CHAPTER 25

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LEXICAL ASPECT

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1. The Delimitation of Lexical Aspect in the Domain of Aspect

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1.1. Basic Terminology and Phenomena

Lexical aspect is a stock concept of natural language semantics and its usefulness, if not necessity, for the explanation of a wide range of language phenomena is well established. It intersects with grammatical aspect, tense, adverbial modification, the syntax and semantics of quantification and various expressions of quantity, argument structure and linking at the lexical semantics-syntax interface and also plays a role in the temporal sequencing of discourse. Lexical aspect is a semantic category that concerns properties of eventualities (in the sense of Bach, 1981) expressed by verbs. In the most general terms, the properties in question have to do with the presence of some end, limit or boundary in the lexical structure of certain classes of verbs and its lack in others.

This basic division among verb meanings is best known as the telic/atelic distinction, in the terminology of Garey (1957). Telic verbs express "an action tending toward a goal," while atelic ones describe situations that "are realized as soon as they begin" (Garey, p. 106). For Garey, the main distinguishing criterion of the telic class is the general concept of some "end" or "limit," rather than the narrower agentivity-oriented "goal" or "purpose," despite the latter being the meaning of the Greek *télos*. This is evident in the fact that Garey illustrates his telic class with non-agentive verbs like *se noyer* 'to drown', alongside agentive verbs like *arriver* 'to arrive'.

The origins of our understanding of lexical aspect lie in Aristotle's distinction of *kinesis* and *energeia*. *Kinêsis* is "motion" or "change," and *energeia* is "actuality,"

"actualization" or "activity." Garey makes no mention of Aristotle, but his telic/ atelic distinction is clearly in the spirit of Aristotle's: *kinêseis* are always for the sake of some external end, while *energeiai* have ends that are "actualized" as soon as they begin: "E.g., at the same time we see and have seen, understand and have understood, think and have thought; but we cannot at the same time learn and have learnt, or become healthy and be healthy" (*Metaphysics*, Θ6, 1048b, 18–36 [Aristotle, 1933–35]; regarding this distinction in Aristotle's work see Kenny (1963, pp. 173–183).

Aristotle's heritage is acknowledged in the use of the terms "Aristotelian classification" or "Aristotelian categorization" in works such as Dowty, Mourelatos (1978), Dowty (1979), and Bach (1986), where they cover categories that subsume lexical aspect classes. What is understood as "Aristotelian" in this context is mainly a set of conceptual tools and grammatical tests developed within the Aristotelian tradition in the philosophy of action, mind and language in the mid-to-late twentieth century (see Ryle (1949); Vendler (1957); Kenny (1963); Taylor (1977); and the discussion in Dowty (1979)).

1.2. Common Tests for the Telic/Atelic Distinction in English

The main telic/atelic distinction and its nature is commonly clarified with a number of diagnostic tests. For English data, the following three tests are among the most reliable and commonly used. First, the telic/atelic distinction interacts with temporal adverbial modifiers. As (1) shows, only telic verbs freely combine with *in NP* modifiers like *in an hour*, and only atelic verbs with *for NP* modifiers like *for an hour* (Vendler 1957).

(1)   a.   John recovered in an hour /(*)for an hour.   TELIC
      b.   John swam (*)in an hour /for an hour.   ATELIC

The *in NP* and *for NP* modifiers are semantically treated as two different kinds of measurement of the extent of eventualities. An *in* adverbial measures the time span within which eventualities expressed by telic predicates culminate, while a *for* adverbial measures the temporal duration of eventualities denoted by atelic predicates. In (1a), for instance, the culmination of an eventuality of recovering falls within the time span of one hour. In (1b), *for an hour* carves bounded one-hour portions out of unbounded situations denoted by *swim*. The use of (1b) conversationally implicates that an eventuality of swimming did not last longer than one hour, which can be explicitly denied without a contradiction, for example, by continuing (1b) with something like . . . *John even swam for two hours*. The interpretations of *in NP* modifiers that are irrelevant for this test concern the measure of time until the onset of the eventualities denoted by atelic verbs from "now" or some other reference point, as in (1b) (Vendler, 1957, p. 147). In the case of *for NP* adverbials, the irrelevant interpretations concern the duration of the result state measured by *for NP* that follows the end of an eventuality described by a telic verb.

This test is intended to access the inherent aspectual class of verbs. Shifts between telic and atelic interpretations induced by temporal (and other adverbial) modifiers are also common. For instance, "(*)" in (1b) means that *in an hour* is acceptable in the relevant telic interpretation of (1b), if the speaker and the addressee know "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, p. 61).

Second, various expressions of quantity differentially select for telic and atelic verbs, as we see in (2) and (3) (observations and examples are adapted from Mourelatos, 1978, and Bach, 1986):

(2)   a. Vesuvius erupted three times.   TELIC
      b. John slept (*) three times last night.   ATELIC
(3)   a. Vesuvius erupted (*) a lot.   TELIC
      b. John slept a lot last night.   ATELIC

Vague quantifiers like *a lot* select atelic verbs, as (3b) shows. Cardinal count adverbials like *three times* are straightforwardly compatible with telic verbs like *erupt*, as in (2a). This is taken as evidence in support of the claim that eventualities in the denotation of telic verbs "can be directly or intrinsically counted," as Mourelatos proposes; they "fall under SORTS that provide a PRINCIPLE of count" (1978, p. 209). The term "SORTS" is used in the sense of Strawson (1959, p. 168): "A sortal universal supplies a principle for distinguishing and counting individual particulars which it collects." So *cat* is a sortal and *water* is not; similarly, *erupt* is a sortal and *sleep* is not. In aligning telic with sortal predicates and atelic with mass ones, Mourelatos builds on independent proposals that verbs, like nouns, have the feature "count" or "mass" (see Allen, 1966; Leech, 1969; Verkuyl, 1971/72; Gabbay and Moravcsik, 1973; Bolinger, 1975). Similarly as inherently mass nouns like *beer* may shift into a count interpretation in cardinal numeral constructions like *three beers* (meaning three portions or three kinds of beer), so inherently atelic verbs like *sleep* may shift into a telic interpretation when modified with cardinal count adverbials like *three times*. So "(*)" in (2b) means that *sleep* is compatible with the cardinal count adverbial *three times* just in case it first shifts into a suitable telic interpretation in order to satisfy the adverbial's countability input requirement. In parallel to count-to-mass shifts, telic-to-atelic shifts are also common. In (3a), "(*)" means that *a lot* is acceptable just in case *erupt* shifts into an appropriate atelic interpretation, which here most naturally amounts to a shift from a set of singular events of erupting to a set of pluralities of such events.

Third, the lexical telic/atelic distinction systematically interacts with the progressive/non-progressive distinction in the domain of grammatical aspect. Telic verbs never sanction the conclusion of "x has φ-ed" from "x is φ-ing," but atelic ones often do (see Taylor, 1977; Bach, 1981 for the "minimal-parts" problem). For instance, if *John is dying* (4a) is true, we cannot conclude *John has (already) died* (4b), but if *John is sleeping* (5a) holds, we can conclude *John has (already) slept* (5b).

(4) a. John is dying.   PROGRESSIVE with base telic verb
     b. John has (already) died.   NON-PROGRESSIVE with base telic verb
(5) a. John is sleeping.   PROGRESSIVE with base atelic verb
     b. John has (already) slept.   NON-PROGRESSIVE with base atelic verb

The general idea for this test can already be detected in Aristotle's quote, given at the outset. The test itself was introduced by Kenny to motivate his performance/activity distinction, which is a special agentivity case of the telic/atelic distinction. The observation that telic verbs never sanction the conclusion of "x has φ-ed" from "x is φ-ing," but atelic ones often do, raises what is today known as the "imperfective paradox" (Dowty, 1977; 1979, p. 133ff.) or the "partitive puzzle" (Bach, 1986): A progressive sentence with a base telic predicate is true at a given time even if the corresponding non-progressive sentence is false and never can be true. In applying this test to other languages than English one should not be mislead by Dowty's 1977, 1979) label "imperfective paradox," given that the "paradox" only arises with formally marked progressives, but not generally with imperfectives, since the latter also have non-progressive interpretations (among their contextually determined uses) that do not lead to the paradox.

