

Telicity Corresponds to Degree of Change

1 Introduction

Analyses of aspect often focus on the variable telicity of creation/destruction verbs (1), but such variability is also shown by directed motion verbs (2) (Levin and Rappaport Hovav 1995) and (so-called) “degree achievements” (3) (Dowty 1979).

- | | | | |
|-----|----|--|--------|
| (1) | a. | Kim ate <u>rice</u> for an hour. | ATELIC |
| | b. | Kim ate <u>a bowl of rice</u> in an hour. | TELIC |
| (2) | a. | <u>The balloon</u> ascended for an hour. | ATELIC |
| | b. | <u>The submarine</u> ascended in an hour. | TELIC |
| (3) | a. | The dripping water lengthened <u>the icicle</u> for an hour. | ATELIC |
| | b. | The tailor lengthened <u>my pants</u> in an hour. | TELIC |

Krifka (1989, 1992) argues that telicity is a function of the structure of the ‘incremental theme’ argument of the verb, and follows from the relation between the structure of the argument and the described event (cf. Dowty 1991; Filip 1999; Jackendoff 1996; Tenny 1987, 1994; Verkuyl 1993; Ramchand 1997).

Focusing specifically on verbs of creation/destruction, Krifka argues that a defining characteristic of the incremental theme role is that it satisfies ‘Mapping to Objects’ and ‘Mapping to Events’:

- | | | |
|-----|----|---|
| (4) | a. | <i>Mapping to Objects</i>
$\forall R[\text{MAP-O}(R) \leftrightarrow \forall e, e', x[R(e, x) \wedge e' \geq e \rightarrow \exists x'[x' \geq x \wedge R(e', x')]]]$ |
| | b. | <i>Mapping to Events</i>
$\forall R[\text{MAP-E}(R) \leftrightarrow \forall e, x, x'[R(e, x) \wedge x' \geq x \rightarrow \exists e'[e' \geq e \wedge R(e', x')]]]$ |

Given (4a-b), a telic interpretation of the predicate arises whenever the incremental theme argument is *quantized*:

- | | | |
|-----|----|---|
| (5) | a. | A predicate P is <i>quantized</i> if and only if no entity that is P can be a subpart of another entity that is P (see Krifka 1998, p. 200). |
| | b. | An event description R is <i>telic</i> if and only if it applies to events e such that all parts of e that fall under R are initial and final parts of e (see Krifka 1998, p. 207). |

- Since a bowl of rice is quantized in (1b), the predicate *eat a bowl of rice* is true only of events whose endpoints correspond to that point in time at which a bowl’s worth of the rice has been consumed.
- Since rice is not quantized, the predicate *eat rice* in (1a) is true of any event of rice-eating, regardless of endpoint.

NB: “The distinction between telicity and atelicity should not be in the nature of the object described, but in the description applied to the object.” (Krifka 1998, p. 207)

This sort of approach results in somewhat different analyses of the three verb classes in (1)-(3) (cf. Ramchand 1997; Tenny 1994):

- In verbs of creation/destruction, telicity involves a mapping from the structure of the incremental theme to the event (*change in (volume/extent of) object*).
- In verbs of directed motion, telicity involves a mapping from the location of the moving object on a path to the event (*change in location*).
- In degree achievements, telicity involves a mapping from a degree to which some property holds of the incremental theme argument to the event (*change in property*).

Solution 1: Stipulate that the thematic relation/argument/semantic parameter that is relevant for calculating telicity is different in these three classes of verbs: I-THEME, PATH, PROPERTY (cf. Ramchand 1997).

This approach misses the generalization that these verbs all describe events in which one participant (underlined in (1)-(3)) undergoes some sort of gradual change — in volume or spatial extent, in location along a path, or in the degree to which it possesses some gradable property.

Solution 2: Handle everything in terms of (metaphoric) movement along a path (Jackendoff 1996).

Isn't there a more direct characterization of what's going on here?

Solution 3: Analyze all of these verbs as describing events that involve a change in the degree to which an object (the 'affected argument'/incremental theme) undergoes a change in the degree to which it possesses some gradable property: a change in degree of volume or spatial extent, a change in degree of progress along a path, a change in degree of some arbitrary property (provided by a gradable adjective).

