

On the state of degree achievement verbs

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1 Introduction

- Deadjectival verbs have in recent years brought into sharp focus the relevance of their underlying adjectival scales and scalar structure in predicting their range of grammatical properties (most notably Kennedy and Levin 2008, *a.o.*).
- Two kinds of analyses: **scalar analyses** built on degree-based semantics (e.g. Kennedy and Levin 2008) and **event decompositional approaches** to deadjectival verbs (e.g. von Stechow 1996).
- Two classes of deadjectival verbs: **result state verbs built around a closed scale core** and **degree achievements built on a totally open scale core** (Kennedy and McNally, 2005; Kennedy, 2007).

- (1) a. Result state verbs: *open, close, dry, straighten, flatten, empty, fill, bent, blur, ...*
b. Degree achievement verbs: *widen, narrow, shorten, broaden, strengthen, rise, fall, cool, ...*

(classification based on Pedersen 2015)

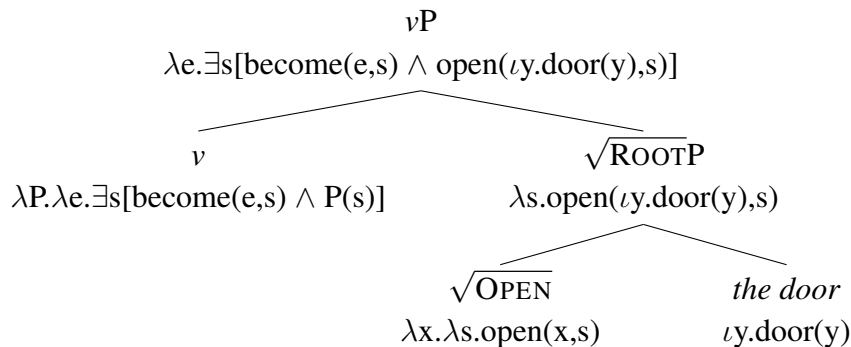
- Against this theoretical and empirical backdrop, in this discussion we aim to:
 1. Provide a **broad overview of the above approaches** and the empirical phenomena motivating them.
 2. **Defend an event decompositional approach** by examining in detail **the range of modifiers possible with degree achievements and their interaction with the presupposition trigger *again*.**
 3. Provide a **formal account of the compositional semantics of degree achievements** in the spirit of event decompositional approaches.
 4. Show that extant **scalar approaches are unable to account for the observations** regarding these modifiers.

2 Decomposing Events

2.1 Result Verbs

- Decomposing verb meanings into structured representations comprising a series of sub-events was first proposed in the GENERATIVE SEMANTICS tradition (e.g. McCawley, 1978; Dowty, 1979).
- The approach has been translated into modern syntactic approaches, beginning most prominently with von Stechow (1996) and adopted and extended by syntactic approaches to word-formation like DISTRIBUTED MORPHOLOGY (e.g. Halle and Marantz, 1993; Marantz, 1997; Harley, 2012).
- Core idea: deadjectival result verbs like *open* can be decomposed into **a stative core with eventive functional heads that introduce meanings like causation and change-of-state**, represented by the semantic operators CAUSE and BECOME (Dowty, 1979; Kratzer, 2005; Harley, 2012, *a.o.*).
- One way of implementing this: an **acategorial lexical semantic root denoting a relation between an individual and a state**, and an **eventive verbalizing ν head introducing change-of-state semantics** that verbalizes the acategorial state, producing the surface verb (e.g. Marantz, 1997; Folli and Harley, 2005; Pylkkänen, 2008; Harley, 2012).

(2) The door opened.



- Oft-cited piece of evidence: *again*-ambiguities. Modification by the presupposition trigger *again* is **systematically ambiguous between a repetitive and restitutive reading**.
 - Repetitive reading: felicitous in a context in which there was **previous event** of the same kind as the asserted event.
 - Restitutive reading: felicitous in a context in which a **previous state** of the same kind as that entailed in the assertion, with no presupposed *change* into that state.
- (3) Susan opened the door again.
- Susan opened the door before. The door was closed, and she opened the door once more. (repetitive)
 - The door was open before, and need not have ever been opened. The door shut, and Susan opened the door, restoring its previous open state. (restitutive)

- **Again: an identity function over predicates of eventualities** (semantic type $\langle\langle v,t\rangle,\langle v,t\rangle\rangle$), **presupposes that an eventuality with the same description as its argument occurred at a prior temporal interval.**

(4) $\llbracket \text{again} \rrbracket P(e)$ is defined iff $\exists e' \exists e'' [e'' < e' < e \wedge P(e'') \wedge \neg P(e')]$. When defined, $\llbracket \text{again} \rrbracket P(e) = P(e)$.