The compatibility of a verb with one diagnostic syntactic context often implies its incompatibility with another. However, as examples in (1)–(3) illustrate, shifts in verb meanings are common, often following predictable patterns in dependence on context (Vendler, 1957; Pustejovsky, 1995; de Swart, 1998; Zucchi, 1998). Any adequate theory of aspectual classes must formulate correct and testable generalizations about such systematic meaning shifts. Apart from the three tests given here for the English data, other diagnostic tests have been proposed and commonly used (Dowty, p. 55ff.). However, they do not converge on coherent Aristotelian aspectual classes, but identify overlapping clusters which merely distinguish subsets of such categories or supersets (Dowty, p. 60; Parsons, 1989. Finally, as already observed, the three tests given here are representative of the tests that work well for the English data, besides other tests (Dowty, p. 55ff.). Their crosslinguistic application raises numerous questions, because it cannot be taken for granted that all the tests developed for English are transferable to other languages, due to language-specific properties, and those that seem to be require some clarification whether they in fact access the same aspectually relevant properties in different languages, and in fact, it is not always entirely clear what exactly the various diagnostic tests used by different researchers really test for in other languages (Sasse, 2002).

1.3. Lexical Aspect and Grammatical Aspect, Aspectual Class, and Aspectual Form

Lexical aspect is often used in direct opposition to grammatical aspect (see de Swart, this volume), especially when the emphasis is on the fact that grammatical aspect is marked by a grammatical marker on a verb in a given sentence. One good example is the imperfective/perfective opposition in Modern Greek:

(6) a. IMPERFECTIVE (IMPERFECT):   *dhúleva* "I worked." / "I was working."
     b. PERFECTIVE (AORIST):   *dhúlepsa* "I worked."

Another example is the imperfective suffix in Slavic languages that is added to the perfective base (Czech examples):

(7) a. PERFECTIVE: *dát* "to give"
     b. IMPERFECTIVE: *dávat* "to give" /"to be giving"

Apart from grammatical markers on verbs, grammatical aspect can be also formally expressed by syntactic constructions, which may contain a free form in the verb's ìauxiliaryî complex, as in the English *be* + V-*ing* progressive construction.

Lexical aspect is also to be distinguished from aspectual class (in the sense of Dowty). This matters, given that the Aristotelian classification and the superordinate telic/atelic distinction concerns not only verbs as lexical items, but also verb phrases and sentences (Verkuyl, 1971/72; Declerck, 1979; Filip, 1990; Dowty, 1991). Sentences must be included, as the quantificational and referential properties of their subjects (8a,b) influence their (a)telicity class and may override the aspectual properties of their constituent verbs and verb phrases. (Example (8a) is taken from Dowty, 1991.)

(8) a. At the turtle race, the winning turtle crossed the finish line   TELIC
         in 42 seconds.
     b. At the turtle race, turtles crossed the finish line for hours.   ATELIC

Although "lexical aspect" is also used to refer to the aspectual class of verb phrases (cf. e.g., van Hout, 2003) and sentences, this use is, strictly speaking, incorrect and should be avoided. The notion of aspectual class is a wider notion than that of lexical aspect, subsuming lexical aspect as a special case when just verbs, taken as lexical items, are at stake. Aspectual *class* is to be distinguished from aspectual *form* (see also Dowty, 1979, p. 52, following Johnson, 1977), whereby the latter concerns the expression of grammatical aspect. In contrast to aspectual form (grammatical aspect), aspectual class need have no overt marker and may remain as an intrinsic semantic property of verbs, verb phrases and sentences.

The term "aspectual class" is also used interchangeably with "*Aktionsart(en)*," a German-language term meaning "manner(s) of action" and used by Agrell (1908) for the classification of overt derivational word-formation devices (mostly verb affixes) that express various aspects of situations (e.g., terminative, resultative, delimitative, perdurative, iterative, semelfactive, attenuative, augmentative), and that were distinguished from inflectional morphology dedicated to the encoding of grammatical

aspect. In the 1970s, in the tradition of the European generative grammar (e.g., Verkuyl, 1971/72; Platzack, 1979), the term *Aktionsart(en)* was freed from its exclusive connection to derivational morphology and extended to cover aspectual classes in the Aristotelian sense of Dowty. In this new, extended sense, it also entered —— American linguistics in the mid 1980s (Hinrichs, 1985).

The relation between aspectual form and aspectual class is subject to much debate. It raises a fundamental question about what is meant by *grammar*, what is to be included in the grammar proper of a language and what is not. This, however, is neither uncontroversial nor well understood (see Bach, 2005). What has emerged as a matter of some consensus is that aspectual classes are possibly universally available (Hoepelman, 1981; Bach, 2004; Van Valin, 2006; von Fintel and Matthewson, 2008), but have highly varied manifestations in natural languages. Not all the languages have grammatical aspect, but certainly all have some means of expressing the semantic notions carried by perfective/imperfective verbs or verb forms, as in Modern Greek or Slavic languages, for instance. This led to the proposal that grammatical aspect is a covert semantic category on the sentential (or propositional) level in languages that lack the overt formal category of grammatical aspect (see Kratzer's (2004) arguments for German, for instance). Consequently, this stimulated debates whether lexical aspect and the semantics of grammatical aspect can be reduced to the same aspectually relevant concepts, analyzed with the same tools and in the same underlying semantic representation. (A good summary of the different views can be found in de Swart, 1998, and Sasse, 2002.)

2. Aspectually Relevant Concepts

The concept of end (limit or boundary), which divides the domain of lexical aspect into telic and atelic, is closely related to two other aspectually relevant concepts: namely, change of state and temporal extent.

Change is the most fundamental aspectually relevant concept, as Dowty (1979, pp. 167, 185) argues, since the explanation for the differences among aspectual classes lies in the change-of-state entailments that are or are not present in the different classes as well as in our expectations about the way changes happen over time. Intuitively, any change is a transition from one state of affairs to another, and therefore, in order to judge whether a change-of-state predicate is true of an individual, we need information about the physical state of the world at two distinct moments at least, i.e., at an interval (Dowty, p. 168; Kamp, 1980). Since state verbs entail no change, and hence no inherent limit or end, there is a natural affinity between stativity and atelicity. All dynamic descriptions of eventualities entail some change, but not all are telic. One of the key questions in aspect studies concerns the nature and representation of the change that characterizes telic descriptions, and how exactly it differs from changes that characterize eventuality

descriptions that are atelic. For instance, how does the change of state entailed by telic verbs like *reach* or *dissolve* differ from that entailed by atelic verbs like *move* or *rain*? Are there different kinds of change, and how many? Is the entailment of an inherent end that characterizes telic verbs like *reach* or *dissolve* inseparable from the kind of change that brings it about? For example, *reach the top of the mountain* is normally understood as entailing successive changes of the location of some moving entity that bring it closer and closer to the top of the mountain, with respect to which its inherent end is characterized, and events described by *reach the top of the mountain* necessarily end when the mountain top is reached. In contrast, when it comes to atelic verbs like *move* any change of location to any degree is sufficient to qualify as falling under *move,* since *move* on its own specifies no inherent end.

Temporal extent separates verbs that denote eventualities with some temporal extent from verbs that denote what is conceptualized as punctual or momentaneous transitions from one state of affairs to another. Examples are Vendler's (1957) achievements like *reach, find, notice* and semelfactive verbs like *flash, hit, knock, kick, slap, tap, blink*. (The term "semelfactive" comes from Latin *semel* "once," "a single time," and *factum* "event," "occurrence.") Semelfactives describe situations that end with the return to the initial state, and in this sense they are "full-cycle resettable" (Talmy, 1985). Temporal extent is grammatically relevant, which is evident, for instance, in its interactions with the three tests mentioned in section 1.2. Take semelfactives as a case in point: They are countable (*The beacon flashed three times*), systematically lead to iterative interpetations when they are modified by durative adverbials (*The beacon flashed for an hour*) or when they occur in the progressive (*The beacon was flashing*).

