when it applies to achievements as it does when it applies to accomplishments, as the following passage shows:

> If achievements denote instantaneous eventualities, then we do not expect semantically regular progressives to be possible, precisely because eventualities without duration are never in progress. (p. 279)

But then it seems to me that it would be more parsimonious to follow authors like Kearns (2003) and assign a special meaning to the progressive operator itself when it applies to achievement predicates, namely, one which results in a preliminary process reading. This could even explain the most specific argument of Piñón (1997) about *dying*, which runs as follows:

> In each case, there seems to be an element of irreducible *lexicalization* involved. Why, for example, can we not refer to a captured spy in her final minutes before committing suicide as someone who is dying? (p. 279)

I will argue that this question can be answered even without recourse to an achievement-specific semantics for the progressive, but it is straightforward given a special, *preliminary process* semantics of this operator and the assumption that the type of the

process leading up to an event falling under a specific achievement is *lexicalized*[11] (which is actually exactly what Rothstein 2004 contends, cf. below): since in the minutes before a spy commits suicide, the preliminary process associated with dying (increasing suffering and/or deterioration of health) is not happening.

What a lexicalization approach of progressive achievements would (weakly) predict is that it should only be a handful of predicates that are accessible in the progressive (though, strictly speaking, the essence of lexicalization approaches in general is that "anything goes" within some bounds, so in theory, all achievements could have a lexicalized progressive). As such, a lexicalization approach cannot easily explain the observation cited in Section 2.1.2 that happenings like *recognise* cannot appear on the preliminary process reading. A pure lexicalization approach in itself makes no predictions about which achievements will have a progressive form lexicalized and what the associated meaning thereof will be, and so nothing guarantees that it is *arriving* rather than *noticing* that is lexicalized.

In addition, as noted by Hana Filip (p.c.), if progressive achievements are lexicalized, we would expect that they are encoded as a simple lexical item (a word) in at least *some* language, but I do not know of such a language. If a vast cross-linguistic study should verify that there is indeed *no* language in which progressive achievement meanings are encoded in a simple lexical item (a word), then this is arguably not an accidental gap, and would severely weaken a lexicalization account of progressive achievements.

However, one welcome aspect of the fact that a lexicalization approach does not predict a uniform semantics for all progressive achievements is that it is compatible with some, but not all progressive achievements implying the imminency of the culmination. Although prototypical progressive achievements like *arriving at the station* or *reaching the top* do have this implication, this is not true of all progressive culminations. Culminations like *win* and *die* can appear in the progressive without implying that the culmination is imminent (cf. Section 5.5.1), as in the sentence *From the day we are born, we are dying*. On a lexicalization approach, this lack of uniformity is easily accommodated.

Achievements as boundaries. Although I do not endorse Piñón's (1997) idea that progressive achievements are all lexicalized, the general approach of Piñón (1997) to achievements as *boundaries* appears to me to capture a fundamental component of

[11] So that it is not the progressive achievement construction that is lexicalized, but merely the type of the preliminary process for each achievement predicate.

their meaning and aspectual characteristics. The idea of achievements as boundaries was entertained already by Mourelatos (1978, 1981) who suggested that achievements "capture either the inception or the climax of an act" (Mourelatos 1978, p. 416).[12] And conversely,

> there cannot be an accomplishment without a closely related end-point achievement — one cannot say "I wrote/shall write the letter" if he cannot say "I finished/shall finish the letter." (Mourelatos 1978, p. 417)

These are observations I will exploit in my notion of a *cover event* associated with culmination-achievements like *arrive* which is a key ingredient of the analysis of progressive achievements I will propose.

2.2.4 Type shifting approaches

2.2.4.1 Accomplishments as the coerced type

Given that not all achievements can appear in the progressive and given that when they do, they typically behave like progressive accomplishments, progressive achievements are most standardly analysed as involving a form of coercion into an accomplishment-like type that can be input to the progressive operator.

Analyses that rely on a type shifting operation, while explaining the commonalities between progressive achievements and accomplishments (for instance, the imperfective paradox), often have difficulty explaining many achievement-specific characteristics of progressives. For instance, most accounts do not address the question why a progressive culmination is generally true only during the very final interval of its "activity part" (say, the journey to the goal in the case of arriving somewhere), that is, why only a very small, final part of the relevant activity is "used" in the coercion of the achievement into a durative predicate.

Rothstein (2004, p. 143–5) does contemplate the question, and introduces a special pragmatic constraint about the culmination of a progressive achievement being a good possibility for explaining the high probability of the culmination (cf. Section 5.5.2), and, by indirect means, the imminency meaning component (cf. Section 5.5.1) of such progressives. By having such a constraint, Rothstein will have difficulty accounting for

[12] If we consider the implications of this view, then what we see is that semelfactives like *flash* or *knock* are excluded from the class of achievements — in accordance with the view of Smith (1991) — since they are not usually the inception or the climax of another event.

cases of progressive achievements without either of these features, as *dying* or *winning*: why is the pragmatic constraint inactive in these cases, but not, say, in the case of *reaching*? More importantly, as I will argue in Section 5.5.2, there are scenarios where no high probability is attached to the culmination, and yet a progressive achievement does have an implication of imminency. However, I do find Rothstein's solution compelling in linking together these two features. What I will therefore suggest is an *opposite* route, that is, accounting for the intuitively high probability of culmination as a cancellable inference based on imminency.

The crux of the issue is that in itself, an account of progressive achievements relying on type shifting of the achievement predicate in the scope of a progressive to a regular accomplishment, like the account of Moens and Steedman (1988), will, in absence of extra explanatory tools, predict a too homogeneous picture with respect to the interpretation and behaviour of progressive achievements: if an achievement in the progressive is coerced into an accomplishment, then we expect it to behave like one. This led some proponents of the event coercion/type shifting accounts to introduce a separate, dedicated category of accomplishments for analysing progressive achievements: "derived accomplishment" for Rothstein (2004), and "durative achievement" for Martin (2011).

Both authors locate the difference between regular and such special accomplishments in the activity part. The difference between a *derived accomplishment* and a regular one is that the activity part of the former, but not the latter is *lexically empty* (Rothstein 2004, p. 49); while the difference between a *durative achievement* and an accomplishment is that the former but not the latter *presupposes* its activity part (Martin 2011). These are two opposing views about the lexical specification of the crucial activity part, and I will side with Martin (2011) — based on evidence inspected in Section 3.2 — in maintaining that the activity part is lexically specified for culmination-achievements and accomplishments alike, but is presupposed in the case of the former. (Indeed, lack of lexical specification in the case of achievements also leads to "false positives", as I will argue below, that is, progressive achievements are predicted to be felicitous which should not.)

2.2.4.2 Derived accomplishments as the coerced type

On the account of Rothstein (2004), achievements in the scope of the progressive are coerced into derived accomplishments, which are like regular accomplishments in having an activity part describing the activity the agent is engaged in, a BECOME-event

describing the change in the theme, and a culmination, but their activity part is lexically empty.

Because Rothstein (2004) has no aspectual class distinction between culminations and happenings, the way Rothstein (2004) aims to explain why *arrive*, but not *notice* can be coerced into a derived accomplishment is to incorporate *incrementality* into the definition of an accomplishment, thereby ensuring that achievements such as *recognise* cannot be coerced into a durative eventuality, since it is not generally preceded by an incremental change. However, Rothstein (2001) herself argued that there are non-incremental accomplishments such as *repair a computer* or *sing the baby asleep*, which means that incrementality in the traditional sense cannot be an integral component of the definition of accomplishments.

Rothstein (2001, 2004) thus argues that incrementality in the sense required by accomplishments in general, is some *inherent linear ordering over the subevents of a particular change*. This is an idea that I will embrace and directly build into the notion of a scale of change in my framework. The reason a different characterisation of this inherent linear ordering is needed is that the exact formalisation that Rothstein provides leads to false positives.

In particular, Rothstein (2004) defines accomplishments based on the incremental chain specific to their BECOME-event, and the incremental relation holding between this BECOME-event and the process part of the accomplishment, where she defines incremental chains and relations as follows (Rothstein 2004, p. 107–8) :

> **Definition 1 (Incremental chain (Rothstein 2004))**
> *Let e be a* BECOME *event. An incremental chain $C(e)$ is a set of parts of e such that:*
>
> 1. *the smallest event in $C(e)$ is the initial bound of e*
> 2. *for every $e_1, e_2 \in C(e)$: $e_1 \sqsubseteq e_2$ or $e_2 \sqsubseteq e_1$*
> 3. *$e \in C(e)$*

> **Definition 2 (Incremental relations (Rothstein 2004))**
> *Let e_1 be an activity, e_2 be a* BECOME *event, and $C(e_2)$ be an incremental chain defined on e_2. INCR$(e_1, e_2, C(e_2))$ (e_1 is incrementally related to e_2 with respect to the chain $C(e_2)$) iff there is a contextually available one-one function μ from $C(e_2)$ onto PART(e_1) (the set of parts of e_1) such that for every $e \in C(e_2) : \tau(e) = \tau(\mu(e))$.*

The problem, I propose, is that by defining incrementality as a particular relation between eventuality parts (namely, parts of the activity and the change that is simultaneously going on), rather than through an explicit reference to a scale, Rothstein's account may fail to exclude events like *recognising John* from incremental, derived accomplishments.

The reason for this is that her definition of a BECOME event — as an event such that "at the time immediately preceding the beginning of e, $\neg\phi$ is the case and at the time immediately following the end of e, ϕ is the case" (Rothstein 2004, p. 107) — does not exclude the possibility that the BECOME event is an extended, non-incremental event with $\neg\phi$ being true throughout, and ϕ at its final instant. It would still have "individuable" parts (a first part at which $\neg\phi$ is true, and a second one at which ϕ is true), each part "has a distinguishable upper bound", and "these parts have a natural and inherent order".

Then, since Rothstein (2004, p. 49) argues that the activity part of accomplishments derived from achievements is not lexically constrained, it is possible to have a one-to-one mapping with some activity and the relevant BECOME event: say, Mary is walking towards John, getting closer and closer, and at one point, she gets close enough and recognises John. Then we could have the activity of walking toward John up until the moment of recognition be the image of the subevent of the BECOME event at which Mary is not yet aware that the person is John, and the final moment of the activity the image of the momentaneous event of her recognising John. Still, it would be odd to say during Mary's walk that ?*Mary is recognising John*, despite the possibility of coercion into an accomplishment structure of the required form.

I will adopt the idea from Rothstein (2004) that reference to an inherent ordering is a crucial component of accomplishments and therefore is a necessary condition for the acceptability of a progressive achievement on the preliminary process reading. Where I will differ from Rothstein's analysis is that I will assume that culminations do in fact lexicalise this inherent ordering and that reifying and referencing this ordering as a scale can tackle the issues that arise for event coercion-based accounts.

2.2.4.3 Durative achievements as the coerced type

Martin's (2011) account differs from that of Rothstein (2004) in that she assumes that culmination-achievements presuppose the occurrence of an activity (rather than having a lexically empty activity part), and in that she makes finer-grained ontological distinctions, building on Piñón (1997), differentiating non-semelfactive happenings and

culminations. I will adopt both of these ideas, but in contrast to Martin (2011), I will argue that lexical association with a specific kind of activity part is sufficient to derive the correct semantics for progressive culmination-achievements, and there is no need to posit durative achievements as the coerced input type for the progressive.

The problem with positing durative achievements is that apparently extra assumptions are needed to explain the infelicitiousness of modification by agentive adverbials and *halfway through*. While Rothstein (2004) does note these characteristics of progressive achievements, she does not offer an explanation of these restrictions within her theory. Martin (2011), in contrast, pays due consideration to these questions, but — by virtue of positing durative achievements — all traditional avenues of explanation relying on the instantaneous nature of achievements is closed off.

So Martin (2011) assumes a principle according to which "an adverb can modify an event whose occurrence is presupposed by a verb if and only if it modifies in the same way the event(s) whose occurrence is asserted by the same verb" to account for the restriction on agentive adverbial modification. However, such a principle, like Rothstein's principle of probable culminations, is either too specific (referring only to *agentive* adverbials) to be explanatorily satisfactory, or — in its present form — too general to be descriptively adequate. For instance, there are actually several adverbs which modify the "presupposed event" and the "asserted event" independently for achievements, as Rothstein (2004, p. 44) argues on the basis the following examples:

(2.18) a. John was dying for a long time, but he actually died quickly.
b. It was very turbulent while the plane was landing, but we actually landed smoothly.
c. #Mary was writing a book slowly, but she actually wrote it quickly.

In fact, Rothstein argues that this is a point of difference between achievements and accomplishments: modification of the progressive form of the first (cf. (2.18a)–(2.18b)), but not the second (cf. (2.18c)) can be independent from the modification of the event predicate itself.

So it seems that even the most well-developed and well thought-out event type coercion accounts of progressive achievements face difficulties in accounting for some aspectual class differences, namely, the exclusion of happenings from preliminary process progressives, and/or the infelicitousness of some adverbial modifications of progressive culminations. I take this to indicate that the problem is rooted in the initial

assumption of these accounts, namely, that the achievement predicate in the scope of the progressive is durative, which is an assumption I will do away with.

2.2.5 A non-partitive semantics for the progressive

The preceding discussion indicates that partitive theories of the progressive (the most generally accepted approach to the progressive) run into complications in the case of progressive culminations like *arriving*.

Let us therefore take the non-partitive analysis in Asher (1992), on whose theory of the progressive, a progressive PROG(φ) is true during a process part normally *leading to or cotemporaneous with* a φ-event. It should be noted here that Bonomi (1999, pp. 185–6) showed that by using the "prior to or cotemporaneous with" temporal relation instead of a mereological (part-of) relation, Asher (1992) makes wrong predictions about accomplishments in some cases.[13] More importantly for our purposes, Asher's (1992) non-mereological formulation also makes wrong predictions for achievements as it stands. Owing to the non-strict temporal ordering relation Asher uses in the definition of the progressive, PROG(φ) is predicted on his account to be assertable and true at the point where a non-durative event type φ is true. Thus, *Mary is arriving at the station* should be true at the exact point when Mary arrived at the station. This does not appear to be intuitively correct, but the more serious problem is that just as Rothstein's (2004) analysis was shown to predict false positives for happenings, so does Asher's (1992). On his definition, *any* progressive achievement, including progressive happenings like #*Mary is noticing the picture* should be always assertable at the point its input predicate is made true which is not the view generally accepted. Happenings are only felicitous in the progressive on a slow-motion reading, but not in everyday settings. Thus, absence of an event-mereological component in a definition of the progressive is no guarantee to the prediction of the correct truth-conditions of progressive achievements.

[13] One of the examples Bonomi (1999) brings is that of a brook which has just been diverted and is approaching a meadow; in this case, at some time long before the water from the brook reaches the meadow, when (ia) can be truthfully asserted, (ib) will also be incorrectly predicted to be true: in the current situation, the water descending to the meadow is a normal course of events, but then the water will also automatically wet the meadow in these normal courses of events. Because the current state of affairs is not required to be a part of the wetting of the meadow, only temporally prior to it, (ib) is predicted to be true, while it is intuitively false.

(i) a. The water is descending to that meadow.
b. The water is wetting the meadow.

Perspectives. Although I will not employ Asher's (1992) temporal relation or his notion of normalcy in the analysis of progressive I propose, there is an aspect of his account that I will adopt, namely, the concept of *perspectives*. A perspective is a proposition describing some characteristic, some aspect of an eventuality. What the admissible perspectives are is defined by the discourse context. Asher defines the progressive relative to a perspective admissible in a given context. Among others, this makes it possible for him to account for the fact that two accomplishments describing a mutually contradictory outcome can be simultaneously in progress in a situation, such as in Heim's example, *Irene is cooking fish stew, but the cat is eating the fish* (these pose problems for the *inertia worlds* approach of Dowty 1979 to the progressive).

Just as Asher (1992), I will use existential quantification over what will correspond to his perspectives in my account of the progressive. On the scale-based account I propose, discourse contexts select a *series of snapshot descriptions* that capture the contextually relevant aspect of the change associated with an eventuality, and a progressive is true if this series of snapshot descriptions can be embedded into a series of snapshot descriptions characterising the change associated with the input predicate of the progressive.

The essence of my account is therefore to integrate the advantages of several earlier theories, namely, theories both of the progressive (and progressive achievements in particular), and of scale-based characterisations of aspectual classes.

2.3 Scale-based frameworks

2.3.1 Scales in formal semantic analysis

Scales have been successfully put to use in the analysis of gradable adjectives such as *tall* (see, e.g., von Stechow 1984, Rotstein and Winter 2004, Kennedy and McNally 2005, Kennedy 2007), analysed as mapping objects to degrees on a scale. The most common formal characterisation of a *scale* is a triple $\langle \delta, S, <_S \rangle$ consisting of a dimension δ (such as length, warmth, price), a set S of *values* (or *degrees* or *points*) and a linear ordering $<_S$ over the set of values. For instance, $\langle \textsc{Warmth}, \mathbb{R}, <_{\mathbb{R}} \rangle$ is a scale of warmth with no minimal or maximal value, while $\langle \textsc{Length}, \mathbb{R}_0^+, <_{\mathbb{R}} \rangle$ is a scale of length with a minimal, but no maximal value.

The semantics of scales, just as the semantics of time (cf. e.g., Landman 1991), can be either interval-based (as in von Stechow 1984, Hay et al. 1999) or (more commonly)

point-based. Although, for instance, Kennedy (2001) and Schwarzschild and Wilkinson (2002) bring for arguments for an interval-based semantics, I will, for simplicity, adopt here the more common point-based analysis.

There is some vagueness surrounding the more minute details about the concept and features of a scale (cf. also Solt 2015). The following is a list of questions with respect to scales which are often left implicit or not addressed:

1. What objects can serve as the carrier set (only abstract degrees, or concrete objects, as well)?
2. Related to the previous question, are degrees numbers (or at least abstract points of measurement)?
3. What are admissible ordering relations?
4. Is the ordered set dense or discrete (or are both admissible)?

As regards the first issue, the general (but usually only implicit) assumption was originally that a scale is composed of a set of abstract objects, degrees, which concrete objects can be mapped to at particular times. This has mostly been the tacit assumption in scale-based works on gradable adjectives (e.g., Kennedy 2001, Kennedy and McNally 2005, Kennedy 2007). On the other hand, as scales gradually found their way into the semantics of verbs, this implicit assumption has been silently rejected by many authors. Kratzer (2004), for instance, argues that the degrees making up a scale can be concrete objects (e.g., the ordered parts of an apple in the case of predicates like *eat an apple*).

It is also often implicitly or explicitly taken for granted (e.g., by Kennedy and McNally 2005, Sauerland and Stateva 2007, 2011) that the degrees of a scale are *(real) numbers* or at least abstract representations of measurement isomorphic to a subset of the real numbers — despite the simple characterisation of a scale as a linearly ordered set — and so we have a *metric* automatically defined over scales. On these approaches, the dimension of the scale would be pivotal (since all scales are made up of numbers) — even though, as Sassoon (2010, p. 173) pointed out, the notion of a dimension might not be clear enough to encode the distinction between some scales, such as width and length. In contrast, the ordering relation $<_S$ of a scale S would always need to be the smaller-than or greater-than relation over real numbers, and so its role would be minimal, only defining the *direction* of the order. On the other hand, if we want to retain maximum generality and remain neutral on what ordered sets can serve

as scales, we can have any linear order serve as $<_S$ (for instance, the earlier-than relation over time points), and degrees can be objects, state descriptions, numbers or any other things that are elements of an ordered set.

Favouring the more general approach to scales is particularly advantageous if we apply a scale-based framework in the verbal domain, in which case it is possible to directly adopt classical homomorphism-based approaches to incremental predicates such as Krifka (1992), allowing linearly ordered sets of parts of a concrete entity to be scales (as proposed by Kratzer 2004, for instance). But even in the semantics of adjectives, authors like Cresswell (1976) and Bale (2008, 2011) have employed scale-based approaches in which degrees are not numbers, but *equivalence classes* under a primitive ordering relation (such as the *taller-than* relation over individuals). In scale-based works, there have been arguments both for (e.g., Bale 2011) and against (e.g., Solt and Gotzner 2012) conceptualizing degrees as equivalence classes rather than numbers.

Those who do not view degrees as numbers argue that not all scales allow for measuring distances between degrees (Cresswell 1976, Bale 2011, van Rooij 2011a). A core argument of these authors is that not all adjectives combine with measure phrases like *2 meters*, and the reason for this, they argue, is that while some adjectives, like *tall*, are associated with an *interval scale*, the scale of others like *happy* is merely an *ordinal scale*, in the terminology of measurement theory, i.e., the former, but not the latter has a metric defined over it. Cresswell (1976) was perhaps the first to note that we can make comparisons like *more beautiful* without units of measurement, and that for some adjectives which do allow for measures, a new relation can be defined over the degrees of their scale based on the "natural metric" of the base relation (say, spatial distance in the case of *tall*).

A further potential advantage of defining a metric over and above scales themselves is that we have the additional freedom of defining the metric in different ways for potentially different scenarios. For instance, when the issue is the loudness of sound events, the ordered scale could be the sound events progressing from the least loud to the most loud, and the metric would be logarithmic when discussing a human agent, but linear when discussing absolute loudness.

As regards the third issue (what kind of ordering relation is assumed?), scale-based approaches nearly unanimously assume linear ordering. However, the path argument of motion verbs in Beavers (2012) is not linearly ordered, even though he also assumes scales to be usually linearly ordered sets with this exception.

As regards the fourth question (namely, whether scales are dense or discreet), this issue is rather less dealt with. Average scales (and certainly those associated with gradable adjectives) are generally dense, but there are certainly discrete cases, as well (such as a scale corresponding to the number of some kind of entity, such as *1 cat, 2 cats, 3 cats, ...*). And one of the main insights of Beavers (cf. Beavers 2002, 2008, 2013) is that there are scales (corresponding to non-gradual changes) which comprise exactly two degrees, which are not only not dense but are discrete, being finite.

2.3.2 Former scale-based frameworks for aspectual analysis

The vast majority of authors employing a scale-based semantics for aspect focus on accounting for *telicity* (e.g., Hay et al. 1999, Filip and Rothstein 2006, Kearns 2007, Filip 2008, Kennedy and Levin 2008, Piñón 2008a, Rappaport Hovav 2008), and to my knowledge, the only author to focus on a scale-based approach to *durativity* is Beavers (2002, 2008, 2013). The reason is probably that scale-based semantics found its way into the verbal domain primarily through deadjectival verbs like *empty, lengthen* (which present a natural bridge from adjectives to verbs) in order to account for their ambiguous behaviour with respect to telicity (cf. e.g., Hay et al. 1999). Scale-based semantics was then extended to all predicates with an (implicit or explicit) argument that measures out events in its denotation (cf. e.g., Filip and Rothstein 2006).

In this respect, too, the theory of Beavers (2002, 2008, 2013) is more general, extending to a far wider range of predicates (though not all predicates, e.g., he argues that *see, smell, play, ponder* are not associated with scales), including those which belong to Vendler's class of achievements. Given that my goal is to account for the accomplishment/culmination/happening distinction and offer a scale-based semantics for the progressive, I will build most closely on Beavers (2002, 2008, 2013), but I will use an even more general framework. But first, let us inspect briefly whether other scale-based frameworks could not be extended or used for these purposes.

2.3.2.1 Localist/conceptual semantic approaches

Before turning to scale-based approaches to verbs in formal semantics, it is worth discussing a closely connected school of thought. Localist approaches originating with Gruber (1965) hold that motion and spatial location plays a key role in the construal of a wide range of domains. This is captured perhaps most concisely by the Thematic Relations Hypothesis (Jackendoff 1983, p. 188), according to which the principal event-,

state-, path- and place-functions in any semantic domain are those used for motion and location. On such a localist/conceptual semantics approach, many different predicates (predicates describing motion, covering, change of possession, change of properties, performance, creation and consumption, alike) can be captured using the same structure of *state descriptions* (using the abstract predicate BE) and *structure-preserving mappings* between the event, time, and a path argument. And as Jackendoff (1996, p. 335) put it,

> the measuring out relations between different parameters of the situation can be formally differentiated in terms of which axes are [connected via structure-preserving binding].

The point of connection of scale-based frameworks in formal semantic theories to localist/conceptual semantic approaches is that on many scale-based approaches, the different dimensions of measuring out for different predicates are unified in the notion of a scale, which is homomorphically mapped to the event, and the dimension of the scale differentiates between different measuring out relations.

I will strive to the make the connection between scale-based and conceptual semantic approaches even closer, extending it to states and to the relation between states and dynamic events.

2.3.2.2 Closed and bounded scales

Kearns (2007) and Kennedy and Levin (2008) (building on Hay et al. 1999) assume a semantics for deadjectival verbs according to which predicates associated with a *closed scale* have default telic interpretations. Let us assume that we extend scales to a wider range of predicates along the line Beavers (2002, 2008, 2013) does, namely, to those implying change in some theme. We now need to find a way to capture the achievement/accomplishment difference, which are all telic predicates, and hence are associated with closed scales on this account. Let us focus on the culmination/accomplishment distinction. Since Kearns (2007) and Kennedy and Levin (2008) use scales containing an infinite number of degrees, what comes to mind as a possibility is the adoption of the idea proposed in Section 2.2.2 that culminations, but not accomplishments specify a sharp endpoint.[14] But at this point, we reach a contradiction, as accomplishments as telic predicates are associated with a closed scale, but a closed scale has one specific maximal element (cf. Appendix A), which means that accomplishments have a sharp final boundary.

[14] Recall that, as discussed in Section 2.2.2, this characterisation may lead to problems, though.

Also, we cannot say that the difference between accomplishments and culminations is instead that the maximal element is not part of the scale for the former, because that would result in an open scale which is associated with an atelic interpretation. As an illustration, consider a closed scale, which is necessarily bounded, as well. An example for this scale is the set of real numbers from 0 to 1, including both endpoints, that is, the interval $[0, 1]$ (see Figure 2.1).

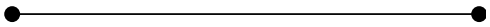

Figure 2.1: A closed scale, e.g., $[0, 1]$

Then, consider a scale, which is *bounded*, but not closed. The set of real numbers from 0 to 1, excluding the endpoints is such a scale (see Figure 2.2). In this case, al-

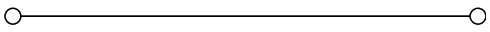

Figure 2.2: A bounded scale, e.g., $(0, 1)$

though the scale is not closed, it does have a lower and an upper bound, e.g., 0 and 1, respectively, in our example of the interval $(0, 1)$. However, what is relevant for telicity is closedness, and *not* boundedness, as the following example shows:

(2.19) John was walking toward the station.

(2.19) is atelic, even though the path (where we assume that a path is a totally ordered set of points) extending to the station is *bounded* (or at least, has an upper bound): it cannot extend further than the station, i.e., the location of the station is an upper bound on it, as in Figure 2.2.

The only way it seems to me that we can model the achievement/accomplishment difference in this model is if we go with the analysis of Beavers (2002, 2008, 2013) who proposed that achievements are associated with a scale consisting of exactly two points, while the scale of accomplishments is multi-valued (i.e., contains more than two points). Since finite discrete scales are by necessity closed, the inherent telicity of achievements (cf. Filip 2008) follows naturally in this case.

2.3.2.3 Scales as defining an ordering over events

On the view expounded in Filip and Rothstein (2006) and Filip (2008), a scale (a linear order) induces a partial order on the set of events, where the events ordered below another event are stages of the "greater" event, in the sense of Landman (1992). Telic predicates on this account denote sets of events that are *maximal* with respect to the ordering over a contextually relevant set of events induced by the scale associated with the predicate. As Filip (2008) stresses, maximalization over events presupposes an external linear order (a scale) over and above the mereological partial ordering over events (and the maximalization operator over events therefore has a stricter input requirement than the maximalization operator over individuals).

However, this analysis of telicity will undergenerate in the case of achievements, as pointed out by Kardos (2012), and also Filip (2008) herself. Since achievements are non-durative, events in their denotation cannot be ordered as stages of one another. With no ordering, maximalization cannot apply, and, thus, achievements do not come out as telic. The only way I can think of to extend the event maximalization account to achievements is, again, by employing Beavers's (2002, 2008, 2013) idea about achievements being associated with two-point scales and also his proposal that events in the denotation of achievements consist of exactly *two* parts (cf. Section 3.1.2). Then these two event parts can be ordered based on the two-point scale projected by an achievement predicate, and achievements are then telic because they only have maximal, two-part events in their denotation.

2.3.2.4 Scales as encoding change in an individual

The starting point of Beavers (2002, 2008, 2011, 2012, 2013) is that dynamic predicates are associated with some change, where "change is defined as some theme transitioning to and maintaining a new value along some property scale, which is an incremental argument" (Beavers 2013, p. 684). Beavers uses an event semantic framework in which a dynamic predicate has an extra argument for a scale that he calls a *scale of change*. Beavers then adapts the mapping relations of Krifka (1992, 1998) to a homomorphism between the event and the scale argument of a predicate by substituting the scale of change for the incremental theme or the path argument as follows:

> **Definition 3 (Movement Relation (MR) of Beavers (2013))**
> *Each part of an event e corresponds to a part of its associated scale s and vice versa; temporal adjacency in e corresponds to spatial/scalar adjacency in s, and the initial and final points in e are mapped uniquely to the initial and final points in s respectively.*

This way, it is the scale argument that measures out an event, and different scalar properties determine different aspectual properties of predicates (cf. Beavers 2013, p. 684):

i) The *specificity* of the endpoint along the scale that needs to be minimally reached determines the telicity of a predicate.

If a predicate specifies an endpoint along the scale, then the predicate is telic; if a predicate does not specify an endpoint along the scale, then it is atelic.

ii) The *mereological complexity* of the scale determines the gradualness of the change associated with the predicate thereby determining durativity.

Minimally complex scales (i.e., scales with exactly two degrees) correspond to non-gradual change, and are associated with non-durative predicates; complex scales (i.e., scales with at least three degrees) correspond to gradual change, and are associated with durative predicates.

I will endorse these correspondences between the scale of change and the aspectual properties of predicates.

As for the first property of specificity, Beavers (2011, 2013) specifies four *degrees of affectedness*, which encodes how specific the predicate is about the theme's progress on the scale. He differentiates the following degrees of affectedness with respect to event predicate ϕ, where $\mathsf{result}'(x, s, g, e)$ specifies that the change that theme x undergoes on scale s during event e ends in degree g:[15]

a. x undergoes *quantized change* iff for all e such that ϕ applies to e: $\exists s[\mathsf{result}'(x, s, \mathrm{g}_\phi, e)]$ (x reaches a specific state g_ϕ on s, e.g., *peel, break, shatter* x)

b. x undergoes *nonquantized change* iff for all e such that ϕ applies to e: $\exists s \exists g[\mathsf{result}'(x, s, g, e)]$ (some result state g obtains, e.g., *cut, widen, lengthen* x)

[15] Below, I reproduce the formulas of Beavers (2011, p. 358) with a slight modification. In the formulas of Beavers (2011, p. 358), ϕ is formally not an event predicate despite Beavers referring to it as such in the text, because ϕ is the antecedent of an implication. The characterisations I give below are faithful to Beavers's intentions.

	Simplex scale (and/or event)	*Complex scale (and/or event)*
quantized	Achievements *break a vase, kill Bill*	Accomplishments *load the wagon, eat the apple*
nonquantized	N/A	Degree achievements *cool the soup*
potential	Semelfactives *hit (once), slap (once)*	Activities *beat, pummel*
unspecified	Semelfactives *cough (once)*	Activities *watch TV*

Table 2.2: The aspectual classes differentiated in the framework of Beavers (2002, 2008, 2011, 2013).

c. x has *potential for change* iff for all e such that ϕ applies to e: $\exists s \exists \theta[\theta(x, s, e)]$ (there is not necessarily any actual change, meaning no incremental MR relation need obtain, e.g., *hit, wipe, scrub, rub* x)

d. x is *unspecified for change* iff for all e such that ϕ applies to e: $\exists \theta'[\theta'(x, e)]$ (no scale, e.g., *see, smell, play (as children), ponder* x)

However, the aspectual distinctions that can be drawn on the basis of these scalar properties is insufficient to distinguish culminations from happenings. Table 2.2 reproduced from Beavers (2013, p. 692) summarizes the aspectual distinctions that are made in this framework. As Beavers (2013, p. 704) himself notes, his account does not reveal why some achievements like *arrive*, but not some others like *notice*, are felicitous in the progressive. Given that an explanation of this is one of the prime goals of the present dissertation, I need to enhance Beavers's framework.

Also, I wish to offer a scale-based semantics for the progressive according to which the progressive involves partitivity over scales of change (for the reason that event partitive analyses have been shown to face problems, cf. Section 2.2). But one cornerstone of Beavers's framework is that not all predicates are associated with a scale, which, just like authors such as Filip and Rothstein (2006), Filip (2008) and Rappaport Hovav (2008), he uses to explain various differences in the linguistic behaviour of scalar and non-scalar predicates. Predicates with no scale of change argument on the analysis of Beavers (2002, 2008, 2011, 2013) include *see, smell, play, ponder, cough once, watch TV, laugh at*. Since many of these predicates do appear in the progressive (cf. e.g., *Fred*

is watching TV), it is evident that the progressive cannot refer to Beavers's scale of change.

In order to be able to account for the difference between culminations and happenings (and accomplishments) and in order to generalize the scale-based framework to all predicates, I adopt a slightly different framework as Beavers, in which I retain his scale of change as the *incremental argument*, but in addition I introduce a different, more general *scale of change* based on the notion of a *perspective* from Asher (1992) (cf. Section 2.2.5).

Chapter 3

THE POINT OF DEPARTURE FOR A NEW ACCOUNT OF PROGRESSIVE ACHIEVEMENTS

In this chapter, I present the basic considerations and formal semantic ingredients that form the starting point of my scale-based analysis of the two single-event readings of progressive achievements: preliminary process and slow-motion readings. First, I study the durativity property of eventualities and predicates and discuss the notion of an instantaneous change. Then, I examine the gradual change that is associated with culmination predicates like *arrive* to establish the relation between these predicates and corresponding events of gradual change. Finally, I introduce the basic domains and parameters of my framework that will be used in later chapters in the analysis of progressive achievements.

3.1 Durativity

In what follows, I discuss topics and present some considerations that are relevant to the semantics of achievements and which will form the starting point for my analysis of slow-motion and preliminary process interpretations. In this section, I examine the notion of durativity relevant for linguistics.

3.1.1 The linguistic relevance of durativity

The aspectual classification of eventuality predicates generally relies on features of *dynamicity*, *telicity*, and *durativity* (cf. Section 1.1). However, the status of durativity

as a linguistically relevant classificatory feature has often been called into question. Authors like Kenny (1963), Taylor (1977), Verkuyl (1989), Pustejovsky (1991) deny that achievements need to be assigned a class of their own, implying or explicitly proposing that the difference in the temporal structure of events described by achievements and accomplishments is non-existent or not important. In contrast, authors such as Vendler (1957), Comrie (1976), Dowty (1979), Moens and Steedman (1988), Smith (1991), Mittwoch (1991), Filip (1993/99), Piñón (1997), Engelberg (2000), Rothstein (2004) maintain that such a difference is linguistically relevant. The most prominent argument of those who lump achievements together with accomplishments is the two-faced behaviour of certain predicates with respect to durativity, while the argumentation of those assigning a separate class to achievements involves several differences in the syntactic and semantic behaviour of achievements and accomplishments.

Note that while telicity is a feature of predicates, rather than eventuality individuals (the very same running-event can be described both with the atelic predicate *run* and with the telic predicate *run to the river*), durativity is an inherited property of predicates, namely, a property inherited from eventualities that a predicate can be used to describe. As Comrie (1976, p. 42) remarked,

> Strictly speaking, it is the situation, rather than the verb, that is punctual, though for convenience we shall retain the traditional practice of using the term 'punctual verb' for a verb referring to a punctual situation.

Or as Beavers (2008, fn. 5) put it,

> Unlike telicity, which is a property of predicates, durativity is a property of events, although predicates may encode sortal constraints on durativity. Thus I refer to predicates that select for durative or punctual events as "durative predicates" and "punctual predicates" respectively.

In other words, we must differentiate the durativity of linguistic expressions (verbs and verb phrases) and the durativity of events in their extension. The debate on durativity is about the linguistic level, i.e., whether this distinction is sensible to make at the level of verbs and verb phrases. But those who argue against such a distinction (e.g., Verkuyl 1972, 1989, 1993) also maintain that there is no such thing as a non-durative *event* — and this forms one cornerstone of their argument. In contrast, I take the position that while there might not be such a thing as a non-durative dynamic event, particular events *count* as durative or non-durative in specific contexts, and the durativity feature of predicates depends on whether or not the events they describe are construed as durative or non-durative in a particular context. This means that an account of the fact that non-durative predicates can be used as durative predicates in

slow-motion scenarios as in *The Challenger is exploding* needs to be explained by an account of when particular *events* are regarded as durative or non-durative, which will be topic of Chapter 4.

And the fact that the same verb may function as an achievement in one context, and as an accomplishment in another, does not mean that we should do away with the distinction between accomplishments and achievements as aspectual classes, *pace* Verkuyl (1989, 1993). This would be like arguing against telicity as a semantically relevant feature on the basis of examples such as Dowty's (1979, p. 61) *John swam in an hour* when it is understood that John is in the habit of swimming a specific distance every day. Indeed, if telic and atelic predicates are differentiated based on differences in linguistic behaviour (such as modification by *in*- and *for*-adverbials), we should proceed no differently for durative and non-durative predicates. Achievements and accomplishments show different behaviour with respect to several phenomena, including the following (cf. Vendler 1957, Dowty 1979, Filip 1993/99, Piñón 1997, Engelberg 2000, Rothstein 2004, a.o.):

- Frame-adverbials (e.g., *in an hour*) are ambiguous between a "duration" and an "after" interpretation when they modify an accomplishment predicate, as in (3.1a), but can only have an "after" interpretation when they modify an achievement predicate, as in (3.1b).

  (3.1) a. John will build the house in 2 years. *(after/duration)*
  b. John will arrive/notice the picture in two minutes. *(after/*duration)*

- Accomplishments may appear in the progressive (cf. (3.2)), but many achievements cannot do so (cf. (3.3a)), and even if a progressive achievement is felicitous, it will have a special interpretation, as in (3.3b)–(3.3c) (cf. Section 2.1).

  (3.2) John is building a house.

  (3.3) a. #John is noticing Mary.
  b. John is arriving at the station. *(preliminary process)*
  c. Look at the screen, the Challenger is exploding. *(slow-motion)*

- Accomplishments, but not achievements, can occur as complements of aspectual verbs like to *finish, stop, start*.

  (3.4) a. John stopped building the house. *(accomplishment)*

b. #John stopped arriving/noticing the picture. *(achievement)*

- Accomplishments, but not achievements can be modified with adverbs of completion like *completely, partly, halfway through* (though see Section 5.4.2).

(3.5) a. John has partly built the house. *(accomplishment)*
b. #John has partly arrived/noticed the picture. *(achievement)*

In the same way a semantic account is needed to explain when a telic or atelic use of a predicate arises, an account has to be provided how certain verbs and verb phrases can behave as a durative or a non-durative predicate in different contexts. But abolishing the punctual/durative distinction between achievements and accomplishments would come at the price of losing a uniform account of the above differences. Given that these differences do exist, it appears that the durativity distinction is, indeed, relevant linguistically, and some changes are construed as *instantaneous*.

3.1.2 The moment of change

There is a problem relating to the representation of achievements as predicates describing instantaneous change, namely, the problem of the representation in a two-valued model-theoretic framework of the *moment of change* (cf. discussions of this topic in Dowty 1979, Landman 1991 and Altshuler and Schwarzschild 2013 for details). Briefly the problem is the following. In order to model instantaneous change from $\neg\phi$ to ϕ, we need to refer to *two* states of affairs, one in which ϕ is false, and one in which it is true. But then this means that at all the time points between these two points, either $\neg\phi$ or ϕ holds. That is, if time is taken to be *dense*, there is either no final moment at which $\neg\phi$ holds, or no initial moment at which ϕ holds. We cannot select two points such that $\neg\phi$ holds at one, ϕ at the other, such that there are no other points between them. But then how can we model instantaneous change in a dense model of time?