The idea can most transparently illustrated by the case of degree achievements:

$$(6) \quad \llbracket \llbracket \text{VP lengthen the icicle} \rrbracket \rrbracket = \lambda e. \text{the length of the icicle at the beginning of } e + d = \text{the length of the icicle at the end of } e$$

Telicity is determined by whether the 'degree of change' argument d is quantized or not:

- If d is quantized, *lengthen the icicle* is true only of events whose endpoints correspond to that point in time at which the length of the icicle has increased by d .
- In contrast, if d is not quantized, *lengthen the icicle* is true of any event of icicle-lengthening.

As we will see below, this sort of analysis can be extended to the entire class of verbs of gradual change.

This analysis differs crucially from Krifka's in that it dispenses with stipulations about the mapping from argument structure to events — in particular, the idea that we need to define particular thematic roles in terms of a homomorphic relation between the structure of that role's argument and the progression of the event.

Instead, the relation between (non-)quantization of an argument (the degree of change) and (a)telicity follows from the basic semantic analysis given to verbs of gradual change.

2 Basic assumptions about scalar semantics

The scalar semantics we propose for verbs of gradual change is based on the semantic analyses of gradable adjectives that we have been discussing for the past few weeks. The crucial components are as follows.

1. SCALES: a set of points totally ordered along some dimension (e.g., *length*, *volume*, *duration*, etc.). We adopt the typology of scale structures argued for in Kennedy and McNally 2002:

- (7) *A typology of scale structures*
- | | | |
|----|---|--------------|
| a. | $\langle S_{(0,1)}, \preceq_{\delta} \rangle$ | OPEN |
| b. | $\langle S_{[0,1)}, \preceq_{\delta} \rangle$ | LOWER CLOSED |
| c. | $\langle S_{(0,1]}, \preceq_{\delta} \rangle$ | UPPER CLOSED |
| d. | $\langle S_{[0,1]}, \preceq_{\delta} \rangle$ | CLOSED |

2. DEGREES: positive or negative intervals on a scale (Seuren 1978; von Stechow 1984b; Kennedy 1999, 2001; Schwarzcild and Wilkinson 1999).

- (8) a. $POS(S) = \{d \subseteq S \mid \exists p_1 \in d \forall p_2 \in S [p_2 \preceq p_1 \rightarrow p_2 \in d]\}$
 b. $NEG(S) = \{d \subseteq S \mid \exists p_1 \in d \forall p_2 \in S [p_1 \preceq p_2 \rightarrow p_2 \in d]\}$

As a starting point, we will adopt a modified version of von Stechow's (1984b) representations for positive and negative degrees:

- (9) *Positive and negative degrees*
- | | |
|----|--|
| a. | $d_p^+ = \{p' \in S \mid p' \preceq p\}$ |
| b. | $d_p^- = \{p' \in S \mid p \preceq p'\}$ |

This will be important for talking about differences between positive/negative degrees, though it may ultimately be the case that we want a different formalism for dealing with this.

3. GRADABLE ADJECTIVES: functions from objects to degrees (Kennedy 1999; Bartsch and Vennemann 1973. We could posit a relational analysis, as in Cresswell 1977; Seuren 1978; Hellan 1981; von Stechow 1984a; Heim 1985, 2000 and many others, but for reasons that will become clear below, assuming a functional analysis is simpler.

Since a particular object may manifest different degrees of the same gradable property at different times — and we are interested in changes in properties over time — we add a temporal argument.

- (10) a. $\llbracket \mathbf{long}(a)(t) \rrbracket$ = the positive projection of a on the length scale at time t
 b. $\llbracket \mathbf{short}(a)(t) \rrbracket$ = the negative projection of a on the length scale at time t

For example, (11) illustrates the positive and negative projections onto the LENGTH scale of an object a at time t :

- (11) LENGTH: $0 \bullet \text{---} \mathbf{long}(a)(t) \text{---} \bullet \text{---} \mathbf{short}(a)(t) \text{---} \circ 1$

This sort of approach assumes that the relational component of predicates headed by gradable adjectives comes from the degree morphology:

$$(12) \quad \begin{array}{c} \text{DegP} \\ \text{Deg AP} \\ | \\ \text{A} \end{array}$$

Possible analyses of familiar degree morphemes:

$$(13) \quad \begin{array}{l} \text{a. } \llbracket [\text{Deg}^0 \emptyset] \rrbracket = \lambda G \lambda d \lambda x \lambda t. \exists d. G(x)(t) \succeq d \\ \text{b. } \llbracket [\text{Deg}^0 \text{more}] \rrbracket = \lambda G \lambda d \lambda x \lambda t. G(x)(t) \succ d \end{array}$$