Although the status of temporal extent as an aspectually relevant criterion is indisputable, its exact role for drawing the lines between aspectual classes is controversial. To give just a few examples, in Vendler's classification, temporal extent along with agentivity sets his accomplishments apart from his achievements. Vendler's accomplishments are agentive actions with some temporal extent, while his achievements tend to be non-agentive and "occur at a single moment" (Vendler, 1957, p. 147). In contrast, Dowty argues that both temporal extent and agentivity are irrelevant (p. 183) for his distinction between accomplishments and achievements, and takes causation to be the single most important meaning component separating the two. Mourelatos uses semelfactives like *hit* as paradigm examples of the telic class (his event class), based on their countability. Smith (1991, p. 28) argues that semelfactives ought to be treated as an atelic aspectual class *sui generis*.

In sum, there are three fundamental aspectually relevant concepts that recur in one way or another in virtually all taxonomies of lexical aspect and across different theoretical frameworks: namely, (i) change of state, (ii) end, limit, boundary, (iii) temporal extent. They are sufficient to distinguish four main classes, namely, state, process, protracted event and momentaneous event (see e.g., Comrie, 1976; Mourelatos, 1978; Bach, 1986; Parsons, 1990):

(9) Aspectual classes

		Change	End/Boundary	Temporal extent
Atelic	state	-	–	+
	process	+	-	+
Telic	event protracted	+	+	+
	momentaneous	+	+	–

This gives rise to the basic question which fine-grained properties of our conceptualizations of change, end (or boundary, limit), and temporal extent of eventualities are entailed (in all the uses) by a given verb, i.e., are grammatically relevant and belong to the semantic representation or the logical form of natural languages, and which details of such conceptualizations fall outside the grammar of natural languages, and hence should not be a part of the semantic representation or the logical form. The various proposals differ with respect to how they analyze the above three concepts, their relation to one another and to other meaning components in the decompositions of particular lexical meanings. The next sections will survey the role these concepts have played in the lexical structure of basic verbs, their consequences for the lexical class membership of verbs and for the way in which aspectual properties of VPs and sentences are derived from them.

3. Change and the Stative/Dynamic Distinction

Since state verbs entail no change, their denotation has no inherent limit or end. They are atelic and many state verbs pattern with dynamic atelic verbs, insofar as they are compatible with *for* NP temporal adverbials:

(10)   Locals believed for years that a mysterious monster lurked in the lake.

Moreover, since state verbs entail no change, they can in principle be judged true of an individual with respect to a *single moment of time*, and hence at *any* instant during the interval at which they are true, as Vendler (1957, p. 149) already observes. Both Vendler and Taylor relate this temporal property of states to their incompatibility with the progressive. Couched in terms of interval semantics, Taylor (1977, p. 206) proposes that the main function of the progressive is to mark a particular time (typically a moment) within a larger interval in which the corresponding non-progressive predicate would be true. It follows then that this distinction is not useful for state predicates like *be hirsute* or *know French*, because they are true at all moments of time *t* within a given interval.

Taylor's explanatory strategy, which makes an appeal to "a kind of Gricean principle of economy" (Dowty, 1979, p. 167), seems plausible at first blush, but both he and Vendler fail to notice that state predicates *can* be used quite naturally in the

progressive (Bach, 1981, p. 77), as examples in (11–14) show, with the exception of *be* when it combines with a prepositional phrase (15) (p. 77).

(11) I'm understanding you but I'm not believing you. (Bach, 1981)
(12) I am understanding more about quantum mechanics as each day goes by. (Comrie, 1976)
(13) John is knowing all the answers to test questions more and more often. (Binnick, 1991)
(14) John is being a hero by standing still and refusing to budge. (Dowty, 1979)
(15) *?Bill is being sick/in the garden. (Bach, 1981)

The use of state verbs in the progressive is often associated with special interpretations, but they all seem to involve some contingent or temporary manifestation of the disposition expressed by the base state verb (see e.g., Comrie, 1976; Carlson, 1977; Dowty, 1979; Bach, 1981; de Swart, 1998; Zucchi, 1998).

Such observations undermine one of Vendler's main generalizations, namely the grouping of states and achievements into one natural class, based on their assumed incompatibility with the progressive, and activities and accomplishments into another, based on their compatibility with the progressive. There are three additional arguments that can be adduced against such a grouping. First, contrary to Vendler's judgment, not only state verbs but also achievements may appear in the progressive (see e.g., Dowty, 1977, Mourelatos, 1978, p. 193): *he is winning the race, he is dying, he is reaching the top, he is falling asleep, he is leaving*. Second, it cuts across the dynamic/stative distinction. Third, it separates achievements and accomplishments, ignoring their essential similarity that has to do with their shared entailment of some end.

Dowty builds on Vendler, and Taylor, but while Vendler (1957) intends to specify "the most common time schemata implied by the use of English verbs" (p. 144), and Taylor (1977) formulates temporal meaning postulates for his three main Aristotelian classes (a good summary can be found in Dowty, 1979, p. 166), Dowty's main thesis is that such temporally-based characterizations of aspectual classes follow from the change-of-state entailments of the various aspectual classes. At the same time, just like Vendler and Taylor, Dowty relies on the progressive test to make the first cut among his aspectual classes, albeit in a different way. Given the key role Dowty attributes to the entailment of change, he correctly observes that the potential for a given state verb to be used in the progressive in a given context is directly related to the extent to which that verb is understood as describing a contingent or temporary condition of some individual, or at least a a potential for a change, rather than a permanent, unchangeable condition. For instance, in (16a, b), the acceptability of the state verb *lie* in the the progressive depends on the degree to which the referent of its subject-NP is moveable, "or to be more exact, (. . .) has recently moved, might be expected to move in the near future, or might possibly have moved in a slightly different eventuality" (Dowty, 1979, p. 175).

(16) a. ??New Orleans is lying at the mouth of the Mississippi.
     b. The socks are lying under the bed.

As can be expected then, (17) is odd, since the color of one's eyes is normally permanent throughout one's adult life.

(17)   *?Julie is having blue eyes.

Dowty (1979, ch. 3.8.2) devotes much attention to the interaction of aspectual classes with the progressive, and grapples with fitting all kinds of states into his classification, which among other things confirms that state and dynamic verbs do not constitute two clearly disjoint classes (see also Comrie, 1976, p. 36). Ultimately, Dowty proposes to split states into *interval states* and *momentary states*. The former can occur in the progressive, like the use of the verb *lie* in (16b), and correspond to Carlson's (1977) stage-level state predicates. They express temporary properties of individuals, and comprise both state and dynamic predicates. Insofar as the truth conditions of Dowty's *interval states* involve an interval (Dowty, 1979, p. 176), they belong with all other types of dynamic predicates. In contrast, *momentary states* like *have blue eyes*, *be intelligent*, *believe*, *know* are incompatible with the progressive and correspond to Carlson's (1977) individual-level state predicates. They express "atemporal" properties that tend to be stable and hold of individuals more or less permanently and typically for a substantial part of their existence, possibly all of it (Chierchia, 1995, pp. 196, 198).

State verbs are the most puzzling of the aspectual classes. Their ontological status is much hazier than that of other classes of verbs and their relation to temporal notions is puzzling (Bach, 1981, p. 71). At the same time, the meaning of individual-level predicates bears affinities to the semantics of genericity, and when analyzed as inherent generics, as Chierchia (1995) proposes, their logical representation is quite complex: namely, they contain a covert habitual morpheme and a situation argument that is locally bound by the generic GEN operator. Such observations and proposals shed doubts on Dowty's (1979, p. 71) claim that state predicates are "aspectually simple and unproblematic," and therefore their corresponding abstract state predicates are "primitive" components in the aspect calculus (see section 6).