Those who consider achievements not to be durative are therefore divided: some regard them as instantaneous, i.e., true at exactly one instant or moment of time, while others hold that achievements are true at exactly two instants. For instance, Rothstein (2004) regards achievements as true at two instants:

> Achievements are genuinely near-instantaneous changes from $\neg\Phi$ to Φ, consisting of a starting point, the final instant at which $\neg\Phi$ holds and a stopping point, the adjacent instant at which Φ holds. (p. 185)

The same stance is taken by Beavers (2008, 2013), for whom achievements describe events consisting of *exactly two* parts (cf. e.g., Beavers 2013, p. 691). However, this account commits us to time being *discrete*, i.e., for every moment, there is a moment immediately preceding it and another one immediately following it.

Another way to overcome the problem of instantaneous change is to assign a special status to the moment of change, cf. the following discussion from Rothstein (2004, p. 197):

> I have assumed a "conventional" theory of change in which a minimal change from $\neg\phi$ to ϕ consists of two instants, one at which $\neg\phi$ holds and an adjacent one at which ϕ holds, but Kamp (1979a,b) raises the possibility that change is a primitive notion and that an event of change holds at the instant which is the event of moving from $\neg\phi$ to ϕ, at which neither $\neg\phi$ nor ϕ holds.

Such a move entails a non-classical, multi-valued logic, which some may consider to be a high price to pay (see also the discussion of Landman 1991, §5.3 on this point). If we reject the idea that there is a moment in time at which neither ϕ, nor $\neg\phi$ holds, wishing to remain within a classical two-valued logic, and do not want to commit us to a discrete view of time, then how can we model instantaneous change from $\neg\phi$ to ϕ?

A third solution to this puzzle is to relegate the change information to outside the instant which is taken to be the moment of change, i.e., at which an achievement predicate is taken to hold true. This is the solution of Dowty (1979), von Stechow (1996) and Piñón (1997). Dowty (1979) uses the BECOME operator to capture change, and in a dense model of time, he (initially, in a time point-based model) defines BECOME ϕ as "true at t iff ϕ is true at t, ϕ is false at t' for some time t' earlier than t, and for all times t'' later than t' but earlier than t ϕ is also false at t''" (Dowty 1979, p. 76). Thus, BECOME ϕ and ϕ can both be true of the same instant, but their truth conditions are different. This poses no conceptual or philosophical problem when predicates are predicates of time points and intervals, but it may raise questions in an event-semantic framework if a dynamic and a stative predicate is true of the same *eventuality*.

von Stechow (1996) adopts Dowty's (1979) decompositional analysis in an event-semantic framework and defines BECOME as follows:

> **Definition 4 (BECOME operator in event-semantics (von Stechow 1996))**
> $[\![\text{BECOME}(P)(e)]\!] = 1$ *iff* e *is the smallest event such that* P *is not true of the pre-state of* e *but* P *is true of the target state of* e*. The pre-state of e is the state that holds immediately before the event* e *occurs. The target state is the state reached at the end of the event.*

This definition eludes the problem of predicating a stative and a dynamic predicate of the same event through reference to pre-states and target states. A similar solution is employed by Piñón (1997), who proposes that although achievements are true of literally instantaneous events, these are invariably the *boundaries* of some extended event.

What I aim to capture in the framework I will present (using a granularity-relative notion of durativity and instantaneousness) is the intuition that even if there might be no literally instantaneous changes, we can *conceive* of changes as being instantaneous by virtue of the fact that some differences are too small to count as relevant in a context. As for modelling instantaneous change itself (at a particular granularity), I will adopt the third line of solution presented above, because it is based on the restrictions a predicate lays on the intervals immediately preceding events in its denotation, and this is an approach which offers us a way to account for the difference between culminations and happenings, as well — which is the topic I now turn to.

3.2 The existential presupposition associated with culmination-achievements

3.2.1 Culminations as presupposition triggers

A widely accepted idea (Piñón 1997, Löbner 2002, Heyde-Zybatow 2008, Malink 2008, Abusch 2010, Martin 2011) is that some achievements — those that are the right boundary of a gradual change — *presuppose* the occurrence of an eventuality, namely, an activity. The basis for this presupposition is that achievements describe events that are boundaries of another eventuality (Mourelatos 1978, Piñón 1997, Heyde-Zybatow 2008).

The standard presupposition test of embedding under negation underpins this claim (cf. e.g., Malink 2008, Martin 2011): (3.6a), just like its positive counterpart, implies (3.6b) (though of course this implication can be cancelled, cf. below).

(3.6) a. John didn't win the race.
b. ⇒ John participated in the race.

We can find similar (cancellable) implications for all other culminations. For example, for *arrive*:

(3.7) a. John didn't arrive at the station.
b. ⇒ John was going toward the station.

Accomplishment verbs do not appear to carry such an existential presupposition in English, inasmuch as no comparable entailment is found when an accomplishment verb is embedded under negation:

(3.8) a. John didn't read the book.
b. ⇏ John was reading the book.

However, based on recent work by Zinova and Filip (2014), it is also worth investigating in more detail the presuppositional trigger status of culminations, too. According to Zinova and Filip (2014), in Russian, even though the occurrence of the activity part is implied when a perfective *accomplishment* verb is embedded under negation (indicating a presupposition), the activity part is asserted, not presupposed in the case of perfective accomplishment verbs (as other tests of presuppositions reveal), and the entailment patterns observed can be explained by a *scalar implicature* rooted in the implicative relations between the imperfective and the perfective. For one, unlike in the case presuppositions in general, no projection from the antecedent of conditionals is observed.

This is, unsurprisingly, borne out by English accomplishments, as well, as seen by the non-entailment from (3.9a) to (3.9b), adapting Zinova and Filip's (2014) example:

(3.9) a. If John read the textbook, he will pass the exam.
b. ⇏ John was reading the textbook.

This contrasts with the behaviour of expressions with genuine presuppositions such as *quit smoking*, since beside negation and modals, conditional antecedents are an archetypal *hole* for presuppositions, i.e., presuppositions are preserved in their scope (Karttunen 1973). Thus, (3.10a) entails (3.10b):

(3.10) a. If John quit smoking, he won't die of lung cancer.
b. ⇒ John had been smoking.

Now, in the case of achievements, we observe the pattern consistent with presuppositional expressions (cf. Abusch 2010), (3.11a) entailing (3.11b) (example from Zinova and Filip 2014), and (3.12a) entailing (3.12b).

(3.11) a. If John won the marathon, he will celebrate tonight.
b. ⇒ John participated in the marathon.

(3.12) a. If John arrived at the station, he met Mary.
b. ⇒ John was going toward the station.

We observe the same pattern of behaviour for the "Hey, wait a minute test!" first suggested by Shanon (1976). He proposed that a speaker presupposes Q on uttering a sentence S if it is suitable for the hearer to respond with 'One moment, I did not know that Q!'. This is exemplified in the dialog in (3.13).

(3.13) a. Sam quit smoking.
b. Hey, wait a minute: I didn't know that Sam smoked!

Based on the English versions of examples considered by Zinova and Filip (2014), we again (and quite similarly to their Russian counterparts) find non-presuppositional behaviour in the case of accomplishments, as expected, that is, (3.14b) is perhaps slightly odd in response to (3.14a):

(3.14) a. Sam read the textbook.
b. ?Hey, wait a minute: I didn't know that Sam was reading the textbook!

On the other hand, achievements, again, do appear to presuppose the occurrence of the corresponding activity part, as (3.15b) seems a legitimate response to (3.15a), and (3.16b) to (3.16a):

(3.15) a. Sam won the race.
b. Hey, wait a minute: I didn't know that Sam was participating in the race!

(3.16) a. Sam arrived at the station.
b. Hey, wait a minute: I didn't know that Sam was going toward the station!

It should be remarked that some native speakers considered the dialogue in (3.14) as not that odd, which should, however, not be taken as evidence for the potential presuppositional status of the occurrence of the activity part of accomplishments (cf. the non-presuppositional behaviour in (3.9)). Instead, it indicates that the "Hey, wait a minute!" test might not be so reliable as, for instance, the test relying on the antecedent

of a conditional. This ties in with the view of Tonhauser et al. (2013, p. 81), who raised objections against "Hey, wait a minute" as a reliable test for presuppositions.

On the other hand, we can establish that the existential entailment of achievements is a presupposition rather than a *conversational implicature* by its cancellation possibilities (Beaver and Geurts 2013). Presuppositions (as in (3.17)) can be cancelled under negation (at least some presuppositions, cf. Abusch 2010, who in fact categorizes *win* as a *soft presupposition trigger* for *participating in the race*), but not in unembedded contexts, while conversational implicatures (as in (3.18)) can be cancelled when unembedded. As (3.19) and (3.20) shows, achievements appear to pattern like presuppositions (though see more on this below).[1]

(3.17) a. John didn't stop smoking. He never smoke.
b. #John stopped smoking. In fact, he never smoke.

(3.18) John ate most of the cookies. In fact, he ate them all.

(3.19) a. John didn't win the race. He never participated.
b. #John won the race. In fact, he never participated.

(3.20) a. John didn't arrive at the station. He was never going toward the station.
b. #John arrived at the station. In fact, he was never going toward the station.

Thus, although preservation of an existential entailment under negation in itself is no guarantee for presuppositional status, further tests of presupposition appear to corroborate that culmination-achievements (like *win*, *arrive*, *reach*, or *die*) do presuppose the occurrence of a specific kind of activity leading up to them. That is, presupposition tests actually reveal that the activity part leading up to these achievements is *not* lexically empty, *pace* Rothstein (2004).

3.2.2 Extra soft presuppositions and the reverse direction

There is, however, a worry with the existential presupposition of culminations that is not generally discussed, namely, that there may be cases where such culmination-

[1] Native speakers have voiced their concern that (3.19b) might, in fact, be assertable in a scenario in which John won the race without participation by virtue of the fact that everyone else was disqualified. In such a scenario, however, I will predict that the progressive is infelicitous, i.e., that *John was winning the race* is not assertable prior to his winning the race by everyone else being disqualified. But this and similar considerations will be grounds below to argue that culminations are what I will call extra soft presupposition triggers.

achievements are true of an event *without* the occurrence of an event of gradual change, which I call their cover event. A case in point is Piñón's (1997) spy who dies by committing suicide (which is instantaneous, and there is no associated cover event), or the case of winning a race by virtue of everyone else being disqualified mentioned in footnote 1 (in which case, again, there is no extended cover event of participating successfully in the race). Also, Dorothy could arrive at the station in a blink of the eye by simply clicking her ruby slippers without moving towards the station. In contrast, a true presuppositional trigger like *quit smoking* can never occur without its presupposition, that is, smoking.

Note that it is a well-known fact that some presuppositions, such as the factive implication of *discover*, are weak and context-dependent and may be obviated. Abusch (2010) calls these *soft presuppositions*, and she includes achievements with a preparatory phase among soft presupposition triggers, along with, e.g., contrastive statives like *bachelor* and verbs of accompanied motion like *accompany*. However, the absence of entailment for these cases is invariably discussed in embedded contexts: in the scope of negation, question or the antecedent of a conditional. What we see in the case of culmination-achievements is that their presupposition can be obviated even in positive, non-embedded contexts, that is, the following is truthfully assertable in the disqualifications scenario:

(3.21) John won the race, even though he never even participated.

Even for (at least some of) the other soft presupposition triggers, such obviation in a positive indicative sentence is impossible (unless they are used in a metaphorical sense):

(3.22) a. #Cardan is a bachelor, even though Cardan is not a male person.
b. #Cardan accompanied Grouse to the bar, even though Grouse didn't go to the bar.

Should we conclude based on the possibility of cancellation in a non-embedded context that the existential presupposition of culmination-achievements is a conversational implicature rather than a presupposition? I would not believe that is the correct conclusion, as, contrary to conversational implicatures, the implication to the occurrence of the activity part does not seem to be *calculable* from general principles of cooperative conversation, but seems to be conventionalized. In addition, the experimental work by Bill et al. (2014) also indicates that the presupposition of the culmina-

tion predicate *win* is different from scalar implicatures: they found that the inference from *The bear didn't win the race* to the bear participating in the race is much more easily cancelled than the inference from *Some of the lions have balloons* to not all of the lions having balloons. Bill et al. (2014) emphasize that this provides evidence that presuppositions and scalar implicatures should be analysed as two separate inferences based on distinct mechanisms, *pace* Chemla (2009) and Romoli (2015) who proposed a unified account of these. Of course, further experimental work is necessary to show that the existential presupposition of *win* and other culminations is different from all other kinds of conversational implicatures, as well, but I regard the lack of calculability as strong indication that the existential inference from culminations is indeed a presupposition.

However, if the inferences from culmination-achievements are presuppositions, then they are not only soft presuppositions as Abusch (2010) proposed, but based on their cancellation properties, they are of a yet different kind, namely, what I would call *extra soft* presuppositions. Thus, we can extend the hierarchy of presuppositions proposed by Abusch (2010) as follows:

- hard presuppositions cannot be cancelled;
- soft presuppositions can be cancelled in embedded contexts;
- extra soft presuppositions can be cancelled.

For example, while culminations like *arrive* are extra soft presupposition triggers for the occurrence of the activity (typically) leading up to them, they are at least soft presupposition triggers for their pre-state: *John arrived at the station* (just as *John didn't arrive at the station* and *If John arrived at the station, then...*) implies that John was not at the station beforehand, and this implication cannot be cancelled.

What I would like to point out, though, is that whenever there is in fact no cover event (the death of the spy, winning by others being disqualified, arriving somewhere magically), then the relevant achievement in the progressive cannot be asserted truthfully, that is, it is in these cases not true prior to culmination that, e.g., the spy was dying, that John was winning the race or that Dorothy was arriving at the station. Thus, the availability of a progressive for the achievement is inherently entwined with the occurrence of a cover event of a specific type (or more precisely, of some type from a specific set of types).

I propose that we can account for this connection and the extra soft presuppositional trigger status of culminations by thinking in a reverse temporal direction, drawing on the idea voiced by Mourelatos (1978, p. 417) that "there cannot be an

accomplishment without a closely related end-point achievement — one cannot say »I wrote/shall write the letter «if he cannot say »I finished/shall finish the letter«". We can say that *whenever* a gradual change belonging to a set of specific types occurs (e.g., for dying, a detrimental deterioration of health or decreasing amount of oxygen supply to the body resulting in loss of life; for winning, successful participation in a race, coming in first place; for arriving somewhere, travelling, driving or walking somewhere), then its culmination can be described with the relevant culmination predicate (*die, win, arrive*), *without exception*. Then a soft presupposition arises if all of these gradual changes entail it: e.g., all gradual changes leading up to an arrival entail movement toward the goal, which is what is presupposed by *arrive*.

This direction of the entailment establishes a close connection between a culmination predicate and gradual changes of a specific type (and nothing precludes there to be multiple types satisfying this entailment, cf. the different cases listed for dying and arriving above), while leaving space for culminations happening without any cover event. But a preliminary process progressive of a culmination is only available if there is a cover event of the relevant type in progress, because only then is there a gradual change leading to the culmination.

Such a reverse thinking about the relevant entailments is similar to the *reverse analysis* of the progressive exploited first by Varasdi (2010, 2014), who argues that the old observation (cf. Dowty 1979) that the entailment from the progressive to the perfective is not valid, while the reverse entailment from the perfective to the progressive is, should form the centre of an account of the progressive. Similarly, I argue that the entailment from the occurrence of a gradual change to a culmination, rather than the non-valid entailment from a culmination to the occurrence of some activity, can form the basis for an account of the extra soft presuppositional trigger behaviour of culminations and an account of their progressive interpretation.

This is the way in which I embed the observation of authors like Carlson (1981) Filip (1993/99), Dini and Bertinetto (1995), Heyde-Zybatow (2008) and Martin (2011) that it is culmination-achievements that are acceptable in the preliminary process progressive. But my account of the progressive exploits a *reverse* thinking — in comparison to the approaches of authors like Heyde-Zybatow (2008) and Martin (2011) — about the relation between a culmination and a gradual change preceding it. Another respect in which my account differs from previous analyses is that the relation between an achievement and its cover events will be mediated through *scales of change*. The way I will capture the relation between events of gradual change and culminations like *arrive* is by characterising culminations with two kinds of scale of change,

namely, extended scales associated with gradual change, and binary scales associated with non-gradual change. The benefit of this dual characterisation is that we can retain the idea that culminations denote sets of instantaneous events, and so we have no problem explaining that they behave like non-durative predicates in most linguistic contexts (e.g., when modified by temporal adverbials); at the same time, by having the truth conditions of the progressive depend on scales of change instead of events directly, we can explain why culminations, but not happenings, can combine with the progressive at an everyday granularity.

3.3 The basic ingredients

In this section, I present the basic assumptions and components of the semantic framework that is presupposed by my analysis of slow-motion and preliminary process progressives, motivated by the considerations about durativity and the existential presupposition of culminations discussed in the foregoing.

3.3.1 The semantic model

Philosophical commitments. This is a dissertation in linguistics, and the same linguistic phenomena could be approached on the basis of very different philosophical principles. However, in this dissertation I will build upon the following general assumptions. I assume a Neo-Davidsonian event-semantic semantic framework with realist commitment as Parsons (1990), that is, I assume that a model contains a set of eventualities (including states) that are *concrete particulars* just like physical objects. Events, similarly to physical objects, exist independently of the language used to describe them and the mind of language users. (Note that a realist need not assume that, for instance, the accomplishment/activity distinction is encoded at the level of event particulars — this is an assumption I, in fact, do not endorse.)

On a realist approach, with some simplification, the following basic commitments are accepted, which have implications for the framework and analysis I will present:

- there is a mind-independent reality in which entities and events have properties of their own;
- denotation is a correspondence between language and the mind-independent reality;
- sentential meaning is truth-conditional.

A verbal predicate of a natural language denotes a subset of the set of eventualities and its semantics is characterised through reference to this set. This is the general approach of model-theoretic semantics, whether or not one endorses realism (cf. Zimmermann 2011): the meaning of a predicate of the object language is characterised in terms of the model. Semantic explanations make use of what we assume about reality: what kind of properties a particular entity bears. Some of these properties are *cognitively relevant*, and therefore have a reflection in natural language. I assume, for example, that the length that an event takes is such a property. Of course, how a certain property is reflected in the semantics of a natural language construction depends equally on the natural language in question. For example, the length of an event may get expressed depending on the particular linguistic context and/or lexical semantic features of a construction.

Domains and parameters of interpretation. In the framework I use, expressions are interpreted with respect to a model M, a possible world w from the set of possible worlds W, a variable assignment function g, a context c from the set of all possible discourse contexts C and a granularity parameter $\{\gamma_i\}$ that is a set of granularity functions over different scales from the set $\mathbb{G}$ of all granularity functions.[2]

The context parameter c of interpretation is the same as in Asher (1992), and will be used to capture the properties of the change associated with an eventuality that is relevant in a given discourse context through the context-relative function $\sigma_{c,w}$ — to be introduced in Section 5.1 — that outputs the scale of change associated with an eventuality in a given context. This function will be used for an analysis of preliminary process progressive sentences like *John is arriving*. The context parameter will also be implicitly used in the definition of the progressive operator itself, which, building on Varasdi (2014), I assume makes reference to a contextually determined set of alternative predicates.

The granularity parameter $\{\gamma_i\}$ is based on the granularity function parameter of information of Sauerland and Stateva (2007, 2011) and will be discussed in Section 4.1. This parameter is used in an analysis of granularity-based changes in the durativity feature, and by extension, slow-motion readings like *The Challenger is exploding*.

The domains of the model are the set U of *individuals*, set E of *eventualities* with a dedicated subset $E_{\text{stat}} \subseteq E$ of *states*, and the set T of *time points* (or *moments*, or *instants*). Note that I follow the Neo-Davidsonian approach of Parsons (1990) who as-

[2]Usually, I will only indicate the single granularity function that is relevant for interpretation, for simplicity.

sumes that any kind of verbal predicate can introduce an eventuality argument, even states — hence the subset E_{stat} within our domain of eventualities. However, while many scholars today assume that all states introduce a Davidsonian eventuality argument (for a discussion, see Maienborn 2005), I follow Kratzer (1995) and assume that it is in fact only stage-level states, but not individual-level predicates, that do so.

The set of individuals and eventualities are both ordered with respect to the usual *part-of* (or mereological) relations $\sqsubset_U$ and $\sqsubset_E$ over individuals and eventualities, respectively, forming a join-semilattice as in Link (1983) and Bach (1986). The set of times is linearly ordered by the usual *earlier-than* relation $<_\mathcal{T}$, forming the linearly ordered set $\mathcal{T} = \langle T, <_\mathcal{T} \rangle$. The set of *time intervals* (or *periods*) $\mathsf{Int}(\mathcal{T})$ is formed in the usual way as convex subsets of T. (For the definitions of generic mathematical terms, here and in what follows, I refer the reader to Appendix A.) I will also use the term *token* for individuals and *type* for predicates.

For the purposes of the dissertation, I do not need a dedicated domain of scales. Instead, scales are constructed from the domains of the model.

3.3.2 Scales

Recall from Section 2.3.1 that formal semantic theories using scales differ in a number of respects, and perhaps most importantly, whether or not they assume that the degrees of scales are measurement points, i.e., whether or not the distance between two degrees can be measured. I aim to offer an analysis which can be incorporated into all scale-based approaches, and to this end, I use a definition of scales that is a common denominator across all approaches. In particular, I adopt the most simple conception of scales as follows:[3]

> **Definition 5 (Scale)**
> *A scale $\mathcal{S}$ is an ordered set $\langle S, <_\mathcal{S} \rangle$, where S is a nonempty set of points (called degrees or values), and $<_\mathcal{S}$ is a linear order over S, such that $\mathcal{S}$ has the greatest lower bound and least upper bound properties.*

The requirement that $\mathcal{S}$ has the greatest lower bound and least upper bound properties ensures that each nonempty subset of $\mathcal{S}$ that is bounded from below has an

[3]Since for the sake of generality I do not subscribe to the idea that the set S of degrees is a subset of the real numbers, the dimension component δ in a common definition of scales (cf. Section 2.3.1) does not play a role in my framework, and is therefore dropped. The subscript S of $<_S$ can also be suppressed if no confusion arises from using simply $<$.

infimum, and each nonempty subset which is bounded from above has a supremum (see Appendix A). This is implicitly accepted by all scholars using scales in formal semantics, and will be necessary for defining granularity functions over scales in Section 4.1.1.

No other properties of a scale are constrained. A scale can be either open or closed and bounded or unbounded (in either directions), finite or infinite and dense, discrete, or neither dense nor discrete. The degrees of a scale need not be numbers or any abstract degrees of measurement. A metric is defined over and above scales through an independent mapping, namely, the *numerifying function* num that I will introduce in Section 4.1.1. Those who wish to adopt an approach on which the degrees of the scales inherently define a metric can assume that this numerifying function is defined for all scales, and the metric it defines over a scale is identical to the inherent metric of the scale.[4]

Following common practice in referring to ordered sets, I will use the term *scale* to refer to both the relational structure $\mathcal{S} = \langle S, <_{\mathcal{S}} \rangle$, as well as its carrier set S. The function carrier outputs the carrier set S of a scale $\langle S, <_{\mathcal{S}} \rangle$:

$$\text{If } \mathcal{S} = \langle S, <_{\mathcal{S}} \rangle \text{ then } \mathsf{carrier}(\mathcal{S}) \stackrel{\text{def}}{=} S. \tag{3.23}$$

In the remainder of the dissertation, I restrict my attention to two kinds of scales: those whose degrees are *elements* of a domain of the model (i.e., elements of U, E or T) and those whose degrees are *subsets* of a domain of the model (i.e., elements of $\wp(U)$, $\wp(E)$ or $\wp(T)$). So let let $\mathcal{X} = \{U, E, T, \wp(U), \wp(E), \wp(T)\}$. Then the set of all scales, notated as $\mathbb{S}$, is defined formally in (3.24).

$$\mathbb{S} \stackrel{\text{def}}{=} \bigcup_{D \in \mathcal{X}} \Big\{ \langle S, <_{\mathcal{S}} \rangle \mid S \subseteq D \text{ and } <_{\mathcal{S}} \text{ is a linear order over } S \Big\} \tag{3.24}$$

An important subset of the set $\mathbb{S}$ of all scales is the set $\mathbb{S}_{\mathsf{stat}}$ of those scales whose degrees are *sets of states*:

$$\mathbb{S}_{\mathsf{stat}} \stackrel{\text{def}}{=} \big\{ \langle S, <_{\mathcal{S}} \rangle \in \mathbb{S} \mid \forall s \in S \colon s \in \wp(E_{\mathsf{stat}}) \big\} \tag{3.25}$$

[4] This is just the most direct way to integrate my proposal in such a framework, the more natural one would be just to do away with the numerifying function and redefine all definitions in which it features in a way that the definitions refer directly to the degrees of the scales.

These are the potential candidates for *scales of change* that I will introduce in Section 5.1. The scale of change and, as I will argue in Section 4.2, the temporal trace τ are on the present framework relativised to granularities, the purpose of which is to model the slow-motion interpretation of progressive achievements.

$\mathbb{D}$ will be used to designate the set of all *degrees* of all scales (defined in (3.26)).

$$\mathbb{D} \stackrel{\text{def}}{=} \bigcup_{\langle S, <_{\mathcal{S}} \rangle \in \mathbb{S}} S \tag{3.26}$$

Any convex subset (i.e., interval) i of the carrier set of a scale $\langle S, <_{\mathcal{S}} \rangle \in \mathbb{S}$ is also a scale (with the ordering over it being the restriction of $<_{\mathcal{S}}$ to interval i), and it is called a *subscale* or subinterval of $\mathcal{S}$. Of special interest will be bounded subscales, so I use $\mathbb{B}$ to designate the set of all *bounded intervals* (see Appendix A) of all scales (see (3.27)).

$$\mathbb{B} \stackrel{\text{def}}{=} \bigcup_{\mathcal{S} \in \mathbb{S}} \{i \mid i \in \mathsf{Int}(\mathcal{S}) \wedge i \text{ is bounded}\} \tag{3.27}$$

The part-of relation over scales corresponds to the subset relation. Just as in the case of events, the restriction of the part-of relation to non-final parts is an important relation, which will feature in my analysis of the progressive, so I define it below.

> **Definition 6 (Non-final subscale)**
> *A scale $\mathcal{S}'$ is a non-final subscale of scale $\mathcal{S}$, notated as $\mathcal{S}' \subset_{\mathsf{nf}} \mathcal{S}$ iff* $\mathsf{carrier}(\mathcal{S}') \subset \mathsf{carrier}(\mathcal{S})$ *and* $<_{\mathcal{S}'} = <_{\mathcal{S}} \restriction \mathsf{carrier}(\mathcal{S}')$ *(that is, the ordering of $\mathcal{S}'$ is the restriction to its carrier set of the ordering of $\mathcal{S}$) and* $\exists d \in \mathsf{carrier}(\mathcal{S}) : \forall d' \in \mathsf{carrier}(\mathcal{S}') : d' <_{\mathcal{S}} d$ *(where $<_{\mathcal{S}}$ is the strict ordering of $\mathcal{S}$).*

I also define the initial subscale relation as follows, using the *non-strict* subset relation in this case:

> **Definition 7 (Initial subscale)**
> *A scale $\mathcal{S}'$ is an initial subscale of scale $\mathcal{S}$, notated as $\mathcal{S}' \subseteq_{\mathsf{ini}} \mathcal{S}$ iff* $\mathsf{carrier}(\mathcal{S}') \subseteq \mathsf{carrier}(\mathcal{S})$ *and* $<_{\mathcal{S}'} = <_{\mathcal{S}} \restriction \mathsf{carrier}(\mathcal{S}')$ *and* $\forall d' \in \mathsf{carrier}(\mathcal{S}') : \forall d \in \mathsf{carrier}(\mathcal{S}) : d \leq_{\mathcal{S}} d' \rightarrow \exists d'' \in \mathsf{carrier}(\mathcal{S}') : d'' \leq_{\mathcal{S}} d$ *(where $\leq_{\mathcal{S}}$ is the non-strict ordering of $\mathcal{S}$).*

Scale complexity. The number of degrees in a scale will play an important role in the present framework. Building on Beavers (2002, 2008, 2013), I make the following distinctions in scale (or scalar) complexity:

No. of deg.	Scale complexity
2<	*multi-valued* (or *complex* or *extended)*
2	*binary* (or *two-valued* or *simplex)*
1	*singleton* (or *one-point* or *degenerate)*

Table 3.1: Scale complexity

Time as a scale. Taking Definition 5 of a scale as a set of linearly ordered points (satisfying the greatest lower bound and least upper bound properties), time straightforwardly qualifies as a scale. Conceiving of time as a scale is not at all a novel idea, as its scalar aspect is highlighted by gradable adjectives and adverbials like *late*, *early* (cf. von Stechow 2009a), and *before*, *after*. And the α *time* constituents in time adverbials like *for two hours* are *measure phrases*, denoting the intervals of time of the relevant size (cf. Krifka 1989, Schwarzschild 2002).

For our purposes, the point of conceiving of time as a scale is that this will enable us to apply to time the framework of granularity functions of Sauerland and Stateva (2007, 2011), which operate on degrees of a scale. Sauerland and Stateva (2007, 2011) already made use of the scalar aspect of time in this respect, in discussing temporal expressions such as *at 6 A.M.*, which exhibit the scalar vagueness that they analysed with granularity functions: *Jane arrived at six A.M.* can be true if Jane, in fact, arrived at 5:58. My goal in exploiting granularity functions over time is to model how the same event can be instantaneous in one context — in which a coarse granularity over time is assumed, and the endpoints of the event are not mutually distinguished — and durative in another context — in which a fine granularity over time is assumed, and the endpoints of the event are mutually distinct.

Chapter 4

SLOW-MOTION INTERPRETATIONS

In this chapter, I focus on slow-motion interpretations and offer an analysis of shifts between punctual and durative interpretations that are rooted in a change in granularity. To this end, I first adopt and enhance formal tools for analysing granularity-relative phenomena, namely, granularity functions which are parameters of interpretation mapping a degree on a scale to an interval containing it. Then I propose that durativity is not a property of eventualities and predicates *per se*, but is dependent on a granularity parameter: in particular, the temporal trace function is relativised to a temporal granularity parameter. The final part of the chapter is then devoted to the discussion of some implications of the proposal for phenomena not related to achievements, including the relation between vagueness and durativity, the vague temporal boundaries of events and the minimal parts problem of activities.

4.1 The granularity parameter

Slow-motion readings of progressive achievements like *Look at the screen, the Challenger is exploding* arise contexts in which fine temporal distinctions are relevant, that is, in "fine granularity" contexts. To model slow-motion readings, therefore, we need to use tools for modelling "granularity". In this section, I will describe the formal tools that can be used to capture the granularity-relativity of the interpretation of linguistic expressions in general. I will use the granularity functions of Sauerland and Stateva (2007, 2011), but I will introduce some enhancements and formal details that were left implicit or were not addressed by the authors.

4.1.1 Granularity functions

Building on Krifka (2007), Sauerland and Stateva (2007, 2011) (henceforth, S&S) propose to handle a form of vagueness (what they call *scalar vagueness*, cf. Section 4.3.1 below) through *granularity functions*, which they use as contextual parameters of interpretation. On their account, a granularity function maps a point of a scale to an interval containing it in a way that it partitions a scale into cells of equal size. Then the cells of the partition consist of points that are indistinguishable at that granularity.

Building on S&S, but modifying their formal characterisation somewhat,[1] a function $\gamma_{\mathcal{S}} \colon \mathsf{carrier}(\mathcal{S}) \to \mathsf{Int}(\mathcal{S})$ is a *granularity function* over scale $\mathcal{S} \in \mathbb{S}$ if it satisfies the following restrictions, where num outputs a number for each point on a scale and which will be given a precise definition below, sup is the supremum, inf is the infimum and $-_{\mathbb{R}}$ is the usual subtraction operator over real numbers:

$$\forall s \in \mathsf{carrier}(\mathcal{S}) \colon s \in \gamma_{\mathcal{S}}(s) \tag{4.1a}$$

$$\forall s \in \mathsf{carrier}(\mathcal{S}) \colon \gamma_{\mathcal{S}}(s) \text{ is convex} \tag{4.1b}$$

$$\forall s, s' \in \mathsf{carrier}(\mathcal{S}) \colon \mathsf{num}(\sup(\gamma_{\mathcal{S}}(s))) -_{\mathbb{R}} \mathsf{num}(\inf(\gamma_{\mathcal{S}}(s))) = \mathsf{num}(\sup(\gamma_{\mathcal{S}}(s'))) -_{\mathbb{R}} \mathsf{num}(\inf(\gamma_{\mathcal{S}}(s'))) \tag{4.1c}$$

$$\forall s, s' \in \mathsf{carrier}(\mathcal{S}) \colon \gamma_{\mathcal{S}}(s) = \gamma_{\mathcal{S}}(s') \text{ or } \gamma_{\mathcal{S}}(s) \cap \gamma_{\mathcal{S}}(s') = \emptyset \tag{4.1d}$$

(4.1a) says that the set to which a granularity function $\gamma_{\mathcal{S}}$ maps a point has to include the point as element. (4.1b) states that the range of $\gamma_{\mathcal{S}}$ is made up of convex sets, i.e., intervals. (4.1c) requires the images of all points by $\gamma_{\mathcal{S}}$ to be of the same size (i.e., a granularity function defines a unit on the scale). (4.1d) is a fourth criterion on granularity functions which is at least implicitly assumed in S&S, and says that a granularity

[1] First, (4.1d) is only implicit in S&S. Second, (4.1c) differs from S&S's formula, who use max and min, I assume for a maximum and minimum. The reason I depart from S&S and use suprema and infima, is that I wish to remain neutral as to which end(s) of the intervals can be open. S&S intend a granularity function to *partition* a scale, but given a dense scale, it is impossible for two neighbouring cells both to include the boundary. For instance, if one cell of the partition is $[4.5, 5.5]$, then the following cell must be a left-open interval $(5.5, 6.5]$ or $(5.5, 6.5)$, that is, it cannot have a minimum.

In terms of the measure of the interval length, using suprema and infima instead of maxima and minima makes no difference, because the only case the supremum is not necessarily a maximum (and an infimum not necessarily a minimum) is when the interval is dense, but in that case, the measure of the open interval not containing the supremum and/or infimum (e.g., $(5.5, 6.5)$) and the measure of the closed interval containing either of those (e.g., $[5.5, 6.5]$) is the same.

In addition, I use the additional function num to mediate between scales and numeric operations like subtraction.

function *partitions* a scale, that is, the images of the points of a scale are either identical or non-overlapping. In other words, granularity functions define a partition of a scale with cells of the same size — in the terminology of Deo (2009), a *regular partition*.[2]

Note that the definition of granularity functions, in particular, (4.1c) presupposes the existence of a supremum and an infimum for the bounded subintervals of a scale. This is guaranteed on our framework by having Definition 5 require that scales have the least upper bound and greatest lower bound properties.

I will use $G_{\mathcal{S}}$ to designate the set of all granularity functions defined over a scale $\mathcal{S} \in \mathbb{S}$:

$$G_{\mathcal{S}} \stackrel{\text{def}}{=} \{\gamma_{\mathcal{S}} : \mathsf{carrier}(\mathcal{S}) \to \mathsf{Int}(\mathcal{S}) \mid \gamma_{\mathcal{S}} \text{ satisfies the criteria in (4.1)}\} \tag{4.2}$$

The set $\mathbb{G}$ of all granularity functions in a model is the set of all granularity functions over all scales in a model:

$$\mathbb{G} \stackrel{\text{def}}{=} \bigcup_{\mathcal{S} \in \mathbb{S}} G_{\mathcal{S}} \tag{4.3}$$

I will drop the scale subscript of γ if it is obvious from the context which scale the granularity function γ is defined on.

Defining a metric. A technical note is due at this point. S&S appear to follow the school of scale-based semantics according to which the carrier set S of a scale is a subset of the real numbers, or at least are abstract points of measurement with an inherent metric. Although many authors make this assumption, it is not uniformly accepted (cf. Section 2.3.1), and wishing to retain greatest generality, I myself defined a scale in Definition 5 as any linearly ordered set of points, which means that a scale does not necessarily have a metric on it inherently. Then, however, we need a measure on the scale to mediate between the scale and numeric operations like the subtraction in (4.1c), similar to the *length scaling* function of Gawron (2009) that assigns a real number to the points of scales (or in Gawron's terminology, *axes*).[3]

[2] Deo (2009) uses regular partitions over time to provide a suitably restricted domain for quantification for aspectual operators like the progressive. However, she does not use a function like granularity functions to assign cells of that partition to specific (time) points (or intervals), and for this reason the formal machinery she uses is insufficient for the more general purposes to which granularity functions can be put to use.

[3] van Rooij (2011b) also assumes that linear orderings form the input for an independent quantitative measurement, that is, measurement is defined over and above the basic linear order defined by, say, differences in tallness or time.

In order to define granularity functions as regular partitions, that is, express that granularity functions partition a scale into units of *equal size*, we first need to map the points of a scale to (real) numbers. This mapping is done by a numerifying function I notate as num, which is defined as follows.[4] Let us define the *numerifying function* $\mathsf{num}\colon \mathbb{D} \to \mathbb{R}$ from the set of all degrees $\mathbb{D}$ to the set of real numbers $\mathbb{R}$ such that it satisfies the following homomorphism requirement (where $\mathbb{S}$ is the set of scales, $<_S$ is the ordering defined over the scale S and $<_{\mathbb{R}}$ is the usual strict smaller-than relation over the real numbers):

$$\forall \langle S, <_S \rangle \in \mathbb{S}\colon \forall s, s' \in S\colon\ s <_S s' \rightarrow \mathsf{num}(s) <_{\mathbb{R}} \mathsf{num}(s') \tag{4.4}$$

Apart from the homomorphism requirement, num is also required to define a *metric* (or *distance function*, see Appendix A) d_S for any scale S such that

$$\forall \langle S, <_S \rangle \in \mathbb{S}\colon \forall s, s' \in S\colon\ d_S(s, s') = \mathsf{abs}(\mathsf{num}(s) -_{\mathbb{R}} \mathsf{num}(s')) \tag{4.5}$$

where abs is the absolute value function over the set of real numbers and '$-_{\mathbb{R}}$' is the usual subtraction on real numbers.

The numerifying function, unlike a measurement unit like *litre*, is not conventional and is not used in language explicitly. Also, just as 2°Celsius and 2 litres have nothing in common apart from the number itself, that is, the fact that they contain the same numeral does not reflect any deeper connection between them, assignment of the same number to two points on two different scales does not carry any information, either. The numerifying function is just an abstract, arbitrary measurement over scales, whose sole purpose is to define a metric over different scales.[5]

[4] num is not to be confused with a *measure function*, which maps objects to degrees, or a *measurement unit*, which maps objects to numbers.

[5] Depending on our choice, we can have num be defined for *all* scales, as it now is, in which case the framework is equivalent with the approach in scale-based works according to which distance measures are inherently defined on all scales (cf. Section 2.3.1). If, on the other hand, we accept the arguments of Cresswell (1976), Bale (2011), van Rooij (2011a) that not all scales are associated with a metric, the function num can be simply assumed to be a *partial function* over the set of scales, not defined for, e.g., the scale of beauty or happiness.