(adapted from Bale 2007)

- Restitutive reading: *again* attaches to $\sqrt{\text{ROOT}P}$, and thereby presupposes that a prior state of the door being open held before its current open state.
- Repetitive reading: *again* attaches to vP , presupposing an event of the door *becoming open* happened before.
- Additional evidence comes from **word order effects** in English (Beck and Johnson, 2004): **when *again* precedes the verb, only the repetitive reading is available** (see von Stechow 1996 for German, Lechner et al. 2015 for more arguments).

(5) Susan again opened the door.

a. Susan opened the door before and she opened the door once more. (repetitive)

b. #The door had always been open, nobody opened it. It closed, and Susan opened the door, restoring its open state.

(restitutive)

2.2 Degree Achievements

- Characterization of the restitutive reading of *again* as **repetition of a state** is problematic when considering non-deadjectival verbs of motion like *rise* and *fall*, as well as degree achievements like *widen* (Fabricius-Hansen, 2001; Jäger and Blutner, 2003; Pedersen, 2015).
- There is clearly a repetitive sense below with (6a) but unclear there is any repetition of a state at all for (6b).

(6) The barometer fell again.

a. The barometer fell previously and fell once more. (repetitive)

b. The barometer rose previously then fell once more. (restitutive???)

- At first glance, a **previous event of *rising*** seems to be licensing the use of *again* in (6b), not a restoration of a previously held state.

– Fabricius-Hansen (2001) characterizes *again*'s presupposition as **counterdirectional**: it presupposes a prior event that in some sense went in the *opposite direction* of the asserted event.

- Nonetheless, von Stechow (1996) argues against this characterization, noting that the approach in Fabricius-Hansen (2001) leaves unexplained the effect of word order seen in (5).

- In these cases von Stechow (1996) suggests that restitutive *again* is taking scope over a **comparative constituent**.

- That is, the restitutive sense of *again* in (6) can be characterized as presupposing a prior state of **being lower than before**.

- Verbs like *fall* involve a comparative operator MORE. This comparative constituent is **stative**, characterizing **a state of an object holding a higher degree of a lowness than at the beginning of an event**.

(7) The barometer fell again. (stative restitutive)

BECOME(*again*($\lambda s[\text{MORE}[\lambda d.d\text{-low}_s(\textit{the barometer}), \lambda d.d\text{-low}_{\textit{beg}(e)}(\textit{the barometer})]]$), e)

a. ASSERTION: The barometer **became lower than it was at the start of an event *beg(e)***.

b. PRESUPPOSITION:

- There was a previous state *s''* in which the barometer was lower than it was at the start of the asserted event *beg(e)*.

- There was a previous state *s'* where it was not lower than it was at the start of the asserted event *beg(e)*.

- s''* temporally precedes *s'*.

(simplified from von Stechow 1996)

- What looks like a counterdirectional reading arises from the second component of *again*'s presupposition: the barometer cannot not be lower than at it was prior to the beginning of the asserted event.

- If at state *s''* the barometer was lower than *beg(e)*, and then transitions to *s'* where it was NOT lower than *beg(e)*, then **the barometer must have risen between *s''* and *beg(e)***, either to the same height or higher than at *beg(e)*.

- This is thus a genuine restitutive reading of *again*: verbs like *fall* and *widen* **contain a comparative operator MORE that can fall under the scope of *again***.

- A problem with von Stechow's account: no compositional analysis is provided that specifies how *beg(e)* is introduced in the stative constituent under a decompositional analysis prior to composition with BECOME.

- Since BECOME introduces the event, *beg(e)* cannot be specified in the stative constituent prior to the introduction of BECOME.

- **Aim for following sections:**

1. Provide more **empirical arguments that a stative comparative constituent is required** in the analysis of degree achievements by examining other classes of modifiers, such as **durative for-phrases**, and the interaction of *again* with **measure phrases** introduced by *from* and *to*.

2. **Provide a compositional analysis, and examine scalar approaches and their predictions** for these modifiers.

3 Further Evidence for Event Decomposition

3.1 Stative Durative Modification

- Durative *for*-phrases specify the amount of time a state persisted (e.g. Dowty 1979).
- (8) CONTEXT: Kim opened the door and it **remained open for two hours** before the wind blew it shut so...
Kim opened the door for two hours.
- This constitutes evidence for a stative constituent with a POS reading i.e. the door was open. Durative *for*-phrases can modify such a constituent and specify its duration.
 - Durative *for*-phrases are also **possible with degree achievements**, specifying the duration of a state as with result verbs.
 - The given context explicitly rules out construing the widening event itself taking two months.
 - Intuition: there is **a state of the river being wider (15 feet) than it was at the start of the widening event (10 feet)** and this state **persisted for 2 months**.
- (9) CONTEXT: A farmer decided to plant some crops next to a river, which was 10 feet wide. Wanting to use the river water for irrigation, but feeling like it was not wide enough, **they pumped rainwater collected over the monsoon season into the river** **over two hours**, widening the river from 10 to 15 feet wide. **Over the next two months**, **the river remained 15 feet wide** until the dry summer months when it narrowed back to 10 feet. So...
The farmer widened the river (to 15 feet) for two months. (Yu, 2020)
- This constitutes additional independent evidence that a stative constituent needs to be available for modification by durative *for*-phrases.