4. The Homogeneity Property

The property of homogeneity is essential to the distinction between the kind of change that is entailed by dynamic atelic verbs as opposed to telic ones. It was introduced by Vendler in order to distinguish between his accomplishments and activities. While both "go on in time, i.e., roughly, (. . .) they consist of successive phases following one another in time" (Vendler, 1957, p. 144), only activities like "running and its kind go on in time in a *homogeneous* [emphasis mine, HF] way; any part of the process is of the same nature as the whole" (p. 146), so for instance, "[i]f it is true that someone has been running for half an hour, then it must be true that he has been running for every period within that half-hour" (pp. 145–146). Accomplishments are not homogeneous, because they "proceed toward a terminus which is

logically necessary to their being what they are. Somehow this climax casts its shadow backward, giving a new color to all that went before" (p. 146). So "if it is true that a runner has run a mile in four minutes, it cannot be true that he has run a mile in any period which is a real part of that time" (p. 146).

This can be understood as meaning that the set terminal point requires that the successive phases preceding it cannot be alike, and none of them is such that it involves the attainment of the terminus. Consequently, accomplishments lack the homogeneity property and are indivisible. Activity predicates are homogeneous and divisible, precisely because they lack the entailment of a set terminal point. This means that Vendler's two key concepts, namely "successive phases" and "terminus," are sufficient to distinguish his four aspectual classes from one another:

(18) Vendler's four aspectual classes

	Successive phases	Terminus
Activity	+	—
Accomplishment	+	+
Achievement	—	+
State	—	—

5. The Subinterval Property and Indefinite Change

Vendler's homogeneity property implicitly relies on the part-whole structure of temporal intervals at which predicates hold, and in this respect it is related to the subinterval property (Bennett and Partee, 1972) and the indefinite change (Dowty, 1979) defined in interval semantics as the characterizing properties of dynamic atelic predicates:

(19)   SUBINTERVAL VPs "have the property that if they are the main verb phrase of a sentence which is true at some interval of time *I*, then the sentence is true at every subinterval of *I* including every moment of time in *I*." (Bennett and Partee, p. 72)

For instance, if the atelic sentence *The ball moved* is true relative to an interval *I*, then *The ball moved* must also be true relative to every subinterval of *I*. In contrast, telic verb phrases like *reached the bottom of the slope* have the nonsubinterval property: If *The ball reached the bottom of the slope* is true relative to a single interval *I*, there is no proper subinterval of *I* relative to which *The ball reached the bottom of the slope* is true.

Dowty (1979) integrates the interval semantics introduced into temporal logic by Bennett and Partee and ties their subinterval property to the entailment of an indefinite change of state that characterizes his activities. On his account, *The ball moved* has the subinterval property, precisely because it is true in any situation in

which the ball changes its location to any degree at all (Dowty, 1979, p. 168ff.). In contrast, the accomplishment sentence *The ball reached the bottom of the slope* has the nonsubinterval property, because it entails a definite change of state; it is true just in case the ball changes its location and its final location is at the bottom of the slope (p. 168ff.).

Strictly speaking, as Bach (1981) among others observes, the subinterval property does not uniformly apply to all activities (his "processes"), since it requires the truth at every moment of time at some interval *I*. For instance, *John walked* cannot be literally true at every single moment of an interval at which it holds, because what intuitively qualifies as walking takes up a subinterval larger than a single moment of time. Trying to determine what constitutes the appropriate minimal interval of walking raises intractable problems that are of pragmatic nature (see also Taylor, 1977, p. 218) and depend on world knowledge.

Despite the problem of the minimal interval or minimal part, Bennett and Partee's subinterval property, and Vendler's homogeneity property capture an important and valid intuition. It also motivates the analysis of lexical aspect classes based on the part-whole relations of their denotations in subsequent mereological theories of aspect (see section 7).

6. Dowty's Aspect Calculus: The BECOME Predicate

Dowty (1979, ch. 3) distinguishes among three main aspectual classes: state, indefinite change (activities) and definite change (accomplishments and achievements).

(20)   Dowty (1979, Chapter 3.8.3, A Revised Verb Classification)
          state: *be empty; know; be a hero.*
          indefinite change: *make noise, roll, rain; move, laugh, dance.*
          definite change: **single**: *notice, ignite; reach, kill, point out* (*something to someone*)
          complex: *flow from x to y, dissolve; build* (*a house*), *walk a mile.*

States and indefinite change of state predicates are atelic, all definite change of state predicates are telic. Dowty's (1979) main innovation is to establish a systematic connection between lexical aspect classes and the components of meaning lexicalized in verbs. To this goal he defines aspect calculus, combining Montague Semantics with interval semantics (Bennett and Partee, 1972) and a decomposition analysis in Generative Semantics (see Lakoff, 1968; McCawley, 1968; Ross, 1972). In formulas of aspect calculus, state predicates serve as basic elements from which non-state predicates are formed by means of the vocabulary of standard first-order logic and the three abstract predicates imported from Generative Semantics (Dowty, 1979, p. 71, 122): DO (agentivity), BECOME (definite change of state), and CAUSE (causation). As (21) illustrates, basic state predicates like *empty* (21a) serve as the base for the

derivation of **single** definite change-of-state predicates (inchoatives, or Dowty's "achievements") by means of the abstract predicate BECOME (21b), and they in turn serve as input into the derivation of **complex** definite change-of-state predicates (causatives, Dowty's "accomplishments") by means of CAUSE (21c).

(21) a. *The room was empty*.   **empty**′(room)
    b. *The room emptied*.   BECOME **empty**′(room)
    c. *John emptied the room*.   [John does something] CAUSE [BECOME **empty**′(room)]

With aspect calculus Dowty defined a new decompositional framework and the first model-theoretic approach to the study of lexical semantics that has since become the main point of reference for the research in lexical aspect. It also stimulated many controversies whose roots largely lie in the fact that the assumptions and tools of Generative Semantics it integrates were not specifically developed for the lexical decomposition of aspectual classes and turn out not to be well suited to this goal. First, DO (agentivity) does not cross-classify aspectual classes, as is today well accepted. In fact, Dowty dissociates his aspectual classes from agentivity by splitting each into an agentive and a non-agentive subclass. In this respect, he departs from the Aristotelian classifications in the philosophy of language, mind and action (see e.g., Ryle, 1949; Vendler, 1957; Kenny, 1963), which serve as his key inspiration, but which emphasize agentivity, since their focus is on the meaning of action verbs and what they reveal about human agency, volition, purposes and goals.

Second, Dowty provides the first formal semantic analyses of BECOME and CAUSE, and although they have been highly influential, they have also been subjected to heavy criticism and revisions. One of the main controversial points is the logical and ontological status of their arguments. In Dowty's aspect calculus, [ϕ CAUSE ψ] is a bisentential connective (following Vendler, 1957; Geis, 1970; Fillmore, 1971; McCawley, 1971; a.o.), where (i) ϕ is often a BECOME sentence or contains an activity predicate, and (ii) ψ is a BECOME sentence (Dowty, p. 91). However, the arguments of CAUSE are treated as events in many early works on causation (e.g., Davidson, 1967; Schank, 1973; Miller and Johnson-Laird, 1976) with an initial causing process and a final resulting state (Chierchia, 1989; Parsons, 1990; Pustejovsky, 1991, 1995; van Hout, 1996; Reinhart, 1997; Wunderlich, 1997; Levin and Rappaport Hovav, 1998; Higginbotham, 2000; etc.). Intuitively, the cause and what is caused (and generally the result or outcome denoted by telic predicates) are best analyzed as eventualities of the appropriate type in the logical structure of predicates (see also Parsons, 1990, p. 108ff).