Given the present formal account of granularity, the latter choice predicts that expressions referring to scales of beauty or happiness are not sensitive to granularity, because the application of *granularity functions* presupposes a metric (cf. requirement (4.1c)). As such, assuming that *strictly speaking* is a "more precise scalar approximator" in the sense of Sauerland and Stateva (2007, 2011), i.e., it indicates a change to a finer granularity context, we expect that it should be much odder to assert a sentence with *strictly speaking* containing a comparative of *beautiful* than a comparative of *tall*. And this appears to be borne out:

That said, the numerifying function may take the place of Bale's (2008) universal scale of comparison which he uses to account for inter-scalar comparisons, such as *Esme is more beautiful than Einstein is intelligent*. On our account, there is no need for a separate universal scale of comparison, because the set of numbers to which scales are mapped by the numerifying function can take on its function. And as the present discussion shows, there is independent need for such a numerifying function beside indirect comparisons, namely, to be able to measure distances and thereby ultimately model granularity changes.[6]

Representing an interval with a point. As it stands, the output of granularity functions are intervals, and not degrees of the scale. Solt (2014), who also uses the framework of S&S, draws attention to this fact, but reference to these intervals that she calls "coarse-grained degrees" is sufficient for her purposes. These "coarse-grained degrees" are intervals, and, as such, unlike points, but also "indivisible", and, as such, unlike regular intervals. Thus, using simply these intervals that are the output of granularity functions is a "departure from the more typical view of degrees as points, and also from existing theories that treat degrees as intervals" (Solt 2014, p. 528).

But for our purposes, we need to refer to regular, pointlike degrees at a coarse granularity over the scale (for instance, in order to be able to have the numerifying function num apply to them, which cannot, formally, take intervals as its argument). I therefore follow van Rooij (2011b), who models granularity changes through set inclusion over the set of individuals, and uses a *single individual* to represent an *equivalence class* of individuals of a finer-grained model at a coarser granularity. I in turn represent an equivalence class of degrees under a given granularity function with a single distinguished degree. To formally model this, all degrees that are mapped to the same interval by a granularity function are mapped to this single, distinguished degree (for which I choose the supremum) by a function called the *degreeifying function*.

(i) a. Strictly speaking, Anna is **taller** than Bill, but come on, their height difference is so negligible, they're of equal height for all intents and purposes!
b. ?Strictly speaking, Mittens is **more beautiful** than Coco, but negligibly so, and so they are equally beautiful for all intents and purposes.

As in my thesis I only consider scales over which granularity functions are defined, I ignore this and have num be defined for all scales for simplicity.

[6] And further motivation for such a numerifying function is given by Sassoon (2010) and Solt and Gotzner (2012) who bring arguments supporting the assumption that most scales used in natural language semantics have a metric defined over them.

So we define the (partial) *degreeifying function* $\mathsf{deg}\colon \mathbb{G} \times \mathbb{D} \nrightarrow \mathbb{D}$ from the set of all granularity functions $\mathbb{G}$ and the set of all points $\mathbb{D}$ such that it outputs a point, the representative of the interval to which the granularity function argument maps the point argument. The following criteria apply to deg, where sup is the supremum of an interval (see Appendix A):

$$\forall s \in \mathbb{D}\colon \forall \gamma \in \mathbb{G}\colon\ \mathsf{deg}(\gamma, s) \text{ is defined iff } \gamma \text{ is defined in } s \tag{4.6a}$$

$$\forall s, s' \in \mathbb{D}\colon \forall \gamma \in \mathbb{G}\colon\ \gamma(s) = \gamma(s') \leftrightarrow \mathsf{deg}(\gamma, s) = \mathsf{deg}(\gamma, s') \tag{4.6b}$$

$$\forall s \in \mathbb{D}\colon \forall \gamma \in \mathbb{G}\colon\ \mathsf{deg}(\gamma, s) = \sup(\gamma(s)) \tag{4.6c}$$

(4.6a) ensures that deg is defined only if its granularity function argument is defined over the scale that its point argument is an element of. (4.6b) is the criterion that ensures mapping all and only points in the same interval to the same point (the selected point represents the interval). (4.6c) ensures that the degreeifying function outputs the supremum of the interval as a representative of that interval (which is an arbitrary decision, we could equally well have chosen the infimum).

The degreeifying function deg is a technically necessary tool for measuring the distance of two points at a particular granularity, and will be used in the definition of granularity-relative temporal traces in Section 4.2.

Figure 4.1 offers a schematic overview of the mappings introduced here that are necessary and collectively sufficient to model granularity in the present scale-based framework which does not assume an inherent metric over scales.

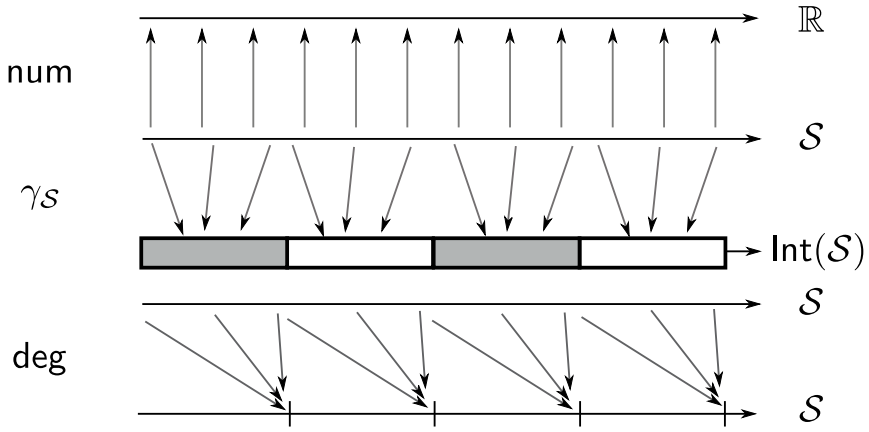

Figure 4.1: The mappings assumed in the framework for modelling granularity

4.1.2 Higher-order granularity parameters

4.1.2.1 The problem of sharp boundaries

A point to be noted in connection with the granularity functions of S&S is that their analysis implies that although some points are not distinguishable at a given granularity (those that are mapped to the same interval by that granularity function), some nearby points belonging to different intervals *are*. An illustration of this problem is given in Figure 4.2.

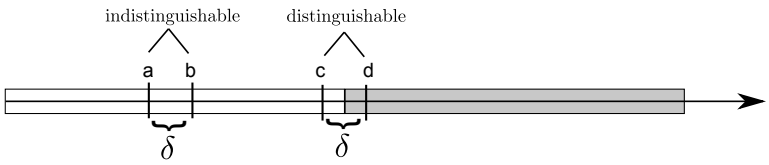

Figure 4.2: The return of the Sorites paradox

Let us take the following example from S&S. On the scale of distance, they define three granularity functions, a fine, an average and a coarse granularity, which map the degree denoted by the expression *5 meters* to the following intervals:

$\gamma_{\text{fine}}(5\text{m}) = [4.95\text{m}, 5.05\text{m}]$

$\gamma_{\text{mid}}(5\text{m}) = [4.75\text{m}, 5.25\text{m}]$

$\gamma_{\text{coarse}}(5\text{m}) = [4.5\text{m}, 5.5\text{m}]$

As can be seen, the unit of the fine granularity function is the smallest, and the image of a particular point is properly included in the image thereof by the coarser granularity functions.

However, with the granularity parameter set to "mid" in the 5 meter example above, a 4.74m-long rod would not qualify as 5 meters long, while a 4.75m-long one would. That is, although granularity functions successfully erase the unwanted distinction between some points (say, 4.75m and 4.76m), they do not do so for all unwanted distinctions (say, 4.74m and 4.75m). This is a serious shortcoming of granularity functions as a tool for analysing vagueness: they do not refer to the distance between degrees, but output arbitrary boundaries.

This is a replication of the Sorites paradox (at what point can we say that a set of sand particles is a heap?) at a higher level:[7] the problem is that there is still a precise boundary between two sets of (indistinguishable) elements. However, another

[7] Cf. also the discussion about the higher-order Sorites paradox in van Rooij 2011b.

well-known theory of vagueness, that of supervaluations proposed by van Fraassen (applied in an analysis of vagueness first by Fine 1975), also suffers from an analogous problem,[8] and short of introducing fuzzy logic or some form of continuous distribution into semantic analysis (such as in the recent probabilistic approaches of Lassiter 2011b or Sutton 2015), there appears to be little hope of overcoming this obstacle.[9]

One way to mitigate the effect of the higher-order Sorites paradox and avoid some of the problems posed by the return of sharp (as opposed to the expected vague) boundaries is, I propose, to combine granularity functions with a supervaluation-like method. Since both granularity functions and supervaluations serve to *relegate* unwanted distinctions to a higher level, superimposing a supervaluation-like approach over granularity functions relegates the unwanted distinctions made by granularity functions to a yet higher level, as I will illustrate. It should be noted at the outset that this move is not a resolution of the Sorites paradox, which, as I noted above, appears to defy a solution in existing frameworks, and the best we can achieve is to do away with as many unwanted distinctions as possible.

4.1.2.2 Minimal distinguishability

The rationale behind combining the theory of granularity functions with a supervaluation-like method is that what "granularity" (in the intuitive sense of the term) is about is the *size* of the differences that are relevant at that particular level of granularity, rather than a specific assignment of individuals and degrees to equivalence classes. Take the three glasses of water in Figure 4.3. At the everyday granularity (say, in a pub

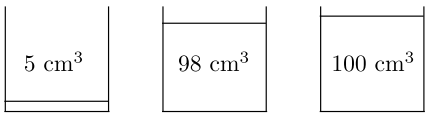

Figure 4.3: Three glasses of water

scenario), the liquid content of the last two glasses on the right would be regarded as equal (even if the agent is told about the 2 cm^3 difference between them). But there

[8] E.g., the boundary between the amounts of sand particles which are *strictly* a heap, and the amounts which are a heap according to *some but not all* valuations is sharp.

[9] Indeed, as Peter Sutton (p.c.) noted, even probabilistic approaches fail to offer a way out of the Sorites paradox, because there is always a sharp cutoff-point when the probability of one predicate — say being red — applying to an individual is greater than the probability of another predicate — say, being orange — applying to it.

may well be scenarios, where this very difference is relevant, such as in a laboratory context, where small differences can be crucial when creating a new liquid solution.

Importantly, the difference between the last two glasses on the right can be relevant merely owing to the fine granularity enforced by the laboratory setting, irrespective of whether the first glass is also present. That is, the set of individuals (in our example: the set of glasses) forming the contrast set for a given judgement (in our example: whether the third glass contains more liquid than the second) does not determine whether a given difference (in our example: 2cm^3) counts as relevant in a context. Therefore, approaches to vagueness and granularity relying solely on comparison classes such as Burnett (2014)[10] will not be sufficient to explain the full range of facts. A similar observation was made by Solt and Gotzner (2012), who bring experimental evidence for the insufficiency of a simple delineation semantics (i.e., one relying solely on contrast classes) for gradable adjectives like *tall* or *dark*.

Consider now the *finer than* relation $\prec$ over granularity functions as defined by S&S which satisfies the following criterion (in our framework) for all scales $\mathcal{S} \in \mathbb{S}$: $\gamma_{\mathcal{S}} \prec \gamma'_{\mathcal{S}}$, that is, $\gamma_{\mathcal{S}}$ is *finer than* $\gamma'_{\mathcal{S}}$ if and only if

(4.7) $\forall s \in \mathsf{carrier}(\mathcal{S})$:

$$\mathsf{num}(\sup(\gamma_{\mathcal{S}}(s))) -_{\mathbb{R}} \mathsf{num}(\inf(\gamma'_{\mathcal{S}}(s))) <_{\mathbb{R}} \mathsf{num}(\sup(\gamma'_{\mathcal{S}}(s))) -_{\mathbb{R}} \mathsf{num}(\inf(\gamma'_{\mathcal{S}}(s))).$$

In words, a granularity function $\gamma_{\mathcal{S}}$ is finer than $\gamma'_{\mathcal{S}}$ if and only if the size of its units is smaller than the size of the units of $\gamma'_{\mathcal{S}}$. Crucially, S&S themselves regard the unit sizes as definitive for granularity precision, rather than actual mappings, since they do not base the *finer than* relation on set inclusion (that is, they do not say that $\gamma_{\mathcal{S}} \prec \gamma'_{\mathcal{S}}$ iff the images of any point by $\gamma_{\mathcal{S}}$ is a subset of the image of the point by $\gamma'_{\mathcal{S}}$).

In order to be able to refer to the unit size of granularities, let us introduce the following notion.

> **Definition 8 (Minimally distinguishable interval size)**
> *Let us define the function* $\mathsf{mdi}\colon \mathbb{G} \to \mathbb{R}$ *from the set of granularity functions to the set of real numbers such that* $\mathsf{mdi}(\gamma_{\mathcal{S}}) = \mathsf{num}\left(\sup\left(\gamma_{\mathcal{S}}\left(s\right)\right)\right) -_{\mathbb{R}} \mathsf{num}\left(\inf\left(\gamma_{\mathcal{S}}\left(s\right)\right)\right)$*, where* s *is an arbitrary point of* $\mathsf{carrier}(\mathcal{S})$*.* $\mathsf{mdi}(\gamma_{\mathcal{S}})$ *is called the* minimally distinguishable interval size *(*MDI*, for short) by granularity function* $\gamma_{\mathcal{S}}$*.*

[10] Burnett's (2014) Contrast Preservation principle requires the presence of a third individual if two individuals become indistinguishable, i.e., on our example, the first glass needs to be present in order for the last two to be distinguishable in one setting and indistinguishable in another.

The essence of granularity is reference to a unit size (or grain size), and on the present framework, this unit size is encoded as the minimally distinguishable interval size MDI. The MDI presents a limit on the difference between degrees which are indistinguishable at a given granularity γ: any interval of a size greater than $\mathsf{mdi}(\gamma)$ is necessarily extended, because its infimum and supremum are necessarily mapped to different intervals by γ, and hence to different degrees by deg. This will be the formal basis for modelling granularity-based durativity changes in Section 4.2.

Comparison with other characterisations of a unit size. There are several independent strands of research bearing on the present notion of a MDI. On the account of Lasersohn (1999), the MDI corresponds to the size of the pragmatic halo associated with an expression in a given context, i.e., the difference (on some dimension) which counts as "pragmatically ignorable", although Lasersohn does not use an explicit measure of this ignorable difference in his formal account. Where the present proposal differs radically from that of Lasersohn (1999) is that it is a semantic account of granularity changes, rather than a pragmatic one. As such, it is immune to an objection of van Rooij (2011b) and Solt (2014) against pragmatic halos, noted (but dismissed as not crucial) by Lasersohn (1999, §6.1) himself: according to this objection to a pragmatic account of vagueness like that of Lasersohn (1999), it can very well happen that no statement with a predicate like *arrive at 2 o'clock* will come out as true (because it may so happen that no arrivals coincide with the point denoted by *2 o'clock* to the exact nanosecond and even beyond nanoseconds), which is highly unintuitive. In contrast, such sentences can be true on a granularity functions-based framework, which is a semantic, rather than pragmatic account of vagueness.

Also, the pragmatic halo account needs to make some stipulations the present granularity function-based theory does not. For instance, Lasersohn (1999) has to stipulate that the *exact denotation* of an expression be the unique element which is *more similar* to itself than any others in its pragmatic halo. No such or similar stipulation is needed in our case because what are ordered (via the finer-than relation) are granularity functions on the basis of unit size, which is independently ascertainable, in contrast to an ordering of individuals based on *similarity*. We get the classical denotation when the granularity is set to "absolutely fine" (cf. Section 4.1.2.4 below), and the denotation at any other granularity assigned to the relevant expression is necessarily a superset thereof.

van Rooij (2011b) also proposes in informal terms that a specific minimal difference size is at the heart of granularity, saying that, for instance, x is taller than y in a partic-

ular context iff the height of x is higher than the height of y plus some fixed small real number ϵ. However, he, like Lasersohn (1999), does not incorporate this notion and difference measures into his formal account, and uses a supervaluation-like approach to granularity.

An account of granularity which does explicitly encode measures and unit size is that of Champollion (2010), who introduces a function ε which outputs 'true' for things that count as small given some measure. For instance, $\varepsilon(\lambda t[\mathsf{hours}(t) = 1])(t')$ is true just in case t' is very small in comparison to one hour. This function is then part of the semantic representation of a sentence (involving, for instance, a *for*-adverbial such as *John waltzed for an hour*), and not a parameter of interpretation as the granularity functions of S&S that I employ. As such, it cannot be used to model the effects that different components of a sentence can have on the granularity parameter used in their interpretation, although such effects do appear to exist.

In particular, the granularity parameter used in the interpretation of different components of a sentence is not generally allowed to vary greatly. For instance, as Tatevosov (2008, p. 418) argued, in Russian (and it seems that in English, as well), modification of "long-term activities" like *rukovodil* 'supervise' is more felicitous with temporal adverbials which, in our terms, are associated with granularity parameters characterised by a unit size comparable to year-long (rather than minute-long) intervals, such as *v 2004 godu* 'in 2004'. Also, as Kearns (1991, p. 61) remarked, a mixing of granularity "produces absurdity, as in *The moment the market slumped John arrived for the meeting*". On the granularity function-based account building on S&S, such a restriction of *commensurable granularity* can be easily captured by a principle requiring the parameters of interpretation (and the granularity parameter among them) to be unchanged in the interpretation of a sentence — much as the variable assignment function is not generally allowed to change.

Also, while Champollion's account needs a specific measure such as the one hour-long interval to determine the unit of granularity, on our account building on S&S, the interpretation function always has a granularity parameter, whether or not there is a specific measure expression (such as *for an hour* in *John waltzed for an hour*) fixing it (cf. also the discussion in Section 4.3.3.3). As such, a "granularity functions as parameters of interpretation" approach is more general, allowing granularity to have relevance even in absence of explicit measures. It can offer an account of gradable adjectives like *full* and approximators like *exactly*, as well as an account of when a sentence like *You're exactly right* can be truthfully asserted (for details, see S&S), while

it is not trivial how Champollion's (2010) account based on ε could be extended to these phenomena.

Tatevosov (2008) also models minimally accessible interval sizes, but he focuses exclusively on event duration. For him, non-durative events are those that are too short to match the minimal duration of an *observation event*. As such, his account of the durative/non-durative distinction is characterised by the same limited generalizability as Champollion's (2010) account in comparison with S&S's granularity functions approach. Because Tatevosov (2008) refers to the temporal length of observation events, it is specific to the temporal domain, while the notion of granularity functions and a MDI is domain-independent, and can be used to explain the extended/non-extended distinction in other dimensions, such as space or abstract property spaces (say, when determining whether a dress counts as redder than another one in some context).

In addition, a drawback of relying on the length of observation events as a limiting condition for durativity is that in many cases, it is arguably not simply the length of observation events that determines whether the agent regards an event as extended in time, but the goals of the agent (cf. the discussion on page 80 about the three glasses of water): the agent may be aware of the duration of, say, a cough (which presupposes that the observation events are smaller in length than the cough), but for the purposes of the discourse context, the objective durativity of that coughing event (and coughing events in general) is *irrelevant*. This is captured on the granularity functions-based account by having the granularity function be a parameter of interpretation, which is affected by a number of factors: the cognitive ability of the agent, the discourse context, as well as the linguistic expressions that are interpreted.

Outside of formal semantics, the MDI of an everyday granularity level on the temporal scale can be identified with the 2-3 second interval size (aptly called by Engelberg 2000 the *cognitive moment*), which several psychological studies (Pöppel 1978, Turner and Pöppel 1983, Feldhütter et al. 1990) have shown to be relevant in different areas of human perception and behaviour. Among others, this is the threshold above which events are perceived as durative, rather than instantaneous:

> Beyond the two horizons of this [cognitive] moment exist the two periods which together constitute duration ... (Turner and Pöppel 1983, p. 297)

4.1.2.3 Overlapping intervals

Given the observation that for the purposes of granularity, what is relevant is unit size, I propose to adapt the granularity functions of S&S in such a way that the granular-

ity parameter of interpretation is defined by the MDI, rather than specific granularity functions. That is, the parameter of interpretation is not a granularity function, but a *set* of granularity functions. So let us define *granularity levels* as equivalence classes of granularity functions with the same unit size:

> **Definition 9 (Granularity level)**
> *A granularity level is a set of granularity functions over the same scale which have the same* MDI. *Unless the context specifies otherwise, the granularity level that is the parameter of interpretation includes* all *granularity functions with the same* MDI. *The* MDI *of the granularity functions in a granularity level is called the* unit *of that granularity level.*

Figure 4.4 illustrates the move from specific granularity functions to granularity levels. This move can be seen as an adaptation of the idea of Rothstein (2004), who

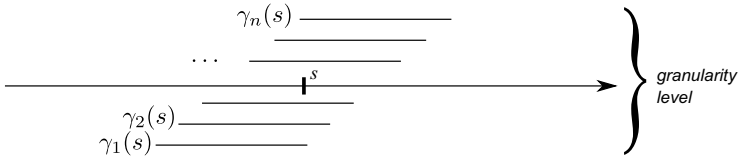

Figure 4.4: A granularity level as a set of granularity functions with the same unit size.

argues that although all activities have atomic parts, the atomic parts of regular activities (but not those of semelfactives) *overlap*. Similarly, although a single granularity function results in a set of disjoint blocks on a scale, there can be a great (perhaps even infinite) number of equally acceptable granularity functions at a particular granularity level, whose mappings are different, and their blocks *overlap* with those of other granularity functions. Figure 4.5 illustrates how the intervals in the range of a set of granularity functions belonging to the same granularity level (designated with $\gamma_1, \gamma_2, \gamma_3$) overlap just as the minimal parts of an activity like *run* (designated with $\mathbf{P}_{\text{min}}$) overlap according to Rothstein (2004).

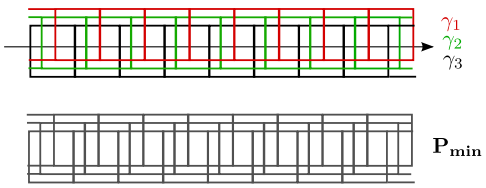

Figure 4.5: Analogy: Overlapping granularity functions and atomic parts of activities

Thus, γ_1 would map, say, the time point 17:14 to the interval 16:45–17:15, while γ_2 would map it into the interval 17:00–17.30. Both satisfy the criteria for granularity functions, and both have the same unit size (half an hour).

While the atomic function of Rothstein (2004) in itself outputs a set of overlapping intervals (eventualities), we need a *set* of granularity functions to achieve this end. Thus, if granularity *levels*, rather than granularity functions, are parameters of interpretation, we will get multiple, but, in a given context, equally acceptable, *interpretations* — similar to a supervaluationist account. And similarly to the idea of a sentence being *supertrue* on a supervaluationist account just in case it is true according to *all* classical valuations, we can now say that two points on a scale are distinguished at a particular granularity level just in case they are distinguished by *all* the granularity functions of that level.

In Figure 4.6, for instance, t_1 and t_2 are not distinguished at the relevant granularity level, because their distance is smaller than the unit of that level, and so there is a granularity function at that level (γ_2) that maps them to the same interval. In contrast, t_1 and t_3 are distinguished at the same granularity level, because their distance is greater than the unit of that level, and so no granularity function at that level maps them to the same interval.

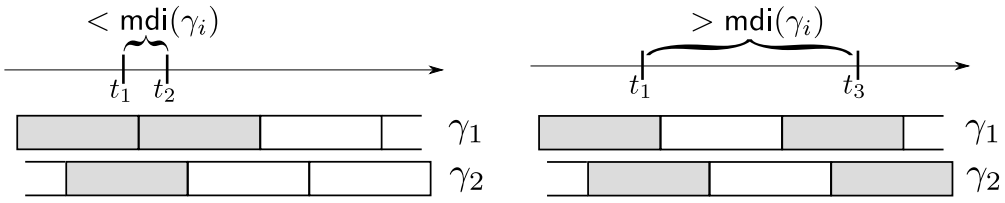

Figure 4.6: Two points are distinguished at a granularity level just in case they are distinguished by all granularity functions at that level.

We can thus elude the problem of the higher-order Sorites paradox that S&S's original account faces.[11] If the distance between two points, t_1 and t_2 on a scale is less than the unit of the relevant granularity level Γ, then there will be at least one granularity function $\gamma \in \Gamma$ such that $\gamma(t_1) = \gamma(t_2)$, that is, one which cannot distinguish between t_2 and t_1. However, if the distance of t_1 and t_2 is greater than one unit, then no such

[11]Note that without the combination of granularity functions with the idea of multiple interpretations, the use of granularity functions would also result in rendering a dense scale, such as time, into a discrete one, which may have unwelcome consequences in our theory. But now we can correctly retain the "denseness" of the scale (even if merely a higher-order denseness, emerging across different possible interpretations), albeit at the price of a supervaluation-like move.

granularity function can be found at granularity level Γ: the two points are always distinguished at that level of granularity.

Importantly, though, the combination of multiple valuations and granularity functions does not solve the Sorites paradox in general. We still have sharp boundaries between the set of *intervals* that are extended at a particular granularity level, and those that are not (the boundary being the MDI). Thus, take S&S's example with *5 metres* above. On their example, the granularity function γ_{mid} maps the degree 5m to the interval [4.75m, 5.25m]. Moving to granularity levels, there are several granularity functions with the same unit, all belonging to granularity level $\Gamma_{\text{mid}} = \{\gamma_{\text{mid}}, \gamma'_{\text{mid}}, \gamma''_{\text{mid}}, \dots\}$. The following granularity functions in Γ_{mid}, for instance, assign different images to the degree 5m:

γ_{mid}(5m) = [4.75m, 5.25m]

γ'_{mid}(5m) = [4.74m, 5.24m]

γ''_{mid}(5m) = [4.76m, 5.26m]

A welcome aspect of moving to granularity levels, as mentioned above, is that 4.74m and 4.75m are indistinguishable at Γ_{mid} just as much 4.75m and 4.76m are, because two points are only distinguishable at a granularity level if all granularity functions at that level distinguish between them. On the other hand, while 4.75m and 5.25m are indistinguishable at Γ_{mid}, 4.74m and 5.25m are *still* distinguishable despite the negligible difference between the two pairs. This is because there is a specific unit size associated with a granularity level, and so any two points whose distance is greater are distinguished at that level, while any two points whose distance is smaller are not: the cut-off point is sharp.

However, we did relegate this unwanted sharp cut-off point to a higher level, doing away with some unwanted results (of say, two very close points, such as 4.74m and 4.75m, being distinguishable). So this is a general gain over the granularity *function*-based account of vagueness: although we cannot tackle the problem of the Sorites paradox, we do eliminate more unwanted distinctions.

4.1.2.4 Precisifications

Let us now elaborate on the notion of precisifications. Landman (1991, p. 139) argues that precisification, or in our terms, moving to a finer granularity, can happen indefinitely, and also that we cannot reach the minimal intervals (or points) of time through these. While I agree with him on the first point and at least leave open the possibility of

an infinite number of granularity levels over a scale, I suggest that it is and should be possible to access the actual points on a scale with them. In particular, we can model objective reality, as a limit point for all epistemic stances, with an *absolutely fine granularity*, which maps each point on a scale to itself. (This is a valid move given that points are intervals, even if degenerate ones.)

> **Definition 10 (Absolutely fine granularity)**
> *In the set of granularity functions $\mathbb{G}$, there is an absolutely fine granularity for each scale. An absolutely fine granularity $\rho_{\mathcal{S}}$ ('reality') defined over a scale $\mathcal{S}$ is such that:*
>
> (4.8) $$\forall s \in \mathsf{carrier}(\mathcal{S})\colon \rho_{\mathcal{S}}(s) = \{s\}$$

Note that there is only a single absolutely fine granularity function for each scale, while there are necessarily multiple granularity functions for almost all greater unit sizes. The absolutely fine granularity level is one of the two granularity levels that contains a *single* granularity function, the other being the level containing the *absolutely coarse* granularity function, which maps each point on a scale to the complete scale, i.e., it is the granularity function (and level) which is unable to make any distinctions on a scale.[12] The absolutely coarse granularity has no linguistic utility, though; it only has theoretical significance. When it is defined, it is the greatest element among the granularity functions defined over a scale with respect to the *finer than* relation, while the least element is the absolutely fine granularity.

Bearing in mind the slight superiority of granularity levels over granularity functions in attacking (though not solving) the Sorites paradox, in the discussion that follows I mostly only refer to granularity functions for the sake of simplicity unless the discussion requires explicit reference to granularity levels.

[12] Formally, though, an absolutely coarse granularity function is only defined for *bounded* scales given the characterisation of granularity functions in Section 4.1.1.

4.2 Granularity-dependent durativity and slow-motion readings

4.2.1 Granularity-induced changes in durativity

Given the right context (a context that involves what I call switching to a "fine granularity"), some non-durative predicates can be construed as describing durative events by virtue of the fact that the events in their extension are in fact not instantaneous in the physical reality. Examples include the following slow-motion readings of the progressive:

(4.9) Look at the screen, the Challenger is exploding now. (Verkuyl 1989)

(4.10) And now the subject is coughing. (Comrie 1976, p. 43, as uttered by a lecturer in an anatomy lecture commenting on a slowed down film about a single cough)

In (4.9), the event described by *explode*, which would be regarded as instantaneous at an everyday granularity, is presented as taking non-zero time at the finer granularity enforced by a slow-motion recording on television. For some predicates, a radical switch in granularity is needed for this effect, such as *cough*, which describe events that objectively take tenths of a second. In their case, more extreme settings, such as a scientific laboratory scenario is needed, as in (4.10).

Note that a switch to a finer granularity does not necessarily entail "zooming in" in the sense of, say, looking at something through a magnifier or a microscope. It merely means that differences which do not matter or are not recognised at a coarser granularity are foregrounded. Take the case of the bullet crossing a panel. A slow-motion recording thereof will not, at the same time, involve an objective magnification in space (as under a microscope), but by virtue of the slower progression of time, it becomes possible and relevant to discern spatial positions of the bullet with respect to the panel (such as the bullet entering the panel, being in the middle of it and then leaving it) inaccessible or irrelevant at a normal playback rate.

The idea that "something can be a durationless moment of time in the present context, but become an interval that has duration after all, when we shift the context to a more finegrained one" (Landman 1991, p. 138) has been recognised by several authors, but as Landman himself then pointed out, the semantic details of such context dependent granularity had never been worked out (though see Section 4.1.2.2 for a discus-

sion of some previous proposals for this or related issues), and Landman did not do so, either. The present section aims to offer a model-theoretic analysis of granularity-based durativity changes in the framework detailed in Section 4.1 building on the theory of granularity functions of Sauerland and Stateva (2007, 2011).

4.2.2 Granularity-relative temporal trace and durativity

As a crucial step in modelling durativity changes, I *relativise* the temporal trace function to granularities. We will still preserve the ability to express the classical temporal trace of an event, because we can exploit the notion of an absolutely fine granularity to this end.

Let $G_{\mathcal{T}}$ be the set of granularity functions defined over the time scale $\mathcal{T} = \langle T, <_{\mathcal{T}} \rangle$. Then the definition of a granularity-relative temporal trace function is as follows.

Definition 11 (Temporal trace function—granularity-relative)
The temporal trace function $\tau \colon G_{\mathcal{T}} \times E \to \mathsf{Int}(T)$ *is a function such that for all* $e \in E$*, if* t_1 *is the starting point of* e *in* T *and* t_2 *its final point, then the temporal trace* $\tau(\gamma, e)$ *of* e *at granularity* γ *over* $\mathcal{T}$ *is defined as the interval given by the points to which the degreeifying function maps the start and endpoint of* e *at granularity* γ*:*

$$\tau(\gamma, e) = [\mathsf{deg}(\gamma, t_1), \mathsf{deg}(\gamma, t_2)] \tag{4.11}$$

The classical notion of the temporal trace function is now captured by the notion of the absolute temporal trace function τ_ρ*, which is the temporal trace function relative to the absolutely fine granularity function* ρ *over* $\mathcal{T}$*:*

$$\tau_\rho(e) \stackrel{\text{def}}{=} \tau(\rho, e) \tag{4.12}$$

That is, the temporal trace of an event at a specific granularity is determined by the location of its start and endpoints at that particular granularity (and the absolutely fine granularity will, of course, return the actual start and endpoints themselves). Note that this granularity-relative temporal trace is a representation of the conceptualisation of the runtime of an eventuality, while the objective link between eventualities and intervals is encoded in the absolute temporal trace function.

We are now in the position to account for how granularity changes can lead to a two-faced behaviour of event predicates with respect to durativity building on the

modelling of conceptualisations of the same event under different granularities. Let $|\cdot|: \mathbb{B} \rightarrow \mathbb{R}$ from the set of all bounded intervals $\mathbb{B}$ to the set of real numbers $\mathbb{R}$ measure the length of an interval, such that for any interval $i \in \mathbb{B}$, the value of $|i|$ is given by the distance $d_S(a, b)$ between the infimum a and supremum b of i, where d_S is the metric defined over the scale S that i is part of (cf. Section 4.1.1). Then, we can have two granularities such that:

(4.13a) $$|\tau(\gamma_{\text{fine}}, e)| > 0$$

(4.13b) $$|\tau(\gamma_{\text{coarse}}, e)| = 0$$

if the following holds for the starting point t_1 and endpoint t_2 of event e:

(4.14a) $$\gamma_{\text{fine}}(t_1) \neq \gamma_{\text{fine}}(t_2)$$

(4.14b) $$\gamma_{\text{coarse}}(t_1) = \gamma_{\text{coarse}}(t_2)$$

That is, the fine granularity distinguishes between the start and endpoints of the event (i.e., maps them to different intervals), while the coarse granularity does not. Graphically, this is illustrated in Figure 4.7. Generalizing the approach to granularity *levels*,

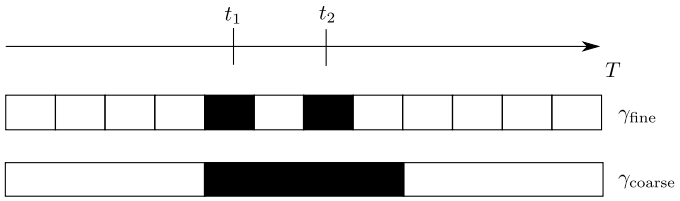

Figure 4.7: Duration switch through a granularity switch

we can say that an event e has zero duration at granularity level Γ iff there is a granularity function $\gamma \in \Gamma$, for which $|\tau(\gamma, e)| = 0$, that is, at that granularity level, some granularity function assigns zero duration to event e. Informally, an event is durative at some granularity level if and only if it is always possible to distinguish the start and endpoints of the event at that granularity level.

Then predicates describing event e behave as an accomplishment at the fine granularity γ_{fine}, and as an achievement at the coarse granularity γ_{coarse} — the two-faced behaviour we have been aiming at. In what follows, I will present how this abstract idea can be put to use in the case of concrete examples.

Instantaneous and durative readings. Kearns (1991, p. 59ff) argued that a sentence like *Just as P, Q* requires *P* to be punctual. Let us inspect this claim in some detail. If *P* is an activity, then indeed the sentence appears infelicitous:

(4.15) #Just as Mary ran/was running on the treadmill, the meeting ended.

One may wonder if it is not the atelicity of *running on the treadmill* that is responsible for infelicitousness, but an accomplishment predicate results in an equally infelicitous sentence:

(4.16) #Just as Mary read the paper, the meeting ended. (Kearns 1991)

In contrast, an achievement predicate results in a felicitous sentence:

(4.17) Just as Mary read the note, the meeting ended. (Kearns 1991)

This pattern is specific to the *Just as...* construction (as well as the *As soon as...* and *The moment that...* constructions according to Kearns 1991): as Daniel Altshuler (p.c.) noted, substituting *just as* for *while*, we arrive at a construction that requires a durative predicate, cf.:

(4.18) a. While Mary ran/was running on the treadmill, the meeting ended.
b. While Mary read the paper, the meeting ended.

On this construction, *read the note* also receives a durative interpretation, as in (4.19).

(4.19) While Mary read the note, the meeting ended.

Thus, the same predicate (*read the note*) can behave both like a durative and an instantaneous predicate, depending on the context — the two-faced behaviour cited extensively by Verkuyl (1972, 1989, 1993). But not only does a predicate like *read the note* have a potential for two-faced behaviour in different contexts, but one and the same event can be described by the same predicate under both a durative and an instantaneous interpretation. Consider the following sentence:

(4.20) Mary read the note in 5 seconds.

(4.17) and (4.20) can be made true by the same event of Mary reading the note, even though, as Kearns (1991) argues, the first clause of (4.17) has a non-durative interpretation, while the same predicate in (4.20) is used with a durative interpretation. But while the first one is evaluated at a coarse granularity at which a 5-second event is regarded as instantaneous, the granularity parameter of the second one is shifted to a finer one (due to the fine granularity introduced by the expression *5 seconds*, cf. the discussion on granularity commensurability in Section 4.1.2.2). So the clause with *Mary read the note* will have the interpretation in (4.21a) and (4.21b) for (4.17) and (4.20), respectively (irrelevant parameters of interpretation are suppressed). ∂ is the presupposition operator from Beaver (1995). I assume *just as* is responsible for the non-durativity presupposition — and so sentences such as (4.15) and (4.16) which violate this presupposition are odd.

(4.21a) $[\![\text{Mary read the note [at } t\text{]}]\!]^{\gamma_{\text{coarse}}} = \exists e[\mathsf{read}(e) \wedge \mathsf{theme}(e, \mathsf{note}) \wedge \mathsf{agent}(e, \mathsf{mary}) \wedge \tau(\gamma_{\text{coarse}}, e) = t \wedge (t <_{\mathcal{T}} \mathsf{now}) \wedge \partial(|\tau(\gamma_{\text{coarse}}, e)| = 0)]$

(4.21b) $[\![\text{Mary read the note in 5s}]\!]^{\gamma_{\text{fine}}} = \exists e[\mathsf{read}(e) \wedge \mathsf{theme}(e, \mathsf{note}) \wedge \mathsf{agent}(e, \mathsf{mary}) \wedge \tau(\gamma_{\text{fine}}, e) = t \wedge (t <_{\mathcal{T}} \mathsf{now}) \wedge \mathsf{seconds}(\tau(\gamma_{\text{fine}}, e)) = 5]$

As can be seen, the requirements on the described event are not contradictory in the case of the two sentences (since the same event might count as durative on a fine granularity, but instantaneous on a coarse one), and so the same event description can be used as a non-extended reference point in time for the clause *the meeting ended*, and modified with a duration-measuring *in*-adverbial.

The analysis above follows the idea of Kamp (1979/2013), who proposed that an instantaneous event in our model is not necessarily instantaneous in the "real world" (p. 91). But Kamp (1979/2013) achieved this by constructing a different time model for each sentence, each of which are individually connected to the real-world model of time, while there is no relation directly between the different models themselves. In contrast, on the present account, we do not need independent, arbitrarily constructed models of time, but instead, a tool with independent application potential, namely, granularity functions, is employed which produces the different models of time used in different contexts.

4.2.3 Constraining the granularity parameter and explaining slow-motion readings

Although as the foregoing discussion showed, we can successfully represent granularity-induced changes in durativity with reference to a granularity parameter of interpretation, the question arises if and how we can constrain this granularity parameter in a given case. In particular, can we predict that a coarse granularity is used in the interpretation of (4.17), but a fine one in the case of (4.20), or in the case of a slow-motion progressive like *Look at the screen, the Challenger is exploding*? The answer, I propose, is that we can, insofar as a distinction between a coarse and a fine granularity is concerned.

Take (4.20), *Mary read the note in 5 seconds*. This sentence is ambiguous between a "duration" and an "after" interpretation: what took 5 seconds is either the note-reading event itself (a reading that is highlighted given a continuation like *She is a fast reader*), or the time after which the note-reading event took place at what is conceptualized as an instant (a reading that is highlighted in a context in which a one-word note is pinned to the wall of a room, and researchers study how long it takes for different subjects to notice and read the note after entering the room). A "duration" reading arises if Mary's note-reading event in a specific scenario took 5 seconds. In this case, a fine granularity parameter is needed at which the event is extended and its temporal trace measures 5 seconds; a coarse granularity at which the event is instantaneous cannot be used to get a duration reading. In contrast, for an "after" interpretation, according to which an instantaneous note reading takes place *after* the 5-second interval, a coarse granularity is required at which the note reading event is instantaneous.