3.2 Degree Phrases, Stative Presuppositions, and Variable Attachment Height

- English degree achievement verbs like *widen* permit degree phrases headed by *from* and *to*. These **specify the degree of width an object holds at the start and end of the widening event**.
- (10) The river widened **from 30 feet** **to 50 feet**.
- These degree phrases interact with *again*'s presupposition in various ways. In particular, **we can use the shape of its presupposition to diagnose the precise attachment site of each of these**

phrases. The following context provides a previous widening event satisfying *again*'s presupposition.

(11) CONTEXT: A river widened from **30 feet / # 50 feet** to 60 feet wide. It got narrowed because of a drought to 30 feet. After a year, the monsoons came and the river's width increased so...

The river widened from 30 feet again.

- Note: **the previous widening event must be from the same width as specified by the *from*-phrase**; a widening from any other width is infelicitous and cannot satisfy *again*'s presupposition.
- Hence, *from*-phrases can be within the scope of repetitive *again*. *From*-phrases can also fall **outside of repetitive *again*'s scope** when attaching to its right (as discussed by Bale 2007).
- When attached to its right, *from*-phrases need not be included within *again*'s presupposition i.e. the previous widening event can be from any width, as compared to (11).

(12) CONTEXT: A river widened from **50 feet** to 60 feet wide. It got narrowed because of a drought to 30 feet. After a year, the monsoons came and the river's width increased so...

The river widened again from 30 feet.

- **Contexts satisfying the restitutive reading of *again* can never satisfy *again*'s presupposition when it includes a *from*-phrase.**
 - Despite the fact that the river was previously at the width specified by the *from*-phrase in the context, *again*'s presupposition is nonetheless not satisfied.

(13) CONTEXT: A river was formed from melting glaciers and its width was **50 feet**. A drought caused it to narrow to 30 feet, before farmers pumped rainwater into it to return it to **50 feet**. Then the monsoon rains came and filled the river with rainwater so...

The river widened from 50 feet again.

- The suggests that ***from*-phrases always require repetitive contexts** and is only ever **an eventive modifier** and not a stative modifier. It also cannot be assimilated to scoping under restitutive *again*.
- Consequently, if *from*-phrases can fall within the scope of *again* (11), then in these contexts *again* must be taking scope over an event predicate.
- Treating *from*-phrases as event modifiers makes intuitive sense: they specify the degree of a property held **at the start of an event**.
- Expectation: *to*-phrases naturally are also eventive modifiers: they specify the degree of a property at the *end* of an event.
- When combined with *again*, repetitive contexts can satisfy *again*'s presupposition. Like *from*-phrases, they can fall both within and outside *again*'s presupposition.

(14) CONTEXT: A river widened to **30 feet / # 50 feet**. It got narrowed because of a drought to 20 feet. After a year, the monsoons came and the river's width reached 30 feet...
The river widened to 30 feet again.

(15) CONTEXT: A river widened to **20 feet**. After a year, the monsoons came and the river's width reached 30 feet. So...
The river widened again to 30 feet.

- Surprising fact: *to*-phrases can be within the scope of restitutive *again*.
- The stative context below renders repetitive *again*'s presupposition unsatisfiable, showing we are dealing with restitutive *again*. Here, the river must previously be at a particular width independently of an event of change.
- Here, a *to*-phrase can fall within restitutive *again*'s scope i.e. there can be **restoration of a state of holding the width specified by the *to*-phrase**. Any other width is infelicitous.

(16) CONTEXT: A river was formed from melting glaciers and its width was **30 feet / # 50 feet**. A drought reduced the river's width and it became just 20 feet wide. Then the monsoon rains came and filled the river with rainwater. Because of that...
The river widened to 30 feet again.

- Since *to*-phrases permit a restitutive presupposition with *again*, *again* must be modifying a stative constituent containing the *to*-phrase.
- It can also fall outside of restitutive *again*'s scope. When it does, the previous state of the river in a restitutive context need not be at the width specified by the *to*-phrase. All that is required: **the river was previously wider than it was (50 feet) prior to the widening event (20 feet) as in the assertion (30 feet compared to 20 feet)**.