Two (independent) points to observe about the system:

1. The treatment of polarity allows us to give a semantic analysis of comparative morphology that works for both positive and negative adjectives.
2. As has been discussed in class, this analysis doesn't posit any quantificational force for the comparative (outside the comparative clause), so we expect no scopal interactions between the comparative morphology and other stuff in the sentence.

$$(14) \quad \begin{array}{l} \text{a. Rod A is longer than rod B (is).} \\ \text{b. } \mathbf{long}(\text{Rod A})(t_u) \succ \mathbf{long}(\text{Rod B})(t_u) \\ \text{c. } \mathbf{long}(\text{Rod A})(t_u) \succ \max\{d \mid d \preceq \mathbf{long}(\text{Rod B})(t_u)\} \end{array}$$

$$(15) \quad \begin{array}{l} \text{a. Rod B is shorter than rod A (is).} \\ \text{b. } \mathbf{short}(\text{Rod B})(t_u) \succ \mathbf{short}(\text{Rod A})(t_u) \\ \text{c. } \mathbf{short}(\text{Rod B})(t_u) \succ \max\{d \mid d \preceq \mathbf{short}(\text{Rod A})(t_u)\} \end{array}$$

$$(16) \quad \begin{array}{l} \text{LENGTH: } 0 \bullet \text{---} \mathbf{long}(A)(t_u) \text{---} \bullet \text{---} \mathbf{short}(A)(t_u) \text{---} \circ 1 \\ \text{LENGTH: } 0 \bullet \text{---} \mathbf{long}(B)(t_u) \text{---} \bullet \text{---} \mathbf{short}(B)(t_u) \text{---} \circ 1 \end{array}$$

4. DIFFERENTIAL COMPARATIVES: Since we are interested in degree of change, we also need to be able to talk about *differences* in the degree to which different things (or the same things at different times) have some property. Differences are also important for “differential comparatives” like (17a)-(17b).

$$(17) \quad \begin{array}{l} \text{a. Rod A is 16 inches longer than rod B.} \\ \text{b. Rod B is 16 inches shorter than rod A.} \end{array}$$

Following (Hellan 1981; von Stechow 1984a; Bierwisch 1989; Faller 1998; Kennedy 2001), we define degree addition as in (18) (von Stechow 1984b), where the differential degree is restricted to be positive.

$$(18) \quad \begin{array}{l} \text{Degree addition} \\ \text{a. } d_p^+ + d_q^+ = d_{p+q}^+ \\ \text{b. } d_p^- + d_q^+ = d_{p-q}^- \end{array}$$

We can now analyze differential comparatives in terms of degree addition:

- (19) a. $\mathbf{long}(A) \succeq \mathbf{long}(B) + d_{16}^+$
 b. $\mathbf{short}(B) \succeq \mathbf{short}(A) + d_{16}^+$

Regular comparatives can also be reanalyzed in these terms, provided we existentially quantify over the differential degree when it is unexpressed (see Hellan 1981; von Stechow 1984a for approaches along these lines, and Kennedy 2001; Schwarzchild and Wilkinson 1999 for slightly different approaches):

$$(20) \quad \llbracket [Deg^0 \mathbf{more}] \rrbracket = \lambda G \lambda d_1 \lambda d_2 \lambda x \lambda t. G(x)(t) \succeq d_1 + d_2$$

If this quantifier (or a differential measure phrase) can scope over certain predicates, we may be able to account for the scope facts discussed in Heim 2000 without giving up the non-quantificational analysis of the comparative. More on this next week.

3 Extending scalar semantics to verbs of gradual change

3.1 Lexical semantics

We claim that all three classes of verbs should be analyzed in a way that is most transparently represented by degree achievements: in terms of changes in the degree to which an object possesses a gradable property (i.e., a measure function). The central claims are:

1. All verbs of gradual change contain gradable properties as parts of their meaning — even verbs of creation/destruction (cf. Kratzer 2000).
 - DEGREE ACHIEVEMENTS: a property determined by the adjectival base
 - DIRECTED MOTION VERBS: a property that measures movement along a path
 - CREATION/DESTRUCTION VERBS: a property that measures spatial extent.
2. The events described by these verbs involve changes (increases) in the degree to which one of their arguments possesses this gradable property.
3. The measure of change corresponds to a (differential) degree argument, which we refer to as the “degree of change” (cf. Hay, Kennedy, and Levin 1999).