Of course, the question *exactly* how coarse or fine a granularity parameter is used in the case of the two interpretations is difficult, if not impossible, to answer. I believe that some form of *principle of economy* limits the choice of granularity. If any granularity level as coarse as or coarser than some specific granularity level, say, Γ_i is suitable to get the "after" interpretation in the case of (4.20), and no difference in the interpretation results from choosing one over the other, then the most economical decision is to use Γ_i as the parameter of interpretation. Conversely, if any granularity as fine as or finer than Γ_i is sufficient for the "duration" interpretation, then again Γ_i should be used.

Compare *read the note* with an achievement like *notice* which describes events that take much less time than note-reading events (and can be measured in hundredths of a second). (4.22) — in contrast to (4.20) — can only have an "after" interpretation,

because no matter how we choose our granularity parameter, no note-noticing event will be 5 seconds long, and so the only coherent interpretation is the "after" one.

(4.22) Mary noticed the note in 5 seconds.

Now take (4.17), *Just as Mary read the note, the meeting ended*. In this case, the *just as* construction presupposes that the note-reading event was instantaneous. Thus, if we take a *fine* granularity at which the note reading event is extended, we arrive at a presupposition failure. Therefore, the only option is to take a coarse granularity at which the endpoints of the note reading event are not distinguished and the event is thus instantaneous. This granularity would need to have a unit size of at least 5 seconds, which is a granularity level that is natural to use in everyday contexts. However, if we take the infelicitous example *#Just as Mary read the paper, the meeting ended* from Kearns (1991), and apply the same reasoning, then in order to avoid presupposition failure, the granularity parameter has to be coarse enough to have a unit size of at least an hour or so, as reading a paper takes minimally that much time. However, this is a granularity parameter that is at least an order of a magnitude coarser than those used in a natural everyday context, and so the presupposition in this case cannot be accommodated.

As for (4.23), we can again refer to a presupposition failure in constraining the granularity parameter.

(4.23) Look at the screen: the Challenger is exploding.

Given a semantics of the progressive as an operator involving partitivity over events (cf. Section 2.1.1), a reasonable applicability condition of the progressive is an input predicate denoting a set of *durative events*. Now, if *the Challenger explode*$_\emptyset$ describes events that take less than, say, half a minute, then using any granularity level with a unit size that is greater than half a minute will result in an interpretation at which the progressive applies to a predicate of instantaneous events, violating the applicability condition. However, if a fine granularity with a smaller unit size is used, then the predicate *the Challenger explode*$_\emptyset$ has events in its extension that are durative, and so the applicability condition of the progressive is satisfied. Because such a fine granularity is necessary to this end, a slow-motion interpretation results.

Given the level of the ease of accommodation of the required granularity parameter, we can also explain why some achievements are much less acceptable in the progressive: for instance, (4.24),

(4.24) #Peter is noticing Mary,

requires an extremely fine granularity level to avoid presupposition failure, one at which differences of a hundredth of a second in size are relevant, but such a fine granularity is much more difficult to accommodate in normal, everyday contexts than that required by *explode*.

In contrast to both (4.23) and (4.24), even an everyday granularity is sufficient in the case of progressive accomplishments, as in (4.25), to ensure that no presupposition failure occurs: the predicate *read a paper* denotes events that are extended at the levels of granularity used in everyday conversation.

(4.25) Mary is reading a paper.

Accomplishments and achievements. On the present framework, all predicates that apply to events which are in actual reality extended can function as either achievements or accomplishments, modulo the granularity parameter of interpretation. Of course, as we have seen in the foregoing, for some predicates, a durative interpretation requires an extremely fine granularity that is difficult to accommodate in most conversational contexts.

Following up on this idea, I propose that the way we can capture the difference between accomplishments and achievements in our framework is by appealing to the *use* of these predicates by speakers. In particular, for each predicate, we can identify a set of what we can call "normal" granularity levels such that the unit size of these granularity levels belongs to a certain range, and in most cases[13] that the predicate is used, it is interpreted with respect to some member of this set of normal granularity levels.

[13]This characterisation is deliberately vague. We could set an arbitrary threshold for what counts as "most common" usage, for instance, 95% — as is common in statistical analysis — but I believe this is a matter for experimental research.

The normal levels of granularity are of course not randomly used by language users, but must intuitively be connected to the temporal magnitude of the events denoted by a predicate (which I will discuss in somewhat more detail on 112).

Then we can say that accomplishments are those predicates that in most cases are interpreted with respect to a granularity parameter at which they denote extended events, while achievements are those which denote instantaneous events at their normal granularity parameters:

- Accomplishments are predicates of change which describe, by vast majority, durative events at the levels of granularity most commonly used in the interpretation of the predicate.
- Achievements are predicates of change which describe, by vast majority, punctual events at the levels of granularity most commonly used in the interpretation of the predicate.

This is how the view promoted by authors like Filip (1993/99) and Engelberg (2000) can be captured, who say that although it is possible to have slow-motion scenarios in which a regularly punctual predicate functions as extended, these scenarios are not common and should not be taken to invalidate the basic, typical use of these predicates, which is punctual. Crucially, the present characterisation of the difference between achievements and accomplishments entails that this difference is not inherent in their *extension*, but is a property of the *linguistic predicates* and their use by speakers. At the same time, we do not preclude scenarios in which the granularity parameter is one which is seldom used in conversation, and in such cases, the durativity feature of an event described by a predicate, and by extension, the durativity feature of the predicate itself, can change, allowing us to cater for such scenarios in a model-theoretic semantics without sacrificing the divide between achievements and accomplishments.

Summary: a granularity parameter is sufficient for slow-motion readings. The goal of the present section was to show how slow-motion readings can be modelled. The crucial components necessary for this are the introduction of granularity functions as a parameter of interpretation and the *relativisation* of the temporal trace function to granularities. In this, I have followed the advice of Janssen (1997) who proposed incorporating as a new parameter of semantics anything that appears to influence meaning and would thereby rule out a compositional semantics. In the framework presented here, we can thus answer the qualms of Kearns (1991), who, like Verkuyl (1989, 1993), argues that there are no truly durationless events (but unlike Verkuyl, would wish to retain durativity as a linguistically relevant feature), and so (linguistic) durativity is "partly a matter of »grain size«", which, she says, is a "problem [...] for truth-conditional semantics" (*op. cit.*, p. 61).

Note that the analysis of slow-motion progressive readings does not require any form of coercion in the sense that no predicate is coerced into a different predicate. The predicate *the Challenger explode*$_{\emptyset}$ denotes the *same* set of events in the scope of the progressive (as in *The Challenger is exploding*) and outside the scope of such an operator (as in e.g., *The Challenger exploded at 16:03*). What changes is a parameter of interpretation: just as speakers aim to determine the most reasonable variable assignment function to use in the interpretation of a sentence, the granularity parameter is likewise narrowed down to one which results in a reasonable interpretation. Thus, slow-motion progressives are to be analysed through *underspecification* — namely, the underspecification of a parameter of interpretation — rather than coercion. The slow-motion interpretation can be derived from the fact that choosing a coarse granularity results in a presupposition failure (failure to satisfy the applicability condition of the progressive).

Crucially, the proposed account of slow-motion readings is compatible with any event-mereological analysis of the progressive, such as those of Landman (1992), Portner (1998), Bonomi (1999) or Varasdi (2010, 2014), because the progressive has in its scope a predicate of *durative* events in felicitous cases. As the discussion in Section 2.2 indicated, however, event-mereological accounts run into problems in the case of preliminary process readings like *Mary is reaching the top*, so in the next chapter, I will argue for a semantics of the progressive which is based on an additional formal tool, the *scales of change*. On that account, I will argue that it is the scale of change, rather than events, that are required by the progressive to be extended, that is, have non-degenerate proper parts.

So in the case of slow-motion readings of progressives like *The Challenger is exploding*, it is a scale of change, rather than an event, that is required to be extended and have proper parts. But importantly, just as the temporal trace is relativised to a granularity over time, so the scale of change will also be relativised to a granularity parameter over time. And given a change to a finer granularity over time at which an event is temporally extended, the scale of change associated with an event at that granularity will also be necessarily extended. Thus, given a temporal trace-based account of slow-motion readings of progressive achievements, such readings can also be modelled in the theory of the progressive referring to scales of change. Before presenting such a scale-based account of the progressive in Chapter 5, I discuss some implications and further uses of a granularity-relative notion of temporal extendedness.

4.3 Implications of the granularity-based account of durativity

4.3.1 Durativity and vagueness

On the present approach, what we see is that there is a connection between durativity (i.e., how we conceptualise objective temporal extent), granularity, and vagueness. In particular, the temporal trace function, and hence durativity, is relativised to a granularity parameter, which is originally used in the account of *scalar vagueness* by S&S. The fact that durativity is amenable to an analysis through granularity functions indicates that it displays this kind of vagueness. Importantly, however, "being durative" is not vague in the sense a vague predicate like *tall* is, which S&S call *epistemically vague*.[14]

The difference between the two types of vagueness, according to S&S, boils down to having or not having a precise interpretation. An *epistemically vague* predicate like *heap* does not have a precise interpretation (and is thus "necessarily" vague), while a *scalar vague* expression like *6 o'clock* does, in this case, a point in time. They argue that these two kinds of vagueness should be differentiated, and accounted for using different tools. A central argument of S&S for such a division is a similar division among *approximators* (which correspond more or less to what Lasersohn 1999 calls *slack regulators*), some of which can modify epistemically vague predicates (cf. *definitely a heap*), while others can only modify scalar vague expressions (cf. *exactly 6 o'clock*, but #*exactly a heap*). What I would here like to point out is that because scalar approximators only apply to predicates whose denotations refer to a point on a scale (cf. S&S's classification of them into "end-point" and "mid-point" oriented approximators), they cannot be used to test the scalar vagueness of predicates like "be durative" whose denotations are not single degrees on a scale.

But I propose that there is a further, conceptually trivial way to linguistically test (and thus support) the distinction between scalar and epistemic vagueness, namely, using an expression which presupposes the existence of a precise interpretation. Thus,

[14] I am not sure this is a fortunate choice of terminology for these expressions, since although some authors (such as Williamson 1994) do presuppose that there is a sharp boundary for predicates like *tall*, which is simply inaccessible epistemically to speakers, this is a contentious view, some authors being of the opinion that vagueness is inherent in the objective reality (cf. e.g., Tye 1990).

the expression *strictly speaking* is compatible[15] with scalar vague predicates only (cf. (4.26a)), but not epistemic vague ones (cf. (4.26b)).[16]

(4.26) a. Strictly speaking, Anna didn't arrive at **6 o'clock** sharp, but a few seconds later, but come on, don't be nitpicking!
b. ?Strictly speaking, this isn't a **heap**, it's not big enough to be one, but come on, it nearly is, don't be nitpicking!

Assuming that natural language expressions like *instantaneous* refer to the abstract concept of durativity analysed in Section 4.2, then as (4.27) shows, durativity ("being durative") belongs to the class of scalar vague predicates: it has a precise, strict sense, but under different granularities, can have a greater "semantic halo".

(4.27) Strictly speaking, the explosion was not **instantaneous**, but it was so rapid, it felt like it happened in a moment.

So, although "being durative" is not vague in the sense of *epistemic vagueness*, i.e., not vague like *heap* or *tall*, it is vague in the sense of scalar vagueness. So we should be able to construct a chain of *Sorites paradox* reasoning, which S&S hold to be the defining characteristic of *vagueness* in general. And I propose that we can.

Say, an explosion took a hundredth of a second. It would qualify as instantaneous in an everyday scenario (i.e., it would be possible to use an *at*-adverbial in the description of the explosion, say, *The house exploded at 12:00 sharp*, while an *in*-adverbial as

[15]It is important to restrict the interpretation of *strictly speaking* to a *more precise approximator* reading in S&S's terms. That is, the reading relevant is the one which concerns the *dimension* of the scale associated with the predicate it modifies. (Similar considerations apply to *exactly*, which is a scalar approximator according to S&S, cf. *#Red wine is exactly healthy*, but they note that under negation, it patterns like an epistemic approximator, cf. *Red wine isn't exactly healthy*.) Hence the addition of "it's not big enough to be one" in (4.26b): it indicates that what is at issue is not, for instance, the shape of a pile of sand, but the *amount* of sand particles.

[16]Peter Sutton (p.c.) noted that colour terms, which are epistemic vague predicates (there is no clear borderline between, say, orange and red) appear not to fit this observation, as they can felicitously appear with *strictly speaking* on the relevant dimension-oriented reading in the following discourse:

(i) A: Strictly speaking, this is not a red cardigan, it's puce. B: Come on, don't nitpick!

I believe this is a very interesting observation which shows that colour terms are *both* epistemic vague and scalar vague predicates. As (i) shows, it is possible to truthfully assert *the cardigan is red* in one context (the everyday context that speaker B assumes) and truthfully deny that the same cardigan is red in a more fine-grained context (the context that speaker A assumes). This is precisely the essence of scalar vagueness.

in *The house exploded in a minute* would not measure the duration of the event). If another explosion also took place which took just a millisecond longer, it would then still qualify as instantaneous (because a millisecond difference in length constitutes an *indistinguishability relation* between runtimes on an everyday scenario). But then taking a chain of events which are successively 1 ms longer than their predecessor, we can arrive at an explosion which took a minute, which would not qualify as instantaneous in a context in which 1-minute intervals are seen as extended: in this context, the *in*-adverbial in the description *The house exploded in a minute* would measure out the *duration* of this minute-long event, and an *at*-adverbial could at most refer to the beginning of the explosion (on the *punctual temporal focus* reading of Taylor 1988). But, just as in the case of a Sorites paradox in general, it is impossible to determine the cut-off point between events which are durative and those which are not.[17]

4.3.2 Endpoints and vagueness

An additional advantage of introducing granularity-relative temporal traces is that it now becomes possible to have the temporal trace of certain events be defined only at certain granularities. Then we can account for the vagueness of the location of the endpoints associated with many (perhaps all) eventualities. For instance, if John wrote a letter to Mary, then when exactly did the letter-writing event start (and, similarly, end)? When John started writing the very first character on the paper? Or at the moment he picked up his pen perhaps? But when did *that* event start? At the moment his fingers touched the pen? Or when his brain fired the first neuron which led to the grabbing movement? Such lines of argumentation could go on potentially indefinitely and there appears to be no objective criterion of delineation.

Similarly, Engelberg (2000) noted in passing that in sentences like the following "we cannot determine the temporal boundaries of the events referred to very precisely".

(4.28) a. This year Jamaal broke his close ties with the Detroit Pistons.
b. Rebecca managed to break the deadlock.

Thus, the temporal boundaries of an event are vague just as the boundaries between tall and non-tall people, or between heaps and collections of grains not big enough to

[17] Note that, as mentioned above, this is a higher-order vagueness that the present account of granularity cannot capture, similar to other classical accounts of vagueness: since the MDI is precise, this will define the boundary of durative and non-durative events.

be heaps. This is problematic in a classical event-semantic framework such as Krifka (1992) on which predicates denote sets of eventualities and the temporal trace function maps an eventuality to a time interval. Time intervals are convex subsets of the set of time points, and in the case of bounded time intervals, their supremum and infimum is of course a single time point. This means that the boundaries (the supremum and the infimum) of the temporal traces of bounded events are sharp down to time points. This problem has not, to my knowledge, received any real attention in previous works, and the (classical) temporal trace function is simply taken for granted as specifying the runtime of any event.

A granularity-relative temporal trace provides a formal solution to the problem of vague event boundaries. The only assumption we need is that there may be a minimal granularity function or level in terms of the finer-than ordering over granularity functions and levels for each event such that the temporal trace of the event is not defined under that particular granularity.

> **Definition 12 (Maximally precise temporal trace)**
> *For each event e, there is a granularity function $\gamma \in G_{\mathcal{T}}$ over time such that for all granularity functions $\gamma' \in G_{\mathcal{T}}$ over time, $\tau(\gamma', e)$ is defined iff $\gamma \preceq \gamma'$ (that is, γ is at least as fine as γ'), with γ possibly but not necessarily being the absolutely fine granularity ρ over time. $\tau(\gamma, e)$ is called the* maximally precise temporal trace *of e.*

If γ is not the absolutely fine granularity ρ, then $\tau(\gamma', e)$ is not defined for granularity functions finer than γ. Suppose that $\tau(\gamma, e) = [t_1, t_2]$. Then for any strictly finer granularity γ', there will be more than one $t, t' \in T$ such that $\mathsf{deg}(\gamma', t) \neq \mathsf{deg}(\gamma', t')$, but $\mathsf{deg}(\gamma, t) = \mathsf{deg}(\gamma, t') = t_1$. That is, the t_1 degree of granularity γ will correspond to more than one point at the finer granularity γ', and so there is no principled way to select one over the other as the starting point of e at γ' (and a similar case can be made for t_2). Figure 4.8 provides an illustration.

As an example, take an event of Mary walking to the station from her house. We can now say that the temporal trace of this event is defined at a granularity level with, say, minute-long units, but it is definitely not defined at a granularity level with microsecond-long units. Thus, it makes no sense to ask at which microsecond exactly did Mary's walk to the station start.

Of course, assuming such a maximally precise temporal trace as in Definition 12 dedicates us to a non-classical logic with truth value gaps, since sentences like those in (4.28) then do not have a truth value with some fine granularity parameters of inter-

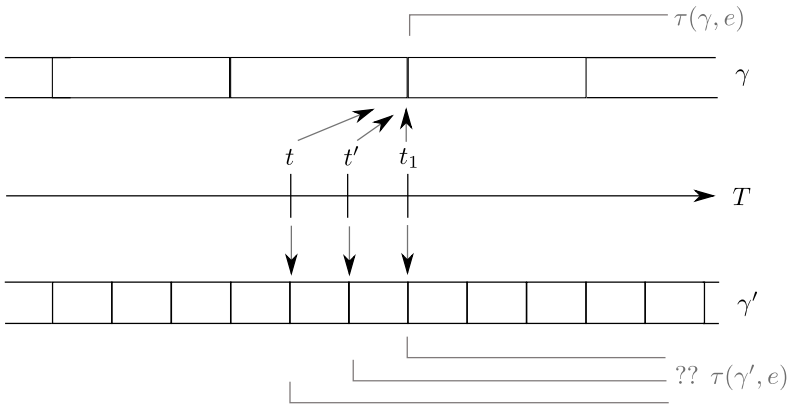

Figure 4.8: γ as the granularity of the maximally precise temporal trace.

pretation. Those who wish to retain classical two-valued logic can disregard Definition 12, and continue to assume that any sentence has a truth value at any granularity level. But I find such truth-value gaps welcome, because this is exactly what captures the fact that it does not make sense of talk about when events described by sentences like those in (4.28) started to the exact nanosecond.

We can generalize the notion of the granularity used in the maximally precise temporal trace of an event to event predicates. We could say that a maximally precise granularity function associated with an event predicate φ with extension $\{e_1, e_2, e_3, \dots\}$ is a granularity function γ_i which is the granularity function of a maximally precise temporal trace of some e_i in the extension of φ, and no other granularity function γ_j of a maximally precise temporal trace of some e_j in the extension of φ is finer than γ_i. Thus, for instance, granularity functions with a microsecond unit cannot be used in the interpretation of a predicate like *walk to the station*.

This way, we now also have a means to explain why there is a discrepancy between the assertability of the progressive form of accomplishments and of achievements describing their culmination. As Hana Filip (p.c.) noted, although *arrive at the station* can describe the culmination of *walk to the station* (cf. the entailment from *Mary walked to the station* $\Rightarrow$ *Mary arrived at the station*), only *Mary is arriving at the station*, but not *Mary is walking to the station* can be asserted at the point when Mary is just reaching for the handle of the door to the station. Because the temporal trace of events described by *arrive at the station* is by several magnitudes shorter than that of those described by *walk to the station*, it makes sense to suppose that the finest granularity that can be used in the interpretation of the former is much finer than that used for the latter. Thus, while small differences at the culmination point (being near the station)

will be distinguishable when talking about arrivals, those very same differences are undefined and indistinguishable when talking about walkings to the station. Thus, it does not make sense to ask whether Mary has strictly speaking walked to the station or is still in the process of walking when she is reaching for the handle of the station door, but it does make sense to ask if she has strictly speaking arrived at the station or is still in the process of arrival.

However, a philosophical issue must be noted at this point. The granularity-relative temporal trace is meant to capture the different possible *conceptualisations* of the temporal boundaries of an event. But if we can restrict the temporal trace to granularity parameters above a granularity that is not the absolutely fine granularity ρ, then what have said about the physical reality? After all, given the realist approach that I endorse (cf. Section 3.3.1), there are actually events, and these must have a runtime, since (at least many) events are spatio-temporally located entities. Should this not entail that the temporal trace of all events is defined at the absolutely fine granularity?

There are several options left open for us to say about objective reality, just as in the case of vagueness in general (cf. Merricks 2001 or Sorensen 2013 for a discussion). We can say, as in Definition 11, that $\tau(\rho, e)$ is defined for each e, and adjust Definition 12 in a way that it specifies a maximally precise temporal trace that is *accessible* to human agents. This would correspond to an *epistemicist* approach to vagueness (according to which there is a sharp boundary between, say, individuals that are children and those that are adults, and we are simply ignorant of this boundary). Alternatively, we can accept that vagueness, including the vagueness of the boundaries of events, is objective and there is in fact no sharp boundary. In this case, we can model the objective runtime of an event with its maximally precise temporal trace according to Definition 12. Since in formal semantics, a modelling of the durativity of predicates is what is at issue, for which the granularity-relative notion of temporal trace of events is what is relevant rather than the objective runtime of events (given that we can describe objectively extended events with instantaneous predicates), I put this philosophical question aside.

4.3.3 Minimal parts and granularity

4.3.3.1 What is the minimal parts issue?

Based on ideas going back to at least Aristotle (cf. his Nicomachean Ethics, 1174a), states and activities are held to be *(sub)divisible*, that is, if they are true at a given inter-

val, then they are true at every subinterval thereof (cf. e.g., Vendler 1957, Bennett and Partee 1972, Dowty 1979, Bach 1981, Verkuyl 1989, Krifka 1989, Rothstein 2004). This is formally captured through the second-order property of *subdivisibility* (aka *divisive reference* as in Krifka 1989, or in an interval-based rather than event-semantic framework, the *subinterval property* as in Bennett and Partee 1972) defined formally in an event semantic framework as in Definition 13.

> **Definition 13 (Subdivisibility (aka divisive reference) (Krifka 1989, a.o.))**
> *A predicate P is* subdivisible *(has* divisive reference*) iff* $\forall x, y(P(x) \wedge y \sqsubset_E x \rightarrow P(y))$*, where $\sqsubset_E$ is the strict mereological part-of relation over eventualities.*

In words, a predicate is subdivisible iff it applies to all the parts of an entity it applies to. Informally, any part of a running is also a running, but not all parts of running to the window are themselves a running to the window.

Note that some authors, such as Vendler (1957), Taylor (1977), Verkuyl (1989), Lascarides (1991), Link (1998, Ch. 8), Rothstein (2004), Zwarts (2005) or Winter (2006), use the term *homogeneity* — either in informal terms or by giving a formal definition as well — to express that a predicate applies to all parts of an individual or an interval that the predicate applies to, i.e., for the property of subdivisibility. However, *homogeneity* stands more generally, as in, e.g., Link (1983), Moltmann (1991), Piñón (1997), Filip (2000), Arche (2014), for the complex property of subdivisibility *and* cumulativity, where a predicate P is cumulative iff $\forall x, y(P(x) \wedge P(y) \rightarrow P(x \sqcup y))$ where $x \sqcup y$ is the event that is the join of x and y. This latter use is the one consistent with the terminology used in works on the mass/count distinction in the nominal domain (e.g., ter Meulen 1981, Bunt 1985, Pelletier and Schubert 2003) for which domain these terms were originally introduced (again, building on ideas of Aristotle, cf. his On Generation and Corruption), though the term "homogeneity" is also used ambiguously in the literature on the mass/count distinction (cf. Nicolas 2014, fn. 13).

A crucial difference between states and activities is that subdivisibility is too strong a property for the characterisation of activities: for instance, "there are parts of running events which are just too small to count as events of running" (Rothstein 2004, p. 11). It is therefore a weaker assumption that most authors today (since at least Taylor 1977, Dowty 1979) subscribe to, namely that there is a non-zero lower bound on the size of events in the extension of an activity predicate. E.g., waltzing is not true of events involving less than three steps, running is not assumed to be true of just a single step, and similar considerations apply to all activities.

Thus, the received view today is that while states have divisive reference, activities are subdivisible only "down to some small intervals that are necessary to make the predicate true" (von Stechow 2009b). This issue affects the semantics of several constructions. For instance, temporal *for*-adverbials are often assumed to involve universal quantification over an interval, but because of the minimal parts feature of activities, quantification needs to be restricted to a set of contextually given relevant subintervals (cf. Dowty 1979, Moltmann 1991, Zucchi and White 2001).

The minimal parts issue is also a problem for many scale-based approaches to telicity. For instance, on Hay et al.'s (1999) account, telicity corresponds to a non-zero lower bound over the amount of change required by a predicate, while atelicity to an absence of such bound. As such, for activities, this view assumes that *any* amount of change satisfies the relevant predicate, i.e., even one step taken toward the bank should qualify as walking toward the bank, for instance. This correctly captures the intuitive idea about activities that these "are realized as soon as they begin" (Garey 1957, p. 106), but runs into the minimal parts problem. The problem that minimal parts pose also affects a scale-based approach (e.g., Beavers 2010) on which activities require a change to an unspecified degree, i.e., approaches assuming *existentially bound target degrees* for activities: if any degree as a target degree can satisfy the predicate, then, again, even one step toward the bank should count as walking toward the bank. So in order to assume some such scale-based account of activities, one needs to ensure that not any amount of change (say, one step) count as *change* (with respect to, say, walking) in a given context.

4.3.3.2 Previous accounts

Several solutions have been proposed for the minimal parts problem of activities, many of which exploit some form of restriction on parthood. Moltmann (1991), for example, restricts quantification over parts to contextually relevant parts through the notion of a *contextually specified part-of relation*. Moltmann (1991) therefore uses distinct part-of relations, since her contextually restricted parthood "has to be understood not as a part relation in a strict mereological sense, but rather as a contextually determined relation that may be coarser than the mereological part relation, as the relation 'is relevant part of'" (p. 633). Positing two different notions of parthood is a formally acceptable way of approaching the minimal parts problem. Indeed, such as solution has been adopted even in bioinformatics to tackle a minimal parts-like puzzle: Rec-

tor et al. (2005) introduced a transitive *determinate parthood* relation and an intransitive *granular parthood* relation in their semantics.

The drawback of such an approach is that the 'relevant part of' relation "lacks strict formal properties such as transitivity and closure" (Moltmann 1991, p. 633), which makes it more unconstrained than using the familiar mereological part-of relation with its well-known formal properties. Thus, while this is a valid approach, it would be better if we could keep in check the parameters of parthood that can vary across different contexts in contrast to simply using a contextually determined parthood relation as such. To bring an analogy, Deo (2009, p. 503) argued her account of the imperfective relying on a *contextually given minimal interval* is more advantageous over one simply restricting the domain of a universal quantifier, because "the context does not directly provide a set of relevant events or intervals, but rather places a condition on the length of the intervals quantified over by the universal". Like Deo (2009) in her analysis of the imperfective, I also believe that the only parameter of parthood that is needed to vary to account for the minimal parts problem is the *size* of the accessible parts.

The closest forerunner of what I will propose is Link (1998, Ch. 12), who introduced the notion of a *temporal granularity parameter of a type* θ, which is the minimal amount of time required for a process to evolve in such a way that it can count as θ (say, *walking*). He then restricted the homogeneity requirement on activities to subprocesses whose temporal trace exceeds the length of the temporal granularity parameter of the relevant type. I will adopt such a restriction on the subdivisibility (homogeneity) requirement in Section 4.3.3.4, but couched in a more general theory of granularity. In particular, my goal in this section is a generalization of Link's (1998) proposal, *decomposing* his notion of a temporal granularity parameter (a primitive) into the minimally distinguishable unit of time at the most precise one of the granularity levels used most frequently in the interpretation of a predicate. The advantage of this decomposition is that the "granularity parameter" I adopt from Sauerland and Stateva (2007, 2011) (which as a parameter of interpretation should not be confused with Link's (1998) "granularity parameter") has applications in the analysis of other phenomena.

There were other authors after Link (1998) who restricted subdivisibility to a specific (or a non-specific) interval. Winter (2006), for example, introduced the property of *weak downward monotonicity* as characterizing activity predicates. For Winter, *John walked between 2pm and 4pm* is true if *there is* a proper subinterval I' of $[2{:}00, 4{:}00]$ such that John walked in all the subintervals I'' that satisfy $I' \subset I'' \subseteq [2{:}00, 4{:}00]$. However, existential quantification may be too weak a requirement: for instance, *John ate at least 3 sandwiches between 2pm and 4pm* can also satisfy the weak downward

monotonicity given an event of John eating 4 sandwiches between 2pm and 4pm, but this predicate this telic, not an activity (cf. Filip 2000 for the problem these kind of sentences pose for quantization-based approaches to telicity).

A similar proposal is the *stratified reference* of Champollion (2010), who builds his account on a function ε determining if some measurable entity counts as *small* given some specific measure. For instance, $\varepsilon(\lambda t[\mathsf{hours}(t) = 1])(t')$ holds iff t' counts as "very small" with respect to one hour. In what follows, I inspect Champollion's (2010) account in more detail.

4.3.3.3 *for*-adverbials

I believe a shortcoming of the account of Champollion (2010) is the lack of connection between the activity predicate and the unit size which supplies the parts accessible for quantification in a particular case.

The goal of Champollion (2010) is to offer a uniform account of the minimal parts problem and an explanation of why *for*-adverbials can be used in the dimension of time and space (cf. *The crack widened for 5 meters*), but not speed or temperature (cf. **John drove for thirty miles an hour* and **The soup boiled for 100 degrees Celsius*). He argues that previous explanations of the latter phenomenon in terms of extensive measure functions (e.g., Krifka 1998) or monotonic properties (e.g., Schwarzschild 2002) are insufficient, as is a requirement of the subinterval property for atelics in light of the minimal parts problem.

Champollion (2010) links admissibility of *for*-modification to the availability of pseudopartitive constructions (*five hours of talks*, *five miles of railroad tracks*, but **five miles an hour of driving*, **five degrees Celsius of water*), which, he argues, have the same requirement as *for*-adverbials. However, I am doubtful that this parallel is entirely exact. Dimensions like weight and volume allow pseudopartitives, as the examples *five pounds of rice* and *five litres of water* of Champollion himself show. But these, to my knowledge, do not allow *for*-adverbials:

(4.29) a. *John dieted for five pounds.
b. *John poured (water) for five litres.

This indicates that *for*-adverbials and pseudopartitives do not have the same requirements, *pace* Champollion (2010). This is only important for our purposes inasmuch as one of the most compelling features of Champollion's (2010) account is the explana-

tion of different linguistic phenomena with the same tools. But if, as it appears, the parallel between these phenomena breaks down, then it is not a disadvantage for an alternative account of, say, the minimal parts not to have an explanation for all of these diverse facts.

But let us inspect Champollion's (2010) proposal for *for*-adverbials. According to Champollion, *for*-adverbials presuppose *stratified reference*, not the subinterval property. To reproduce here his example, the predicate *waltz* has stratified reference with respect to dimension τ and granularity $\varepsilon(\lambda t[\mathsf{hours}(t) = 1])$ iff the following holds ('*' is the "plural predicate" star operator of Link (1983) that operates on a one-place predicate P and generates all the individual sums of members of the extension of P; and W stands for the predicate described by *waltz*):

(4.30) $\forall e\Big(W(e) \rightarrow e \in {}^*\lambda e'\big(W(e') \wedge \varepsilon(\lambda t[\mathsf{hours}(t) = 1])(\tau(e'))\big)\Big)$

In words, he puts this as follows: every waltzing event consists of waltzing subevents whose runtimes are very small compared to an hour. This is the presupposition of *waltz for an hour*. But consider now the following sentence:

(4.31) John waltzed for just half a minute (and then tripped, so, red-faced, he left the ballroom).

On the theory of Champollion (2010), this sentence would have the following presupposition (cf. (4.30)):

(4.32) $\forall e\Big(W(e) \rightarrow e \in {}^*\lambda e'\big(W(e') \wedge \varepsilon(\lambda t[\mathsf{minutes}(t) = 0.5])(\tau(e'))\big)\Big)$

(4.32) says that every waltzing event is made up of waltzing subevents whose runtimes are very small compared to half a minute. Suppose that waltzing events can be of 3 seconds in length, roughly the time it takes to perform three steps. (Note that nothing hinges on what specific length we consider for the purposes of the argumentation.) Therefore, intervals of 3 seconds should count as "very small" with respect to half a minute, because (4.32) requires that *all* waltzing events be made up of very small waltzing-events with respect to half a minute, i.e., including the 3-second waltzing events. But then if waltzing events are allowed to last 3 seconds, then it should be possible to utter the following:

(4.33) John waltzed for just 3 seconds (and then tripped, so, red-faced, he left the ballroom).

But this, in turn, would be required to have the following presupposition:

(4.34) $\forall e[W(e) \rightarrow e \in {}^*\lambda e' \, (W(e') \wedge \varepsilon(\lambda t[\mathsf{seconds}(t) = 3])(\tau(e')))$

This requirement says that every waltzing event is made up of waltzing subevents whose runtimes are very small compared to 3 seconds. This, however, is not satisfied by *waltz*, since waltzings cannot be made up of waltzing parts that are radically shorter then 3 seconds. This is a general algorithm to produce examples problematic for Champollion's (2010) account: since his analysis only takes the *for*-adverbial into account, by setting the *for*-adverbial to correspond to recursively smaller and smaller interval sizes allowed by the stratified reference requirement, after while, the resulting presupposition will (incorrectly) not be satisfied.

4.3.3.4 Minimal parts and minimally distinguishable intervals

Given the above recursive algorithm to produce a counterargument for an analysis of the minimal parts problem relying on a specific measure that is not dependent on the predicate, the advantage of Link's (1998) account, I believe, is that the minimal size of events available for quantification is relativised to predicates. However, instead of using Link's (1998, Ch. 12) dedicated function directly specifying a minimal interval size for a predicate, the tools adopted in Section 4.2 for an account of temporal extendedness are sufficient for an account of the minimal parts problem, as well.

Recall that temporal extendedness in the account proposed in Section 4.2 is relative to a granularity parameter of interpretation and extended parts of an event can only be at least as long as the MDI of the granularity parameter. I therefore propose that the subdivisibility requirement should apply to activity predicates down to the parts which are extended at a normal level of granularity associated with the predicate, where a "normal" level of granularity is used in the sense discussed on page 95 — namely, these are the set of granularities with a unit size belonging to a given range such that in most cases when the relevant predicate is used, some member of this set of normal granularities is used.

The subdivisibility requirement of activities could then be modified as follows, building on Link (1998):

> **Principle 1 (Subdivisibility down to granularity-relative extended parts)**
> *Let P be an activity predicate. Take granularity level Γ_m from the set of normal granularities used in the interpretation of a predicate P for which there is no finer granularity within this set. For any part e_i of any eventuality in the extension of P, P must apply to e_i if e_i is extended at Γ_m.*

Note that this is not simply a restatement of the problem: the problem of minimal parts is that there is a lower bound on the *size* of events that can fall under an activity predicate, say, *walk toward the bank*. Principle 1 instead claims that an activity, say, *walk toward the bank*, applies to *any* subevent of an event it applies to if the subevent is extended at the finest granularity level in the set of normal granularities associated with the predicate. The size of the subevents down to which subdivisibility is required is encoded in an independently required parameter, the set of normal granularity functions associated with a predicate.

So, for example, *John ran for a while* is evaluated in 95% of the cases with respect to a granularity level in $\{\Gamma_1, \Gamma_2, \ldots, \Gamma_n\}$ over time, the finest one of which is Γ_m, with a unit size of, say, 5 seconds. In order for *John run*$_\emptyset$ to qualify as an activity, it has to be subdivisible down to extended parts at Γ_m. So all parts of an event of John running that are accessible as extended parts at Γ_m should be events of John running. And indeed, all parts of John running greater than 5 seconds are events of John running, so subdivisibility is satisfied. At the same time, the event of John running still has parts smaller than 5 seconds, but they are only accessible for quantification when switching to a granularity finer than Γ_m.

The account of the minimal parts problem proposed here bears some connection to the solution that Chierchia (2010) put forth for the nominal domain, inasmuch as it employs a tool originally introduced for the analysis of *vagueness*. Chierchia uses supervaluations, and proposes to analyse the difference between count and mass terms and still retain the idea of the existence of minimal parts (atoms) in a given context by treating the predicate "be an atom" as vague. The present account achieves a similar result via the use of granularity functions also originally proposed by Sauerland and Stateva (2007, 2011) for analysing what they call scalar vague predicates — without, however, being dedicated to the vagueness of the notion of an "extended part" (at least not to its being *epistemically* vague, cf. Section 4.3.1).

***for*-adverbials revisited.** On the present account, the size of the minimal parts of an activity is dependent on a normal granularity parameter (which is dependent on the predicate), rather than the granularity parameter used in the interpretation of a sentence (which is dependent on a number of things including the relevant predicate, the *for*-adverbial, other linguistic components, and the context). All we need of a *for*-adverbial is the usual requirement (in particular, presupposition) of the subdivisibility (but in the sense of Principle 1) of the predicate it modifies. Given this presupposition, *for*-adverbials do not need to have a universal quantificational analysis, but can be assumed to have the same asserted content as *in*-adverbials, namely, an event duration measuring interpretation. So the asserted content of (4.31) and (4.33) at granularity γ is as follows, respectively:

(4.35) a. $\exists e \exists t(W(e) \wedge \tau(\gamma, e) = t \wedge (t <_\mathcal{T} \mathsf{now}) \wedge \mathsf{minutes}(t) = 0.5)$
b. $\exists e \exists t(W(e) \wedge \tau(\gamma, e) = t \wedge (t <_\mathcal{T} \mathsf{now}) \wedge \mathsf{seconds}(t) = 3)$

The universal quantification over proper parts follows from the subdivisibility of predicates admissible for modification by a *for*-adverbial. Assume that the unit size of the finest normal granularity Γ_m associated with *waltz* is 3 seconds. If *John waltzed for half a minute* is true, then he was also waltzing during each substantially great (i.e., minimally 3-second) part of the 30-second waltzing event. At the same time, *John waltzed for 3 seconds* can be true of an event, while it is not required to be true of smaller parts of that event, since subdivisibility only requires *John waltz* to be true down to the extended parts of waltzings at the normal granularity Γ_m of *waltz*, i.e., down to 3 second-long parts. (Note that this view is compatible with *waltz* being true of events shorter than 3 seconds: it is simply not *required* to be true of such events.) Making the requirement of the *for*-adverbial refer to the set of normal granularities associated with a predicate precludes the application of the recursive step of requiring smaller and smaller minimal sizes.

Open questions. Of course, it should be emphasized that this is by far not an exhaustive account of the minimal parts problem. For example, it suffers from a problem of sharp boundaries similar to that faced by many accounts of vague predicates, including supervaluations, scale-based approaches to gradable predicates like that of Kennedy (2007), and also granularity functions themselves (cf. Section 4.1.2). Given that we can always identify the smallest unit among those defined by the normal granularities associated with a predicate, I (just like Link 1998) predict that there is a specific interval size for each predicate such that the predicate is required to hold of subevents

down to that size. Importantly though, the subdivisibility requirement does not preclude the possibility that the predicate can apply to shorter events, it merely does not require it.

A further open question is how exactly the set of normal granularities come to be associated with a predicate, that is, *why* speakers use in the interpretation of a specific predicate by vast majority some granularity level whose unit size belongs to a limited range. This question is especially pertinent given that the minimal parts problem is not merely a linguistic issue, it is also an ontological one, and the present approach to this problem relies on the language use of speakers through reference to normal granularities. However, which contexts the speakers use a predicate in is dependent on its extension, and more specifically, it seems plausible to assume that the granularity parameters used most in the interpretation of a predicate are dependent on the size of the events in its extension.