(17) CONTEXT: A river was formed from melting glaciers and its width was **50 feet**. A drought reduced the river's width and it became just 20 feet wide. Then the monsoon rains came and filled the river with rainwater so...
The river widened again to 30 feet.

3.3 Interim Summary

1. Durative *for*-phrases provide further evidence for a stative constituent in the decompositional analysis of degree achievements, because they can specify the duration of a state (an object holding a higher degree of a property at the end of an event than at the start).
2. *From*-phrases and *to*-phrases occurring with degree achievement verbs like *widen* can fall within the scope of *again*'s presupposition, but exhibit different distributional properties.
3. *From*-phrases can only be eventive modifiers, and thus only modify constituents denoting a predicate of a change event.

4. *To*-phrases, on the other hand, may attach to stative constituents that are not eventive.
5. When attached to a stative constituent with *again*, the relevant presupposition is that there was a state of an object holding a property to a degree specified by the *to*-phrase, without requiring that there be a prior change culminating in such a state.
6. Together, these motivate the presence of separate stative and eventive layers within a decompositional analysis of degree achievements.

4 Analysis

- As established above, there is a **constituent within the syntax-semantics of degree achievement verbs that denotes a predicate of states**.
- **The states at issue are comparative: they are states of an object holding a higher degree of a property as compared to another state**, as in von Stechow (1996).
- Many different ways to implement this in principle, mainly to do with the semantic ontology of the underlying adjectival base.
- Our approach: building on Wellwood (2015) in adopting the view that **the core of an adjective is a relation between states and individuals of type $\langle e, \langle v, t \rangle \rangle$** .¹

$$(18) \quad \llbracket \text{wide} \rrbracket: \lambda x. \lambda s. \text{wide}(x, s)$$

- **Reference to degrees is introduced compositionally through the comparative operator MORE**.²
- The standard of comparison is **a different state, held by the same individual, with the same property denoted by the underlying adjective**.³

$$(19) \quad \llbracket \text{MORE} \rrbracket: \lambda V_{e,vt}. \lambda x. \lambda s. V(x)(s) \wedge V(x)(s') \wedge \mu(s) > \mu(s')$$

- Note that MORE introduces a **free state variable s'** , which is **the standard of comparison for the state s** . This state variable will ultimately be bound to the initial state of the event, either by abstracting over the variable in the syntax or by having v itself perform binding, as in Kratzer's (2009) approach to binding minimal pronouns by functional heads.

¹We use $\text{wide}(x, s)$ as shorthand for the Neo-Davidsonian representation $\text{wide}(s) \wedge \text{Holder}(s) = x$.

²There are other empirical arguments for postulating degrees as being compositionally introduced rather than encoded directly in the semantics of gradable adjectives, such as **nominal and verbal comparatives using the same morphosyntactic ingredients in English**. See Wellwood (2015) for more details.

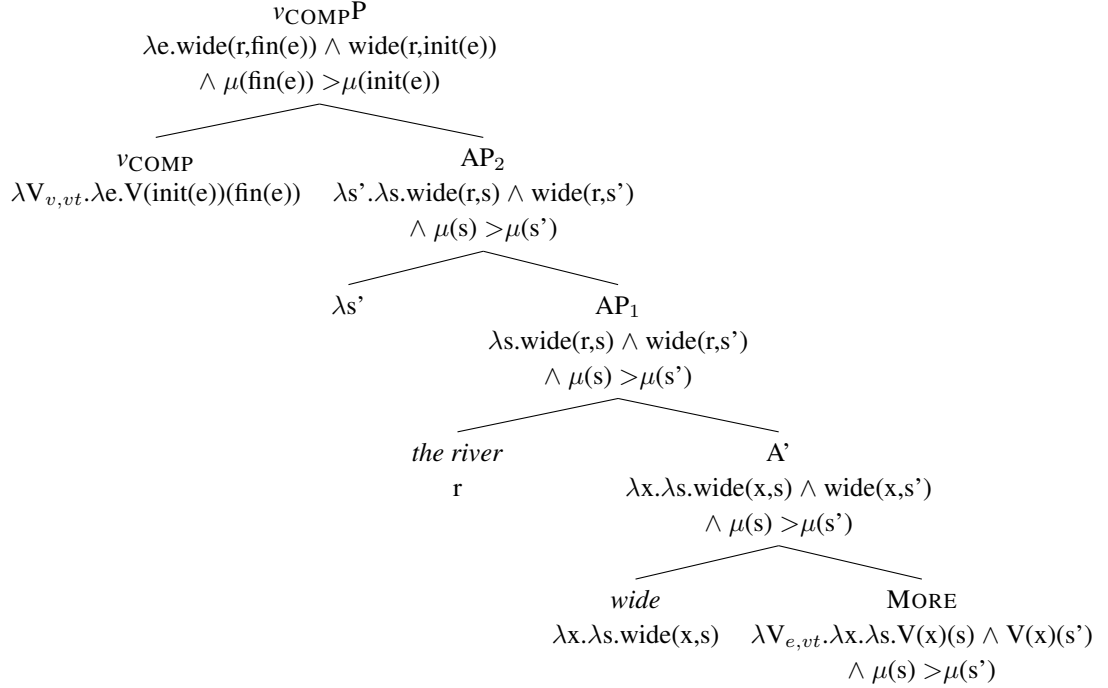
³The standard of comparison could, in principle, be a degree, derived from a clausal standard with degree abstraction and a MAX operator, as in standard approaches to clausal comparison. We do not adopt this approach and stick with encoding a measure of another state in MORE for brevity.