The core proposal: for any verb of gradual change V_Δ with associated gradable property \mathbf{g}_v , $[\text{VP } V_\Delta \text{ x } d\text{-much}]$ is true of an event e if and only if x increases in \mathbf{g}_v -ness by d -much.¹

- (21) a. The tilting of the earth lengthened the day by 5 minutes.
 b. (The tilting of the earth caused) the day to increase in (temporal) length by five minutes.

- (22) a. The balloon ascended 100 meters.
 b. The balloon increased in vertical position by 100 meters.

- (23) a. Kim ate two bowls of rice.

¹Note that we mostly ignore external arguments and causation, since causation is not a relevant factor: both causative and inchoative verbs show the same behavior with respect to (a)telicity. This is actually an important fact, since it indicates that causation and telicity are independent (Abusch 1986; Pustejovsky 1991; Van Valin and LaPolla 1997).

- b. (Kim caused) some quantity of rice to increase in eatenness by two bowls.

The lexical semantic analysis is made explicit in (24a), where \mathbf{g}_v is the gradable property associated with the verb, d is the degree of change argument, and BEG and END are functions from events to times that return an event’s beginning and end points, respectively. For perspicuity, I will sometimes use the abbreviation in (24b).

$$(24) \quad \begin{array}{l} \text{a. } V_{\Delta} = \lambda x \lambda d \lambda e. \mathbf{g}_v(x)(\text{END}(e)) = \mathbf{g}_v(x)(\text{BEG}(e)) + d \\ \text{b. } V_{\Delta} = \lambda x \lambda d \lambda e. \text{INCREASE}(\mathbf{g}_v(x))(d)(e) \end{array}$$

This analysis is similar to the one developed in Jackendoff 1996, but differs in that the latter is based on movement along a path, rather than change in a gradable property.

The following lexical semantic representations illustrate the analysis as applied to various members of the three classes of verbs, where “ d -much” corresponds to the (syntactically optional) degree of change argument.

(25) *Degree achievements*

$$\begin{array}{l} \text{a. } [\text{VP lengthen } x \text{ (by } d\text{-much)}] = \lambda e. \text{INCREASE}(\mathbf{long}(x))(d)(e) \\ \text{b. } [\text{VP shorten } x \text{ (by } d\text{-much)}] = \lambda e. \text{INCREASE}(\mathbf{short}(x))(d)(e) \end{array}$$

(26) *Verbs of directed motion*

$$\begin{array}{l} \text{a. } [\text{VP } x \text{ ascend (} d\text{-much)}] = \lambda e. \text{INCREASE}(\mathbf{up}(x))(d)(e) \\ \text{b. } [\text{VP } x \text{ descend (} d\text{-much)}] = \lambda e. \text{INCREASE}(\mathbf{down}(x))(d)(e) \end{array}$$

(27) *Verbs of creation/destruction*

$$\begin{array}{l} \text{a. } [\text{VP write (} d\text{-much of) } x] = \lambda e. \text{INCREASE}(\mathbf{written}(x))(d)(e) \\ \text{b. } [\text{VP eat (} d\text{-much of) } x] = \lambda e. \text{INCREASE}(\mathbf{eaten}(x))(d)(e) \end{array}$$

3.2 Telicity corresponds to degree of change

It follows from this analysis that the semantic value of the degree of change argument — whether or not it is quantized — determines the predicate’s telicity.

(28) *Quantized $d \rightarrow$ telic VP*

$$\begin{array}{l} \text{a. } [\text{VP lengthen the icicle by 3 centimeters}] \\ \text{b. } \lambda e [\mathbf{long}(\text{icicle})(\text{END}(e)) = \mathbf{long}(\text{icicle})(\text{BEG}(e)) + 3 \text{ cm}] \end{array}$$

(29) *Non-quantized $d \rightarrow$ atelic VP*

$$\begin{array}{l} \text{a. } [\text{VP lengthen the icicle (by some amount)}] \\ \text{b. } \lambda e \exists d [\mathbf{long}(\text{icicle})(\text{END}(e)) = \mathbf{long}(\text{icicle})(\text{BEG}(e)) + d] \end{array}$$

This example involves a degree achievement, but the same sort of analysis applies to all verbs of gradual change, as we will show in detail below. We thus achieve our initial goal of providing a fully general account of all three classes of verbs.

Moreover, on this approach, whether a predicate is telic or not is strictly a function of the scalar properties of the degree of change — we do not need to establish a mapping from the degree of change (or any other argument) to the event.