A number of authors (e.g., Vanden Wyngaerd 2001, Tatevosov 2008) have argued for the need to associate some measure of an average, typical runtime with eventuality predicates. And once we accept that predicates are associated with a measure (of temporal duration), then they should be like any other measure expressions, and be associated with increasingly coarser granularities at measures of increasingly greater magnitude (for instance, *one million* is generally interpreted less precisely that *one hundred*). This is rooted in *Weber's law*, an influential principle of psychology, according to which the size of the difference threshold for measurable categories is proportional to their original size (to illustrate it with an example from Fults 2011, 7 and 8 are discriminated more or less as easily as 70 and 80, or as 700 and 800).

This psychological principle predicts that predicates with a significantly greater average runtime (such as *a planet cool*$_{\emptyset}$) tend to be interpreted at a coarser granularity. This seems to be borne out: for instance, in a narrative discourse, the time-lag tolerated between events described by the two sentences of the discourse (which intuitively is related to the *unit* of the granularity parameter of interpretation) is greater given predicates with substantially greater average runtime (cf. (4.36a)–(4.36b), but also examples by Dowty 1986, p. 46ff and Link 1998, p. 255).

(4.36) a. Susan walked in. Peter left.
b. The Earth cooled. The oceans formed.

I believe that what the "normal" granularities associated with a predicate are is a matter of study for psychology rather than semantics. In this, I side with Dowty (1986),

who remarked that what counts as "immediately after" is "only determined by the hearer's understanding of the nature of events being described in the narrative, the overall degree of detail in which events are being described, and common knowledge about the usual temporal relationships among events" (*op. cit.*, p. 47).

What I wished to show here instead is that we can attack the problem of minimal parts with tools we need in our semantics in any case, and so we do not require additional tools (such as weak downward monotonicity) for specifically the minimal parts problem.

Chapter 5

PRELIMINARY PROCESS INTERPRETATIONS

This chapter offers a semantic analysis of the progressive in a novel scale-based framework with the goal of deriving the correct interpretations for progressive achievements. I first present a novel conception of the scale of change as a series of snapshot characterisations describing the change that is relevant in a discourse context, and introduce some auxiliary notions including cover events and primary and secondary scales of change. This forms the basis for a scale-based characterisation of aspectual classes, and a novel scale-based definition of the progressive. In the bulk of the chapter, I concentrate on preliminary process interpretations, and show how the unique behaviour of progressive culmination-achievements can be explained. The chapter will be concluded with a brief look at how the counterparts of the progressive in some languages other than English can be captured by varying some parts of the definition of the progressive.

5.1 Scales of change

As foreshadowed in Chapter 2, given the problems faced by different event semantic analyses of progressive culminations, I propose to omit reference to events in the extension of the input predicate of the progressive and offer a semantics of the progressive such that its truth conditions depend on *scales of change*, instead. As noted in Section 2.3, the range of predicates associated with a scale in previous scale-based theories of aspect does not fully correspond to those that are admissible in the progressive (e.g., *watch TV* or *rain* is not associated with a scale on any previous account, but they are felicitous in the progressive). This means that a novel conception of a "scale

of change" is necessary if we want to relativise the truth conditions of the progressive to it, one which is more general and applies to all the predicates that can appear in the progressive. Also, my goal is to have scale mereology take the place of event mereology in the semantics of the progressive, but this means that a scale of change needs to be associated directly with eventualities and not only predicates, so that it is possible to express the condition that the scale of an ongoing eventuality is *part* of the scale of the predicate argument of the progressive operator. Thus, I need a notion of a scale of change that is essentially a perspective over an eventuality, and then generalize this notion to predicates based on the scales of change associated with eventualities in the extension of the predicate.

As a crucial further step, I need to model the dual-faced nature of culminations like *arrive*, which behave similarly to happenings in combination with temporal adverbials and other modifiers, but are, unlike happenings, felicitous in the progressive. The way this can be achieved in a scale-based framework is to associate them with *two* kinds of scales, one of which are the scales associated with events in the extension of the relevant culmination predicate, and a second kind which are the scales associated with events of *gradual change* that culminate in events in its extension. That is, a novel idea is to have a dual scale-based characterisation of a predicate, where one type of scale characterises its inherent properties (or asserted change), and the second type its relational properties (or presupposed change). The goal of this section is to introduce the above ingredients of the scale-based theory of aspect that will be employed in a new analysis of the progressive.

5.1.1 The scale of change as a series of snapshot characterisations

There are a number of different ways to implement an idea in a specific formalism.[1] The framework to be presented here—building primarily on the work of Beavers (2002, 2008, 2011, 2012, 2013), but still radically departing from it—lends itself well to accounting for the semantics of the progressive, but there are several possible alternative ways of formalizing the ideas presented here, the choice among which should be determined by a study of further phenomena.

Recall from the discussion in Section 2.3.2.4 that the framework I need has to be much more general than that of Beavers, applying to all predicates (with the possible exception of non-temporary, individual-level predicates which Klein 1994 calls 0-state

[1]For instance, Beavers (2002, 2008, 2011, 2013) uses different formalisations of his framework, sometimes (as in Beavers 2013) even within a single paper.

predicates like *2 plus 2 is 4* or *be a mammal*). Thus, as a radical departure from former scale-based accounts, I assume that the *scale of change* does not correspond to an incremental argument, but is simply a series of sets of states. Given that non-scalar predicates like *watch TV* and *rain* cannot be uniformly and uniquely characterised with a series of states, I also depart from former scale-based accounts in assuming a "bottom-up" framework. In particular, I assume that a scale of change is defined for an *eventuality*, rather than directly for a predicate.

To this end, I draw on the concept of a *perspective* over a situation from Asher (1992) (cf. Section 2.2.5): a scale of change for an eventuality is a series of degrees capturing the change associated with an eventuality relevant in a discourse context. Where I depart from Asher's (1992) notion of a perspective is that

i) instead of characterising a complete eventuality or situation as a *whole*, I characterise different temporal parts of the eventuality (as well as intervals directly preceding or following it) separately, drawing on the scalar tradition of modelling aspect, and

ii) instead of using *propositions* to describe the contextually relevant aspects of an eventuality, I use sets of states (i.e., predicate extensions), though this is a purely arbitrary decision based on the idea that using a set of states instead of propositions to characterise event stages is closer in spirit to the event semantic framework I adopt. But every formal definition in what follows can be adapted to an approach closer to that of Asher (1992) on which the degrees of a scale of change are propositions.

In sum, in the present framework, a degree of a scale of change is a set of states which captures the contextually relevant properties of a particular "snapshot" of the relevant eventuality. In essence, the scale of change can be seen as a "scalarized perspective" over a situation, a perspective with temporal distinctions.

For the sake of illustration, we can conceive of a scale of change as a *film*: just as a film in fact consists of individual snapshots, i.e., frames or photos, which capture one static stage of the happening in the film, a scale of change consists of snapshots, i.e., sets of states, which capture one static stage of the ongoing change. But just as there are a number of things we are left in the dark about when watching a film (such as what the far side of objects in the film looks like), so the scale of change disregards certain properties of a particular event and only encodes the properties that are relevant in a given context.

And just as different films can be made about the same event depending on the goals of the director, the same event can be associated with different scales of change in different discourse contexts, depending on the goals of the interlocutors. To take an example, the same event of a game of chess can be presented as the winning party winning or as the losing party losing depending on the *focus* of the film or the discourse. This indicates close ties of the present proposal with theories of discourse coherence and attention — in fact, a connection between theories of discourse coherence and film directing has been recently proposed by Cumming et al. (2014), which indicates that there may be a deeper logical connection between discourse coherence, agent goals, the scale of change as a "scalarized perspective" over situations (and also the progressive, which I will analyse in terms of these scalarized perspectives), and the film analogy above.

Formally, the scale of change is defined as follows.[2] (Note that the granularity argument of $\sigma_{c,w}$ is a granularity function over the *time scale*, and not the scale of change itself.)

> **Definition 14 (Scale of change (of an eventuality))**
> $\sigma_{c,w} : G_{\mathcal{T}} \times E \to \mathbb{S}_{\mathsf{stat}}$ *assigns, for a context* $c \in C$ *and world* $w \in W$*, the* scale of change *to an eventuality at a particular granularity, where* $G_{\mathcal{T}}$ *is the set of all granularity functions over the time scale* $\mathcal{T}$*,* E *is the set of all events and* $\mathbb{S}_{\mathsf{stat}}$ *is the set of all scales whose degrees are sets of states.*

For example, the scale of change assigned to an event of John's walking to the station in a particular discourse context can consist of sets $d, d', d'' \ldots$ of states such that John has a specific proximity to the station in each state, with this proximity being greater in states in higher degrees of the scale, as illustrated graphically in Figure 5.1.

In a different discourse context, the same event may be associated with a different scale of change. The predicate used to describe the event is usually one of the key factors influencing which aspects, which properties of the event are relevant, but it is not the sole factor. For instance, when uttering *John walked to the station* in reply to the question, *Did John get any exercise at all today?*, then arguably the relevant aspect of the change going on during the walking event is the number of steps John took or perhaps the number of calories he burned as the event progressed.

[2] The decision to have the context and the world parameters as indices rather than as arguments of σ is based purely on considerations of simplicity and relevance: these two parameters will not be as important when talking about scales of change.

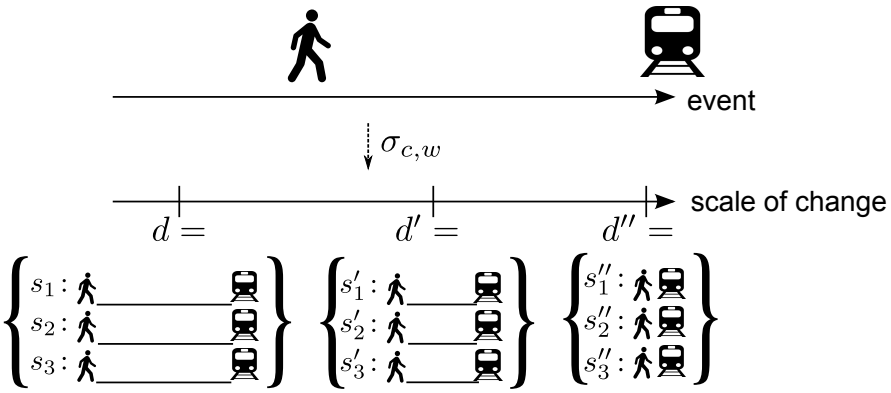

Figure 5.1: An illustration of the scale of change associated with an eventuality of John's walking to the station in a particular world and discourse context.

The scales of change associated with an eventuality *predicate* (such as *John walk$_\emptyset$ to the station*) are then simply the set of all scales of change associated with all events in its extension, but see Section 5.1.3 for further details. The present theory can be seen a generalized version of Klein (1994), who captured the profile of change associated with different predicates through state schemata, cf. Table 5.1. But while Klein used binary distinctions (a state either holds or does not hold), a scale of change-based approach exploits finer degrees of differentiations.

Schema	**Predicate type**	***Example***
$- - -$	0-state predicates	*2 plus 2 is 4.*
$\ldots - - - \ldots$	1-state predicates	*The light was on.*
$\ldots - - - + + + \ldots$	2-state predicates	*John built a house.*

Table 5.1: The predicate schemata of Klein (1994)

States and scales of change. A departure from former scale-based approaches like those reviewed in Section 2.3.2 is that I assume, in the spirit of Klein (1994) and Jackendoff (1983), that (state individuals and thereby also) state predicates are also associated with "scales of change". Even though this idea is not indispensable for an account of progressive achievements, it is a natural generalization of the scale-based approaches. According to the generalization I propose, the scale of change captures the profile of change associated with an eventuality or a predicate. The way it captures the profile of the change associated with states, that is, *lack* of change, is by associat-

ing them with a degenerate scale consisting of a single state predicate. Taking the film analogy, a state can be visually captured with a single frame of film, i.e., a photo.

This generalization was already the intention of Beavers (2002, §6), but he noted that given his definition of the Movement Relation (cf. Definition 3) and the extra restrictions he laid on it, unwanted predictions would result for states, namely, that they cannot be durative, which is why he forgoes this generalization. The restriction I lay on the mapping between an eventuality and its scale of change (see Appendix B) is different, and is compatible with states having extended temporal traces; thus, it effectively implements the desiderata of Beavers's (2002) theory without the unwanted consequence of prohibiting durative states.

Indeed, on the framework I propose, what would actually require an extra support would be to have state particulars (and hence state predicates) *not* be associated with a scale of change: since a scale of change is a *perspective* over an element of the set E of events, and since states are a subset of this set according to the model assumed in Section 3.3, then states must also be associated with scales of change. Indeed, Asher (1992) exploited only perspectives over states or situations (Asher used these terms interchangeably) in his theory of the progressive. Since the present notion of a *scale of change* is a generalization of Asher's (1992) perspective, it must apply to all cases which Asher's perspective did, including states.

Put in a broader perspective, a scale of change on the present account is associated with any eventuality particular — and one major property of eventuality particulars is that they are located in *time* (Parsons 1990). Thus, moving to the level of predicates, I propose that scales of change should be associated with all predicates which can be modified with *temporal adverbials* (which I take to be an indication that these predicates denote sets of eventualities, which are located in time). Because all dynamic predicates, as well as temporary states can be modified with temporal adverbials (cf. *John was at home yesterday* for an example with a temporary state), then, on this view, all of these predicates must be associated with scales of change. This foreshadows my proposal in Section 5.2 that some stative predicates, however, are *not* associated with scales of change according to this view, because they cannot be modified with a temporal adverbial. These predicates are individual-level states like *be a mammal*: cf. the infelicitousness of *#This animal was a mammal yesterday*. The only scenario on which such a sentence is felicitous is one on which the animal was a mammal yesterday, but is not a mammal today (cf. Altshuler and Schwarzschild 2013 on the *cessation implicature* of past tense sentences), that is, in a context where *be a mammal* is a stage-level, rather than an individual-level predicate.

An extension of the scale-based semantics to states yields a closer parallel with the framework of Jackendoff (1983, 1996) given the following points of connection:

- "[The abstract motion described by a verb is reduced] to the more primitive function BE – as is desired by those who wish to treat motion as a series of locational 'snapshots'." (Jackendoff 1996, p. 323)

  "What distinguishes an Event from a State? Intuitively, an Event has a time-course, whereas a State 'just sits there'" (Jackendoff 1996, p. 327)

  On the present approach, the scales of change associated with dynamic predicates contain at least two degrees, i.e., consist of several states ('snapshots'), while the scales of change of states are single-valued, i.e., a single 'snapshot', corresponding to the state itself.

- "However, the reduction is in terms of a continuous function, thereby meeting the objections [...] to the 'snapshot' approach." (Jackendoff 1996, p. 323)

  In the case of activity and accomplishment predicates, their scales of change are generally densely ordered, satisfying the continuity property mentioned by Jackendoff.

Given that I adopt Jackendoff's (1996) approach to dynamic predicates as a series of 'snapshots', the proposed representation of activities will be compatible with both a *homogeneous* view of these predicates (cf. Bennett and Partee 1972, Dowty 1979, Krifka 1992), as well as with one according to which activities consist of a continuous *series* of multiple, possibly an infinite number of changes from one state to another (John Beavers, p.c., and cf. also Pustejovsky 1991 for a view of activities as a sequence of events).

Note that the scale-based approach ensures that multiple "snapshots" do indeed correspond to "change" in the intuitive sense of the term, because no two degrees of a scale of change can be identical (because a scale is a linearly ordered set, and a set can only contain the same element once); and if different snapshots of the event are associated with different sets of states, a change of state is implied:

> **Principle 2 (Non-degenerate scales of change imply change)**
> *For any c, w, γ, e, if the carrier set of $\sigma_{c,w}(\gamma, e)$ contains more than one degree, then e is associated with a (gradual or non-gradual) change.*

Incremental arguments. While using a *scale of change* consisting of states, I also retain the notion of what is called a *scale of change* by Beavers (2012, 2013), which is the linearly ordered set that measures out an event in the extension of scalar/incremental predicates. I will call this scale an *incremental argument* based on Beavers (2013). This incremental argument (following authors like Tenny 1987, Dowty 1991, Jackendoff 1996, Filip 1993/99, Hay et al. 1999, Filip 2008, Beavers 2013, a.o.) unifies the incremental theme of creation and consumption verbs like *drink*, the path argument of directed motion verbs like *walk*, and the property scale of degree achievements like *cool*.

The Movement Relation of Beavers (2002, 2008, 2013) (reproduced above in Definition 3), a mapping between the incremental argument and the event, is defined for scalar/incremental predicates, but not others like *rain* or *watch TV*. Given a homomorphic mapping between the incremental argument and the event, and a homomorphic mapping between the event and the scale of change, the incremental argument is also homomorphically mapped to the scale of change, constraining its structure. In what follows, I will not be concerned with the specific behaviour of scalar/incremental predicates, and will only focus on what I call the scale of change, which is a more general notion than the incremental argument to represent change.

5.1.2 The mapping to the scale of change

The scalar trace. I assume a mapping called the *scalar trace* to the scale of change $\sigma_{c,w}(\gamma, e)$ of an eventuality e. This mapping is similar in function to the Movement Relation of Beavers (2002, and elsewhere) — that is in turn built on the homomorphic mappings of Krifka (1992, and elsewhere). The precise details of the formalisation of the scalar trace are not directly relevant to the analysis of progressive achievements I will present, so I omit its definition here, and refer the reader instead to Appendix B, where it is characterised in detail. I have drawn on Beavers (2002) in characterising many of the formal properties of the scalar trace to ensure the same results: for instance, the scale of change associated with an eventuality respects temporal flow, i.e., progressing to *higher* degrees on the scale change corresponds to the characterisation of *later* temporal parts of the eventuality. (For instance, in the case of an event of John walking to the station, later parts of the walking event must be associated with a set of states in whose case John's proximity to the station is greater.)

Importantly for our purposes, just as Beavers's (2002) constraints on his Movement Relation guarantee that durative dynamic events are associated with *multi-valued* scales while non-durative dynamic events with *two-valued* scales, the scalar trace also

guarantees such a correspondence between durativity and scale complexity, as elaborated in Appendix B.

An important departure from most of the scale-based approaches to aspect and in particular that of Beavers (2002, 2008, 2011, 2012, 2013) in characterising the mapping to scales of change is that I assume that the scale of change is not linked to eventualities directly, but their relation is mediated by another scale (usually time), as in Gawron (2005, 2009) and Deo and Francez (2013). The advantage of defining the scalar trace as a mapping from some independent ordered set like time rather than directly from the event itself is twofold:

- we can utilize the scale of change to explain not only phenomena restricted to the temporal trace of an event, but also phenomena involving intervals preceding and following it;
- by being able to vary the dimension of the mediating scale, we can have a uniform account of a wider range of phenomena.

Characterising achievements. If the scalar trace function can capture states of affairs outside the temporal boundaries of the eventuality, it is possible to characterise result states, as well as intervals leading up to an event in terms of the same scale of change that is used to describe the structure of the event itself.

This is particularly crucial in the case of events described by achievements. Endorsing the approach to duratvity of Beavers (2002, 2008, 2013), events in the extension of achievements are associated with a binary scale of change (for instance, for an event of John's arrival at the station, a set of states of John not being at the station and a set of states of John being at the station). In order for Beavers's generalized movement relation between event parts and scale parts to be defined, he has to assume that events in the extension of achievements are composed of *exactly two* parts (cf. Section 3.1.2).

On the present proposal, events in the extension of achievements can be literally instantaneous (i.e., their temporal trace is a single point in time, at least at the relevant granularity), and their scale of change still consists of two degrees. This is possible because the first degree can be the image of a point (if time is discrete) or all points in some contextually determined interval[3] (if time is dense) immediately preceding the pointlike temporal trace of the event (in our example of John's arrival at the station, all points in an interval preceding John's arrival can be mapped to the set of states of

[3]Recall that the scale of change is context-relative.

John not being at the station), while the second degree of the scale of change can be the image of the point that is the temporal trace of the event (in our example, the time of John's arrival can be mapped to the set of states of John being at the station). Thus, like Piñón (1997), and Dowty (1979, §§2.3.2, 3.3), we evade the problem of instantaneous change by relegating the change information to outside the boundaries of the event (or in the case of Dowty, the interval at which BECOME ϕ is true for some proposition ϕ).

Varying the mediating scale. As for the second gain of adopting a mediating linear order, it enables us to accommodate cases where the relevant ordering is spatial or some other dimension. These are the so called *(spatial and abstract) extent* readings analysed extensively by Gawron (2005) and Deo and Francez (2013), and illustrated by the authors with examples like the following:

(5.1) a. The road widens between San Francisco and San Jose.
b. The plot thickens in chapter three.
c. Fish ears grow with increased CO_2.

We can now accommodate the analysis of Gawron (2005) and Deo and Francez (2013), who argue for a mediating linear order in the case of degree achievements, whose identity can explain the observed (temporal, spatial extent, abstract extent) readings of a predicate like *widen*. Note that in our case, it is not only degree achievements, but all predicates which are assumed to have such a mediating structure. And I propose that it is welcome, since many other different kinds of predicates can display such readings when supplied with some comparative expression, cf.:

(5.2) a. It rains more as you go farther south.
b. People eat more fish as you go toward the ocean.
c. You are more irritated, the less sleep you get.

As shown by (5.2c), or the famous description of Douglas Adams's *Mostly Harmless* as *The fifth book in the increasingly inaccurately named Hitchhikers Trilogy*, (abstract or physical) spatial readings are even available to states. And as these examples show, while the scale of change of states is necessarily a singleton when mapped to a temporal scale, they can have multivalued scales of change when mapping happens along another dimension, such as the scale consisting of the increasing number of books in the Hitchhikers series.

The difference between degree achievements and other predicates is that a comparative like *more*, *better* or *increasingly* is needed in the latter cases, and this is because only degree achievements lexicalize comparatives (cf. their received analysis based on an increase in degree, as in Hay et al. 1999), that is, only these verbs lexicalize their associated scales (cf. e.g., Rappaport Hovav 2008, Fleischhauer and Gamerschlag 2014) — on our account, their incremental argument which constrains the scale of change.

Note that such a comparative construction with, e.g., *more* is not available to all verbs, just as verb gradation with 'very' is not universally possible (Fleischhauer 2013). For one, *more* cannot be added to telic predicates, which is true in the case of degree achievements, as well: although *John cooled his soup more than Mary* is acceptable, **John cooled his soup to room temperature more than Mary* is not, the standard explanation being that the degree argument is already saturated. But I propose that many, if not all, of those predicates that do combine with *more* also show the same potential for a temporal/spatial/property dimension ambiguity as degree achievements.

In sum, it is expedient to assume an intermediate level of ordering mediating between an event and its associated scale of change for at least two independent reasons. However, in what follows, I will ignore cases when the mediating scale is not time, given that my goal here is an account of temporal aspect. Thus, "scales of change" and "scalar traces" are hence restricted to those which are relative to the time scale.

5.1.3 Predicate-level scales

Predicate-level scales of change should intuitively capture the change that is common to all events in the extension of a predicate. Therefore, just as a predicate extension is a set of events, I assume that predicate-level scales of change are sets of event-level scales of change. To take our film analogy, the scales of change associated with a predicate can be thought of as all the possible films that can be made about the same kind of event, for example, of a girl drinking a cup of water.

Formally, the set of the *primary scales of change of a predicate* is the set of all the scales of change associated with all the eventualities in the extension of an eventuality predicate:

Definition 15 (Primary scales of change)
If $\hat{}\varphi$ *is an eventuality property (i.e.,* $[\![\hat{}\varphi]\!]^{M,w,g,c,\gamma}: W \rightarrow \wp(E)$*), then the set* $\mathsf{PrSoC}(\hat{}\varphi)$ *of the scales of change associated with* $\hat{}\varphi$ *is the set of all scales assigned to all possible* φ*-events, that is,* $\mathsf{PrSoC}(\hat{}\varphi) \stackrel{\text{def}}{=} \{\sigma_{c,w}(\gamma, e) \mid \gamma \in G_{\mathcal{T}} \wedge c \in C \wedge w \in W \wedge e \in [\![\varphi]\!]^{M,w,g,c,\gamma}\}$.

Note that the definition refers to eventuality properties, i.e., a natural language predicate is characterised by the scales of change of all events in its extension at all possible worlds.

I will also talk about the scales of change of predicate φ at a particular granularity γ, which is the set of all scales $\mathcal{S} \in \mathsf{PrSoC}(\hat{}\varphi)$ such that the granularity argument in $\mathcal{S}$ is γ. This set of scales can be designated as $\mathsf{PrSoC}_{\gamma}(\hat{}\varphi)$.

The primary scales of change of a predicate capture the properties of the events in its extension. As such, all of Vendler's achievements (happenings and culminations alike) are associated with two-valued primary scales of change, because events in their extension are instantaneous dynamic events, and are as a result associated with two-valued scales. On the film analogy, to visually capture an achievement, it is enough to have to snapshots, two photos, for instance, of John not being at the station and of John being at the station (for *John arrive*$_{\emptyset}$ *at the station*), or two photos of John not seeing Mary and of John seeing Mary (for *John notice*$_{\emptyset}$ *Mary*).

However, the idea about culminations like *arrive* going back to at least Carlson (1981) is — continuing with the film analogy — that they are also implicitly associated with longer "films", for instance, a film about walking to the station. This is often captured as culminations *presupposing* the occurrence of a preceding activity (cf. Section 3.2): this activity is not part of their asserted content (cf. Heyde-Zybatow 2008 for an explicit account), and events in the extension of culminations are not required to be temporally extended (for an alternative view, see Filip 1993/99, Altshuler and Filip 2013, discussed in Section 2.2.2). Instead, events in the extension of culminations stand in a particular *relation* to extended events of gradual change. In what follows, my aim is to determine the nature of this relation in order to exploit it in the characterisation of culmination predicates.

5.1.3.1 Cover events

In order to analyse the difference between happenings and culminations, I will make use of the auxiliary notion of a cover event. Where these two kinds of achievement

appear to differ is that culminations like *arrive* (but not happenings) describe events which are typically preceded by a gradual change (cf. Section 3.2). The term *cover event* refers to the event of this gradual change whose final degenerate part is the event described by a culmination predicate (i.e., the cover event contains the culmination point as well as the "process part").

But as the discussion of Rothstein's (2004) event-mereological solution in Section 2.2.4.2 revealed, the simple characterisation "final degenerate part" is insufficient for our purposes: The set E of events forms a join-semilattice, and so the join of two events e, e' is always an event itself, as well (cf. Section 3.3.1). Thus, the join of any arbitrary event of gradual change (say, an event of Mary walking toward John) with an instantaneous dynamic event (say, an event of Mary noticing John) is also an event, but we do not want to call their join a cover event of the latter. We have to refer to something more substantive than simple event mereology, and this is where scales of change can be put to use.

To this end, let us define the cover event relation as a relation between an extended event and its final degenerate part such that the change associated with the extended event is an elaboration of the change associated with the degenerate event. In terms of our contextually determined scales of change, this means that the sets of states making up the degrees of the scale of the extended event (say, an event of walking to the station) must be subsets of the sets of states making up the degrees of the scale of the degenerate event (say, an event of arrival at the station). Formally, the cover event relation is defined as follows.

Definition 16 (Cover event)
For any $e, e' \in E$ such that $e \sqsubset_E e'$, e' is a cover event *of e iff for some context $c \in C$, world $w \in W$ and granularity function $\gamma \in \mathbb{G}$,*

- *$\sigma_{c,w}(\gamma, e)$ is binary and $\sigma_{c,w}(\gamma, e')$ is multi-valued and*
- *there is a mapping* cov *from $\sigma_{c,w}(\gamma, e')$ to $\sigma_{c,w}(\gamma, e)$ such that*
  1. *the maximal degree, and only the maximal degree, of $\sigma_{c,w}(\gamma, e')$ is mapped to the maximal degree of $\sigma_{c,w}(\gamma, e)$, and*
  2. *all non-maximal degrees of $\sigma_{c,w}(\gamma, e')$ are mapped to the minimal degree of $\sigma_{c,w}(\gamma, e)$, and*
  3. *$\forall d \in \sigma_{c,w}(\gamma, e') \colon d \subseteq \mathsf{cov}(d)$, that is, all degrees (as sets of states) of the scale of change of the cover event e' are subsets of the degree of the scale of change of event e to which they are mapped.*

Figure 5.2 provides an illustration of the cover event relation between events.

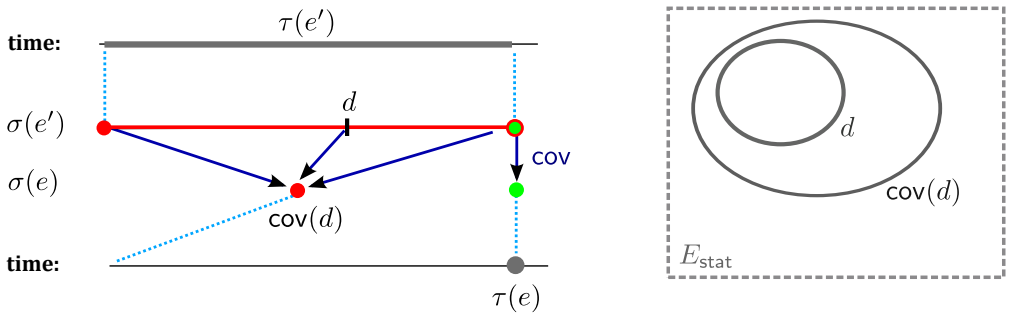

Figure 5.2: The cover event relation between events. (Parameters not important for the illustration are suppressed for simplicity.)

The key part of the definition is the final requirement. This ensures that not only is e a mereological part of e', but the change happening throughout e' is an elaboration of the change associated with e. For example, take an event of John walking to the station and its final part, the event of John's arrival at the station in that scenario. Then the scale of change associated with the instantaneous event of John's arrival consists of *i)* the set of states of John not being at the station, and *ii)* the set of states of John being at the station. The scale of change of John's walking event in turn consists of sets of states of John being located closer and closer to the station (as in Figure 5.1 on page 118), with the maximal degree consisting of states of John being located at the station. Then the non-maximal degrees of the scale of the walking event are all different subsets of John not being located at the station, while the maximal degree as the set of states of John being at the station is identical to (and hence a subset of) the maximal degree of the scale of John's arrival. John's walking event is therefore the cover event of John's arrival in this scenario.

In contrast, take the following scenario also with an extended event and its final degenerate part. Let e be an event of Mary noticing John, and e' a composite event of Mary walking toward John and noticing him. The scale of change of e is an ordered pair of the set of states of Mary not being aware of John and the set of states of Mary being aware of John. But as for e', the series of states characterising the change that is going on while Mary is walking toward John are not elaborations of the set of states characterised by Mary not being aware of John: they are sets of states of Mary being located at a given distance from John. These are *not* subsets of the set of states of Mary not being aware of John (Mary may well be aware of John in many states of being located at a distance from him at which point she is not yet aware of him in the given

scenario). Therefore, e' is *not* a cover event of e, because the final requirement on the cover event relation is not satisfied. Even if the set d of states of Mary not being aware of John were an element of the scale of change of e', any other degree d' of the scale of e' would need to be different from this set (which follows from treating scales as linearly ordered sets, cf. the discussion in relation to Principle 2 above). But there are no graded differences in Mary's awareness of John during e', and so d' cannot be a subset of d, contradicting the final requirement on cover events.

As the example reveals, the cover event relation differentiates between instantaneous events in the extension of culminations and instantaneous events in the extension of happenings, exploiting the idea that the former, but not the latter are typically characterised by a gradual change leading up to them (cf. Section 3.2). To foreshadow the analysis of progressive culminations in Sections 5.3–5.4, I will assume that a progressive culmination like *John is arriving at the station* can be true during the runtime of the cover event of an event in the extension of the culmination. The scale-based definition of the cover event will then exclude progressive happenings like *Mary is noticing John* to be true in the interval leading up them.

An interesting case is presented by events in the extension of the predicate *die*. Given that a progressive culmination is true during a cover event, the famous aphorism, *From the day we are born, we are dying* can also be accounted for. In this case, the gradual change that goes on from the moment humans are born until they die is their being progressively older. Thus, the complex event that is the life of a human is in this special context associated with a scale consisting of degrees with states of being of a progressively greater age. These are all subsets, and what is more, different subsets of states of being *alive*, which is the set of states that is the first degree of the scale associated with a dying event in this context. The event corresponding to the life of an individual is therefore a cover event of the event corresponding to the death of the individual. The progressive of the predicate describing the dying event will therefore be predicted to be true during the greater event of being born, living and dying in this special discourse context.

From events to predicates. Although it will not be needed for the formal analysis, we can in some cases also talk about type-level cover event predicates in the following sense. An accomplishment predicate ψ is a *cover event predicate* of achievement predicate φ just in case for all worlds w and some context c and granularity γ, $\forall e' \in [\![\psi]\!]^{M,w,g,c,\gamma} : \exists e \in [\![\varphi]\!]^{M,w,g,c,\gamma}$ such that e' is the cover event of e. That is, whenever an event belonging to the extension of accomplishment predicate ψ occurs, then

its final non-extended part belongs to the extension of the culmination-achievement φ. Thus, the extension of the achievement φ is a superset of the set of events that are the final non-extended parts of events belonging to the extension of the accomplishment ψ.

The cover event predicate relation can be linguistically detected, for instance, by entailments in the perfective: e.g., right after culmination, (5.3a) entails (5.3b).

(5.3) a. Mary has (just) climbed to the top of Mount Everest.
b. Mary has (just) reached the top of Mount Everest.

No corresponding entailments with an accomplishment can be found for happenings.

Note that the way a cover event is defined, a culmination predicate may have several cover event predicates. For instance, there may be different ways of arriving somewhere (on foot, by plane etc.), and so *walk to the station* and *drive to the station* are both cover event predicates of *arrive at the station*. Not all culminations are associated with cover event predicates in a language. For instance, for culmination predicate *win* or *die*, there appears to be no accomplishment predicate describing a gradual change culminating in winning or dying other than some lengthy paraphrase or a complex predicate including the predicate *win* or *die* itself.

5.1.3.2 Secondary scales of change

Given the notion of a cover event, we now define the notion of a *secondary scale of change*. A secondary scale of change serves to capture the intuitive idea that culminations are characterised not only by their own asserted instantaneous change, but also by the presupposed gradual changes that lead up to events they describe. On our film analogy, all films about, say, walking to the station (i.e., films about complete walks to the station) are necessarily also all films about arriving at the station, so *arrive*$_\emptyset$ *at the station* can be presented as a film about a walk to the station equally as well as two photos of not being at the station and of being there.

Admittedly, a dual characterisation with a primary and a secondary scale is stipulative, rather than following from some more basic principles, but it can be used to explain the ambivalent behaviour of culminations. That is, using two-valued primary scales and multi-valued secondary scales is a formalisation of the idea of Filip (1993/99) and Altshuler and Filip (2013) that culminations like *arrive* are characterised by *both* an instantaneous *and* a gradual change, and different linguistic phenomena are

sensitive to one or the other. Thus, while culmination predicates are true of instantaneous events and are thus compatible with, e.g., time point adverbials and are not admissible as complements of aspectual verbs, they can appear to behave like accomplishments in the scope of an operator having the ability to access their secondary scales — and as I will argue in Section 5.3, the progressive is such an operator.

So just as primary scales of change are the set of all scales of change associated with events in the extension of a predicate, let us now define the secondary scales of change of culminations as the set of all scales of change associated with cover events of events in their extension:

Definition 17 (Secondary scales of change (of culminations))
The set of secondary scales of change $\mathsf{SeSoC}(\hat{}\varphi)$ *associated with an event property* $\hat{}\varphi$ *contains the set of scales of change of the cover events of events in the extension of* φ *at all possible worlds.*

Formally, if $\hat{}\varphi$ *is an eventuality property (i.e.,* $[\![\hat{}\varphi]\!]^{M,w,g,c,\gamma} : W \rightarrow \wp(E)$*), then* $\mathsf{SeSoC}(\hat{}\varphi) \stackrel{\text{def}}{=} \left\{\sigma_{c,w}(\gamma, e') \mid \exists e \in [\![\varphi]\!]^{M,w,g,c,\gamma} : e' \text{ is a cover event of } e \text{ at } \gamma \in G_{\mathcal{T}}, c \in C, \text{ and } w \in W\right\}$.

Note that the way Definition 17 is formulated, secondary scales are currently only defined for culminations, and serve no other purpose. However, I leave open the possibility that the definition could be modified and extended to other cases. For instance, it might be possible to capture the temporariness of a stage-level state like *John be happy* (or, in general, of any 1-state predicate, in the terminology of Klein 1994) by assuming that its secondary scales contain multi-valued scales of change describing John's level of happiness or sadness throughout his life — whether this is a viable route to take is a subject for future research.

The idea that a predicate can be associated with two kinds of scales is a radical departure from all former scale-based approaches. Scale-based analyses of both adjectival and verbal phenomena so far have assumed that each predicate is associated with a single scale and the properties of this single scale determine the properties of the predicate. The present proposal opens up a wide topic of how two scales can *interact* with each other — which has not received much attention in scale-based works, as yet.

Intuitively, while a primary scale of change captures the internal change associated with a predicate, a secondary scale of change captures a *relational* component of the

predicate. Thus, PrSoC and SeSoC should not be seen as components of a predicate in the sense of lexical decompositional approaches (e.g., Dowty 1979, Pustejovsky 1991, Levin and Rappaport-Hovav 2005, Ramchand 2008), i.e., they do not refer to different parts of the event structure associated with the predicate. Instead, they are different aspects of a predicate's meaning: the primary scale capturing inherent, the secondary scale capturing relational properties thereof (put differently, PrSoC and SeSoC can be seen as capturing the asserted and presupposed contents, respectively, in the two-layered framework of Heyde-Zybatow 2008 and Malink 2008).

As an analogy, take *relational nouns* like *mother* which "describe objects as standing in a certain relation to others" (Löbner 1985, p. 292).[4] These are generally analysed as denoting two-place relations (Löbner 1985, de Bruin and Scha 1988, Partee and Borschev 2003, Barker 2012, Partee and Borschev 2012). But as noted already by Löbner (1985), relational nouns can also be used as *sortal nouns*, referring to individuals rather than relations (as in *She is a good mother*) if their additional argument is existentially bound.[5] Formally, if relational nouns denote two-place relations (e.g., $\lambda y \lambda x.\, \mathsf{mother\_of}(y, x)$), then by applying to them the *detransitivization type-shifter* $\mathsf{Ex} = \lambda R \lambda x. \exists y R(y, x)$ of Barker (2012), we get a sortal noun (a noun denoting a set of individuals, e.g., $\lambda x. \exists y\, \mathsf{mother\_of}(y, x)$).

Culmination predicates can be seen in analogy to *detransitivized* relational nouns: they denote events of instantaneous change which are related to a separate event of gradual change. A substantial difference between culminations and relational nouns is that the relation in the case of culminations is much weaker: as argued in Section 3.2, not all events falling under a culmination predicate need be related to an event of gradual change. (In contrast, all mothers have to have a child.) This is why the complex notions of a cover event and secondary scales of change are needed: they serve to characterise the complex relation culminations stand to events of gradual change.

As regards the scales of change associated with different predicate types, the following is now the case:

[4] Löbner (1985) actually distinguishes *functional nouns* like *mother* from *relational nouns* like *daughter* (the mother of an individual is necessarily unique, in contrast to a daughter). However, in later works, the more common practice is to assume that "the *basic* types of nouns are sortal nouns, proper names and relational nouns, and for the most part, functional nouns are simply an accidental subclass of the relational nouns" (Partee and Borschev 2012, p. 445f).

[5] That relational nouns can refer to individuals rather than relations in a context might not even be simply a *possibility* for them, at least in German: in an extensive corpus study, Horn (in preparation) found that relational nouns in German are used as non-relational nouns in more than two-thirds of the cases (in a corpus of diverse kinds of texts including, among others, newspaper articles and narratives).