- We take the **verbal functional head** (v_{COMP}) to **abstract over s'** , and specify s' as the **initial state of the event, $\text{init}(e)$** , and s as the **final state of the event, $\text{fin}(e)$** (Dowty, 1979).⁴

$$(20) \quad \llbracket v_{\text{COMP}} \rrbracket: \lambda V_{v,vt}. \lambda e. V(\text{init}(e))(\text{fin}(e))$$

- A full derivation is shown below, assuming v_{COMP} can be spelled out as **-en**, and that **head movement of the A head to v_{COMP}** and **movement of the holder argument for Case derive the surface order**.

(21) The river widened.



- **Again** may attach to $v_{\text{COMP}}\text{P}$ (repetitive), or to AP_1 prior to abstraction over s' (restitutive). Note that $\text{init}(e)$ ends up in the restitutive presupposition due to abstraction over s' and saturation by $\text{init}(e)$ owing to the semantics of v_{COMP} .

- (22) a. **Repetitive presupposition:** $\exists e', e'' [e' < e'' < e \wedge \text{wide}(r, \text{fin}(e')) \wedge \text{wide}(r, \text{init}(e')) \wedge \mu(\text{fin}(e')) > \mu(\text{init}(e')) \wedge \neg(\text{wide}(r, \text{fin}(e'')) \wedge \text{wide}(r, \text{init}(e'')) \wedge \mu(\text{fin}(e'')) > \mu(\text{init}(e'')))]$:
 There was a previous event e' where the river was wider at the end of e' than at the beginning of e' , followed by an event e'' where the river was not wider at the end of e'' than at the beginning of e'' , and both e' and e'' temporally precede e .⁵
- b. **Restitutive presupposition:** $\exists s', s'' [s' < s'' < \text{fin}(e) \wedge \text{wide}(r, s') \wedge \text{wide}(r, \text{init}(e)) \wedge \mu(s') > \mu(\text{init}(e)) \wedge \neg(\text{wide}(r, s'') \wedge \text{wide}(r, \text{init}(e)) \wedge \mu(s'') > \mu(\text{init}(e)))]$

⁴ v_{COMP} thus introduces the relevant dimension along which the object's degree of a property changes, here along the temporal dimension. v_{COMP} can also specify a spatial dimension of change in sentences like *The river widens at the bottom of the mountain*. We leave exploration of this for future work; see (Rappaport Hovav, 2021) for more details.

⁵The second clause containing negation allows for both an intermediate narrowing event or a successive increase context where no change occurred in the river's width in the intermediate interval prior to the asserted event, as noted by Pedersen (2015).

There was a previous state s' where the river was wider than at the beginning of the asserted event $init(e)$, followed by a state s'' where the river was not wider than at the beginning of the asserted event $init(e)$, and s' and s'' precede $fin(e)$.

- The analysis of durative *for*-phrases is straightforward: these can be given a simple semantics as below. α **can be eventive or stative**, τ **is the temporal trace function**, and *for*-phrases **may compose with various constituents via PREDICATE MODIFICATION**.

$$(23) \quad \llbracket \text{for two hours} \rrbracket: \lambda\alpha.\tau(\alpha) = 2 \text{ hours}$$

- Attachment of the *for*-phrase to $v_{\text{COMP}}P$ gives rise to the interpretation on which **the event in which the river widened lasted 2 hours**.
- Attachment of the *for*-phrase to the stative constituent AP_1 prior to abstraction of s' gives rise to the interpretation on which **the state of the river being wider than it was at the beginning of the event lasted 2 hours**.
- *From*-phrases can straightforwardly be modeled as **eventive modifiers** specifying the degree of a property an object held at $init(e)$.
- The **event variable is directly linked to the property scale denoted by the verb** since we build degree achievements out of underlyingly stative adjectives (see Baron 2020 for discussion).