Of course, it now becomes absolutely crucial that we answer the following question: how is the semantic value and corresponding (non-)quantizedness of the degree of change argument determined?

3.3 Aside: Why INCREASE and not (also) DECREASE?

We have characterized gradual change as an *increase* in the degree to which an object possesses a gradable property. But couldn't gradual change involve a *decrease* in some property? Wouldn't this be the right way to analyze verbs like *descend*, *shorten* or *eat*?

In fact, decreasing changes can be characterized as *increases in negative properties*, as we have already seen. However, we might still wonder why don't we find pairs like 'lengthen' (*increase in length*) and 'lengthess' (*decrease in length*)?

A possible explanation?

- Assume that change involves a shift from $\neg P$ to P (Wright 1963, 1968; Dowty 1979).
- If an object possesses a gradable property P to degree d , then for any $d' < d$, that object also possesses property P to degree d' .
- Therefore, change in the degree to which an object possesses some gradable property should involve an increase (of a positive or negative degree).

4 Capturing (a)telicity

How is the value of the degree of change determined? In particular, what determines whether this argument is quantized or non-quantized? There appear to be four ways to determine the value of this (possibly implicit) argument. It may be:

1. explicitly provided by linguistic material (e.g., measure phrases),
2. inferred based on the lexical semantics of the verb or its arguments (e.g., open/closed scale, mass/count distinction?),
3. inferred based on real-world knowledge (e.g., pants vs. icicles), or
4. it may be bound by a default existential quantifier (the 'elsewhere' case).

4.1 Explicitly specified degree of change

4.1.1 Measure phrases

A quantized or non-quantized measure phrase may explicitly provide a value for d .

(30) *Some quantized measure phrases*

- a. 5 meters
- b. 40 fathoms
- c. 10 pages
- d. a scoop
- e. a bowl (of rice)

If the measure phrase is quantized, we get a telic interpretation:

- (31) a. They are widening the road 5 meters. \nrightarrow They have widened the road 5 meters.
 b. The lake cooled 4 degrees in two days/?for two days.
- (32) a. The curtains are falling 10ft. \nrightarrow The curtains have fallen 10ft.
 b. The submarine ascended 40 fathoms in an hour/?for an hour.
- (33) a. Kim is eating a scoop. \nrightarrow Kim has eaten a scoop.
 b. Kim wrote 10 pages in 45 minutes/?for 45 minutes.
- (34) a. Kim is drinking a bottle of water. \nrightarrow Kim has drunk a bottle of water.
 b. Kim ate a bowl of rice in 5 minutes/?for 5 minutes.

The fact that all three classes of verbs take overt measure phrase arguments — which are standardly assumed to denote degrees — further supports the claim that they all have the same underlying scalar semantics.

Note that verbs of creation/consumption, unlike the other two classes, cannot express both the measure argument and affected argument independently — we get one or the other, or a ‘combination’ of the two (as in (34)). We will return to this point below.

- (35) *Some non-quantized measure phrases*
- a. a bit
 - b. a quantity
 - c. a part

Entailments indicate that non-quantized measure phrases give rise to atelic predicates.

- (36) a. The soup is cooling a bit. \Rightarrow The soup has cooled a bit.
 b. Kim is drinking a quantity of milk. \Rightarrow Kim has drunk a quantity of milk.
 c. The sub is ascending a part of the way towards the surface. \Rightarrow The sub has ascended a part of the way towards the surface.

We appear to run into problems with *for*-PPs.

- (37) The soup cooled a bit ?for 10 minutes/in 10 minutes.
 (37) Kim drank a quantity of milk ?for 30 seconds/in 30 seconds.
 (37) The sub ascended a part of the way towards the surface ?for an hour/in an hour.

This is not surprising — see Zucchi and White’s (2001) discussion of twigs, sequences and quantities of milk. We will return to an explanation below.

4.1.2 *Scalar adverbs*

A “maximizing” adverb may specify that some point on the scale must be reached, in which case the degree of change is quantized, and the predicate has a telic interpretation.

- (38) *Maximizing adverbs*
- a. completely
 - b. totally
 - c. halfway

- (39) a. They are totally straightening the rope. \nrightarrow They have totally straightened the rope.
 b. The cake is cooling completely. \nrightarrow The cake has cooled completely.
- (40) a. Kelly drank the milkshake halfway in 10 minutes/?for 10 minutes.
 b. The curtains fell halfway in 10 seconds/?for 10 seconds.