- Accomplishments (like *drink a bottle of wine*) are associated with multi-valued scales of change (at their normal granularities).
- Happenings (like *explode* and *flash*) are associated with binary scales of change (at their normal granularities).
- Culminations (like *arrive* and *die*) are associated with both binary and multi-valued scales, where the multi-valued scales belong to their secondary scales of change.

Thus, we now have enough tools in our framework to make the above three-way distinction among telic predicates that we needed to set apart based on their different interpretations in the progressive.

5.1.3.3 Scales of satisfaction

Before presenting a scale-based characterisation of different aspectual classes, I introduce two further auxiliary notions. These will not be relevant for my analysis of progressive achievements, but are nonetheless useful in distinguishing different aspectual classes — in particular, *telic* and *atelic* predicates, for the distinction of which we have to make reference to the satisfaction conditions of a predicate.

For each predicate and scale of change, we can define a final subscale of a scale of change, such that if any point of this subscale is reached, the relevant eventuality predicate is satisfied. In the case of *run to the bank*, this part of the scale would be a single point, namely, the state of being at the bank, since any running event with an endpoint on a path before or beyond it would not qualify as running to the bank. (Running to a point beyond the bank would be running to *that* point, rather than to the bank.) This — possibly degenerate — final subscale of the scale of change will be called the *scale of satisfaction* for that particular eventuality predicate. The complement of this subscale — that is, the complete initial part of the scale of change at which the predicate is not satisfied, is called the scale of *pre-satisfaction*. In other words, any primary scale of satisfaction associated with a predicate can be partitioned into two blocks such that the boundary of the blocks is the point where the predicate gets satisfied: Figure 5.3 provides an illustration.

Formally, a scale of satisfaction is defined by collecting all the degrees which are target states of some event in the extension of the relevant predicate: these are the stages of the change where the relevant predicate is satisfied:

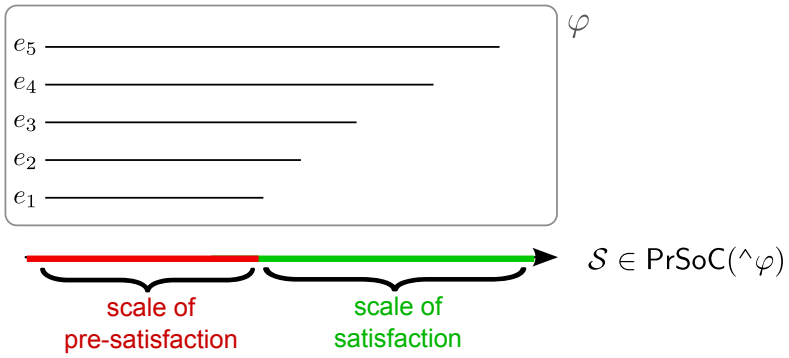

Figure 5.3: Illustration of the scales of satisfaction and pre-satisfaction

Definition 18 (Scale of satisfaction)
The scale of satisfaction $\mathsf{Sat}(\hat{}\varphi)(\mathcal{S})$ *for eventuality property* $\hat{}\varphi$ *and a scale of change* $\mathcal{S} \in \mathsf{PrSoC}(\hat{}\varphi)$ *is that subscale of* $\mathcal{S}$ *which contains all and only those points* $p \in \mathsf{carrier}(\mathcal{S})$ *such that there is a* $c \in C, w \in W$ *and* $\gamma \in G_{\mathcal{T}}$ *for which there is an* $e \in [\![\varphi]\!]^{M,g,w,c,\gamma}$ *such that* $\sigma_{c,w}(\gamma, e) \subseteq_{\mathsf{ini}} \mathcal{S}$ *and* $\max(\sigma_{c,w}(\gamma, e)) = p$ *(where* $\subseteq_{\mathsf{ini}}$ *is the initial subscale defined in Definition 7 and* max *is the maximum).*

Note that the scale of satisfaction is not the image of the temporal trace of an eventuality in the extension of the predicate: instead, it is the image of the set of all *possible endpoints* for the eventuality predicate in a given situation.

Then we can define the scale of pre-satisfaction as the complement of the scale of satisfaction:

Definition 19 (Scale of pre-satisfaction)
The scale of pre-satisfaction $\mathsf{Presat}(\hat{}\varphi)(\mathcal{S})$ *for an eventuality property* $\hat{}\varphi$ *and a scale of change* $\mathcal{S} \in \mathsf{PrSoC}(\hat{}\varphi)$ *is the complement of* $\mathsf{Sat}(\hat{}\varphi)(\mathcal{S})$ *in* $\mathcal{S}$.

5.2 Scale structures by aspectual class

5.2.1 Primary scale structures

In a scale-based framework, the difference between aspectual classes is modeled with reference to their scale structure. I will follow Beavers (2008, 2013, cf. Section 2.3.2.4) in maintaining that the aspectual properties of predicates depend on two scalar properties:

i) *The specificity* of the degree that needs to be reached to satisfy the predicate determines telicity.
ii) *The mereological complexity* of the scale determines durativity.

As an account of telicity is orthogonal to the topic of the present dissertation, I do not go into the complexities of choosing one account over another. I here simply follow Hay et al. (1999) and assume that a telic predicate φ specifies a (non-zero) lower bound on the amount of change; in other words, in each situation, a specific non(-zero) degree needs to be minimally attained on the scale for φ to be satisfied. This idea can be translated in the present framework using the notion of a scale of satisfaction:

> **Definition 20 (Telicity based on scale structure)**
> *An eventuality predicate φ is telic iff for all w, g, c, γ, in all $\mathcal{S} \in \mathsf{PrSoC}(\hat{}\varphi)$, there is a specific, non-minimal degree $d \neq \min(\mathcal{S})$ such that d is the minimal element of the scale of satisfaction, that is, $d = \min(\mathsf{Sat}(\hat{}\varphi)(\mathcal{S}))$.*

As for durativity, as already noted, I follow Beavers (2002, 2008, 2013), and assume that binary scales correspond to non-gradual change, and are associated with non-durative predicates, while multi-valued scales correspond to gradual change, and are associated with durative predicates. I extend Beavers's account of mereological complexity in the way intended by Beavers (2002, §6) to statives. Table 5.2 summarizes the complexity of the scales I assume to be associated with different kinds of predicates.

States. Let us now inspect the general structure of the change associated with different aspectual classes. As for states like *be happy*, since they involve no change, I assume that the scale of change associated with them is necessarily a singleton, that is, it contains a single degree corresponding to a single state.[6] Given the constraints de-

[6]Of course, the single degree on the scale of change can also be a degree on some orthogonal multi-valued scale — a property/location scale — to which modifiers such as *almost* and spatial extent read-

No. of deg.	*Change*	*Aspectual class*
2<	Gradual change	Accomplishments, activities
2	Non-gradual change	Vendler's achievements
1	No change	1-state stative predicates
N/A	No potential for change	0-state predicates

Table 5.2: Scale complexity, properties of change and aspectual classes

tailed in Appendix B, the primary scales of change $\mathsf{PrSoC}(\hat{}\varphi)$ associated with a state predicate φ are indeed all singleton, because all state individuals are associated with singleton scales. As regards the temporal extent of states, I endorse the most common conception that states hold at non-degenerate intervals and at any instant of the interval at which they hold.

Note that given the focus of the present dissertation on achievements, I disregard complexities pertaining to other classes, including states: I will not go into the question of how to differentiate non-temporary, *0-state predicates* (in the terminology of Klein 1994[7]) like *The pen is red* and temporary, *1-state predicates* like *The light is on*, or how to the differentiate *momentary* states like *be asleep* and *be a mammal* from *interval* state predicates like *sit* (in the terminology of Dowty 1979, Ch. 3). I here list some ways in which I believe the 0- vs. 1-state predicate distinction might be captured on the present framework:

a) 1-state predicates are associated with singleton primary scales of change; 0-state predicates are associated with an empty scale of change (note that this requires lifting the nonemptyness requirement imposed on scales), i.e., their primary scale of change is the empty set $\emptyset$.

b) Both 0-state and 1-state predicates are associated with singleton primary scales of change; but 1-state predicates are in addition associated with multi-valued secondary scales of change (cf. Section 5.1.3.2).

ings as in Section 5.1.2 have access. E.g., *be almost black* is associated with a scale of change consisting of the single degree of being of that particular colour, but that particular colour is also a degree on a multivalued scale of colours.

[7]The reason I use the terms *0-* and *1-state predicates* rather than "stage-level" and "individual-level" predicates (as in the literature building on Carlson 1977) or "temporary" and "non-temporary" states (as in Bach 1981) is that Klein's (1994) terminology is ideally suited to capture the essence of these predicates on the present framework: 1-state stative predicates are characterised by scales containing 1 degree, while 0-state predicates are not even associated with 1-degree scales, cf. Table 5.2.

c) Only 1-state predicates are associated with a singleton primary scale of change; 0-state predicates are not associated with a primary scale of change.

d) Only 1-state predicates are predicates of eventualities; 0-state predicates are predicates of intervals (and as such, are not associated with primary scales of change).

Here, I opt for the solution that 0-state predicates are predicates of intervals, for the reason that 0-state predicates appear to pattern widely differently from all other predicates (cf. e.g., Kratzer 1995, who also assumes on this basis that individual-level predicates, in contrast to other predicates including stage-level states, do not hold of eventualities). For instance, they do not appear to be amenable to modification with spatial or temporal adverbs (#*John was a male at noon/in London*), indicating that they do not denote sets of spatio-temporally located entities. In addition, a prime reason Davidson (1967) proposed the introduction of events into semantics (and note that he himself did not regard any state predicates as having an event argument) is to cope with the problems that the stacking of modifiers like *slowly, deliberately, with a knife*, etc. onto predicates poses. But 0-state predicates do not typically allow such modifiers, only sentential modifiers like *probably*, which arguably operate on propositions, not event predicate denotations. However, a careful consideration of which, if any, of the above solutions to distinguishing 0- and 1-state predicates is suitable is left for further research. Unless indicated otherwise, by *state*, I refer to (state particulars, i.e., elements of E_{stat}, or) 1-state stative predicates.

Dynamic predicates. For dynamic predicates, the following considerations apply:

1. given the constraints on dynamic events detailed in Appendix B, accomplishments and activities are associated with multi-valued primary scales of change, and Vendler's achievements with a binary one (cf. Section 5.1.2);
2. accomplishments and achievements are telic, that is, there is a specific non-zero point at which their scale of satisfaction starts, whereas activities are satisfied by any change.

Based on this, the generic scale structure of the primary scale of change for predicates belonging to different aspectual classes is presented in Figure 5.4.[8]

[8] A generic scale structure is an abstraction over all scales of change associated with a predicate. The scale structure for accomplishments is a generalization over regular accomplishments and those of the "quantization puzzle" (cf. Filip 2000) such as *eat at least 3 sandwiches*. Note that the approach of Hay et al. (1999) does not share the shortcoming of most scale-based approaches to telicity, such as the closed-scale approach of Kearns (2007) and Kennedy and Levin (2008), which make wrong predictions

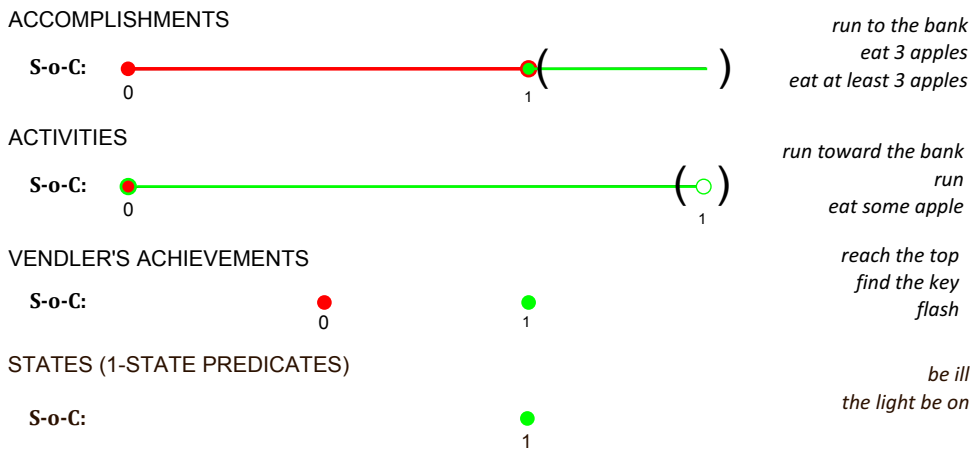

Figure 5.4: The primary scale structures for different aspectual classes. The scale of satisfaction is encoded in green, while the scale of pre-satisfaction is encoded in red. Endpoints that are included in an interval are displayed with a full bullet, while those excluded are indicated with an empty bullet.

5.2.2 Differentiating types of Vendler's achievements

As detailed in Section 5.1.3.2, the way the culmination/happening distinction can be made is by reference to *secondary scales of change*: culminations, but not happenings are associated with multi-valued secondary scales of change. This forms the basis for predicting a different interpretation for the combination of different modifiers and operators with happenings, culminations and accomplishments.

As for the question of how semelfactives and non-semelfactive happenings are differentiated, I argue that their difference does not lie in *structural* properties of their associated scales of change. Instead, it depends on the specification of the temporal duration of the states described by the two degrees on the scale of change of the respective predicate types. For non-semelfactive happenings like *recognise* and *explode*, the states corresponding to the minimum (not being aware of someone, and being whole, respectively) and the maximum (being aware of someone, and not being whole, respectively) are specified to hold at a *non-degenerate interval*, i.e., to take some minimally specified time. For semelfactives like *The light flash*$_{\emptyset}$, the states corresponding to the minimum (the light not being illuminated) and the maximum (the light being illumi-

about the predicates of the quantization puzzle, just as Krifka's (1989, 1992, 1998) quantization and homomorphism-based account (cf. Filip 2011b). As an example, given an event during which John ate 6 sandwiches, the scale of satisfaction for *eat at least 3 sandwiches* contains all degrees equal to or higher than the state of John having eaten the third sandwich.

nated) are *not* specified to hold for more than an instant (at the particular granularity). This *lack* of a constraint on the duration of either their pre-state or their post-state is what makes semelfactives "full-cycle" predicates (in the terminology of Talmy 1985, 1988) and enables them to be iterated easily. Of course, nothing then precludes these states from holding at a longer interval, which is the most general case for their pre-state (usually, a light is assumed not to be illuminated for some period before flashing), but it is also possible for their result state (the light being illuminated), as the following example shows:

(5.4) Then, it flashed and remained illuminated.[9]

The same observation was made by Beavers (2013), whose example was *I hit the car (once), but my hand got stuck so I never pulled it away.*

5.2.3 Verbs and verb phrases

Based on the foregoing, the following summarizes the kind of scales that are associated with English non-stative *verbs* (whose the asserted content may be represented in any way, such as through a decompositional analysis building on Dowty 1979, or in a Neo-Davidsonian framework as in Parsons 1990, etc.) at their natural granularity levels:

- Activities (e.g., *walk*): these are associated with multi-valued scales, because the events in their extension are extended, and so the scales of change associated with these events are necessarily multi-valued in all contexts.
- Accomplishments (a marginal class, e.g., *recover*): these are also associated with multi-valued scales (but with a specific degree at which their scale of satisfaction starts), because the events in their extension are extended. The result state of these verbs holds for an extended period of time.
- Telic scalar/incremental verbs (e.g., *cross*): these are associated with binary and multi-valued scales alike, as events in their extension include both instantaneous events (e.g., events in the extension of *John crossed the border at noon*) and extended events (e.g., those in the extension of *The army crossed the border in 2 hours*). The result state of these verbs holds for an extended period of time.

[9] http://www.ptcruiserlinks.com/forum/general-pt-cruiser-discussions/27896-mil-check-engine-light-without-dtc.html

- Culminations (e.g., *arrive*): these are associated with binary scales of change, as events in their extension are non-extended and hence associated with binary scales in all contexts; but they are also associated with multi-valued secondary scales of change. The result state of these verbs holds for an extended period of time.
- Non-semelfactive happenings (e.g., *explode*): these are associated with binary scales of change, as events in their extension are non-extended and hence associated with binary scales in all contexts. The result state of these verbs holds for an extended period of time.
- Semelfactives (e.g., *flash*): these are associated with binary scales of change, as events in their extension are non-extended and hence associated with binary scales in all contexts.

For instance, the primary scales of change of the culmination *arrive* include the following, where γ is any natural granularity function for *arrive* (for brevity, I omit the model M and the variable assignment g parameters):

$$\begin{aligned}\mathsf{PrSoC}_\gamma(\hat{}\textit{arrive}) = \{&\langle \cup\{[\![\mathsf{not\_at}(j,z)]\!]^{w,\gamma,c} \mid w \in W\}, \cup\{[\![\mathsf{at}(j,z)]\!]^{w,\gamma,c} \mid w \in W\}\rangle,\\ &\langle \cup\{[\![\mathsf{not\_at}(j,z)]\!]^{w,\gamma,c'} \mid w \in W\}, \cup\{[\![\mathsf{at}(j,z)]\!]^{w,\gamma,c'} \mid w \in W\}\rangle,\\ &\langle \cup\{[\![\mathsf{not\_at}(m,x)]\!]^{w,\gamma,c} \mid w \in W\}, \cup\{[\![\mathsf{at}(m,x)]\!]^{w,\gamma,c} \mid w \in W\}\rangle,\\ &\langle \cup\{[\![\mathsf{not\_at}(m,x)]\!]^{w,\gamma,c'} \mid w \in W\}, \cup\{[\![\mathsf{at}(m,x)]\!]^{w,\gamma,c'} \mid w \in W\}\rangle, \dots\}.\end{aligned}$$

At the verb phrase level, at which the agent (and often the goal) of *arrive* are specified, many of these scales are eliminated, leaving only those scales which are associated with events in the extension of the *verb phrase*, e.g.,

$$\begin{aligned}&\mathsf{PrSoC}_\gamma(\hat{}\textit{John arrive}_\emptyset\textit{ at the station}) =\\ &\quad\{\langle \cup\{[\![\mathsf{not\_at}(j,\mathsf{station})]\!]^{w,\gamma,c} \mid w \in W\}, \cup\{[\![\mathsf{at}(j,\mathsf{station})]\!]^{w,\gamma,c} \mid w \in W\}\rangle,\\ &\quad\ \langle \cup\{[\![\mathsf{not\_at}(j,\mathsf{station})]\!]^{w,\gamma,c'} \mid w \in W\}, \cup\{[\![\mathsf{at}(j,\mathsf{station})]\!]^{w,\gamma,c'} \mid w \in W\}\rangle, \dots\}.\end{aligned}$$

The secondary scales of change of *arrive*, in turn, include the following (where z_i, z_j are different from z and are on a path extending to z, and likewise for x_i, x_j and x):

$$\begin{aligned}\mathsf{SeSoC}_\gamma(\hat{}\textit{arrive}) = \{&\langle \cup\{[\![\mathsf{at}(j,z_i)]\!]^{w,\gamma,c} \mid w \in W\}, \cup\{[\![\mathsf{at}(j,z_j)]\!]^{w,\gamma,c} \mid w \in W\},\\ &\dots, \cup\{[\![\mathsf{at}(j,z)]\!]^{w,\gamma,c} \mid w \in W\}\rangle, \langle \cup\{[\![\mathsf{at}(m,x_i)]\!]^{w,\gamma,c} \mid w \in W\},\end{aligned}$$

$$\cup\{[\![\mathsf{at}(m,x_j)]\!]^{w,\gamma,c} \mid w \in W\},\ldots,\cup\{[\![\mathsf{at}(m,x)]\!]^{w,\gamma,c} \mid w \in W\}\rangle\}.$$

Again, at the verb phrase level, only those scales are kept which are associated with events in the extension of the verb phrase.

As for the happening *explode*, it is only associated with primary scales of change, namely, those binary scales of change that are associated with events in its extension:

$$\begin{aligned}\mathsf{PrSoC}_\gamma(\hat{}\textit{explode}) = \{&\langle\cup\{[\![\mathsf{whole}(x)]\!]^{w,\gamma,c} \mid w \in W\},\\ &\cup\{[\![\mathsf{disintegrated}(x)]\!]^{w,\gamma,c} \mid w \in W\}\rangle,\\ &\langle\cup\{[\![\mathsf{whole}(x)]\!]^{w,\gamma,c'} \mid w \in W\},\cup\{[\![\mathsf{disintegrated}(x)]\!]^{w,\gamma,c'} \mid w \in W\}\rangle,\\ &\langle\cup\{[\![\mathsf{whole}(y)]\!]^{w,\gamma,c} \mid w \in W\},\cup\{[\![\mathsf{disintegrated}(y)]\!]^{w,\gamma,c} \mid w \in W\}\rangle,\\ &\langle\cup\{[\![\mathsf{whole}(y)]\!]^{w,\gamma,c'} \mid w \in W\},\cup\{[\![\mathsf{disintegrated}(y)]\!]^{w,\gamma,c'} \mid w \in W\}\rangle,\ldots\}.\end{aligned}$$

The scales of change of a semelfactive like *flash* have the same structure as those of non-semelfactive happenings, e.g.,

$$\begin{aligned}\mathsf{PrSoC}_\gamma(\hat{}\textit{flash}) = \{&\langle\cup\{[\![\mathsf{dark}(x)]\!]^{w,\gamma,c} \mid w \in W\},\cup\{[\![\mathsf{illuminated}(x)]\!]^{w,\gamma,c} \mid w \in W\}\rangle,\\ &\langle\cup\{[\![\mathsf{dark}(x)]\!]^{w,\gamma,c'} \mid w \in W\},\cup\{[\![\mathsf{illuminated}(x)]\!]^{w,\gamma,c'} \mid w \in W\}\rangle,\\ &\langle\cup\{[\![\mathsf{dark}(y)]\!]^{w,\gamma,c} \mid w \in W\},\cup\{[\![\mathsf{illuminated}(y)]\!]^{w,\gamma,c} \mid w \in W\}\rangle,\\ &\langle\cup\{[\![\mathsf{dark}(y)]\!]^{w,\gamma,c'} \mid w \in W\},\cup\{[\![\mathsf{illuminated}(y)]\!]^{w,\gamma,c'} \mid w \in W\}\rangle,\ldots\}.\end{aligned}$$

But the pre- and result states (represented by the first and second degree on each scale, respectively) of semelfactives are not specified to hold for more than an instant, as opposed to those of *explode*-like happenings.

It is again to be emphasized that these predicate-level scales of change are inherited from events, and so the *extension* of a predicate at different possible worlds is what ultimately determines the scales associated with it. As additional information is added (complements, modifiers etc.), the extension shrinks (e.g., the extension of *John arrive*$_\emptyset$ *at the station* is a subset of the extension of *arrive*), and along with it, the set of associated scales of change also shrinks (because the scales of change associated only with events that are not in the extension of the more complex predicate are not scales of the complex predicate).

5.3 The progressive

5.3.1 Integrating a definition of the progressive into the scale-based framework

The amount of existing work on the semantics of the progressive is immense and intricate, ranging from temporal viewpoint accounts (such as Bennett and Partee 1972, as well as Klein 1994) through modal approaches (such as Dowty 1979, Landman 1992, Asher 1992, Portner 1998, Bonomi 1999) and accounts which rely on the progressive as a primitive (such as Parsons 1990, Gendler Szabó 2004, 2008) to analyses relying on informational, indicative links (Varasdi 2010, 2014). I will not offer a comprehensive semantics of the progressive here aiming to address all the intricate issues which have formed the centre of debate for the past decades, but will instead focus on its viewpoint component, and argue that it should be about *change* (i.e., something qualitative), rather than *runtime* (i.e., something quantitative) — as opposed to, for instance, temporal adverbials like *at noon* or *in an hour* which *are* about runtime. As such, the analysis offered below is a simplification, aiming only to capture one aspect of the relevant operators, but I will hope to show the at least *prima facie* tenability and potential advantages of a scale-based approach.

A further limitation to keep in mind is that the present discussion, just as the thesis itself, is geared toward English. At the same time, I subscribe to the view that the basic semantics of aspectual operators are similar across languages (or at least, across some set of languages), with language-specific variations captured by parametric differences — in the fashion of Altshuler (2014), who presented a typology of partitive aspectual operators parametrizing language-specific differences through a handful of criteria. Section 5.6 will therefore be devoted to a brief look at how the present account of English aspectual operators could be extended to aspect in other languages.

As for English, I here propose to conceive of the progressive as expressing that a change of a particular kind is going on, and there is still a potential to satisfy the corresponding predicate at a later stage. In terms of the scale of change, this means having the possibility to continue to higher degrees to become an eventuality falling under the relevant predicate. There are a number of ways in which to make this informal idea explicit, the most straightforward solution being to embed the scale-based idea into an existing progressive theory in lieu of temporal or event mereological relations. To this end, I will briefly (and without any exhaustivity) discuss some considerations for selecting a theory from the available theories of the progressive.

The scale of change-based approach naturally lends itself to a Landman-style characterisation, for instance. The degrees on the scale of change can be seen as corresponding to the boundaries of *stages* in the account of Landman (1992). We may say, building on Landman (1992) (but without using his sophisticated machinery involving continuation branches, for simplicity), that $[\![\text{PROG}(^\wedge P)(e)]\!]^{M,w_0,g,c,\gamma} = 1$ iff there is a P-event e' occurring in a world w which is a reasonable option for e in the world w_0 of evaluation, whose scale of change is a proper superset of that of e, that is, $\sigma_{w_0,c}(\gamma, g(e)) \subset \sigma_{w,c}(\gamma, e') \wedge e' \in [\![P]\!]^{M,w,g,c,\gamma}$. The problem with such an existential quantification-based characterisation is that it is known to be vulnerable to cases where only a disjunctive progressive statement is true, such as the coin-flipping scenario that prompted Dowty to modify his possibility-based account (Dowty 1977) to a necessity-based one (Dowty 1979), or the multiple-choice paradoxes described by Bonomi (1999).

In particular, the proposed possibility-based scalar account of the progressive will result in *false positives*. For example, to take the coin-flipping scenario, the proposed definition, just like that of Dowty (1977), would incorrectly predict that all of (5.5a)–(5.5c) is true when a coin has just been flipped (because the change going on is compatible with all three predicates), even though speakers would only regard (5.5c) as true:[10]

(5.5) a. The coin is coming up heads.
b. The coin is coming up tails.
c. The coin is coming up heads or tails.

One way to overcome this problem is to change existential quantification over reasonable worlds to universal quantification over continuation *trees*, as suggested in Gendler Szabó (2004). Another option is to go with the approach in Dowty (1979) who employs universal quantification over *inertia worlds* (worlds in which the course of events develops inertially), which is the choice of Deo (2009), for instance.

However, there have been several objections raised against the notion of inertia worlds from as early on as Vlach (1981), who argues that in a scenario when Max is hit by a bus while crossing a street, close to the moment when Max is hit, in no

[10] Landman's (1992) account predicts that exactly one of (5.5a)–(5.5b) is true, which is also an incorrect prediction. The reason the proposed Landman-style scale-based definition patterns with that of Dowty (1977) instead of Landman (1992) is that it does not refer to a single continuation branch constructed based on similarity between worlds but uses existential quantification over reasonable worlds instead. The definition could be made more faithful to Landman (1992) by restricting existential quantification to reasonable worlds on the continuation branch, but that would not eliminate the problem of a false positive.

inertia worlds does he get across the street, which would incorrectly predict that at that moment, *Max was crossing the street* is false. Indeed, similar problems might apply to the notion of a "reasonable option" in Landman (1992). Take the sentence

(5.6) Samantha was crossing the minefield.

from Asher (1992), which he mentions as a potential counterexample to his own progressive theory referring to "normal" worlds. As Asher notes, people are not normally able to cross minefields, so we can assume that successfully crossing the minefield is also not a *reasonable option* for Samantha, so Landman (1992) (whether employing existential or universal quantification), like Asher (1992), would incorrectly predict (5.6) to be false — a *false negative* due to the notion of reasonability.

So given these very brief considerations, I here opt for an account of the progressive based on Varasdi (2014), who employs quantification over event predicates, instead of possible worlds. Informally, and with some simplification, on his account, PROG$(P)(e)$ holds iff, out of a contextually determined set of disjoint predicates including P, it is only P-events into which e can develop. In this case, the observed characteristics of e are *indicative* of P with respect to the contextually given set of alternative predicates.

5.3.2 The components of the progressive

I now turn to adapting Varasdi's (2014) to my scale of change-based framework. We need a definition according to which a progressive is true whenever a change of the relevant kind (and only the relevant kind out of a set of alternatives) is happening, and there is still a possibility for it to continue. What we aim to capture with a scale- and alternatives-based definition of the progressive is that the way we categorize ongoing eventualities in terms of complete types is by matching the *change schemata* of the types to the actual change and select the one that fits out of a set of alternatives. Thus, in what follows, let us collect the components needed for an adequate scale-based definition of when PROG$(\hat{}\varphi)(e)$ is true.

A non-final subscale component. The most crucial part of a scale-based definition of the progressive has to take the place of those components of event-mereological definitions of the progressive that refer to a part-of relation between events. The goal of the whole scale-based framework is to enable us to have the progressive refer to

a part-of relation over scales, instead. So instead of a (non-final) part-of relation over events ($e \sqsubset_E e'$), our progressive definition will have to include a (non-final) part-of relation over scales of change. To this end, the non-final subscale relation defined in Definition 6 will be used ($S_i \subset_{\mathsf{nf}} S_j$). The rationale behind the non-final subscale requirement is based on the intuitive view of the progressive as referring to the interior part of an event (cf. Section 2.1.1). But by using scales, instead of events, we can ensure that culmination predicates, which are associated with multi-valued secondary scales, are admissible in the progressive. Thus, the superscale (S_j) of the non-final subscale relation has to be *either* a primary scale of change associated with the input predicate, or a secondary scale of change associated with it. As for the scale that we require to be its subscale, it must be associated with the eventuality of which the progressive is predicated: it is the ongoing event that has to realize a part of the change associated with the predicate. Thus, a non-final subscale component of the progressive definition will be $\sigma_{w,c}(\gamma, e) \subset_{\mathsf{nf}} \mathcal{S}$ for some $\mathcal{S} \in (\mathsf{PrSoC}(\hat{}\varphi) \cup \mathsf{SeSoC}(\hat{}\varphi))$.

Such a non-final scale requirement directly ensures that the culmination point is not part of the event that makes the progressive true. And it also ensures that the predicate φ need not get realized in the actual world: because the primary and secondary scales associated with a predicate contain the scales of change of all eventualities the predicate applies to at *all* possible worlds, the scale of change whose non-final subscale is realized by an actual event may never be realized in the world of evaluation. The scale of change in question might be associated with an event that is only realized at a different possible world.

The non-final subscale requirement also precludes the progressive from applying to a state predicate P, which is associated with singleton primary scales of change (cf. Section 5.2). Because there are no degrees below a single degree, the scale of change of e in the definition cannot be a non-final subscale of any of the scales of P. So states cannot satisfy the non-final subscale requirement of the progressive. Note that it is well known (cf. Dowty 1979, Bach 1981) that states (more precisely, 1-state predicates) *can* sometimes appear in the progressive, in which case they take on a transitoriness meaning component (cf. the contrast between Bach's 1981 pair of examples, *I live in Massachusetts* and *I'm living in California*: the latter, but not the former implies that the place of residence in question is temporary). The way this combinability with the progressive can be modelled in the present framework is to have 1-state predicates be associated with activity-like secondary scales of change, as proposed in Section 5.1.3.2, and then the progressive could be made true by such a *multi-valued secondary scale of*

change. Given the non-final subscale requirement, this would imply that the state can change in the future, which may be responsible for the implication of transitoriness.

A contrastive component. At this point, however, the requirement on the progressive is too weak, because it involves existential quantification over scales (just as we have seen in the initial reasonable options-based definition in Section 5.3.1). We need a way to exclude false positives in multiple-choice scenarios like the coin-flipping case mentioned in Section 5.3.1. This is where the account of Varasdi (2014) can be directly put to use: we need to refer to a contextually determined set Θ_c of alternative predicates that capture the outcome possibilities relevant in the given context. Then, just as Varasdi (2014), we can require that exactly one of these alternatives (namely, the predicate that is the argument of the progressive) satisfy the requirements of the progressive — in our case so far, that the scale of an actualized event be a non-final part of a primary or secondary scale of change of the predicate. Now, when a coin is flipped, the contextually relevant predicates are *the coin come*$_\emptyset$ *up heads* and *the coin come*$_\emptyset$ *up tails*, and the change going on is characteristic of both elements of this set of alternatives, so the progressive of either predicate will fail to be true. For further reasons to refer to a set Θ_c of alternatives in the definition of the progressive, see Varasdi (2014).

Complexity requirement. The components of the scale-based definition discussed so far still overgenerate true progressives. In particular, e can be a state associated with a singleton scale of change, and then nothing precludes it from satisfying the non-final subscale and potentially the contrastive components of the definition for a happening predicate φ (e.g., *notice*). In particular, if the scale of e is a singleton, it can be identical to the initial degree of a binary scale of φ, and so a false positive would arise: e.g., *Mary is noticing John* would be incorrectly predicted to be felicitous at an everyday granularity.

What we need is to ensure that a *change* of the relevant kind is going on. A state cannot be *indicative* of an achievement (or an activity or an accomplishment, for that matter) in the terminology of Varasdi (2014); or in the terminology of Landman (1992), it cannot be a *stage* of one. Landman (1992) refers to "stages" instead of simply parts in his definition of the progressive for precisely this reason: while a state may be part of an event, it cannot be a stage of it, because a stage has to be "developed" enough to be recognizable as a stage of some event. Using the idea put forth in Section 5.3.1 that the boundaries of stages correspond to the degrees on a scale, we can translate Landman's stage-based requirement into a requirement on scale complexity: the scale

of the ongoing event e has to be developed enough to be of the *same complexity* as the scale of the predicate whose non-final part it is. Thus, an activity or an accomplishment can only be in progress if an extended change is happening, because the ongoing event e has to be associated with a multi-valued scale which in turns entails that e has to be extended.

In contrast, take an achievement predicate Q, and take its primary scales of change. PrSoC($\hat{}Q$) for such a predicate consists of binary scales, i.e., scales of the structure $\langle d_1, d_2 \rangle$. Then, given the non-final subscale requirement, the progressive of φ could only be true of e if the scale of change of the eventuality e is a *singleton*, consisting of d_1. But then the complexity requirement is violated, because $\sigma_{w,c}(\gamma, e)$ is not a binary scale. Unless the achievement Q is associated with a multi-valued secondary scale — which is true for culminations, but not happenings (cf. Sections 5.1.3.2 and 5.2.2) — the progressive of Q can never be true.

If a progressive can never be true for a predicate, then it is reasonable to exclude the application of this operator to that predicate. Thus, the applicability condition of a multi-valued input scale is just as much a reasonable criterion for the scale-based definition of the progressive as the durative input requirement for temporal or event mereological definitions of the progressive. So I assume the following principle:

> **Principle 3 (Applicability condition of the progressive)**
> *Do not apply PROG to $\hat{}\varphi$ if $\hat{}\varphi$ is not associated with mostly (primary or secondary) multi-valued scales of change.*

The output of the progressive. What remains now is to take a stand on what kind of predicate the output of the progressive is, although this question is actually orthogonal to our focus, because a scale-based definition could be formulated with respect to any view we take about the output of the progressive. As our characterisation stands so far, the output of the progressive is a *process*, in line with the view of Mourelatos (1978): it is true of extended events and it is not telic, as it holds of all extended parts of an event that it holds of. If we want our definition to adhere to the *stativizer* view of the progressive as in Vlach (1981) and Moens and Steedman (1988), we can have the progressive apply to a state s that is a mereological part of the event e we have been discussing so far. Alternatively, the progressive PROG($\hat{}\varphi$) could also be a predicate of *time intervals*, as in Dowty (1979), Portner (1998) or Deo (2009) in the way that

PROG($\hat{}\varphi$) is true of an i such that $i = \tau(\gamma, e)$ for the event e we have been discussing so far.

A careful consideration of the behaviour of the progressive must ultimately decide between the approaches outlined in the previous paragraph. Just as I did not go into a detailed survey of which former progressive account to embed in my scale-based framework and decided on the basis of a handful of rough preliminary considerations, I here do not consider detailed arguments for or against one or the other view of the progressive. One reason to chose the stativizer view is that as remarked by, for instance, Dowty (1986), statives and progressives tend to behave similarly in terms of their discourse properties (but Dowty remarks that progressives differ from states in not typically allowing an inceptive reading[11]). Note that the parallel between the behaviour of statives and the progressive holds only if we restrict our attention to temporary states, but not when we take into account individual-level states like *John is a male*. But a progressive is clearly not an individual-level property (or put more generally, it is not what Klein 1994 calls a 0-state predicate), which is shown by its combinability with a time point adverbial: *John was walking at noon* is just as felicitous as *John was happy at noon* (a stage-level/1-state predicate), in contrast to *#John was a male at noon* (an individual-level/0-state predicate). Thus, on a stativizer view of the progressive, the output of the progressive operator must be a 1-state predicate. And given a commitment to 0-state predicates being predicates of time intervals (cf. Section 5.2.1), this is borne out, as the progressive outputs a predicate of state tokens, and so can only be a 1-state predicate.

No perfect progressive. A more interesting case can be made for the stativizer view of the progressive based on the perfect progressive that is also pertinent to the focus of the dissertation. It has been noted in previous works (cf. e.g., Mittwoch 1991, Rothstein 2004) that even achievements which may combine with the progressive are generally infelicitous (cf. (5.7b)) or bizarre and ironic (cf. (5.7c)) in the perfect(ive) progressive, in contrast to accomplishments (cf. (5.7a)), as the following examples from Rothstein (2004, p. 44) illustrate.

(5.7) a. She has been cooking dinner (for half an hour).
b. #Fred and Susan have been leaving.
c. ?Fred and Susan have been leaving for an hour.

[11] Though it seems to me that, for instance, *Suddenly, he was singing* most naturally has an inceptive reading.

As noted by several authors (e.g., Comrie 1976, Dowty 1979, Kamp and Reyle 1993, Portner 2003, de Swart 2007), while the perfect of telic predicates describes their result state, the perfect of statives such as *John has lived in New York for three years* has a continuative or persistent reading (beside an experiential perfect reading) on which the relevant state is understood to be still ongoing. If we take the view of the progressive as a stativizer (i.e., it outputs states), then what is predicted is a *continuative interpretation* when the input to the perfect is a progressive. (And conversely, we predict that the progressive cannot have a perfect in its scope if we also take a stativizer view of the perfect.) This prediction is borne out, as illustrated by a perfect progressive like *John has been writing the letter for 3 hours* which has a continuative, rather than a result interpretation.

Now, since a progressive achievement is generally synonymous with an *about to* construction and so takes very little time (see, e.g., Kearns 1991, Rothstein 2004), it is generally odd to assert that it was going on for the relatively long time that a reference interval in everyday scenarios entails. Thus, the ironic nature of (5.7c) arises from the expectation that Susan and Fred's state of leaving an hour before was to be over quite soon thereafter, and so they cannot seriously have been leaving at that time.

So I propose that the oddness of achievements in the perfect progressive is rooted in a similar non-compatibility of interval sizes as is the reduced combinability of non-semelfactives with the iterative reading of the progressive (cf. Section 2.1.2). But just as there are non-semelfactive iteratives, there are also non-ironic perfect progressive achievements:

(5.8) a. …the world has been winning the race between population growth and food production[12]

b. Like a man who has been dying for many days, a man in your city is numb to the stench.[13]

Importantly — and in line with the present proposal — the achievements that can appear in such a (non-iterative) perfect progressive construction are typically those in whose case the imminency meaning component is often *absent*: *win* and *die* are well known to be entirely acceptable in situations when the culmination (the actual death

[12] http://www.voanews.com/content/global-population-predictions-report-united-nations-science/2454734.html

[13] https://www.goodreads.com/quotes/554034-like-a-man-who-has-been-dying-for-many-days

and the culmination of the race) is not, yet, imminent. The example below illustrates such a situation:

(5.9) [H]e was one hundred and seventy days dying and not yet dead (from *The Stars My Destination* by Alfred Bester)

But for achievements like *arrive* in whose case a progressive like *John is arriving* is synonymous with *John is about to arrive*, we do observe the incompatibility between the imminency of the culmination and the natural length of a reference interval for a perfect progressive. As such, in their cases, a pluractional (iterative or habitual, cf. Bertinetto and Lenci 2012) reading of the perfect progressive can ensue only, as in (5.10).