$$(24) \quad \llbracket \text{from 30 feet} \rrbracket: \lambda e.\mu_{ft}(init(e)) = 30$$

- As an event modifier, we predict *from*-phrases and *again* can interact as they share this same attachment site. Attaching under *again* produces presuppositions satisfied by contexts like (11), attaching above *again* predicts presuppositions satisfied by contexts like (12).
- *To*-phrases are slightly trickier; we **do not necessarily want these to specify the measure of $fin(e)$** since they **can produce restitutive presuppositions with *again***.
 - Endowing them with an eventive analysis like that of *from*-phrases predicts that they should be incompatible with restitutive readings, contrary to fact.
- We therefore analyze *to*-phrases simply as **predicates of states**, specifying the measure of a state and modifying stative constituents via PREDICATE MODIFICATION.

$$(25) \quad \llbracket \text{to 30 feet} \rrbracket: \lambda s.\mu_{ft}(s) = 30$$

- *To*-phrases attach straightforwardly to AP_1 in (21), specifying the measure of the state s .
 - This **amounts to measuring $fin(e)$** , due to details of composition with v_{comp} .
- This **predicts *to*-phrases can interact with restitutive *again***, since this is the exact same attachment site for stative presuppositions.

- Attaching under *again* produces presuppositions satisfied by contexts like (16), while attaching above it produces presuppositions satisfied by contexts like (17).
- A final caveat if *to*-phrases are stative modifiers: what of repetitive contexts like (14) and (15)?
- The case of (17) can be straightforwardly analyzed as a case of the restitutive reading. In this case, the *to*-phrase is still modifying the stative constituent, but falls outside the scope of *again*.
- The case of (15) is more problematic: this context does not satisfy the restitutive presupposition of *again*. This most likely calls for **an additional, eventive variant of *to***, on a par with *from*.

$$(26) \quad \llbracket \text{to 15 feet} \rrbracket = \lambda e. \mu_{ft}(\text{fin}(e)) = 15$$

- Crucially, no similar ambiguity holds for *from*-phrases: *from*-phrases are always eventive.

5 Alternative Analyses

5.1 Measure of Change Functions

- Alternative approaches: **take the scalar structure of the underlying adjective to be central** to the grammatical properties of deadjectival verbs and eschew event decomposition.
- Many different ways of implementing this. We focus on a notable one: Pedersen’s (2015) **degree vector approach**, building on Kennedy and Levin (2008), who take adjectives to lexicalize **measure functions** i.e. functions of type $\langle e, \langle i, d \rangle \rangle$, mapping an individual to a degree on a scale at a particular point in time (time variables suppressed for brevity).

$$(27) \quad \begin{array}{l} \text{a. } \llbracket \text{dry}_{Adj} \rrbracket: \lambda x. \text{DRY}(x) \\ \text{b. } \llbracket \text{wide}_{Adj} \rrbracket: \lambda x. \text{WIDTH}(x) \end{array}$$

- Pedersen (2015) proposes a **degree vector** analysis for deadjectival verbs.
 - The measure function denoted by the underlying adjective is converted into a measure of change function, which returns a *degree vector*: **a pair of degrees such that the second member of the pair is greater than the first.**
- This can be encoded in the -EN morpheme. Here, we relativize the analysis to events (following Spathas 2019). -EN takes a measure function (underlying adjective, type $\langle e, \langle v, d \rangle \rangle$) and returns a measure of change function (type $\langle e, \langle v, dd \rangle \rangle$).⁶

$$(28) \quad \begin{array}{l} \text{a. } \llbracket \text{-EN} \rrbracket: \lambda g_{e,vd}. \lambda x. \lambda e. \langle g(x)(\text{init}(e)), g(x)(\text{fin}(e)) \rangle \\ \text{b. } \llbracket \text{wide} \rrbracket: \lambda x. \lambda e. \text{width}(x)(e) \\ \text{c. } \llbracket \text{-EN wide} \rrbracket: \lambda x. \lambda e. \langle \text{width}(x)(\text{init}(e)), \text{width}(x)(\text{fin}(e)) \rangle \end{array}$$

⁶Type-theoretically, a degree vector would be its own type of pairs of degrees rather than of type $\langle d, d \rangle$, which is a function that takes a degree argument and returns a degree. We represent this type simply as *dd*.

- Since a degree vector is not truth-evaluable, a verbal POS is needed to convert it into a property of individuals and events. Pedersen suggests that verbal POS introduces a standard of change that is a **set of degree vectors**, and asserts that **the degree vector expressed by -EN is a member of this set of degree vectors**.
- **INTERPRETIVE ECONOMY (Kennedy, 2007) regulates this set of degree vectors**; top closed adjectives have the maximal degree as the standard of comparison, while open scale adjectives simply need the second degree to be bigger than the first.