Third, one of the most problematic issues raised by the aspect calculus is the uniform treatment of accomplishments as causatives. The single most important meaning component that sets Dowty's accomplishments apart from his achievements is "a subsidiary event or activity bringing about/causing the change" (Dowty, 1979, p. 183). Examples of Dowty's accomplishments are *build a house* (agentive, temporally extended), *shoot someone dead* (agentive, temporally not extended), *the collision mashed the fender flat* (non-agentive); examples of achievements are *reach the age of 21* or *awaken, notice, realize, ignite* (non-agentive), *kill, point out* (agentive)

(p. 184). For Dowty, agentivity and temporal extent are irrelevant in differentiating his accomplishments from achievements. In this respect Dowty differs from Vendler, whose accomplishments are temporally extended and agentive, while achievements are punctual occurrences and non-agentive.

There are two main counterarguments that can be adduced against a uniform analysis of accomplishments as causatives. First, causation is neither a necessary nor a sufficient property of accomplishments. There are causatives that are not accomplishments (i.e., telic): *The clowns walked the elephants around in a circle for five minutes/#in five minutes.* Nor is causation necessary, because there are accomplishments that are not causatives, e.g., directed motion predicates like *John drove a car from Boston to Detroit*, which are analyzed as causatives in Dowty (1979, pp. 207–213, 216), but which lack the properties of causatives (Van Valin and LaPolla, 1997; Levin and Rappaport Hovav, 1999). Second, a uniform causative treatment of accomplishments has undesirable consequences for the analysis of complex predicates like those resulting from aspectual composition: *John ate two apples* (accomplishment/telic) vs. *John ate popcorn* (activity/atelic). Since the accomplishment or activity interpretation here depends on the quantificational and referential properties of the Incremental Theme argument (see also below), it is the properties of the Incremental Theme argument that drive the decision whether a given complex predicate and its head verb are to be analyzed as causative. This is clearly unsatisfying, as Levin (2000) observes, since paradigmatic examples of lexical causative verbs like *kill* or *break* are causative in all of their occurrences, regardless of the properties of their objects. A causative analysis of verbs of consumption like *eat* is rejected by, among others, Van Valin and LaPolla (1997), Higginbotham (2000) and Levin (2000).

In sum, although Dowty's uniform analysis of accomplishments as causatives initially enjoyed a widespread use, the introduction of causation into aspect calculus via Generative Semantics is problematic. A uniform treatment of accomplishments as causatives is unjustified, and causation is orthogonal to the cross-classification of aspectual classes, as is also evident from other approaches to aspectual classes (e.g., Garey, 1957; Bennett and Partee, 1972; Verkuyl, 1971/72; Mourelatos, 1978), including mereologically-based theories that emphasize space-time analogies as the basis for a theory of aspectual classes (Bach, 1981, 1986; Krifka, 1986/89, 1992, 1998; Filip 1993/99) (see section 7).

Since neither agentivity (DO) nor causation (CAUSE) cross-classify aspectual classes, BECOMEϕ remains the only abstract predicate of Dowty's aspect calculus with aspectual import. BECOME represents what is often understood as the core of telicity in the logical structure of verbs and sentences, namely its inchoativity or transition component, and it is the shared meaning component of Dowty's achievements (predicates involving *single*, definite changes of state) and accomplishments (*complex* definite change-of state-predicates).

(22)   BECOMEϕ is true at a (minimal) time interval t at whose initial bound $\neg\phi$ holds and at whose final bound ϕ holds (Dowty, 1979, p. 140ff.), where ϕ is an embedded clause that corresponds to a (result) state or an activity clause (pp. 77–78, 124–125).

The semantics of BECOMEϕ is inspired by von Wright's (1963, 1968) notion of a "change of state" (Dowty, 1979, p. 74ff.) and Kenny's treatment of "performances" (pp. 77–78): "[a]ny performance is describable in the form: 'bringing it about that p'" (Kenny, 1963, p. 178), whereby "every performance must be ultimately the bringing about of a state or of an activity" (p. 178) in order to prevent an infinite regress.

The conceptual and logical independence of BECOMEϕ from other elements of the aspectual calculus raises the question whether there is a level of logical (or lexical) conceptual representation dedicated just to telicity, clearly distinct from other kinds of representation, and if so, what its properties are and how exactly they interact with properties of other types of logical (or lexical) representation, including causation and agentivity. Crucial empirical evidence for distinguishing among different proposals for logical-conceptual decompositions bearing on this issue and for evaluating their empirical predictions is to be sought in the crosslinguistic comparison of lexicalization patterns. We may also ask whether BECOMEϕ is adequate for the representation of all the relevant telicity phenomena in natural languages and how it contributes to the understanding of the nature of telicity. It is clearly too narrow even when it comes to the empirical data that Dowty himself mentions. Among his paradigmatic examples of telic predicates are those consisting of activity verbs combined with durational adverbials like *run a mile /for an hour, smile for an hour* (see also Bach, 1981, p. 74). However, strictly speaking, such telic predicates are not amenable to the analysis with BECOMEϕ, since ϕ stands for a result state or an activity, and *run a mile /for an hour, smile for an hour* and the like cannot be plausibly claimed to entail any result state in the usual, non-trivial sense. The motivation of the telic property of such predicates belongs to one of the main goals of the mereological approaches to aspect to be discussed next.

7. Mereological Approaches to Aspect: Incremental Relations

The advent of mereological approaches to aspect in the early and mid-1980s (Bach, 1981, 1986; Hinrichs, 1985; Krifka, 1986/89) helped event semantics (Davidson, 1967) assert its place in the domain of aspect, after it had already gained prominence within Discourse Representation Theory (Kamp, 1979; Kamp and Rohrer, 1983). The mereological theories share the idea that the aspectually relevant properties of predicates of eventualities (time-occupying entities) can be motivated in terms of analogies to predicates of objects (space-occupying entities) (Taylor, 1977). Eventualities are basic ontological entities just like objects (Davidson, 1967), and both their domains are structured by the basic binary relation *part-of* "≤," which is defined from the *sum* "⊕" operation (Sharvy, 1980) for forming sums or plural entities

(Bach, 1981, 1986; Link, 1983, 1987). This mereological move is motivated by the goal of overcoming certain intractable problems posed by the purely temporal characterization of Aristotelian classes within temporal logic, including interval semantics (Bennett and Partee, 1972; Taylor, 1977; Dowty, 1977, 1979). At the same time, it broadens the empirical scope of a theory of lexical aspect to the similarities between the count/mass and telic/atelic distinctions, which were already observed in the traditional and structuralist linguistics (e.g., Leisi, 1953) and that take center stage in cognitive linguistics (Langacker, 1987; Talmy, 1988; Jackendoff 1996, 2010).

There are three types of similarities between the count/mass and telic/atelic distinctions. First, telic verbs are nominalized to count-quantified existential constructions (e.g., *There was a /at least one /two . . .*), while atelic verbs to mass-quantified constructions (e.g., *There was shoving and brawling in the cafeteria and nearby hallways*) (Mourelatos).

Second, there is a direct structural analogy "count noun: mass noun = telic verb: atelic verb" (i.e., "count noun is to mass noun as telic verb is to atelic verb"). Telic predicates are aligned with sortal predicates of objects (Mourelatos, 1978) in so far as they are taken to provide a criterion for counting and individuation of events in their denotation and fail to be divisive. For instance, what *boy* and also *arrive* describe has no proper parts that are again describable by *boy* and *arrive*, respectively. This view of telic predicates motivates Bach's (1981) mereological property of antisubdivisibility, and Krifka's (1986/89, 1992) quantization property:

(23)   A given nominal or verbal predicate *P* is **quantized** if and only if some *x* or *e* falls
       under *P*, then it cannot have a proper part *x'* or *e'* that also falls under *P*. Examples: *boy;
       arrive*.

All quantized predicates of eventualities are telic, but not all telic predicates are quantized, since quantization is a stricter notion than telicity (Krifka, 1992, 1998). For the purposes of this summary, telic predicates will simply be taken as quantized (see also Krifka, 1992, p. 36).