In contrast, “minimizing” adverbs, which specify that the change cannot go past some point on a scale, result in a non-quantized degree of change and an atelic predicate.

- (41) *Minimizing adverbs*
 a. slightly
 b. partially
 c. somewhat
- (42) a. They are straightening the rope slightly. \Rightarrow They have straightened the rope slightly.
 b. The independent counsel is broadening the investigation somewhat. \Rightarrow The independent counsel has broadened the investigation somewhat.
- (43) a. The submarine is ascending slightly. \Rightarrow The submarine has ascended slightly.
 b. The curtains are falling a bit. \Rightarrow The curtains have fallen a bit.

Again, though, we seem to have a problem with *for*-PPs!

- (44) a. ??They straightened the rope slightly for 10 minutes.
 b. ??The independent counsel broadened the investigation somewhat for 3 weeks.

4.2 Lexically inferred implicit degree of change

As we have already seen, the scale associated with a gradable adjective may be closed or open. This property influences the default telicity of the predicate.

This effect is clearest with degree achievements since their scale structure is most transparent (see Hay et al. 1999, for additional discussion).

When the base of a degree achievement is a closed-scale adjective, a quantized degree of change is inferable from scale structure: it is the degree of change required to get to the end of the scale.

- (45) a. They are straightening the rope. \nrightarrow They have straightened the rope.
 b. The tub is emptying. \nrightarrow The tub has emptied.

When the base is an open-scale adjective, the default interpretation is atelic (see section 4.4 below).

- (46) a. They are lengthening the rope. \Rightarrow They have lengthened the rope.
 b. They are widening the road. \Rightarrow They have widened the road.

Precisely the same effects are seen in verbs of directed motion. Proportional modifiers can be used here to test for scale structure, just as with gradable adjectives:

- (47) a. Kim entered the house completely.
 b. ??Kim approached the house completely.
- (48) a. Kim is entering the house. \nRightarrow Kim has entered the house.
 b. Kim is approaching the house. \Rightarrow Kim has approached the house.

The open/closed scale distinction may be at the root of the mass/count effect on telicity of verbs of creation/destruction: count nouns (with determiners) are associated with a closed scalar structure (where the maximal value is the degree that corresponds to affecting the argument completely); mass nouns are associated with an open scalar structure.

- (49) a. Kim ate a sandwich completely.
 b. ??Kim ate rice completely.
- (50) a. Kim is eating a sandwich. \nRightarrow Kim has eaten a sandwich.
 b. Kim is eating rice. \Rightarrow Kim has eaten rice.

Alternatively, we may want to say that direct objects of creation/consumption verbs directly supply the value of both the affected argument and the measure argument (see the discussion above) — this is a question that still needs to be resolved. More on this next week too.

4.3 Contextually inferred degree of change

When the meaning of the verb's arguments are such that a quantized value of change can be inferred, a telic interpretation results, even in cases in which the same verbs are atelic in the absence of such information.

In the examples in (51), context and world knowledge provides information about what the final degree should be — the specified length of alteration, the windowsill, the stage — which means that the degree of change is quantized.

- (51) a. The tailor is lengthening my pants. \nRightarrow The tailor has lengthened my pants.
 b. Kim is lowering the blind. \nRightarrow Kim has lowered the blind.
 c. The curtain is falling. \nRightarrow The curtain has fallen.

This is not the case in the examples in (52), and the predicates are atelic:

- (52) a. The traffic is lengthening my commute. \Rightarrow The traffic has lengthened my commute.
 b. Kim is lowering the heat. \Rightarrow Kim has lowered the heat.
 c. The temperature is falling. \Rightarrow The temperature has fallen.

4.4 The elsewhere case

If neither a measure phrase, nor the scalar properties of the underlying predicate, nor other contextual factors conspire to provide a value for d , it is existentially bound at the level of the verbal predicate. The result is a non-quantized, atelic predicate (see (29b) above).

- (53) a. They are lengthening the rope. \Rightarrow They have lengthened the rope.
 b. The metal cooled for an hour.

- (54) a. The sub is ascending. \Rightarrow The sub has ascended.
 b. Kim pushed the cart for an hour.
- (55) a. Lee is reading. \Rightarrow Lee has read.
 b. Kim ate for 15 minutes.