- (29) a. Standard for top-closed adjectives like *dry*: $S_{MOC_{dry}}: \{ \langle d, MAX_{dry} \rangle: d <_{dry} MAX_{dry} \}$
 b. Standard for open adjectives like *wide*: $S_{MOC_{wide}}: \{ \langle d, d' \rangle: d <_{width} d' \}$

- (30) $\llbracket POS -EN wide \rrbracket: \lambda x. \lambda e. \langle width(x)(init(e)), width(x)(fin(e)) \rangle \in \{ \langle d, d' \rangle: d <_{width} d' \}$

- One advantage: **it becomes easy to define a counterdirectional meaning for *again***. Repetitive *again*: takes a property of events as its argument and presupposes that an identical event happened previously.
- **Counterdirectional *again*: applies to a measure of change function and presupposes scalar change in the reverse direction happened previously.**

- (31) Presupposition produced when counterdirectional *again* applies to [-EN wide]:
 $\lambda x. \lambda e'. \langle width(x)(init(e')), width(x)(fin(e')) \rangle \in \{ \langle d, d' \rangle: d >_{width} d' \}$ where e' temporally precedes asserted event e

- Degree vectors: captures same range of facts regarding telicity as Kennedy and Levin (2008), also provides a straightforward way of accounting for the counterdirectional requirement of *again* with deadjectival verbs (what we call restitutive presuppositions).

5.2 Problems with Measure of Change Functions

- For our purposes: a crucial property of the above analysis is that there is **no property of events until after POS is introduced**.
- Prior to composition with POS: function returns a degree vector and not a function to truth values.
- **Issue 1: no way to account for *for*-phrases specifying duration of a state** in (9), repeated below.

- (32) CONTEXT: A farmer decided to plant some crops next to a river, which was 10 feet wide. Wanting to use the river water for irrigation but feeling like it was not wide enough, **they pumped rainwater collected over the monsoon season into the water over two hours**, widening the river from 10 to 15 feet wide. **Over the next two months**, the river remained 15 feet wide until the dry summer months when it narrowed back to 10 feet so... **The farmer widened the river (to 15 feet) for two months.**

- Durative *for*-phrases attach to eventive verbs whether they are built out of underlying adjectives or not, like the activity verb *run*.

(33) Kim ran **for two hours**.

- *For*-phrases should be simple modifiers of properties of events. If so, a degree vector approach **predicts that the only reading with durative *for*-phrases is one in which the event of widening lasted two hours**.
 - It should not be able to measure the duration of a state, as no stative predicate is present in the structure for the *for*-phrase to modify.
- This is because **the event argument associated with the change event is accessible only after verbal POS is introduced**. There is **no way to extract the second degree in a vector and specify that an object held this degree for a duration that is independent of the event of change**.
- **Issue 2**: because measure of change functions are of semantic type *dd*, there is no way to smoothly integrate the degrees denoted by *from*- and *to*-phrases. **These cannot straightforwardly specify the beginning or ending degrees via logical conjunction** since a measure of change function is not truth-evaluable.
- Reminder of the issue: consider again the denotation of a measure of change function.

(34) a. $\llbracket \text{-EN wide} \rrbracket: \lambda x. \lambda e. \langle \text{width}(x)(\text{init}(e)), \text{width}(x)(\text{fin}(e)) \rangle \quad \langle e, \langle v, dd \rangle \rangle$
 b. $\llbracket \text{POS -EN wide} \rrbracket: \lambda x. \lambda e. \langle \text{width}(x)(\text{init}(e)), \text{width}(x)(\text{fin}(e)) \rangle \in \{ \langle d, d' \rangle: d \langle_{width} d' \rangle \} \quad \langle e, \langle v, t \rangle \rangle$

- The degrees involved in measure of change functions are not straightforwardly extractable. **They are not abstracted over in (34a)**.
- One possibility is to abstract over the degree vector (notated \vec{d}), and have *from*- and *to*-phrases specify the vector's first and second projections (notated π_1 and π_2 , respectively).
 - This would require modifications to the analysis of *again*.