Atelic predicates like *run* and mass nouns like *wine* have the property of additivity, according to Bach (1981): namely, if *x* is some quantity of coffee, and *y* also, then their sum is also describable by *wine* (see also the property of cumulativity in Quine, 1960, p. 91). Similarly, if *e* falls under *run* and *e'* also, then *e* together with *e'* is also describable by *run*.

(24)   A given nominal or verbal predicate *P* is **cumulative** if and only if some *x* and *y* or *e*
       and *e'* fall under *P*, then the mereological sum "⊕" of *x* and *y*, *e* and *e'* also falls under
       P. Examples: *coffee; run.*

Quantized predicates can be derived from cumulative predicates by means of extensive measure functions (e.g., *liter*, *kilogram* or *hour*): *a liter of wine, run for an hour* (Krifka, 1986/89).

The structural analogy "count noun: mass noun = telic verb: atelic verb" is formalized in Bach (1986) by means of the algebraic device of a join semilattice, which was first used for the analysis of the semantics of mass terms and plurals in Link

(1983). The denotation of telic verbs like *arrive* has the structure of an atomic join semilattice just like the denotation of count nouns like *boy*. In contrast, the denotation of atelic verbs like *run* has the form of a non-atomic join semilattice just like the denotation of mass nouns like *wine*.

Third, there are interactions and mutual constraints between nominal and verbal predicates in the derivation of telic and atelic interpretations of verb phrases and sentences, for which Verkuyl (1971/72) coins the term "aspectual compositionality." The basic data are illustrated by examples in (25) and (26).

(25) a. John ate two apples in an hour /*for an hour.   TELIC
      b. John ate apples (*)in an hour /for an hour.   ATELIC
(26) a. John watched two apples on the display   ATELIC
         (*)in an hour /for an hour.
      b. John watched apples on the display (*)in an hour /for an hour.   ATELIC

Only in (25), but not in (26), are the referential and quantificational properties of the direct object correlated with the (a)telicity of a verb phrase, which intuitively amounts to a kind of "semantic concord" (Leech, 1969, p. 137) between the two: namely, in (25a), the direct object that denotes bounded objects is correlated with a telic verb phrase describing bounded events, while in (25b), the direct object is unbounded and is correlated with an atelic verb phrase describing unbounded events. In contrast, both (26a) and (26b) are atelic, independently of the referential and quantificational properties of the direct object. The first relevant observations of this phenomenon were made by Poutsma (1926) and Jakobson (1933) (see Verkuyl, 1971/72; 2001, p. 202), followed by Garey (1957) (see Filip, 1989).

In mereological approaches to lexical aspectual classes, the goal of motivating the aspectual composition shifts attention to the entailment of a change of state in the denotation of telic predicates that is manifested in the changes in the denotations of their objects. Take *eat two apples* in (25a), for instance. They denote eventualities whose part structure is directly correlated with the changes in the part structure of the apples eaten. Every proper part of two apples corresponds to one proper part of an eventuality during which those two apples are consumed, and vice versa, and since *two apples* denotes a bounded object, it follows that *eat two apples* must have bounded eventualities in its denotation. Based on such intuitions, Krifka (1986/89) provides the first model-theoretic and mereologically based analysis of the aspectual composition, which establishes a new link between the algebraic event semantics (Bach, 1986) and the thematic role theory. Krifka proposes to treat the systematic relations between the part structure of objects and eventualities, as in the denotation of *eat two apples,* in terms of thematic relations, since generally relations between objects and eventualities are characterized as thematic relations.

The thematic relation implicated in the aspectual composition is the "Incremental Theme." This term was coined by Dowty (1987, 1989, 1991) for the original "Gradual Patient" or "Successive Patient" of Krifka (1986/89, 1992). It is defined in terms of the structure-preserving mappings (i.e., homomorphism,

incremental relations) between the part structure (algebraic semilattice) of the denotation of the (Strictly) Incremental Theme relation and the part structure (algebraic semilattice) associated with its eventuality argument. Krifka's (1986/89) main claim is that the structure-preserving mappings are the source of the aspectual composition(ality) and in the simplest cases at least an entailment of a well-defined class of verbs. This makes sense, given that the main difference between (25), which exhibits aspectual composition, and (26), which does not, lies in their head lexical verb, *eat* vs. *watch*, respectively. Given the structure-preserving mappings entailed by verbs like *eat*, the aspectual composition straightforwardly follows from the standard composition with their Incremental Theme argument, as schematically represented in (27): namely, a quantized Incremental Theme argument (*two apples*) is correlated with a quantized (telic) verbal predicate (*eat two apples*), while a cumulative Incremental Theme argument (*apples)* with a cumulative (atelic) predicate (*eat apples*), in sentences denoting singular eventualities.

(27) $\phi = \lambda e \exists x \ [\alpha(e) \wedge \delta(x) \wedge Incremental\_Theme(e, x)]$ (following Krifka, 1992)
          ϕ is quantized/cumulative if δ is quantized/cumulative

In contrast, since the verb *watch* does not lexically specify the requisite mapping relation, its Theme argument *on its own* has no (a)telicity effects.

   One immediate consequence of Krifka's mereologically based account of aspectual composition is that incremental predicates are added as an additional class to telic and atelic ones, which implies that they are lexically unmarked with respect to telicity, i.e., they are neither quantized (telic) nor cumulative (atelic) (see Filip, 1993/99, and implicit suggestions in Krifka, 1986/89, 1992; Dowty, 1991). As a result, there are three main aspectually relevant classes of verbs:

(28)   (i)   telic predicates like *recover*, which are quantized.
          (ii)   atelic predicates like *run,* which are cumulative.
          (iii) incremental predicates, paradigmatic examples being verbs of creation (*build, write*, *compose*), verbs of consumption/destruction (*eat, burn*), performance verbs (*recite, play*).

   This also means that incrementality is independent of telicity in the lexical structure of verbs and also at the level of sentential semantics:

(29)   (i)   Telicity does not require incrementality. (Krifka, 1992, 2001; Filip, 1993/99)
          (ii) Incrementality does not guarantee telicity.

Telicity does not require incrementality, because there are telic predicates like *to burst* or *to make a dot* that describe instantaneous situations that have no (non trivial) part structure, but are indivisible, and hence quantized/telic, and also pass the countability test proposed by Mourelatos (1978) (see above). Incrementality does not guarantee telicity, since there are predicates like *eat apples/soup for ten minutes* that are incremental but atelic/cumulative, because their Incremental Theme argument is cumulative.

In Dowty's (1987, 1988, 1991) theory of thematic proto-roles and verbal argument selection, the Incremental Theme property is treated as the most significant Proto-Patient thematic property for the object selection of transitives. The Incremental Theme can also be an entailment for a subject of transitives, as in *At the turtle race, the winning turtle crossed the finish line in 42 seconds* (Dowty, 1991). (See also Declerck, 1979; Filip, 1990, which provides an additional support for the claim that the classification into aspectual classes concerns whole sentences, and not just VPs and verbs (Verkuyl, 1971/72).

Both Dowty (1991) and Krifka (1986/89, 1998) also emphasize that incremental relations hold between an eventuality argument and an "incremental participant" (Krifka's term, 1998) that is not syntactically realized as a single syntactic argument, a direct object or a subject, and that they may have verb external sources, both linguistic and also extra-linguistic. For instance, in *John drove from New York to Chicago* (Dowty, 1991, p. 568ff.), the PP's refer to the beginning and end point of the implied Incremental Path Theme, and the verb *drive* relates the proper parts of the implied Path to the proper parts of an event (see also Krifka, 1998). Such directed motion predications are quantized if the implied Incremental Path Theme is bounded, as in *John drove from New York to Chicago* or *We flew over the lake in an hour*, and cumulative, if it is unbounded, as in *We flew over water for hours* (examples from Talmy, 1985). Krifka (1986/89; 1992, p. 45) also observes that the mapping properties may also depend on a lexical filler of one of the verb's arguments as well as on the linguistic and extra-linguistic context, rather than only on the lexical entailments of a verb. For instance, in (30a), the quantized argument *seventeen clouds* of the non-incremental verb *see* can function as an Incremental Theme, and give rise to the quantized/telic interpretation of (30a), in a situation in which the clouds are taken to be seen in succession, one (group) after another.