4.5 Telicity and context

The inference to a quantized degree of change in the cases discussed above arises through conversational implicature (cf. Krifka 1989; Filip 1999; Jackendoff 1996; Hay et al. 1999): as shown by (56), the inference is cancellable.

- (56) a. I straightened the rope, but not completely.
 b. The tailor lengthened my pants, but not completely.

The implicature can be explained in terms of principles of informativeness. For example, in the case of scale structure influencing telicity, what is unique about closed-scale adjectives is that the endpoint of the scale is a possible reference point. It follows that the most informative interpretation of, e.g., *I emptied the tub*, is the one in which the rope is straightened completely (cf. *The tub is empty*.)

In contrast, when a quantized value for the degree of change is explicitly supplied, as in the following examples, telicity is not cancellable.

- (57) a. #They straightened the rope completely, but the rope isn't completely straight.
 b. #They widened the road 5 feet, but the road didn't increase in width by 5 feet.
- (58) a. She ate the sandwich in 5 minutes.
 b. She ate the sandwich for 5 minutes.
- (59) a. She ate the sandwich but as usual she left a couple of bites.
 b. ??She ate the whole sandwich, but as usual she left a couple of bites.
- (60) a. She ran a race but didn't quite finish it.
 b. ??She ran a mile but didn't quite finish it.

5 Bits and quantities

What is wrong with *for*-PPs in the following examples if the measure phrases are non-quantized?

- (61) a. The soup cooled a bit ?for 10 minutes/in 10 minutes.
 b. Kim drank a quantity of milk ?for 30 seconds/in 30 seconds.
 c. The sub ascended a part of the way towards the surface ?for an hour/in an hour.
- (62) a. ??They straightened the rope slightly for 10 minutes.
 b. ??The independent counsel broadened the investigation somewhat for 3 weeks.

These are not a problem if we adopt Zucchi and White’s (2001) analysis of twigs and sequences (in predicates like *write a sequence of numbers*). First, we assume that the degree variables introduced by these expressions are existentially bound from outside the VP (unlike the implicit argument examples above, which are bound inside VP).

- (63) a. The soup cooled a bit.
 b. $\lambda e[\mathbf{cool}(soup)(\text{END}(e)) = \mathbf{cool}(soup)(\text{BEG}(e)) + \mathbf{d}]$

What is crucial here is that \mathbf{d} is free inside the VP. Since its value is determined by an assignment function, the VP is quantized: (63b) is true only of events that involve an increase in coolness by $g(\mathbf{d})$ -much. Assuming that *for*-PPs presuppose that the predicate they modify is non-quantized, we account for the incompatibility.

6 Conclusion

Verbs of gradual change contain gradable properties as part of their meaning. Telicity is determined solely by the semantic properties of the degree of change; it is not determined by a lexical diacritic (e.g., [+/- BOUNDED]) or some kind of morpho-syntactic feature(s).

Contrary to what is often taken to be the conventional wisdom (i.e. Dowty 1991; Krifka 1989), the incremental theme argument does not (directly) determine telicity. The incremental theme does *indirectly* determine telicity to the extent that its structure affects possible values of the degree of change.

More generally, we see that telicity and degree of change (our functional analogue of the traditional incremental theme) are to some extent independent: a verb may have a degree of change (and an incremental theme) without being telic (cf. Krifka 1986, 1989; Filip 1999; Jackendoff 1996; but see Dowty 1991, p. 607 for a different view).

Most generally, our analysis indicates that scalar representations play a much broader role in natural language semantics than has previously been assumed. The role of scalar representations extends beyond the semantics of gradable adjectives to a core property of verb meaning: the determination of aspectual properties. Possibly to other areas of word meaning as well...?

References

- Abusch, Dorit. 1986. Verbs of change, causation and time. Technical report, Center for the Study of Language and Information, Stanford University, Stanford, CA. Report CSLI-86-50.
- Bartsch, Renate, and Theo Vennemann. 1973. *Semantic structures: A study in the relation between syntax and semantics*. Frankfurt: Athäenum Verlag.
- Bierwisch, Manfred. 1989. The semantics of gradation. In *Dimensional adjectives*, ed. Manfred Bierwisch and Ewald Lang, 71–261. Berlin: Springer-Verlag.
- Cresswell, M. J. 1977. The semantics of degree. In *Montague grammar*, ed. Barbara Partee, 261–292. New York: Academic Press.
- Dowty, David. 1979. *Word meaning and montague grammar*. Dordrecht: Riedel.
- Dowty, David R. 1991. Thematic proto-roles and argument selection. *Language* 67:547–619.
- Faller, Martina. 1998. A vector space semantics for comparatives. Ms., Stanford University.
- Filip, Hana. 1999. *Aspect, eventuality types, and nominal reference*. New York: Garland Press. (1993 Berkeley Ph.D thesis).