(35) a. $\lambda \vec{d}. \lambda e. \vec{d} = \langle \text{width}(\text{init}(e)), \text{width}(\text{fin}(e)) \rangle$
 b. $\llbracket \text{from 10 feet} \rrbracket: \lambda F. \lambda \vec{d}. \lambda e. F(\vec{d})(e) \wedge \pi_1(\vec{d}) = 10 \text{ feet}$
 c. $\llbracket \text{to 15 feet} \rrbracket: \lambda F. \lambda \vec{d}. \lambda e. F(\vec{d})(e) \wedge \pi_2(\vec{d}) = 15 \text{ feet}$

- More straightforwardly, *from*- and *to*-phrases can be modeled as **applying to properties of events and thus scope over POS** in (34b).
- The denotations will then look familiar: a measure function μ returns the degree associated with *init*(*e*) or *fin*(*e*) and equate this with a degree *from* and *to* take as their first argument. This is logically conjoined with the denotations in (34b) through rules like EVENT IDENTIFICATION.

- We illustrate with example denotations below.

- (36) a. $\llbracket \text{POS -EN wide from 30 feet} \rrbracket: \lambda x. \lambda e. \langle \text{width}(x)(\text{init}(e)), \text{width}(x)(\text{fin}(e)) \rangle \in \{ \langle d, d' \rangle: d <_{\text{width}} d' \} \wedge \mu(\text{init}(e)) = 30 \text{ feet}$
 b. $\llbracket \text{POS -EN wide to 30 feet} \rrbracket: \lambda x. \lambda e. \langle \text{width}(x)(\text{init}(e)), \text{width}(x)(\text{fin}(e)) \rangle \in \{ \langle d, d' \rangle: d <_{\text{width}} d' \} \wedge \mu(\text{fin}(e)) = 30 \text{ feet}$

- **Issue 3:** but under a scalar analysis where *from-* and *to-*phrases modify the event of change, we **predict restitutive presuppositions containing them in their scope to be impossible.**
- Examples like (16), repeated below, should not be possible. ***To*-phrases should always be associated with an event of change, specifically the final state of this event.**
- There is **no previous event where the river comes to hold a greater degree of width than at the beginning of the event** and hence repetitive *again*'s presupposition cannot be satisfied.

- (37) CONTEXT: A river was formed from melting glaciers and its width was 30 feet / # 50 feet.
 A drought reduced the river's width and it became just 20 feet wide. Then the monsoon rains came and filled the river with rainwater so...
The river widened to 30 feet again.

- If *to*-phrases apply to properties of events as we argued previously, then the context above **cannot be explained by Pedersen's counterdirectional *again* either.**
- Reason: **the degree specified by the *to*-phrase is outside the scope of counterdirectional *again*.** All that is needed to satisfy the presupposition produced is **any narrowing event regardless of the width the river narrowed from.**
- **The narrowing of the river from 50 feet to 20 feet should satisfy counterdirectional *again*'s presupposition.** There is no explanation under a scalar analysis why an initial width of 50 feet is infelicitous.
- Counter-analysis: *to*-phrases are really attaching to a measure of change function and hence can fall under counterdirectional *again*'s scope. But this is indistinguishable from a decompositional analysis like what we proposed. Onus is to figure out a way of writing the semantics of *to*-phrases that applies to measure of change functions while maintaining the analysis of counterdirectional *again*.

5.3 Summary of the Issues with Scalar Approaches

- Scalar analyses do not make available a result state constituent corresponding to the state an object holds as compared to some other state, independent of the event of change.
- Yet we saw here that a range of modifiers (*durative for*-phrases and *to*-phrases) make reference to exactly such a stative constituent, which should never be possible under scalar approaches.

- To do so, *from-* and *to-*phrases have to extract the initial and ending degrees of a property from measure of change functions, which are degree vectors.
 - Doing so, however, is not straightforward without modifying the analysis.
- *From-* and *to-*phrases need to be event modifiers on such an approach.
- Correspondingly, postulating a counterdirectional *again* that composes with functions returning degree vectors does not capture the range of stative presuppositions observed, since *from-* and *to-*phrases will necessarily lie outside the scope of *again*.

6 Conclusion and Directions

- We defended an event decompositional approach to the syntax-semantics of degree achievement verbs, specifically those built out of relative adjectives.
- Provided a compositional syntax-semantics that makes available a stative constituent that encodes comparison between states.
- We showed that apparent counterdirectional presuppositions that arise in the interaction of *again* with degree achievements are indeed reducible to run-of-the-mill **restitutive presuppositions**.
- The state contributed by the stative component of a degree achievement can also be **the target of durative for-phrases**, specifying the state’s duration.
- A stative comparative constituent also paved the way for an account of the **differential availability of restitutive presuppositions with degree phrases headed by from- and to-phrases**.
- We proposed that **to-phrases may modify this comparative stative constituent, while from-phrases may only modify the eventive layer**. This explains the range of presuppositions produced with *again*.
- Finally, we showed that extant scalar approaches utilizing measure of change functions that return either a difference degree or a degree vector face non-trivial challenges in accounting for the empirical observations discussed here.

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