(30)   a. Mary saw seventeen clouds for three minutes/in three minutes.
       b. Mary saw clouds for three minutes/*in three minutes.

Moreover, what counts as a suitable "incremental participant" may not be tied to any particular verb-argument combination, but instead may be inferred using pragmatic principles of interpretation and world knowledge, as in *John was becoming an architect but was interrupted before he could finish his degree*, where it is the stages that John went through to reach the status of an architect, and did not complete (Dowty, 1991, p. 569). Such examples indicate, according to Krifka (1986/89; 1992, p. 45), that the mapping properties are not "hard-wired" in a thematic relation, but may also follow from other knowledge sources, including our understanding of how events normally evolve in the world.

There is a widespread consensus that the phenomena that fall under the aspectual composition(ality) involve incrementality, i.e., some structure-preserving mapping(s) between objects and eventualities (and also their run times). Apart from the algebraic mappings in the mereological theories, which were first discussed as a "homomorphism" (Krifka, 1986/89, 1992; Dowty, 1991) and later labeled

"incrementality" or "incremental relations" (Krifka, 1998), the relevant mappings are identified as the *add-to* relation in Verkuyl (1971/72), the *measuring out* (of an event) relation in Tenny (1987, 1994), the *structure-preserving binding relations* in Jackendoff (1996), and *Mapping to Events* in Kratzer (2004, based on Krifka). The main disagreements concern the source of the mapping properties (or incrementality) in the lexical meaning of verbs, and its status in the grammar of natural languages, given that the structure-preserving mappings have a variety of verb-external sources. For instance, as Jackendoff (1996) argues, they are an emergent property of the lexical structure of verbs interacting with pragmatics, and therefore cannot be a factor in argument selection, contrary to Dowty (1987, 1989, 1991). In syntactic approaches to telicity, they are either a property of the *[telic]* inflectional head above VP (Kratzer, 2004) or not a part of the grammar of natural languages at all and instead entirely determined by world knowledge and pragmatic factors (Borer, 2005). Higginbotham (2000) argues they are a consequence of telicity, rather than a basis for it.

However, the explanatory power of such alternative proposals is problematic, since none of them has succeeded in motivating even the basic data in the domain of the aspectual composition, as exemplified in (25) and (26), which the mereological theories can account for. The proposals that place a heavy explanatory burden on pragmatics (e.g., Jackendoff, 1996; Borer, 2005) would seem to predict that telicity effects should always be cancelable in a suitable linguistic and/or extra-linguistic context. But this prediction is not borne out for all the relevant cases. There are telic predicates like *prove the theorem, eat three apples, eat a bowl of soup* that resist a shift into an atelic interpretation by means of the durative *for NP* adverbial (31a), for instance, and that also disallow continuations that negate the final stage of events in their denotation (31b). This behavior strongly suggests that telicity is an *entailment* of such predicates, and since it is tied to predicates headed by *strictly incremental verbs*, it is plausible to view the source of this behavior in the lexical properties of this class of verbs.

(31)   a. John proved the theorem *for an hour. (Zucchi, 1998)
       b. John proved the theorem, *but died before he could finish proving it.

Neither does the aspectual composition lend itself to a purely syntactic explanation, based on a uniform link between the telicity of a verb phrase and some telicity feature related to the morphology of its direct object that is mediated by a syntactically based feature agreement mechanism. In its unconstrained form the syntactic agreement mechanism overgeneralizes since not all the direct object DP's with the feature taken to trigger telicity in the requisite telic structure yield VP's that are telic, according to the standard empirical tests. For instance, although *two apples* contains the cardinal quantifier *two* that provides the telic "quantity" feature in the sense of Borer (2005), *watch two apples* (26a) is atelic. At the same time, the agreement mechanism undergeneralizes, since it cannot motivate the influence of the subject argument on the (a)telicity of verb phrases and sentences (see above).

8. "Degree of Change" via Part Structures, Measures, and Scales

The most recent degree-based or scalar approaches to aspect have provided the main impetus for the current focus of lexical aspect studies on the meaning components that encode scales, measure functions and changes along paths in a variety of measurable dimensions. Such meaning components have already proven useful in the previous aspect studies. For instance, Tenny (1987, 1994) distinguishes three main types of scales for "measuring out" of events (see Ramchand, 1997; Filip, 2005; Rappaport Hovav, 2008, for similar proposals):

(32) (i) a scale measuring the extent/volume of an object (as in the cases of aspectual composition, e.g., *eat two apples* vs. *eat apples/soup*);

(ii) a scale of distance measuring a path in the concrete spatial domain, e.g, *walk three miles /from A to B;*

(iii) a property scale, measuring temperature, consistency of objects, and the like, e.g., *heat the water (by 40 degrees, melt (into a gooey mess), whip the cream stiff.*

What is understood by "degree-based approaches" is a cluster of semantic and pragmatic approaches to aspect whose main empirical focus is on "degree achievements" (in the sense of Dowty), which fall under (32)/(iii) above.

(33) "degree achievements" (Dowty, 1979):
a. Verbs derived from GRADABLE ADJECTIVES: *cool, empty, lengthen, ripen, ...*

b. DIRECTED MOTION VERBS: *sink, ascend, descend, reach, come . . .*

Among the representative works that have shaped this general framework are Piñón (1997, 2000), Hay et al. (1999), Rotstein and Winter (2004), Caudal and Nicolas (2005), Gawron (2005), Kennedy and McNally (2005), Kearns (2007), Kennedy and Levin (2008), Beavers (in press), among others. They share the common goal of providing a uniform analysis of degree achievements, based on the idea that degree achievements denote (or have closely related) functions from (objects and) events to degrees on some property scale that measures the degree of change that some participant undergoes in the course of an event. This unified analysis presupposes a fundamental parallel between Themes of changes of location and traditional Patients of changes of state (see also the Localist Hypothesis originating in Gruber, 1965; also Lyons, 1967; Anderson, 1971; Jackendoff, 1976, 1983, 1990; Van Voorst, 1993; DeLancey, 2000; Talmy, 1988, 2000).

The most sophisticated and elaborate accounts have so far been developed for verbs derived from gradable adjectives. The main goal is to formulate predictions concerning the availability of telic and atelic interpretations from the characteristics of the state denoted by *x is A*. The predictions appeal to one major classificatory parameter: namely, whether the base adjective entails (i) a closed scale (a scale with a maximal, minimum element, or both), as in *empty, darken* derived from absolute

gradable adjectives, or (ii) an open scale (a scale that lacks a maximal, minimum element), as in *cool, shorten* derived from relative gradable adjectives. (See Kennedy, 2007, for more details regarding the properties of scales.)

The main observation to be explained is that all deadjectival verbs, just like other degree achievements, allow for telic or atelic interpretations, depending on the context (see Dowty, 1979, p. 88), but independently of the quantificational and referential properties of their Theme argument.

(34) a. The soup cooled for ten minutes /in ten minutes.   OPEN SCALE
      b. The sky darkened for an hour /in an hour.   CLOSED SCALE

The main puzzle posed by degree achievements is the determination of the end-point of events relative to the associated scale that is necessary for telic interpretations (for detailed discussions see Kearns, 2007; Kennedy and Levin, 2008). This raises two main questions: What is the nature of property scales associated with adjectives and verbs derived from them? What is the nature of the maximal element of a scale associated with a deadjectival verb on a telic interpretation?