- Hay, Jen, Christopher Kennedy, and Beth Levin. 1999. Scale structure underlies telicity in ‘degree achievements’. In *Proceedings of SALT IX*, ed. Tanya Matthews and Devon Strolovitch, 127–144. Ithaca, NY: CLC Publications.
- Heim, Irene. 1985. Notes on comparatives and related matters. Unpublished ms., University of Texas, Austin.
- Heim, Irene. 2000. Degree operators and scope. In *Proceedings of SALT X*. Ithaca, NY: CLC Publications.
- Hellan, Lars. 1981. *Towards an integrated analysis of comparatives*. Tübingen: Narr.
- Jackendoff, Ray. 1996. The proper treatment of measuring out, telicity, and perhaps even quantification in english. *Natural Language and Linguistic Theory* 14:305–354.
- Kennedy, Christopher. 1999. *Projecting the adjective: The syntax and semantics of gradability and comparison*. New York: Garland. (1997 UCSC Ph.D. thesis).
- Kennedy, Christopher. 2001. Polar opposition and the ontology of ‘degrees’. *Linguistics & Philosophy* 24:33–70.
- Kennedy, Christopher, and Louise McNally. 2002. Scale structure and the semantic typology of gradable predicates. Unpublished ms.
- Kratzer, Angelika. 2000. Building statives. In *Proceedings of BLS 26*. Berkeley, CA: Berkeley Linguistics Society.
- Krifka, Manfred. 1986. Nominalreferenz und zeitkonstitution: Zur semantik von massentermen, individualtermen, aspektklassen. Doctoral Dissertation, University of Munich.
- Krifka, Manfred. 1989. Nominal reference, temporal constitution and quantification in event semantics. In *Semantics and contextual expression*, ed. Renate Bartsch, Johann van Benthem, and Peter van Emde Boas, 75–115. Stanford, CA: CSLI Publications.
- Krifka, Manfred. 1992. Thematic relations as links between nominal reference and temporal constitution. In *Lexical matters*, ed. Ivan Sag and Anna Szabolcsi. Stanford, CA: CSLI Publications.
- Krifka, Manfred. 1998. The origins of telicity. In *Events and grammar*, ed. Susan Rothstein, 197–235. Dordrecht: Kluwer.
- Levin, Beth, and Malka Rappaport Hovav. 1995. *Unaccusativity: At the syntax-lexical semantics interface*. Cambridge, MA: MIT Press.
- Pustejovsky, James. 1991. The syntax of event structure. *Cognition* 41:47–81.
- Ramchand, Gillian C. 1997. *Aspect and predication*. Oxford: Clarendon Press.
- Schwarzchild, Roger, and Karina Wilkinson. 1999. Interval semantics for scalar predication. Unpublished ms., Rutgers University.
- Seuren, P.A.M. 1978. The structure and selection of positive and negative gradable adjectives. In *Papers from the Parasession on the Lexicon, Chicago Linguistics Society*, ed. Donka Farkas, W.M. Jacobsen, and K.W. Todrys, 336–346. Chicago, IL: Chicago Linguistic Society.
- von Stechow, Arnim. 1984a. Comparing semantic theories of comparison. *Journal of Semantics* 3:1–77.
- von Stechow, Arnim. 1984b. My reply to cresswell’s, hellan’s, hoeksema’s and seuren’s comments. *Journal of Semantics* 3:183–199.
- Tenny, Carol. 1987. Grammaticalizing aspect and affectedness. Doctoral Dissertation, Massachusetts Institute of Technology.
- Tenny, Carol. 1994. *Aspectual roles and the syntax-semantics interface*. Dordrecht: Kluwer.
- Van Valin, Robert, and R.J. LaPolla. 1997. *Syntax: Structure, meaning and function*. Cambridge, UK: Cambridge University Press.
- Verkuyl, Henk J. 1993. *A theory of aspectuality*. Cambridge, UK: Cambridge University Press.

Wright, Georg H. von. 1963. *Norm and action*. New York: Humanities Press.
Wright, Georg H. von. 1968. *An essay on deontic logic and the general theory of action*.
Amsterdam: North-Holland Publishing Co.