(5.10) ...spring has been arriving weeks early for years[14]

Thus, if we take the stativizer view of the progressive, then a continuative reading of a perfect progressive is correctly predicted, and the incompatibility with progressive achievements implying imminency of the culmination can also be explained.

The definition of the progressive. Given the foregoing discussion, I propose the following definition of the progressive, according to which PROG($\hat{}\varphi$)(s) holds iff the state denoted by s is a part of some event e such that the scale of change associated with event e is a *non-final part* of a primary or secondary scale of change of φ, and *only* φ out of the contextually given alternatives (defined as in Varasdi 2014), with the proviso that the complexity of the scale of e is the same as that of φ whose non-final part it is:[15]

> **Definition 21 (The progressive in a scale-based account)**
> $[\![\text{PROG}(\hat{}\varphi)(s)]\!]^{M,w,g,c,\gamma} = 1$ *iff*
>
> 1. ***(Progressive as a stativizer:)*** $g(s) \in E_{\text{stat}}$ *and there is an eventuality* e *occurring in* w *such that* $g(s) \sqsubseteq_E e$ *(where* $\sqsubseteq_E$ *is the non-strict part-of relation over eventualities) and*

[14] http://www.theguardian.com/environment/blog/2014/mar/20/spring-equinox-google-doodle-season

[15] The contrastive requirement will be slightly revised below in Section 5.3.3.

2. ***(Non-final subscale requirement:)*** *there is a scale* $\mathcal{S} \in (\mathsf{PrSoC}(\hat{}\varphi) \cup \mathsf{SeSoC}(\hat{}\varphi))$ *such that* $\sigma_{w,c}(\gamma, e) \subset_{\mathsf{nf}} \mathcal{S}$ *(where* $\subset_{\mathsf{nf}}$ *is the non-final subscale relation defined in Definition 6, and* PrSoC *and* SeSoC *are the primary and secondary scales of change of a predicate as defined in Definitions 15 and 17, respectively), and*

3. ***(Complexity requirement:)*** $\sigma_{w,c}(\gamma, e)$ *is of the same complexity as* $\mathcal{S}$ *(where the three levels of scale complexity are those listed in Table 3.1) and*

4. ***(Contrastive requirement:)*** *there is no* $\psi \neq \varphi \in \Theta_c$ *such that* $\sigma_{w,c}(\gamma, e) \subset_{\mathsf{nf}} \mathcal{S}'$ *for some* $\mathcal{S}' \in (\mathsf{PrSoC}(\hat{}\psi) \cup \mathsf{SeSoC}(\hat{}\psi))$*, where* Θ_c *is a set of mutually disjoint predicates that includes* φ*, given by context* c*.*

Figure 5.5 provides an informal graphic rendering of the scale-based definition of the progressive (disregarding the contrastive requirement).

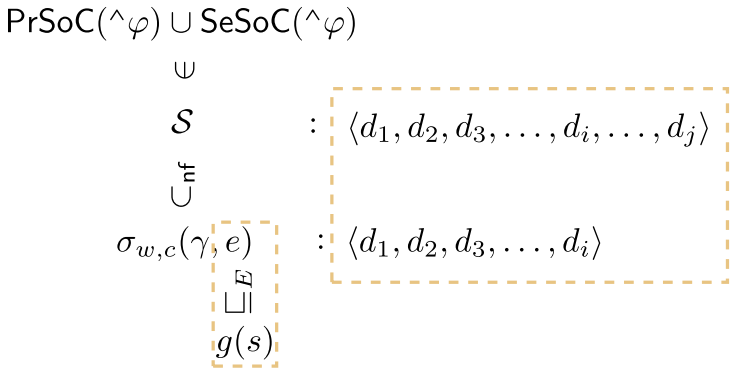

Figure 5.5: Illustration: the progressive in a scale-based account

It is important to emphasize that the progressive does *not* operate on scales even in this framework. PROG operates on an eventuality property and outputs an eventuality predicate. It is in determining the *truth conditions* of a progressive sentence that we refer to scales.

Event-parts vs. scale-parts. Where Definition 21 differs from that of Varasdi (2014) is that it focuses on scale inclusion rather than event inclusion and thus offers a way to account for progressive culminations via reference to their multi-valued secondary scale. Indeed, culminations are the only case where the two progressive accounts differ. In the case of accomplishments, the $\sigma_{w,c}(\gamma, e) \subset_{\mathsf{nf}} \mathcal{S}$ part of the definition holds just in case e is a non-final part of some $e' \in [\![\varphi]\!]^{M,w',g,c,\gamma}$ for some possible world w', that is, if it is a non-final part of some (possible) φ-event.

On Varasdi's (2014) account, the progressive of activities is made true by the eventuality occurring in the world of evaluation itself (corresponding to e in Definition 21), as he uses the *non-strict* part-of relation $\sqsubseteq_E$ over eventualities. So activities also constitute a minor point of difference, but not in the truth conditions of the progressive, because what makes activities activities is that they can be potentially continued infinitely (cf. the characterisation of them by Beavers 2013 as involving a change to an *existentially bound* value on their scale of change), that is, there is always a possible event falling under the activity predicate with a more developed scale of change than the maximal one occurring in the world of evaluation. So whenever a progressive activity holds on Varasdi's definition, it holds on mine, and *vice versa*.

As for achievements, in Section 5.4 I will inspect in more detail how the theory proposed here fares. But first, I present some potential complications to Definition 21 of the progressive, one of which will prompt a slight revision in the contrastive requirement.

5.3.3 False positives and negatives and the role of the contrast set

No false positives. The question may arise whether the essentially disjunctive criterion referring to primary and secondary scales ($\mathsf{PrSoC}(\hat{}\varphi) \cup \mathsf{SeSoC}(\hat{}\varphi)$) in Definition 21 is not subject to the same problems as a disjunctive definition of the progressive referring to either the asserted or the presupposed content that I tentatively suggested in Section 2.2.2 as a solution for accounts of culminations as presupposing their activity part. However, the problem for that proposal was that there are all kinds of presupposed contents (an example was *manage to open the door*, which presupposes trying to open the door), and so allowing the progressive to access these contents heavily overgenerates the cases when a progressive sentence is predicted to be true. In contrast, secondary scales of change are specific to the actual change we want to associate with a predicate. Thus, false positives like x *is managing to open the door* while x is simply trying to open the door are excluded on the present disjunctive definition of the progressive.

However, there is a class of predicate which raises problems for the present account as well, namely those involving aspectual verbs like *stop* or *finish*. These present a problem for a theory of the progressive according to which the progressive can access the presupposed content of a predicate—because *stop* ϕ*-ing* presupposes the prior truth of ϕ-ing, and so, for instance, *John is stopping walking* is incorrectly predicted to be true during an event of John walking. These cases also present a problem for

a coercion account like that of Rothstein (2004) — because, in an exactly parallel way to how Rothstein's analysis was shown in Section 2.2.4.2 to incorrectly predict *Mary is recognising John* to be true during Mary's walk toward John prior to her noticing him, *John is stopping walking* is also incorrectly predicted to be true at the time John is walking, because *stop walking* can be successfully coerced into a derived accomplishment in Rothstein's (2004) sense with its activity part being the process of John walking.

While the present account successfully excludes the progressive of happenings like *notice* or *recognise* from being true during some process preceding an event in their extension through the requirement on *cover events* to the effect that, informally, the different stages of the process have to be *elaborations* on the pre-state of the happenings (cf. Section 5.1.3.1 for details), the problem is that the cover event relation is formally satisfied by, say, a walking-event and an event of stopping walking. Informally, the pre-state of stopping walking is a state of being in the process of walking (a progressive state), and the contextually relevant aspects of different stages of the walking process are of course elaborations on being in the process of walking (say, having taken one step, lifting one's leg for the second time, etc.). Thus, the scales of change associated with walking-events will count as secondary scales of *stop walking*, to which the progressive then can have access. So, given simply a definition of the progressive involving partitivity over scales does not exclude the false positive x *is stopping walking* being true during a walking-event.

However, Definition 21 of the progressive has further conditions on the truth of the progressive, and in particular, the *contrastive requirement*. As seen already above in Section 5.3.2, a contrastive component of the progressive is necessary to exclude some false positives, namely, the incorrect truth of *The coin is coming up heads* in the coin-flipping scenario. This same component also successfully excludes the truth of x *is stopping walking* during the event of x walking. Arguably, for the evaluation of a progressive like x *is stopping walking*, the relevant alternative outcomes are {*stop walking*, *continue walking*}. But then although the scale of change associated with a walking-event (describing different stages of walking) is a non-final subscale of a scale associated with *stop walking* for the reason mentioned above, it is also a non-final subscale of a scale associated with the activity *continue walking*, contradicting the contrastive requirement. Thus, x *is stopping walking* is — correctly — not predicted to be true during x's walk according to Definition 21.

Excluding false negatives. The problem with the definition, as it stands, is that it allows for *false negatives*. In particular, in the very same scenario of x walking, x *is continuing to walk* is also — this time incorrectly — predicted by the Definition 21 to be false, because the case is exactly parallel to x *is stopping walking*: the set of alternative outcome predicates includes x *stop walking*, and so the contrastive requirement is again not satisfied. The problem is that the *cover event* relation as defined in Section 5.1.3.1 is only sensitive to the relation between the gradual change associated with the cover event and the initial phase of the non-gradual change associated with an instantaneous event, and does not model the intuitive idea that the gradual change is not only the elaboration of the *pre-state* of an achievement predicate, it also brings the state of affairs closer to the *post-state* of the achievement being realized: in the case of *arrive*, for instance, movement towards the goal brings the theme closer to being *at* the goal. In contrast, walking does not bring the agent closer to stopping walking. However, I see no way of modelling this idea in a classical semantic framework. We could of course simply say that culmination predicates like *arrive* (but not predicates like *stop*) are specified in the lexicon to be associated with a specific set of secondary scales, but this would be merely a representation of the state of affairs, and would not follow from the properties of the *model* — which would be the requirement of a model-theoretic analysis (cf. the discussion in Section 3.3.1).

The solution I propose is instead to integrate a further line of research into our analysis, namely, one which refers to a notion of "significant difference" among alternatives. Such a notion has been proposed for example by Fara (2000) for the semantics of gradable adjectives like *expensive* (according to which *the car is expensive* means that the car costs significantly more than is typical) and by Lassiter (2011a) for the semantics of the adjectives *probable* and *likely* (according to which x *is probable* is true if the probability of x is greater than a value that is significantly greater than the average likelihood of the contextually relevant alternatives).

More pertinent to the present analysis, Martin (2015) introduced such an element of significantly greater difference into Varasdi's (2014) progressive definition in order to explain the behaviour of *defeasible causatives* like *explain*. Defeasible causatives are predicates whose encoded change of state can be entirely denied, e.g., *The teacher explained the theorem to the students* is compatible with the truth of *But the students failed to understand the theorem*. Martin (2015) shows how Varasdi's (2014) progressive theory relying on the properties of a situation being *indicative* of exactly one outcome predicate out of a set of alternatives can be used to explain the behaviour of defeasible causatives if his definition is modified in the following way (my italics):

> Given a set of alternatives $\Theta_C = \{\theta_1, \theta_2, \ldots, \theta_n\}$ and an event e, we say that the set of properties $\mathcal{F} = \{P \mid P(e)\}$ of event e *indicate* θ_k w.r.t. Θ_C iff e realizes significantly more sine qua non conditions of θ_k than of any other alternative in Θ_C: $|\mathcal{F} \cap \mathsf{Sqn}(\theta_i)|$ is *significantly bigger* if $i = k$ than otherwise (i.e., if $i \neq k$).

I propose to integrate Martin's (2015) modification of Varasdi's (2014) account into my own definition of the progressive. In particular, we can say that the contrastive requirement of Definition 21 for the truth of PROG($^\varphi$)(s) requires the following:

- (***Revised contrastive requirement:***) the ratio of the number of the scales in the set $\mathsf{PrSoC}(^\theta_k) \cup \mathsf{SeSoC}(^\theta_k)$ that satisfy the rest of the requirements of the progressive and the number of scales in $\mathsf{PrSoC}(^\theta_k) \cup \mathsf{SeSoC}(^\theta_k)$ that do not do so is significantly greater for $\theta_k = \varphi$ than for any $\theta_k \neq \varphi$ in the set of contextually relevant alternatives Θ_c.

Since each event of walking can be continued and stopped alike, the number of scales of *continue walking* and of *stop walking* whose source is a walking-event is the same. But these are all secondary scales of *stop walking*, which describes a non-gradual change, and whose *primary* scales of change are therefore all two-valued. These two-valued primary scales of change cannot satisfy the requirements of the progressive (cf. the discussion on the interplay of the non-final subscale and complexity requirements in Section 5.3.2), and so a significantly greater percentage of the scales associated with *continue walking* satisfy the conditions of the progressive in such a scenario than those associated with *stop walking*.

That the progressive has such a graded contrastive requirement is useful in our account of progressive achievements, but as Martin's (2015) proposal shows, these do not constitute the sole motivation for it. In fact, Károly Varasdi (p.c.) has suggested that progressive accomplishments probably also require reference to such "significant difference" instead of a hard requirement on the contrast set as in Varasdi (2014) for the following reason: consider a scenario when a ball dropped into the top part of a chute rolls into a box in 99.5 percent of the cases, while in half a percent of the cases, it accidentally (by a design flaw) gets diverted near the bottom and rolls into a puddle instead; while the ball is in the top part of the chute, although the course of events is compatible with both outcomes, it seems that *The box is rolling into the box* is true, or at least truthfully assertable. This claim is testable and must be experimentally verified with native speakers of English; but if it is indeed so, then the revised contrastive requirement is needed for our semantics of the progressive in any case, and exploiting

it further to exclude false negatives like *continuing walking* only provides further support for its necessity.

5.4 Culminations and happenings in the progressive

5.4.1 Deriving progressive culminations and happenings

Progressive culminations and happenings. As for culminations, Definition 21 correctly predicts that their progressive is true during the process parts of their cover events. Because the type-level scales of culminations include the multi-valued scales of change of their cover events as secondary scales, then whenever there is an eventuality e realizing a non-final part of the scale of change of some possible cover event e', that is, $\sigma_{w,c}(\gamma, e) \subset_{\mathsf{nf}} \sigma_{w,c}(\gamma, e')$, then it also realizes a non-final part of a secondary scale of change of the culmination ($\sigma_{w,c}(\gamma, e) \subset_{\mathsf{nf}} \mathcal{S}$ for some $\mathcal{S} \in \mathsf{SeSoC}(\hat{}\varphi)$).

For instance, *John is arriving at the station* is true just in case there is an event of John approaching the station whose scale of change in the given discourse context is a subscale of a secondary scale of *John arrive$_\emptyset$ at the station*. Formally, if

$$\begin{aligned}\mathsf{SeSoC}_\gamma(\hat{}\textit{John arrive}_\emptyset\ \textit{at the station}) = \{\langle \cup\{[\![\mathsf{at}(j, z_i)]\!]^{w,\gamma,c} \mid w \in W\},\\ \cup\{[\![\mathsf{at}(j, z_j)]\!]^{w,\gamma,c} \mid w \in W\}, \cup\{[\![\mathsf{at}(j, z_k)]\!]^{w,\gamma,c} \mid w \in W\}, \ldots,\\ \cup\{[\![\mathsf{at}(j, z)]\!]^{w,\gamma,c} \mid w \in W\}\rangle, \ldots\},\end{aligned}$$

where z_i, z_j, z_k are points on a path to the station with an increasingly greater proximity to the station whose location is z, then PROG(^*John arrive$_\emptyset$ at the station*) is true (in the evaluation world w_0) of a state that is part of an event e whose scale of change is

$$\begin{aligned}\sigma_{w_0,c}(\gamma, e) = \{\langle \cup\{[\![\mathsf{at}(j, z_i)]\!]^{w,\gamma,c} \mid w \in W\}, \cup\{[\![\mathsf{at}(j, z_j)]\!]^{w,\gamma,c} \mid w \in W\},\\ \cup\{[\![\mathsf{at}(j, z_k)]\!]^{w,\gamma,c} \mid w \in W\}\rangle.\end{aligned}$$

A shortcoming of the present analysis, as it stands, is that it falls short of explaining why a progressive culmination like *John is arriving at the station* is true only at the *very last stage* of the process leading up to it, that is, it fails to account for the imminency meaning component — just like other analyses of progressive achievements, cf. Section 2.2. This will form the topic of Section 5.5.1 below.

In contrast to culminations, however, happenings do not have secondary multi-valued scales of change (cf. Section 5.2), so their progressive can never be true at an everyday granularity. They require a fine granularity scenario at which their scale of change is extended (cf. Chapter 4). One exception is when a happening predicate holds of an event that is extended at even a normal, everyday granularity. This is the case for the following example from Dowty (1979, p. 180):

(5.11) John is gradually realizing that you are right.

In this case, the progressive is felicitous, because *gradually realize that* x *is right* is a predicate that is true of events that are extended at everyday levels of granularity, and so its progressive can be true if there is a change corresponding to the nonfinal subscale of a (primary) scale of change associated with this complex predicate. Of course, the same event could also be described without *gradually*, as well, in which case the happening *realize that* x *is right* is automatically understood in a restricted sense as referring to the kind of realization-events that are extended in time, that is, as synonymous with *gradually realize that* x *is right*, because otherwise the sentence could never be true.

Note also that if no change corresponding to that of a cover event is going on, then even the progressive of a culmination predicate is not true. Thus, to take Piñón's (1997) example of a spy committing suicide: prior to shooting herself, the spy cannot be said to be dying, as there is no change matching any cover event of *die*, that is, there is no actual (nonstative) e such that $\sigma_{w,c}(\gamma, e) \subset_{\mathsf{nf}} \mathcal{S}$ for any $\mathcal{S} \in \mathsf{SeSoC}(\mathsf{die})$.

The advantage of a scale-based approach. The essence of the present account is that the input criterion for the progressive refers to scales of change, rather than aspectual types. On such a framework, we can predict the different readings of different progressive achievements, as seen above. A further advantage of a scale-based account is that by excluding an instantaneous to durative event type coercion, it is unproblematic to retain standard explanations of achievement behaviour relying on non-durativity, such as the infelicitousness of modification by adverbs of completion (cf. Section 5.5 below).

It is conceivable that whether the progressive has access to such a "secondary scale" is a *parameter* which can differ by language. The English progressive does have such access, while, as I will argue in Section 5.6.2, the progressive in Hungarian does not, that is, the only possible reading of a progressive achievement is the slow-motion, fine

granularity one. The *être en train de* progressive in French similar to Hungarian, being tendentially incompatible with achievements on the preliminary process reading (Bertinetto 2000).[16] Italian has a progressive form (*stare* + GERUND) which allows for a preliminary process progressive with achievements (i.e., it has access to secondary scales), and another progressive (*stare a* + INFINITIVE) which does not (Bertinetto 2000).

A further advantage of a scale-based approach to the progressive is that we can account for the non-uniform behaviour of different progressives with a uniform semantics for the progressive. Kearns (2003) and Martin (2011) have suggested that achievements are incompatible with the "standard progressive", because their progressive is true during their preliminary process, rather than their component process. In contrast, on the scale-based account proposed here, we have a unified semantics for the progressive, namely, that of an internal viewpoint over change (rather than temporal parts).

At the same time we can still account for the observation of Martin (2011) (and a related observation of Kearns 2003) to the effect that progressive (culmination-)achievements are special inasmuch as they (as opposed to progressive accomplishments) do not entail the existence of a part of an event which can possibly satisfy the base predicate. For example, no partial arrival is implied to occur by *Mary is arriving at the station*, while *Mary is reading the book* does imply that a partial book-reading event has already taken place. This is because on the present account, the progressive is true during the change possibly culminating in an arrival or the reading of a book, respectively, but while a complete event of reading the book contains partial book-reading events as parts, an event described by *arrive* is still merely the culmination, lacking any part structure. We have no durative *arrive*, it is only the output, the atelic progressive predicate *arriving at the station* that is durative. In the following section, I inspect in more detail the related issue of modification by adverbs of completion, which forms an important topic in an analysis of achievements.

5.4.2 No partial completion

There are two distinct, but closely related observations about achievements having no partial completion. One is the observation that a progressive culmination-achievement

[16] In contrast to Hungarian, though, this incompatibility is not absolute, cf. e.g., the felicitous *Il est en train de gagner intelligemment la partie* 'He's winning the game cleverly' (from Martin 2011), but such constructions are generally avoided according to Bertinetto.

does not imply that the achievement itself is partially realized, which I have already discussed above.

The other observation relates to modification by *adverbs of completion* like *halfway, halfway through, completely, partly*. I will here only focus on *halfway (through)*, primarily because it syntactically takes as its argument an *-ing* form. All cases without an *-ing* form (such as the infelicitousness of *#Mary has partly arrived at the station*) are easily explained, because in our scale-based semantics, there are no durative achievements at normal granularity levels, and so such achievements cannot be modified by adverbials requiring duration.

What is often assumed (cf. e.g., Piñón 1997, Rothstein 2004) is that achievements cannot be modified by *halfway through*:

(5.12) #Mary is halfway through arriving at the station.

The present analysis leaves the received, duration-based reasoning about this intact. If *halfway through* takes an eventuality predicate as its argument, then in the case of culminations, that is either a non-durative event predicate (in (5.12), arrive-at-the-station), and hence the unacceptability, or the complex progressive predicate (in (5.12), PROG(arrive-at-the-station)), which again is problematic for the following reason. It is generally accepted that adverbs of completion (*halfway through* at the least) can only modify telic predicates (cf. e.g., Vanden Wyngaerd 2001, Rotstein and Winter 2004, Kennedy and McNally 2005, Piñón 2005, but similar observations were already made by Tenny 1987, p. 170), cf. the unacceptability of (5.13).

(5.13) a. #John is halfway through pushing the cart./#John has halfway pushed the cart.
b. #John is halfway through living in New York./#John has halfway lived in New York.

Since progressives are arguably atelic predicates[17] (irrespective of whether we accept the stativizer view of authors like Vlach 1981 and Moens and Steedman 1988, or the process as output view of Mourelatos 1978), we should expect them to be infelicitous in combination with adverbs of completion like *halfway through*. It is important to

[17]Standard tests of atelicity (Vendler 1957, Dowty 1979) confirm this. For instance, progressive sentences can be felicitously modified with a temporal *for*-adverbial like *It seemed to me that Robinson Jeffers was building that house for years and years* from http://www.rain.org/campinternet/backcountry/weeklies/jeffers-eastwood.html.

bear in mind that the *-ing* form can not only signal the progressive, but has several other functions, as well, including nominalization (as in *Eating the cake was not a nice thing to do*), in which case the *-ing* form denotes sets of complete events of the relevant type.

In the case of *halfway through eating the cake*, *halfway through* can be argued to be the main predicate which syntactically takes an *-ing* complement. This is underpinned by the fact that

i) *halfway through* can take a nominal complement as in *halfway through the tour* (which indicates that when it combines with an *-ing* form, that is arguably a nominalization), and

ii) *halfway through* can appear without any complements as in *I'm halfway through* (which indicates that it is the main predicate). Although such examples might perhaps be argued to be a case of ellipsis, such ellipsis is not possible in the case of *partly* and *completely*, which are genuinely adverbs (*#I'm partly*).

We may therefore conclude that all adverbs of completion modify the base predicate rather than the progressive, even *halfway (through)* which requires an *-ing* form. But as already noted, the base predicate in the case of culminations is non-durative in the present framework, and so infelicitousness is expected.

On the other hand, we do find occasional examples of such modification of achievements with adverbs of completion, that is, at least for some speakers, at least some cases are acceptable. For instance, we find examples with happenings like *explode*:

(5.14) a. The bomb, **halfway through exploding**, turned itself into a beam of energy...[18]

b. Then with expert skill she did a somersault through the half-open sliding door and crawled behind two round barrels that looked as though they had frozen **halfway through exploding**.[19]

This is unsurprising, because happenings are expected to behave like accomplishments in a suitably fine-grained scenario.

But there are also cases with *halfway through* modifying a culmination. However, as an inspection of the interpretation of *halfway*-modification will indicate, these adverbs do not refer to the same interval as (preliminary process) progressive culmina-

[18] http://www.ihoz.com/spandex-p17.html

[19] http://www.kidpub.com/book-page-or-chapter/awoken-chapter-one-nick-1893129929

tions. They either make reference to the complete interval of change leading up to the culmination (i.e., the complete cover event), as in (5.15a), or to a smaller interval corresponding to the actual change described by the achievement, which enforces a slow-motion reading, as in (5.15b).

(5.15) a. **Halfway through arriving**, I'm told that we're all gonna sit down and watch a slideshow about my brother.[20]

b. The zoom-in-freeze-shot of the guy who killed you is hilarious cos' sometimes it catches the guy **halfway through dying**.[21]

Slow-motion readings like (5.15b) are straightforward, as — given a switch to a fine granularity — these cases are durative telic event predicates, just as in examples with happenings like those in (5.14). But what about cases like (5.15a)? Note that we find analogous felicitous examples with *halfway*, which syntactically does not take an *-ing* complement contrary to *halfway through*:

(5.16) a. If the view at this point was great – how much greater could the view be from the top? Some people are satisfied with their current view without realizing that **they have only halfway arrived**. If this is good – what would happen if you went higher?[22]

b. I am no doubt more than **halfway arrived** at insanity…[23]

This lends support to the proposal above that *halfway (through)* modifies the base predicate rather than the progressive. And it follows that in order for the modification of achievements (which are non-durative) with adverbs of completion like *halfway (through)* to be acceptable, these adverbs must themselves either coerce achievements into a durative predicate, or — preferably, to retain homogeneity in our semantics — access the achievement's secondary scale of change.

Note that adverbs of completion can combine with both adjectives (*halfway empty*) and verbs (*has halfway eaten X*). Piñón (2005) offered a comprehensive, degree-based account of these two uses, arguing that adverbs of completion make reference to the *degree* to which a situation type is realized. So these adverbs of completion are sensitive to and refer to degrees, i.e., a scale (instead of an event runtime), irrespective of

[20] http://discussions.redstaffapps.com/viewtopic.php?f=108&t=715
[21] http://forums.taleworlds.com/index.php?topic=178785.90
[22] http://willc1day.blogspot.de/2014/08/keep-climbing.html
[23] http://www.sandiegoreader.com/news/2009/nov/04/tgif-fear-cold-and-dark/

whether it is a scale of change or an abstract scale such as emptiness, and the extendedness of this scale is a reasonable applicability condition, just as for the progressive.

We can therefore say that for some speakers (e.g., Piñón and Rothstein), such adverbs, unlike the progressive, do *not* have access to a secondary scale of change (and hence *#halfway through arriving* is infelicitous, as it does not satisfy the criterion of an extended scale), while for some other speakers, they do.

5.4.3 Complements of aspectual verbs

Another central characteristic of achievements that any theory thereof should account for is that achievements are infelicitous as complements of aspectual verbs (Dowty 1979, Mittwoch 1991, Piñón 1997, Kearns 2003, Rothstein 2004) — as in (5.17).

(5.17) ?Mary started/finished/stopped/continued arriving at the station.

Let us take the aspectual verb *finish*. Examples with *finish* + an accomplishment predicate are felicitous (cf. (5.18a)), and note that this is so despite the fact that the progressive outputs an atelic predicate, and atelics — again, as with *halfway through* — are not as felicitous as complements of *finish* as accomplishments (cf. Dowty 1979, p. 60, and (5.18b)).[24]

(5.18) a. John finished building the house.
b. ?John finished pushing the cart/being in the room.

So we can conclude, that just as in the case of *halfway through* modification, the *-ing* form here is arguably not the progressive. Having made this point for one aspectual verb, we can generalize this to all the others (such as *stop, start*) as well, since a convincing argument should be made if we would want to maintain that one aspectual

[24]Note that there are some felicitous examples, but these appear to me to be of two special kinds. On the one hand, an activity predicate as the complement of *finish* is often contextually understood to be associated with some culmination point. For instance, *I finished working* conveys in an office setting that my work day has ended, i.e., it does not simply convey that I just stopped working and went home.

On the other hand, take a restaurant setting in which you can tell a waiter that *I've finished eating*, even though half of your meal is still on your plate. This is, I would say, a different use of *finish*, which is only compatible with *incremental predicates*, and informally means something like "an event-part of the relevant kind has been completed, and no greater event-part of the same kind will be". On this use, it is incompatible even with accomplishment predicates that are not incremental: *I've finished repairing your computer* cannot be uttered truthfully if the repair is not complete (cf. *I've finished eating my soup*, in a restaurant setting, which can be uttered even though half of the soup is still in the bowl).

verb takes the base predicate as its argument, and another, the progressive. Now, if we do not have coercion of an achievement predicate into an accomplishment predicate in our semantics at all, we have no problem drawing on the non-durativity of achievements in explaining their unacceptability as complements of aspectual verbs.

It must be noted here that happenings are unlike culminations and are admissible as the complement of *start* when the event in question is conceived of as extended, which indicates that they can behave like accomplishments:

(5.19) One of the ammo piles was hit and **started exploding**. (from *Blood on the Risers* by John Leppelman)

The same applies to the complement position of *continue*:

(5.20) The ammunition ship began to blow up, and it **continued exploding** until about 11 a.m. (from *The GI's War: American Soldiers in Europe During World War II* by Edwin P. Hoyt)

Although according to Smith (1991, p. 57), even predicates which we classify as happenings do not typically combine with *finish* or *stop*, we do find examples where they do:

(5.21) a. Father, of course, went off like a bomb and hasn't **stopped exploding** yet. (from *A Land Fit for Heroes: Miss Kirkwood's Class of Heroes* by Sullatober Dalton)

b. The ominous and rapidly-growing bulge aside, there was plenty to keep geologists on their toes during that two and a half week lull beginning in mid-April 1980. The mountain may have **stopped exploding**, but on April 20th, seismicity hit a two-week high.[25]

c. And when the universe has **finished exploding** all the stars will slow down, like a ball that has been thrown into the air, and they will come to a halt and they will all begin to fall towards the centre of the universe again. (from *The Curious Incident Of The Dog In The Night Time* by Mark Haddon)

[25] http://blogs.scientificamerican.com/rosetta-stones/prelude-to-a-catastrophe-our-best-judgement-of-risk/

d. Why the Population Time Bomb Hasn't **Finished Exploding**[26]

In contrast, examples with culminations like *arrive* in the complement position of aspectual verbs seem to require extended, mass or plural themes, resulting in a durative predicate (just as happenings are used duratively in the complement position of aspectual verbs):

(5.22) a. My dividend cheques **stopped arriving** after only two years[27]
b. There is no way to know whether data has **finished arriving**, or whether more might arrive in a millisecond (from *Python Programming On Win32: Help for Windows Programmers* by Mark Hammond & Andy Robinson)
c. The audience had only barely **finished arriving** at the venue before the tickets for the show had sold out.[28]

It must be noted though that the topics of modification by adverbs of completion and appearance in the complement position of aspectual verbs are both extremely intricate and far-reaching, and it has been impossible to truly do justice to them here. I merely wished to show what I hold to be the core observations and the routes of explanation that the present framework offers. In what follows, I turn to some further important characteristics of culminations and argue that they are all connected in some way to the imminency meaning component of progressive achievements.

5.5 Imminency and other characteristics

Like event coercion accounts of the progressive (e.g., Moens and Steedman 1988, Rothstein 2004, Martin 2011, cf. the discussion in Section 2.2), the account presented here does not in itself account for the constraint of imminency, but as I will argue, this meaning component presents more complications than is customarily assumed, anyway. More importantly, I will discuss characteristics that are specific to culmination-achievements, and argue that many of them are related to or interact with the impli-

[26] http://www.smithsonianmag.com/smart-news/why-the-population-time-bomb-hasnt-finished-exploding-6752037/?no-ist

[27] http://www.telegraph.co.uk/finance/personalfinance/money-saving-tips/jessicainvestigates/11363172/My-dividend-cheques-stopped-arriving-after-only-two-years.html

[28] http://www.thedailystar.net/shout/the-jazzperiment-performance-imran-ahmed-quintet-74799

cation of the imminency of the culmination — similarly to the way I argued in Section 5.3.2 that the lack of a perfect progressive is connected to this implication.

5.5.1 Implication of imminency

Imminency is a well-known meaning component of *arrive*-like progressive achievements (see, e.g., Kearns 1991, Rothstein 2004): a progressive achievement is roughly similar in meaning to a construction with *about to*. Thus, we have the equivalence in (5.23) for these achievements, but the non-equivalence in (5.24) for accomplishments.

(5.23) a. The flight is now arriving at Gate 10.
b. ⇔ The flight is about to arrive at Gate 10.

(5.24) a. John is building a garden shed right now.
b. ⇏ John is about to build a garden shed right now.

It is only preliminary process readings which display this characteristic, while slow-motion readings do indeed appear to behave like accomplishments and do not imply that their culmination is close, as evidenced by the following hypothetical but acceptable conversation in a scientific scenario similar to one described by Comrie (1976, p. 42):

(5.25) *(A scientist is explaining to her audience a slow-motion recording of a subject's brain as the subject is recognising a face on a photo.)*
Here you can see the subject recognising a face. It will take quite a long time, as this is an extremely slowed down recording to enable us to study the neurological mechanism behind recognition.

And the progressive of a happening is not synonymous with an *about to* construction, either, as the latter, but not the former, is compatible with the (slow-motion) process not having started yet, as in (5.26).

(5.26) a. The Challenger is exploding now.
b. ⇏ The Challenger is about to explode now.

In contrast, there is no readily conceivable situation in which only one of *Mary is arriving at the station* and *Mary is about to arrive at the station* is true. It appears

that *arriving at the station* carves out the very final part of its cover event, a journey, and cannot be true before it.

A point of complication, noted already in Section 5.3.2 above, is that some culmination predicates, such as *win* and *die*, do *not* imply imminency in the progressive. Thus, a doctor can truthfully say that *John is dying, but I don't know how much time he has*. The imminency meaning component appears to be characteristic of and restricted to those predicates which describe the culmination of some type of physical movement (*arrive, reach*). But because the set of monomorphemic achievements in English is quite limited (Filip 2008) — and the set of culmination predicates, in particular, appears to be a closed class — it is difficult, if not impossible, to make well-founded generalizations about how we can characterise the set of culminations that imply imminency.

For this reason, I adopt the idea of *lexicalization* from Piñón's (1997) proposal about progressive achievements (cf. Section 2.2.3). But crucially, I do not believe that it is progressive achievements that are lexicalized; instead, I believe it is the lexical specifications of a culmination predicate itself that should be responsible for the imminency implication. On the present framework, the way this can be achieved is by assuming that some culminations (*arrive, reach*) are not characterised by the scales of their *cover events*, but by the scales of a *final part* of their cover events. That is, it is lexically specified for culminations like *arrive* and *reach* that their secondary scales are the scales of final parts of events of moving to the goal.

5.5.2 Probability of success

Rothstein (2004, p. 143–4) drew attention to the observation (which was noted in passing already by Comrie 1976, p. 47) that reaching the endpoint is a "good possibility" in the case of progressive achievements — as opposed to accomplishments — that is, they "cannot be used with an explicit doubt as to whether it is possible to reach the culmination". Rothstein introduced a principle about progressive achievements encoding precisely this observation, which she *also* invoked in the explanation of the imminency meaning component. However, I here wish to argue that while the imminency of the culmination is virtually always implied by a progressive culmination like *arrive*, the probability of success is a less stable implication.

In particular, there are examples of progressive achievements akin to the progressive accomplishment *Samantha was crossing a minefield, when she was blown up* (Asher 1992, p. 492), which constitute counter-examples to the relevant culmination

being probable. Consider a situation in which a group of terrorists aim to blow up a train just before it arrives at the station. Then it is perfectly acceptable for them to say at the crucial moment,

(5.27) The train is arriving at the station, activate the bomb!

although it is not a "good possibility" for the train to arrive at the station under these circumstances, and the speaker is explicitly aware of this fact.

While not incorporating it into our semantics of progressive achievements, we can explain and endorse Comrie's and Rothstein's intuition of the "good possibility" of success in the case of progressive culminations through the fact that these are true at a much smaller interval in comparison to accomplishments. Therefore, there is simply less opportunity for them statistically to be disrupted. Note that this hinges on the objective length of events of the relevant kind, which means that we expect slow-motion progressives to also display this feature, and in an even more pronounced way (their progressive being true at an interval which under normal circumstances is conceived of as punctual). This, intuitively, appears to be true, as sentences like *The bomb is exploding* or *The subject is recognising the stimulus* do appear to strongly imply that the disruption of the process is highly unlikely.

However, because "probability of success" is at most only a very weak implication even in the case of achievements like *arrive*, it is difficult to establish if different achievement predicates,[29] or indeed, if accomplishments and achievements, do in fact differ in this respect.

5.5.3 Imminency instead of stages

An assumption put forth by Rothstein (2004, p. 146) is that "progressive achievements are not seen as stages in other events", by which she aims to capture the observation

[29] As for *win* and *die* (which do not have an imminency implication), they are also compatible with the culmination not having a great probability, as I think the following examples indicate:

(i) a. Mariota is winning the race right now, but several players are right on his tail. (http://drewtroutman.sportsblog.com/posts/1218752/week_10_heisman_watch.html)

b. And Spiderman is dying now, but he's not going to stay that way. (http://www.comicvine.com/barry-allen/4005-22804/forums/is-the-return-of-barry-allen-a-complete-failure-619700/)

that (5.28a) can be used to describe Mary crossing the border at Maastricht, and then continuing to Amsterdam, while (5.28b) cannot.

(5.28) a. Mary is running to the Netherlands. In fact she is running to Amsterdam.
b. Mary is arriving in the Netherlands. In fact she is arriving in Amsterdam.

Rothstein (2004, p. 146) asserts that this is because the activity part of accomplishments derived from achievements, as opposed to that of regular accomplishments, is lexically empty, and thus "it makes no sense to assert that the BECOME event associated with one derived accomplishment is part of the BECOME event associated with a different derived accomplishment", and (5.28b) therefore "can be used only if the event verifying *Mary arrive in the Netherlands* and *Mary arrive in Amsterdam* are the same event".

I propose that there is a different, simpler explanation for the difference between (5.28a) and (5.28b), which goes as follows. We have established that *arrive* in the progressive implies that the culmination point is close. Now, the arrival in the Netherlands and the arrival in Amsterdam cannot both be a short way away if Mary is running and is crossing the border at Maastricht. In fact, both culminations being a short way away can only happen if Mary is arriving by airplane or by ship (the former because a plane covers huge distances in a very short time; the latter because Amsterdam itself lies on the coast). In contrast, the accomplishments in (5.28a) make no such constraints, and both can therefore be made true if the appropriate conditions hold when Mary is crossing the border at Maastricht.

5.5.4 Modification by agentive adverbials

Achievements are typically not able to combine with agentive adverbials like *deliberately, carefully, attentively* (Dowty 1979), and this feature is carried over to their progressive form, as well. Piñón (1997), for example, attributes this behaviour to the intuitive assumption that any sort of intentional activity or act takes time, if only a short time, and so achievements, being instantaneous, lack the temporal extent required for intentional activity. Note that this route of explanation presupposes that achievements (but not semelfactives, which even on a single-event reading can easily be modified with agentive adverbials, cf. *cough deliberately*) are indeed true at exactly one *objective* time point. Considering the problems that an instantaneous view of change poses (cf. Section 3.1), however, one may wish to endorse the idea that there are no objec-

tively instantaneous dynamic events. Also, Piñón's (1997) explanation does not in itself account for the fact that agentive adverbials also fail to modify progressive achievements, which, in whatever way we derive them (or even if progressive achievements are simply lexicalized) are *durative*, and so should on his account be able to combine with agentive adverbials.