A number of proposed analyses presuppose that gradable adjectives are analyzed as (a measure function) mapping objects to degrees on a scale that measures one of their properties (Bartsch and Vennemann, 1972; Cresswell, 1977; von Stechow, 1984, Heim 1985, 2000; Klein, 1991; Kennedy 1999; a.o.): e.g., $^{\text{a}}$ $[\![[_{\text{A}}\ cool]]\!]$ $^{\text{o}}$ = $\lambda d\lambda x.\mu_{\text{TEMP}}(x) \leq d$. As is common in the studies on gradable adjectives, a scale is characterized in terms of three parameters (Kennedy, 2007):

(35) Scale: (i)   *a set of degrees* (measurement values) *totally ordered* with respect to some
            (ii) *dimension*, which indicates the property being measured (volume, temperature, length, weight, loudness, intensity, etc.); and
            (iii) *an ordering relation* on the set of degrees, which distinguishes between predicates that describe increasing properties (like *tall*) and those that describe decreasing properties (like *short*).

Based on such a theoretical apparatus, Hay et al. (1999) propose the following descriptive generalization: when a predication describes a bounded degree of change on the associated scale, it is telic, when it describes an unbounded degree of change, it is atelic. Kennedy and Levin (2008) develop this idea further by proposing that all degree achievements are to be analyzed in terms of measure of change functions $m\Delta$ that are derived from basic measure functions m lexicalized by gradable adjectives in a way that is related to the semantics of comparison. A "measure of change function" $m\Delta$ is a function that measures the degree d to which an object x changes relative to some scalar dimension over the course of an event e. Open-scale deadjectival verbs have a default atelic interpretation, which merely requires some change of the referent of their Theme argument, but not a change to some specific degree on the associated scale. For instance, *The soup cooled* has a default lexically determined interpretation which merely requires that the soup decrease in temperature to some degree. The stronger telic interpretation requires the context and our world knowledge to fix what counts as the maximal change in the relevant

property at a given situation, given conventional practices and expectations of the discourse participants.

(36) The soup cooled in ten minutes (Kearns, 2007)
  (i)   . . . so we had to reheat it. *cool:* "too cool to eat"
  (ii) . . . so we started eating it (before it cooled too much). *cool*: "cool enough to eat"

Closed scale deadjectival verbs have a default accomplishment interpretation, which requires that the referent of their Theme argument has a property whose value is the standard endpoint of the scale, which is fixed by the conventional lexical meaning of closed scale deadjectival verbs (and their related root adjectives): namely, it is the maximal degree of change attributable to the referent of its Theme argument.

Degree-based theories have a narrower empirical and theoretical scope than the mereologically-based theories, and it is unclear how a scalar account of motion predicates can be provided based on the analysis of deadjectival verbs, despite the formal correspondence between property scales and paths (see e.g., Zwarts and Winter, 1997; Faller, 2000; Zwarts, 2000; Winter, 2005). For instance, many directed motion predicates with implicit closed scales like *reach* and all motion predicates with explicit closed scales only have telic interpretations (i.e., the theme must reach the endpoint of the path, see also Rappaport Hovav, 2008), unlike deadjectival verbs based on closed scale adjectives:

(37) a. The climbers reached the summit *for an hour /in an hour.
     b. John ran to the store *for an hour /in an hour.

Neither is it straightforward to extend degree-based approaches to telicity to the phenomena that are successfully treated by means of the Incremental Theme relation (Kennedy, 2010).

The mereologically based frameworks and degree-based ones each provide a different valid intuition about the notion of change and different hypotheses about the aspectually relevant meaning components of dynamic verbs that lead to (a)telicity effects. They are best viewed as complementary, rather than competing, hypotheses (pace Jackendoff, 1996), and their integration promises to lead to a comprehensive and a more adequate theory of aspect than any of them can offer separately. The integration of incrementality and scalarity into the repertoire of aspectually relevant concepts also raises the question about their relation to each other. They are independent of each other conceptually, formally as well as at the level of lexical and syntactic structure. Formally speaking, the incremental mappings relate two denotational domains (one of objects and the other of eventualities) structured by the mereological part relation "≤" (modeled as join semilattices). The notion of a "scale" is a total order, a linearly ordered set, or a chain, which is a linear extension of a partial order. The meaning components of "incrementality" and "scalarity" are taken to be independent of each other in the organization of lexical semantic structure (Filip and Rothstein, 2005; Filip, 2008; Rappaport Hovav, 2008):

(38) (i) Incremental (stem) verbs do not lexically encode either scales or measure functions.

   (ii) The scale with respect to which incremental predicates are interpreted as telic is specified externally to their incremental head verbs, normally by the lexical material of their Theme argument (e.g., *eat two apples/a bowl of soup*) or resultative secondary predicates (e.g., *The supermodel ate the cracker to the last crumb/herself out of the modeling business*.) (Filip and Rothstein, 2005; Filip, 2008)

Scalar verbs lexically encode scales, but even if they are closed, they do not guarantee the telicity of a whole sentence (see Kearns, 2007; Filip, 2008; Kennedy and Levin, 2008; Rappaport Hovav, 2008).

(39) Closed scales lexicalized by scalar verbs ("degree achievements") do not guarantee telicity.

Telic interpretations of predicates with scalar verbs are enforced by *overt* specifications of maximal values on the relevant scales (Filip, 2008): *The sky darkened to pitch black.*

   One place in the grammar of natural language where the mereological and degree-based approaches to aspect may be seen as intersecting is the grammar of measurement. In scalar approaches to telicity, measure functions that provide the units for the scales are taken to be entailed by verbs derived from gradable adjectives, and this analysis is assumed to be extendable to other degree achievements. In mereological approaches to telicity, extensive measure functions play a key role in the derivation of quantized (telic) nominal and verbal predicates (in the sense of Krifka, 1986/89, 1992, and elsewhere). It is plausible then to assume that the notion of a measure function is (among) the basic notion(s) needed in model structures for a unified semantic analysis of a variety of telicity phenomena, separately covered by mereological and degree-based theories (Filip, 2008).

   The results of mereological and scalar approaches to lexical aspect converge on a clear revision of the way in which lexical aspectual classes have been thought of since Dowty (1979) with respect to the nature of the meaning components lexicalized in verbs and the lexical aspectual classes they motivate. First, we see the emergence of two new lexical aspectual classes—incremental verbs and scalar verbs (i.e., deadjectival verbs and basic directed motion verbs)—that are not aligned with the traditional lexical aspectual classes, e.g., either the four classes proposed by Vendler (1957) or the tripartite classification into processes, events and states common in event semantics.

   Second, also in departure from such traditional Aristotelian taxonomies that are predicated on the essential telic/atelic distinction, incremental verbs and scalar verbs are taken to be underspecified for telicity, neither telic nor atelic. Both the mereological and degree-based (or scalar) frameworks implicitly or explicitly assume the strategy of semantic underspecification in the lexicon in order to account for the ease with which incremental and scalar (aka degree achievement) verbs can be integrated into either telic or atelic predications, rather than assuming fully determined telic and atelic lexical meanings with coercion operations, lexical ambi-

guity, generalized lexical rules, and the like. The insights of the recent mereological and degree-based approaches raise the following fundamental questions: What is the classification schema of lexical aspectual classes that best fit the natural language data? What constitutes valid empirical evidence (like linguistic tests) for such a classification schema?

9. CONCLUSION

This short review of the vast domain of lexical aspect focused on the idea introduced by Dowty that the explanation for the differences among aspectual classes lies in understanding the change-of-state entailments that are or are not present in the different classes (Dowty, 1979, p. 167) as well as in our expectations about the way changes happen over time (p. 185). The main issue here concerns which fine-grained properties of our conceptualizations of change are a part of the semantic representation/the logical form and motivates a variety of (a)telicity effects we observe in the grammar of natural languages, and which fall outside the grammar proper. Current research at the intersection of mereological and degree-based frameworks suggests that future directions in the domain lexical aspect will also profit from building on the insights and formal tools of the philosophy and logic of measurement.

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