I myself only have the following rather weak account of why achievements are incompatible with agentive adverbials, which however does not face the problems of Piñón's (1997) proposal. The conversational goal of an assertion of a sentence with a culmination-achievement like *arrive* or *reach* appears to be the conveying of the temporal location of the culmination (including focusing on its *occurrence*). But it is not really possible for an agent to have control over the temporal location of the culmination in relation to the *reference time* of an assertion.

However, some culminations can, in fact, be quite natural even without the progressive with such adverbs of intention:

(5.29) a. The way the Courier explained it Fort William had **deliberately won** the toss to get a home draw.[30]

b. I ended up getting Trick Room back off and **carefully won** the game by double targeting the Pokémon he chose not to Protect for three turns in a row.[31]

(5.30) a. I told a priest this in confession and he told me that if I **died deliberately** (by suicide) I would probably go to hell.[32]

b. Many have **died carelessly** by swimming here and getting sucked under the rock bowls.[33]

But there are several restrictions to these cases. Firstly, we do not really find analogous cases for the progressive. That is, if an achievement predicate in the progressive is modified by an agentive adverbial, it appears to be invariably a case of a pluractional reading, as in (5.31).

[30] http://keepingoutofthed.blogspot.hu/2009/07/mary-chooses-currachd-ruadh-for-wedding.html

[31] http://nuggetbridge.com/reports/press-x-to-bubble/

[32] http://www.chastitysf.com/q_death.htm

[33] http://www.virtualtourist.com/travel/North_America/United_States_of_America/Hawaii_State_of/Hawaii_Big_Island/Hilo-772311/Off_the_Beaten_Path-Hilo-Waterfalls-BR-1.html

(5.31) He was **deliberately winning** games at very close scores to keep the other guy thinking he could win the next game.

Second, the set of predicates admitting this modification is limited, and appears to more or less coincide with those (e.g., *win* or *die*) which do not imply the imminency of the culmination. Of course, since the achievements in these cases are not in the progressive form (cf. the first restriction noted above), an implication of imminency or lack thereof cannot be directly used in the explanation of this phenomenon, but there is a quite distinct difference between exactly those sets of predicates which do and those which do not have this implication in the progressive. Exceptions involving felicitous cases of an agentive adverbial modifying a culmination like *arrive* include examples akin to the following:

(5.32) John **deliberately arrived** at the party late.

In these cases, however, one might argue that what *deliberately* scopes over in the example is *late*: i.e., it is the lateness of the arrival that was deliberate, not the arrival itself, which is underpinned by the fact that *some* adjunct appears to be necessary in these cases. This is quite parallel to what happens in "pseudocausal sentences" like *The delayed departure caused much consternation* according to Eckardt (2000): *caused* (in our case, *deliberately*) is sensitive to which expression is (silently) focussed and thus provides *alternatives* for interpretation.

5.6 Beyond English

Although many accounts of progressive operators focus on a specific operator in a specific language (very frequently, the English progressive), an implicit or explicit goal of most, if not all theories is to account for cross-linguistic similarities and differences via varying a limited number of parameters (cf. e.g., the enterprises of Deo 2009 or Altshuler 2014). The present section serves as a brief and rough inspection of how the proposed scale-based aspectual framework might be extended to some languages other than English, but without any goal of exhaustiveness or in-depth analysis.

5.6.1 The Russian imperfective and the Hindi perfective

Altshuler (2014) offers a typology of what he calls *partitive operators*, which includes not only progressive and imperfective operators of different languages, but some perfective operators, as well, notably, the Hindi perfective (signalled morpho-syntactically by *-yaa*). He argues that both the Russian imperfective and the Hindi perfective can describe events which are either complete or incomplete with respect to the input accomplishment predicate. Examples cited by Altshuler are as follows:

(5.33) a. Ja **dočit-yva-l** poslednie stročki pis'ma.
I read.up-yva(IMPF)-PST last lines letter
'I (have) read the last lines of the letter.'
b. ...xotja ne do-čita-l ix do konca.
even.though not read.up-PST them until end
'...even though I did not finish it.' (Russian)

(5.34) maayaa-ne biskuT-ko **khaa-yaa** par use puuraa nahiin khaa-yaa
Maya-ERG cookie-ACC eat-yaa(PFV) but it-ACC finish not eat-yaa(PFV)
'Maya was eating the cookie, but did not finish it.' (Hindi)

Compatibility with both culmination and non-culmination can be captured in the present framework by using the simple non-strict subset relation $\subseteq$ as opposed to the non-final subscale relation $\subset_{\mathsf{nf}}$ in the semantics of the aspectual operator. That is, while the English progressive would require there to be a strictly higher degree than that mapped to the endpoint of an event e on the scale of change for the relevant predicate, the Russian imperfective and the Hindi perfective allow for the event e itself to satisfy the relevant predicate. This is a direct adoption of the event-based analysis offered by Altshuler (2014), as well as Filip (1993/99, p. 214), who use $e \sqsubseteq e'$ in the semantics of the Slavic imperfective and $e \sqsubset e'$ in that of the English progressive.

So I propose the following tentative definition, which aims to capture the Russian imperfective (and we may assume something similar for the Hindi perfective, cf. below):

Definition 22 (The imperfective in a scale-based account)
$[\![\text{IMPF}(\hat{}\varphi)(e)]\!]^{M,w,g,c,\gamma} = 1$ *iff*

1. ***(Subscale requirement:)*** *there is a scale* $\mathcal{S} \in (\mathsf{PrSoC}(\hat{}\varphi) \cup \mathsf{SeSoC}(\hat{}\varphi))$ *such that* $\sigma_{w,c}(\gamma, g(e)) \subseteq \mathcal{S}$, *and*

2. ***(Complexity requirement:)*** *$\sigma_{w,c}(\gamma, g(e))$ is of the same complexity as $\mathcal{S}$ and*

3. ***(Contrastive requirement:)*** *there is no $\psi \neq \varphi \in \Theta_c$ such that $\sigma_{w,c}(\gamma, g(e)) \subseteq \mathcal{S}'$ for some $\mathcal{S}' \in (\mathsf{PrSoC}(\hat{}\psi) \cup \mathsf{SeSoC}(\hat{}\psi))$, where Θ_c is a set of mutually disjoint predicates that includes φ, given by context c.*

The analysis of the difference between the (Hindi) perfective and the (Russian) imperfective, in turn, can, again, be adopted from Altshuler (2014) and Filip (1993/99, Ch. 4). In particular, Filip (1993/99) argues that the (Slavic) perfective applies to maximal ("total") events, and Altshuler (2014) argues that the perfective (but not the imperfective) describes the *maximal stage* of an event only. In our scale of change-based approach, this can be translated as the Hindi perfective being true only of an event whose endpoint is associated with the maximally attained degree in its context on the relevant scale of change. That is, an addition to Definition 22 for the Hindi perfective would be the following:

- (***Maximality requirement:***) there is no e' occurring in w such that $\sigma_{w,c}(\gamma, g(e)) \subset \sigma_{w,c}(\gamma, e')$ and $\sigma_{w,c}(\gamma, e') \subseteq \mathcal{S}''$ for some $\mathcal{S}'' \in (\mathsf{PrSoC}(\hat{}\varphi) \cup \mathsf{SeSoC}(\hat{}\varphi))$.

In effect, the present section showed that former insights about aspectual operators encoded in event-mereological accounts can be incorporated into the scale-based account of the progressive, as well.

5.6.2 The restricted progressive in Hungarian

The Hungarian progressive is more restrictive than English in many respects. For one, the Hungarian progressive does not allow a futurate reading, but only a partitive interpretation: a sentence like *I'm going to the cinema tomorrow* cannot be expressed with the progressive construction. I will here focus on another limitation: the Hungarian progressive does not have a preliminary process reading. But first, it is necessary to offer a brief introduction to the Hungarian progressive in general.

The Hungarian progressive. The Hungarian progressive, unlike the English progressive, is not wholly productive, and is subject to numerous restrictions. For one, its interpretational opportunities are restricted, and may only have the traditional, "viewpoint" reading, i.e., of viewing an event "from within" (cf. Bennett and Partee 1972).

This restriction is related to the restriction that the Hungarian progressive needs to be anchored to some specific time — either the speech time, or to an overt or implicit but contextually recoverable event. The temporal trace of the eventuality which a progressive describes is understood to properly include that time. (Csirmaz 2008, drawing on Jespersen, calls this the *framing effect*.)

Also, the progressive in Hungarian is traditionally assumed to be restricted to agentive predicates (Kiefer 2006). However, this is not a strict criterion, as there are plenty of acceptable non-agentive progressive sentences, particularly sentences describing natural phenomena, such as the Hungarian equivalent of *The Sun was setting* in (5.36) below. In fact, the agentive requirement of the Hungarian progressive may actually be disappearing diachronically.

Moving to restrictions on the surface form, the Hungarian progressive has no morphological marking, as it is only signalled by word order (particle-verb inversion) and a distinctive suprasegmental form (accenting each postverbal constituent, including the verbal particle). For example (indicating stress with ′), *′József ′**le-ment*** ‘Joseph went down’ is perfective, while *′József (′épp) ′**ment ′le*** ‘Joseph was going down’ is progressive. As a result, focus, which results in the same inverted word order and a specific suprasegmental pattern (postverbal deaccenting), neutralizes the difference between the perfective and the progressive, making it difficult to test whether a specific sentence is progressive. In what follows, therefore, my examples will include the particle *épp* ‘just/just now’, which serves to signal progressivity.

Since the progressive in Hungarian is signalled by particle-verb order inversion, it is expected that verbs without a particle can be ambiguous with respect to their grammatical aspect. This is, in fact, borne out: for instance, *telefonál* ‘talk with/call someone over the phone’ can be interpreted both perfectively and imperfectively.

The Hungarian progressive is also not wholly productive in terms of which particles allow a progressive form, and the most general telicizing particle *meg-* is not generally acceptable in a progressive construction. Particles typically allowing the progressive are directional ones, unless the meaning of the particle+verb complex is non-compositional, as in *be-néz* ‘fail’ (colloquial, lit.: ‘in-see’). Therefore, in what follows, I will use verbs with such particles where the meaning of the particle+verb complex is at least partly compositional (and so some similar verb complexes are acceptable in the progressive).

No preliminary process progressives. Hungarian achievement verbs are not generally compatible with the progressive aspect in Hungarian (Kiefer 1992, 2006). In particular, culminations are genuinely incompatible with a preliminary process reading of the progressive which is their most natural progressive reading in English. The following sentence is thus infelicitous when the train is not actually rolling into the station:

(5.35) ?A vonat épp **érkezett be** az állomásra.
The train just arrive.PAST PRT(in) the station.SUBL
'The train was arriving at the station.'

Because the Hungarian progressive is often assumed to require that its predicate argument be agentive (cf. Kiefer 2006), and achievements are sometimes regarded as non-agentive (cf. Pustejovsky 1991), their incompatibility appears to be explained trivially. However, quite aside from the issue of whether or not achievements can in general be regarded as non-agentive, there are, in fact, acceptable non-agentive progressives in Hungarian, such as the following:[34]

(5.36) Épp **kelt fel** a nap.
just rise PRT(up) the sun
'The sun was rising.'

So the agentivity requirement in itself is not enough to explain the unavailability of preliminary process progressives in Hungarian. Moreover, a slow-motion reading *is* available to achievements, even non-agentive ones, cf.:[35]

(5.37) ...épp **esett le** a gyerek a pelenkázóról
just fall PRT(down) the child the baby changing table-ABL
'...the child was falling off the baby changing table.'

This seems to indicate that while the progressive in English has access to secondary scales of change, the same is not true of the Hungarian progressive. That is, the definition of the Hungarian progressive only has $\mathsf{PrSoC}(\hat{}\varphi)$ in its clauses, rather than the disjunctive $\mathsf{PrSoC}(\hat{}\varphi) \cup \mathsf{SeSoC}(\hat{}\varphi)$ as the English progressive. As such, the applicability condition of the progressive prohibits its application to culminations in Hungarian, unless their scale of change is multi-valued via a switch to a finer granularity.

[34] http://iroklub.napvilag.net/iras/22226
[35] http://magyarnarancs.hu/lelek/keresik-a-kifogasokat-78161

Chapter 6

Conclusion

The aim of this dissertation was to show that viewing time and change as scales and adopting various tools from scale-based theories for an analysis of durativity, granularity, aspectual classes and viewpoint aspect, a number of different puzzles relating to achievements and verb semantics in general cease to be puzzling for our semantics.

One innovation of the dissertation is the relativisation of the temporal trace function to granularity functions, originally developed for an analysis of scalar vague predicates. This, I argued, can be used in an analysis of slow-motion durative uses of achievements. Some further uses of a granularity-relative temporal trace — and thereby a granularity-relative notion of extendedness — include approaching the well-known minimal parts problem of activities without the need for extra formal tools, as well as an analysis of the lesser known, but equally puzzling problem of vague event boundaries.

A further innovation of the dissertation is a novel notion of a scale of change that integrates the scale notion of scale-based approaches to aspect and the notion of a perspective over a situation from previous work on the progressive. Building on this concept of a scale of change, I approached both aspectual classes and the semantics of the progressive in a new scale-based framework, which differs from previous scale-based approaches to aspect in that it applies to a greater range of eventuality predicates, instead of only those with incremental arguments. The differences between aspectual classes, and in particular, different achievements of Vendler, are modelled and explained as differences in the structure of the scale of change associated with such predicates:

- Culmination-achievements like *arrive* are associated with both their own binary scales of change and the multi-valued scales of change of their cover events, which are events of gradual change culminating in an event in the extension of the culmination-achievement. As a result of this characterisation, the progressive interpretation most natural to these predicates is that of a preliminary process progressive, because the gradual change the progressive can access is the change leading up to the culmination point.
- Non-semelfactive happenings like *recognise* are associated with a binary scale of change at everyday granularity levels and multi-valued scales at suitably fine granularity levels, and their result states are required to hold for more than an instant. As such, the progressive interpretation most natural to them is a slow-motion one (rather than an iterative or a preliminary process one).
- Semelfactives like *flash* are associated with binary scales of change with no temporal specification for either their preliminary or result states. As a result, their most natural progressive interpretation is an iterative one.

I have argued that once we model the structures of change associated with different predicates with scales and assume a scale-based approach to durativity and the progressive, we can systematically derive the two progressive readings specific to achievements (those that I called the preliminary process and slow-motion uses) and their behavioural characteristics, without needing to assume "durative achievements" as input to the progressive operator or a non-uniform semantics for the progressive. Under the present proposal, the applicability condition of the progressive concerns the scale, rather than the eventuality type, which, I argued, leads to a more constrained account that can explain the different readings of the progressive when applied to predicates of different types (accomplishments, culminations, happenings alike) while at the same time retaining a unified semantics for this aspectual operator.

The thesis contains ideas that are relevant for scale-based accounts in formal semantics, in general. First, it unifies two different lines of research in scale-based literature: one focusing on granularity and the vagueness of scalar expressions, and another focusing on aspectual phenomena. And in contrast to what is the received practice in scale-based approaches, the framework presented here allows a single predicate (in particular, culmination predicates) to be associated with two different kinds of scales (in particular, binary and multi-valued scales). The proposal also aims to draw attention to the fact that the scale-based approach can be generalized and used to explain a greater range of phenomena by exploiting extreme cases satisfying the formal defini-

tion of a scale. The notion of a scale of change itself is a case in point: it is simply a series of states with an arbitrary ordering over them (which is of course required to respect temporal flow, but is not necessarily a "natural" ordering like a scale of dryness).

However, a number of questions have been left unanswered and innumerable details have not have been worked out in the present thesis. A question relating to progressive achievements that has been left for further research is for example how the imminency meaning component of progressive achievements can be derived (or whether it can be derived at all instead of simply being a matter of lexical specification as I here assumed), but I did attempt to show that it is an important factor in the semantics of culminations over and above implying synonymity with an *about to* construction. I also did not tease apart the lexical content of verbs and aspects of their meaning that are defined at the sentential level and/or in a specific context. And while I brought several different arguments for a minimally three-way distinction among Vendler's achievements, I did not inspect a wide range of predicates belonging to these classes, but focussed instead on predicates which have formed the centre of the debate on progressive achievements, and I also did not look for further potential classes of non-durative predicates.

In this light, the work done in the present thesis appears rather limited in its scope and results, but it adds to the ongoing discussion in the topics of the progressive, aspectual classes, achievements, and scale-based semantics.

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APPENDICES

A The mathematical concepts used in the dissertation

The definitions to follow are taken mostly from Landman (1991).

Structures and orders.

(i) $\wp(A)$ is the *power set* of A which consists of all subsets of A, that is, $\wp(A) = \{X \mid X \subseteq A\}$.

(ii) The *union* $A \cup B$ of two sets A and B is the set containing all elements of A and B, that is, $A \cup B = \{x \mid x \in A \vee x \in B\}$ ("the set of all elements x such that x is an element of A or x is an element of B").

If H is a set whose elements are sets, then the set that is the union of all sets in H is

$$\bigcup_{X \in H} X = \{x \in X | X \in H\}.$$

(iii) The *complement* $B \backslash A$ of a set A in set B is the set consisting of the elements of B that are not elements of A, that is, $B \backslash A = \{x \in B \mid x \notin A\}$.

(iv) A *binary relation* from A to B is a subset of $A \times B$, where $A \times B = \{\langle a, b\rangle \mid a \in A \wedge b \in B\}$ is the *Cartesian product* of A and B.

(v) The *composition* $S \circ R$ of $R \subseteq A \times B$ and $S \subseteq B \times C$ is $\{\langle a, c\rangle \in A \times C \mid \exists b \in B\colon \langle a, b\rangle \in R \wedge \langle b, c\rangle \in S\}$.

(vi) A *partition* of a set A is a set P such that $P \subseteq \wp(A)$ and $\emptyset \notin P$ and $A = \cup\{B \mid B \in P\}$ (P covers A) and $\forall X, Y \in P\colon \big((X \cap Y = \emptyset) \vee X = Y\big)$ (elements of P do not overlap). Elements of P are called *blocks* or *cells*.

(vii) $\langle A, \leq\rangle$ is a *partially ordered set* if $\leq$ is a *partial order* over A, that is, it satisfies the following for all $x, y, z \in A$:

(a) $x \leq x$ (*reflexivity*)
(b) $(x \leq y \wedge y \leq z) \rightarrow x \leq z$ (*transitivity*)
(c) $(x \leq y \wedge y \leq x) \rightarrow x = y$ (*antisymmetry*)

If $\langle A, \leq \rangle$ is a partially ordered set, the A is called its *carrier set*.

(viii) A *strict partial order* $<$ is defined for a partial order $\leq$ as follows: $x < y \stackrel{\text{def}}{=} x \leq y \wedge x \neq y$. It satisfies the following for all x, y, z:

(a) $\neg(x < x)$ (*irreflexivity*)
(b) $(x < y \wedge y < z) \rightarrow x < z$ (*transitivity*)
(c) $x < y \rightarrow \neg(y < x)$ (*asymmetry*)

(ix) $\langle A, \leq \rangle$ is a *linearly ordered set* if $\leq$ is a *linear order* (also called a *total order*) over A, that is, it is a partial order which satisfies *totality* (or *connectedness*), that is: $\forall x, y \in A \colon x \leq y \vee y \leq x$, or for strict orders, $\forall x, y \in A \colon x < y \vee y < x \vee x = y$.

(x) An ordering $\leq$ is *dense* iff $\forall x, y \big(x < y \rightarrow \exists z (x < z \wedge z < y)\big)$.

(xi) An ordering is *discrete* iff it is not dense in any subset of the ordered set.

(xii) A subset Y of an ordered set X is *convex* iff if a, b are in Y, so is any point between them, that is: $\forall a, b, c \in X \, ((a < b \wedge a \in Y \wedge b \in Y) \rightarrow \forall c \, ((a < c \wedge c < b) \rightarrow c \in Y))$.

Bounds, maxima and related terms. For a partial order $\langle T, \leq \rangle$ and a subset S of T, the following concepts can be defined:

(i) S has an *upper bound* (is bounded above) in T iff $\exists t \in T \colon \forall s \in S \colon s \leq t$.

(ii) S has a *lower bound* (is bounded below) in T iff $\exists t \in T \colon \forall s \in S \colon t \leq s$.

(iii) S has a *supremum* (*least upper bound*, *join*) $\sup(S)$ in T iff $\exists t \in T$ such that t is an upper bound of S and $\forall t' \in T$ if t' is an upper bound of S, then $t \leq t'$.

(iv) S has a *infimum* (*greatest lower bound*, *meet*) $\inf(S)$ in T iff $\exists t \in T$ such that t is a lower bound of S and $\forall t' \in T$ if t' is a lower bound of S, then $t' \leq t$.

(v) S is *bounded* in T iff S has both an infimum and a supremum.

(vi) S is *lower closed* iff S has an infimum t and $t \in S$.

(vii) S is *upper closed* iff S has a supremum t and $t \in S$.

(viii) S is *closed* iff it is lower closed and upper closed.

(ix) S has a *maximal element* iff $\exists t \in S \colon \forall s \in S \colon (s \neq t \rightarrow \neg t \leq s)$

(x) S has a *minimal element* iff $\exists t \in S\colon \forall s \in S\colon (s \neq t \rightarrow \neg s \leq t)$

(xi) S has a *maximum* (a *one*, or a *greatest element*) $\max(S)$ iff $\exists t \in S\colon \forall s \in S\colon (s \leq t)$

(xii) S has a *minimum* (a *zero*, or a *least element*) $\min(S)$ iff $\exists t \in S\colon \forall s \in S\colon (t \leq s)$

(xiii) T is a *join-semilattice* iff any nonempty finite subset of T has a join (a least upper bound).

A supremum and an infimum, and a maximum and a minimum, if it exists, is unique (and the maximum is of course also the supremum of a set, likewise a minimum is also the infimum), while a partially ordered set may have any number of upper and lower bounds and maximal and minimal elements. In my thesis, I am mostly concerned with scales, which are linearly ordered, in which case a maximal (minimal) element is also a maximum (minimum).

Existence of a supremum and an infimum. In the case of scales used in formal semantics, whether or not a lower (upper) bounded scale does or does not have a *greatest* lower (*least* upper) bound has no linguistic relevance. In particular, all scales used in formal semantics have the *greatest lower bound (least upper bound) property*: all nonempty subsets of the scale that are bounded from below (above) have a greatest lower (least upper) bound.

This is not a trivial property, e.g., it is not satisfied by the set of *rational* numbers: the set of rational numbers smaller than $\sqrt{2}$ is upper bounded, but it does not have a least upper bound in the set of rational numbers, since $\sqrt{2}$, its least upper bound in the set of real numbers, is not a rational number.

Intervals. Let $\mathcal{X} = \langle X, <_{\mathcal{X}} \rangle$ be a linearly ordered set.

i) $\mathsf{Int}(\mathcal{X}) \subseteq \wp(X)$ designates the set of *intervals* (or *periods*) constructed from $\mathcal{X}$, that is, the set of all convex subsets of X.

Each $i \in \mathsf{Int}(\mathcal{X})$ is linearly ordered with the *restriction* of $<_{\mathcal{X}}$ to i, that is, with $<_{\mathcal{X}} \restriction i = \{\langle x, y\rangle \in <_{\mathcal{X}} |\ x, y \in i\}$.

ii) I use $<_{\mathcal{X}}$ in an extended sense for the *complete precedence relation*, and so for any intervals $i_1, i_2 \in \mathsf{Int}(\mathcal{X})$, $i_1 <_{\mathcal{X}} i_2$ iff $\forall x_1 \forall x_2[((x_1 \in i_1) \wedge (x_2 \in i_2)) \rightarrow x_1 <_{\mathcal{X}} x_2]$.

iii) A *bounded interval* is an interval that is bounded. A *closed interval* is an interval that is closed.

If x is the infimum and y is the supremum of an open bounded interval, then the bounded interval can be given as (x, y) (in this case, x and y are not elements of the interval).

If x is a minimum and y is a maximum of a closed interval, then the interval can be given as $[x, y]$ (in this case, x and y are elements of the interval).

iv) Unless it is necessary to refer to sets in a given context, a *degenerate interval*, i.e., an interval consisting of a single point can be designated only as its element for simplicity, that is, for any $x \in X$, x can designate the degenerate interval $[x, x]$ instead of $\{x\}$.

v) The part-of relation over $\mathsf{Int}(\mathcal{X})$ corresponds to the subset relation $\subset$.

I will use the notions of a supremum and infimum for intervals of strict linear orders (and not just for subsets of non-strict orders, as in the definitions above), for which they can be defined in the following way: if $\mathcal{S} = \langle S, <_S \rangle$ is a linearly ordered set, and $i \in \mathsf{Int}(\mathcal{S})$ is an interval of S, then s is the supremum of i iff the following holds:

(i) $$\forall x \in i \colon \Big(\big(x <_S s \vee x = s \big) \wedge \forall y \in S \big(y <_S s \rightarrow [y \in i \vee \forall z (z \in i \rightarrow y <_S z)] \big) \Big)$$

And s is the infimum of i iff the following holds

(ii) $$\forall x \in i \colon \Big(\big(s <_S x \vee x = s \big) \wedge \forall y \in S \big(s <_S y \rightarrow [y \in i \vee \forall z (z \in i \rightarrow z <_S y)] \big) \Big)$$

Mappings between structures.

i) A *function* $f \colon A \rightarrow B$ from A into B is a relation $f \subseteq A \times B$ such that $\forall a \in A \colon \exists! b \in B \colon \langle a, b \rangle \in f$, that is, the domain of f is A, and there is a unique element of B mapped to each element of A.

ii) A *partial function* $f \colon A \nrightarrow B$ from A into B is a function from some $X \subseteq A$ into B. The *domain* $\mathsf{Dom}(f)$ of the partial function f is the subset X of A where f is defined.

iii) A function $f \colon A \rightarrow B$ is *injective* iff $\forall a, a' \in A \colon f(a) = f(a') \leftrightarrow a = a'$.

iv) A function $f \colon A \rightarrow B$ is *surjective* iff $\forall b \in B \colon \exists a \in A \colon b = f(a)$.

v) A function f is a *bijection* iff it is injective and surjective.

vi) If $\mathbf{A} = \langle A, \leq_A \rangle$ and $\mathbf{B} = \langle B, \leq_B \rangle$ are partial orders, then a function $h \colon A \rightarrow B$ is a *homomorphism* from $\mathbf{A}$ into $\mathbf{B}$ iff $\forall a, a' \in A \colon a \leq_A a' \rightarrow h(a) \leq_B h(a')$.

vii) An *embedding* is an injective homomorphism.

viii) An *isomorphism* is a bijective homomorphism.

ix) A *metric* (or *distance function*) on a set X is a function $d \colon X \times X \rightarrow \mathbb{R}$, where $\mathbb{R}$ is the set of real numbers, such that for all $x, y, z \in X$, the following holds (where the subscript $\mathbb{R}$ indicates that the relations $\geq_{\mathbb{R}}$, $\leq_{\mathbb{R}}$ and the operation $+_{\mathbb{R}}$ are the usual ones defined over the real numbers):

(a) $d(x, y) \geq_{\mathbb{R}} 0$
(b) $d(x, y) = 0$ iff $x = y$
(c) $d(x, y) = d(y, x)$
(d) $d(x, z) \leq_{\mathbb{R}} d(x, y) +_{\mathbb{R}} d(y, z)$

B The scalar trace

Let us define the scalar trace $\mathsf{ST}_{e,\sigma_{c,w}(\gamma,e)}$ associated with an event e and its scale of change $\sigma_{c,w}(\gamma, e)$, which is a partial function that maps an interval of time[1] to an interval of a scale of change associated with an eventuality.[2]

Definition 23 (Scalar trace function)
The partial surjective scalar trace function $\mathsf{ST}_{e,\sigma_{c,w}(\gamma,e)} \colon \mathsf{Int}(\mathcal{T}) \nrightarrow \mathsf{Int}(\sigma_{c,w}(\gamma, e))$ *associated with eventuality* e *maps a subset of the set of time intervals to parts of the scale of change* $\sigma_{c,w}(\gamma, e)$.

1. *For any* $i \in \mathsf{Int}(\mathcal{T})$, *if* $\mathsf{ST}_{e,\sigma_{c,w}(\gamma,e)}(i) = \{d\}$, *where* d *is a set of states, then* d *must be instantiated at* i *which means that* $\exists e' \colon i = \tau(\gamma, e') \wedge e' \in d$; *and for any* $i \in \mathsf{Int}(\tau(\gamma, e))$, *if* $\mathsf{ST}_{e,\sigma_{c,w}(\gamma,e)}(i) = \{d\}$, *then there must be an* $e' \sqsubseteq_E e$ *such that* $i = \tau(\gamma, e')$ *and* $e' \in d$.
2. $\mathsf{ST}_{e,\sigma_{c,w}(\gamma,e)}$ *is order-preserving relative to the non-strict linear orders over* $\mathsf{Int}(\mathcal{T})$ *and* $\sigma_{c,w}(\gamma, e)$, *that is,* $l_1 \leq_{\mathcal{T}} l_2 \Leftrightarrow \mathsf{ST}_{e,\sigma_{c,w}(\gamma,e)}(l_1) \leq_{\sigma_{c,w}(\gamma,e)} \mathsf{ST}_{e,\sigma_{c,w}(\gamma,e)}(l_2)$ *(if* $\mathsf{ST}_{e,\sigma_{c,w}(\gamma,e)}$ *is defined in* l_1 *and* l_2*).*

The definition requires the scalar trace to be surjective, that is, all parts of the scale of change are mapped to some interval. Thus, the scale of change captures exactly the change that is associated with eventuality e. The scalar trace is a partial function, because it doesn't make sense to have the change associated with an eventuality (say, Mary's crossing the street at a given time) be defined for at all moments and intervals of time (say, at the time of the Big Bang or 2000 years after Mary's death).[3]

[1] I here restrict scales of change and the scalar trace to time-relative cases, and so the following restrictions only apply to a scalar trace whose domain is a set of time intervals. But as Section 5.1.2 indicates, the system of scales of change and scalar traces can be extended to any linear order instead of time.

[2] The precise definition of a granularity-relative temporal trace $\tau(\gamma, e)$ is given in Section 4.2.

[3] This is an especially pertinent issue with respect to the maximum of the scale of change: intuitively, for an event of Mary's crossing the street, the final degree in its associated scale of change is Mary being on the other side of the street. But there is no degree on the scale of change to which we could map the times that are located years after Mary's death, or even after she moved from that side of the street: the final degree of Mary being on the other side of the street doesn't hold any more, and due to the requirement of order-preservation below, no other degrees can be images of these times, either.

The first requirement in the definition ensures that the mapping from times to a scale of change is not arbitrary: within the temporal trace of the event, the scale of change captures a property of the relevant temporal part of the event; and outside the temporal trace of the event, at least a state of the relevant kind has to hold. The second requirement in the definition ensures that the scale of change and the scalar trace respect temporal flow (i.e., an interval preceding another one cannot be mapped to a higher part of the scale).

Just as Beavers (2002, and elsewhere) put several additional constraints on his Movement Relation, there are some further constraints we have to put on the scalar trace, which are simply declared rather than derived from more basic principles. But they are not arbitrary: just as the formal constraints that Beavers (2002, and elsewhere) declared on his Movement Relation between events and scales and the formal constraints that Krifka (1992, and elsewhere) declared on the homomorphic mappings between an event and an incremental theme or path, the constraints on the scalar trace mapping were determined on the basis of the inspection of the linguistic behaviour of predicates denoting different sets of events. For better readability, let us here abbreviate $\mathsf{ST}_{e,\sigma_{c,w}(\gamma,e)}$ as ST^e.

1. The domain of the scalar trace (i.e., the subset of $\mathsf{Int}(\mathcal{T})$ where ST^e is defined) is *downward closed* with respect to the subset relation between intervals: $\forall I\colon I \in \mathsf{Dom}(\mathsf{ST}^e) \Rightarrow \forall I' \subseteq I\colon I' \in \mathsf{Dom}(\mathsf{ST}^e)$; and the domain must also have a greatest element, that is: $\exists I \in \mathsf{Dom}(\mathsf{ST}^e)\colon \forall I' \in \mathsf{Dom}(\mathsf{ST}^e)\colon I' \subseteq I$.

   This ensures that the change that the scale of change captures happens over a given interval, and all parts of this interval correspond to a part of the change described by the scale of change (there are no "gaps").

2. $\forall I, I' \in \mathsf{Dom}(\mathsf{ST}^e)\colon \big(\gamma(\sup(I)) = \gamma(\sup(I')) \wedge \gamma(\inf(I)) = \gamma(\inf(I'))\big) \rightarrow \sigma_{c,w}(\gamma, e)(I) = \sigma_{c,w}(\gamma, e)(I)$

   The scalar trace does not differentiate between intervals whose boundaries are not distinguished at granularity γ: all such intervals have the same image.

3. Since the scale of change describes the series of states making up the change happening during an event e, the *scalar trace must be defined in the temporal trace* of e: $\tau(\gamma, e) \in \mathsf{Dom}(\mathsf{ST}^e)$.

   Note that $\tau(\gamma, e)$ is not required to be the greatest element in $\mathsf{Dom}(\sigma_e)$ with respect to set inclusion. (For example, in the case of events in the extension of achievements, points outside of the temporal trace of the event will also be mapped to the scale of change.)

4. The *final moment* of $\max\big(\mathsf{Dom}(\mathsf{ST}^e)\big)$ is identical to or precedes the moment up to which the state corresponding to $\max(\sigma_{c,w}(\gamma, e))$ holds following the final moment of the temporal trace of the event e, where $\max$ is the greatest element of an ordered set (cf. Appendix A).

Intuitively, the last moment in time relevant to the change described by $\sigma_{c,w}(\gamma, e)$ is the moment up to which final state in $\sigma_{c,w}(\gamma, e)$ holds without interruption. This state may continue beyond the temporal trace of the eventuality e.[4]

5. The *initial moment* of $\max\big(\mathsf{Dom}(\mathsf{ST}^e)\big)$ is not so easily given a generic characterisation, as it is more subject to contextual determination. In the case of a durative dynamic event e (i.e., one to which activity and accomplishment predicates can apply), $\tau(\gamma, e)$ is an *initial subinterval* of $\mathsf{Dom}(\mathsf{ST}^e)$, that is, the change associated with durative eventualities starts at the point an eventuality starts.

6. The *supremum* of the temporal trace of a *dynamic eventuality* e, if it exists, is mapped to a part of the scale to which no prior interval is mapped. That is, if $t = \sup\big(\tau(\gamma, e)\big)$, then for any $i <_{\mathcal{T}} t$, $\mathsf{ST}^e(i) \neq \mathsf{ST}^e(t)$.

7. The *infimum* of the temporal trace of a *dynamic eventuality*, if it exists, is mapped to a part of the scale to which no interval following it is mapped. That is, if $t = \inf\big(\tau(\gamma, e)\big)$, then for any i such that $t <_{\mathcal{T}} i$, $\mathsf{ST}^e(i) \neq \mathsf{ST}^e(t)$.

   This, together with the previous constraint, corresponds to the *minimality* requirement on the *movement relation* of Beavers (2002, 2008).

8. All intervals in the domain of the scalar trace that *precede the temporal trace* of the eventuality are mapped to the *same* degree of the scale. That is, for any i, i' such that both $i <_{\mathcal{T}} \tau(\gamma, e)$ and $i' <_{\mathcal{T}} \tau(\gamma, e)$, it holds that $\mathsf{ST}^e(i) = \mathsf{ST}^e(i')$, if ST^e is defined in i, i'.

9. All intervals in the domain of the scalar trace that *follow the temporal trace* of the eventuality are mapped to the *same* degree of the scale as the final moment of the temporal trace. That is, if $t = \max\big(\tau(\gamma, e)\big)$, then for any i such that $t <_{\mathcal{T}} i$, it holds that $\mathsf{ST}^e(i) = \mathsf{ST}^e(t)$, if ST^e is defined in i.

   This, together with the previous constraint ensures that no event-relevant change is happening outside the eventuality, i.e., outside of an event, only a pre-state and a post-state can hold (if at all), but no change.

[4] As such, the scale of change can be seen as an attempt to capture the *nucleus structure* of Moens and Steedman (1988), and the event structure of Pustejovsky (1991). In both cases, the event structure for telic predicates contains a result state, in particular, which is inherently associated with an event in the extension of the relevant predicate. Because an eventuality can be associated with different result states under different descriptions, the result state should not be a function of solely the event. On the present framework, this is accomplished with the contextually determined scale of change: the discourse context parameter selects the series of states that is relevant for the discourse purposes. Making the concept of a result state dependent on the context paves the way for explaining coercions like *Today, John swam in an hour* from Dowty (1979, p. 61): although only accomplishments, but not activities, require reference to a result state in a particular context, the discourse context may still specify a result state for activities, as well.

10. For a dynamic eventuality e, if $\tau(\gamma, e) = t$ for some $t \in T$, then $\exists i <_{\mathcal{T}} t\colon i \in \mathsf{Dom}\left(\mathsf{ST}^{e}\right)$.

    That is, if a dynamic event is instantaneous, then the domain of the scalar trace includes some interval preceding it.

11. For state s, $\forall i, i' \in \mathsf{Dom}\left(\mathsf{ST}_{s,\sigma_{c,w}(\gamma,s)}\right)\colon \mathsf{ST}_{s,\sigma_{c,w}(\gamma,s)}(i) = \mathsf{ST}_{s,\sigma_{c,w}(\gamma,s)}(i')$.

    That is, all elements of the domain of the scalar trace for a state are mapped to the same degree. Given the surjectivity of the scalar trace, this entails that states are associated with *singleton* scales.

Durativity and scale complexity. The constraints on the scalar trace ensure that if a dynamic eventuality is non-extended, then its scale of change is *not complex* (does not consist of more than two degrees), because times preceding the (temporal trace of) the event can only be mapped to a single degree (requirement 8), and the times following it can only mapped to the same degree as the time point corresponding to the event's temporal trace (requirement 9). With the added assumption in 10, that in the case of non-extended dynamic events, the context always includes an interval preceding their temporal trace in the domain of the scalar trace, this ensures that non-extended dynamic events are associated with a *binary scale*, i.e., one consisting of exactly two degrees.

Conversely, if an eventuality is dynamic and extended, then its scale of change is *complex*, because both greatest lower bound (requirement 7) and the least upper bound (requirement 6) of the temporal trace have different images as other parts of the temporal trace. Thus, the present framework retains the feature of the framework of Beavers (2002, 2008) according to which scale complexity corresponds to durativity, despite differences between the scalar trace and Beavers's movement relation.

Note that the requirements also ensure that the scale of change associated with any particular eventuality token is *closed*, i.e., it has a maximum and a minimum. Importantly, this is not at odds with the characterisation of atelic *predicates* as being associated with an open (rather than closed) scale (cf. Section 2.3.2.2). At the level of *events*, just as Filip and Rothstein (2006) and Filip (2008) have argued that there is always a *maximal event* with respect to an independent ordering in given context, so, in a given context, for a given event (which corresponds to the maximal event of Filip and Rothstein 2006 and Filip 2008), the change associated with it has a definite endpoint.

But for an activity predicate P, since it can continue potentially indefinitely, then for any $e \in P$, there is necessarily some $e' \in P$ occurring in some possible world such that $\sigma_{c,w}(\gamma, e) \subset_{\mathsf{nf}} \sigma_{c,w'}(\gamma, e')$. Thus, the *generalized scale* associated with P is open, as for each $\mathcal{S} \in \mathsf{PrSoC}(\hat{}P)$, there is a bigger $\mathcal{S}' \in \mathsf{PrSoC}(\hat{}P)$ (where PrSoC returns the set of primary scales of change associated with an eventuality predicate, cf. Definition 15).

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Düsseldorf, 5th June 2015

Zsófia Gyarmathy