Directed motion entailments in the semantics of roots: A root-sensitive approach[1]

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Abstract. Syntactic, decompositional theories of verb meaning hold that verbs are created in the syntax by merging roots, which provide idiosyncratic information, with functional heads, which introduce structural components of meaning such as change or causation. In this paper, we examine the consequences of such a view for verbs of inherently directed motion like *arrive, enter, ascend, descend, depart, leave*, etc. (Levin, 1993; Rappaport Hovav, 2014). We show that this class of verbs does not show uniform behavior with respect to sub-lexical modification with modifiers like *again* and durative temporal modifiers, which are well-established diagnostics for decompositional theories of verb meaning (e.g., Dowty, 1979; von Stechow, 1996; Beck and Johnson, 2004). This suggests that a syntactic, decompositional view may be appropriate only for some of these verbs, while others must contain all directed motion entailments within their verb roots. We argue that a root-sensitive approach to lexical decomposition of this verb class is necessary in order to account for their distinct grammatical properties.

Keywords: lexical semantics, verbs of inherently directed motion, roots, event structure, sub-lexical modification.

1. Introduction

Syntactic, decompositional theories of verb meaning assume that verb meanings are composed of a syntactic event structure that decomposes into event templates, e.g., v_{BECOME}, defining the temporal and causal structure of the event, and roots, e.g., $\sqrt{\text{BREAK}}$, providing real-world, idiosyncratic details about the state or event they name (see Dowty, 1979; Goldberg, 1995; Pesetsky, 1995; Rappaport Hovav and Levin, 1998; Hale and Keyser, 2002; Harley, 2005; Ramchand, 2008; Acedo-Matellán and Mateu, 2014; Alexiadou et al., 2015: *a.o.*).[2] There is hence an assumed (strong) division of labor between roots and functional structure: the meanings roots and functional structure introduce are mutually exclusive, and therefore roots cannot introduce templatic meanings i.e., the meanings encoded by functional heads, as proposed in Embick's (2009) Bifurcation Thesis for Roots (see also Borer, 2005a; Arad, 2005; Dunbar and Wellwood, 2016).

(1) Bifurcation Thesis for Roots (BT-R): If a component of meaning is introduced by a

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[2]Syntactic approaches actually differ in the view they assume towards root meaning. Borer (2003, 2005a, b) argues that roots lack any type of information, insofar as content is only introduced when roots appear in some grammatical context, whereas Mateu and Acedo-Matellán (2012); Acedo-Matellán and Mateu (2014) accept that roots have idiosyncratic information about the state or action they denote, but such information is not grammatically relevant. Others, e.g., Marantz (1997), Harley and Noyer (2000), Alexiadou et al. (2006, 2015), classify roots into ontological-types that determine grammatical properties. Thus, although there are subtle difference between these approaches, they all share the assumption that root meanings simply consist of idiosyncratic, conceptual content (except for Borer, 2003, 2005a, b).

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> semantic rule that applies to elements in combination [= a functional head], then that component of meaning cannot be part of the meaning of a Root. (Embick, 2009: 2)

In the present paper, we investigate the consequences of such a view for verbs of inherently directed motion (hereafter, VIDM), e.g., *arrive, enter, ascend, descend, depart, leave* (Levin, 1993). Some syntactic approaches to the meanings of VIDM argue that verbs such as *arrive* syntactically decompose and are therefore associated with a complex event structure where the entailment of change of location—characteristic of such a verb class—is introduced structurally in the syntax by a functional projection in the verbal domain (e.g., Moro, 1997; Irwin, 2012). Here, we argue that VIDM do not show uniform behavior in regards to their grammatical properties, despite seemingly belonging to the same semantic class. More specifically, we show that VIDM behave differently when modified by sub-lexical modifiers like *again* and durative temporal modifiers of the *for x time* type. Namely, only a subclass class of VIDM generate restitutive readings with *again* and allow *again* and temporal modification of its result state, while others systematically disallow restitutive readings and temporal modification. Yet another subclass generates comparative restitutive readings, sometimes called *counterdirectional* readings, with *again* of the sort observed with deadjectival verbs that denote properties on open scales, i.e., degree achievements (Kennedy and Levin, 2008; Pedersen, 2015). This suggests that a decompositional view may be appropriate only for some of VIDM, while others entail change within their roots, contra the Bifurcation Thesis for Roots. Accordingly, we need a root-sensitive view in probing the meaning entailments of these verbs and whether they can be syntactically decomposed into constituents that introduce distinct meaning components.

We proceed as follows. In Section 2, we provide a background of VIDM as outlined in Rappaport Hovav (2014), and discuss the recent proposal by Irwin (2012) whereby VIDM such as *arrive* are argued to syntactically decompose into a particle and a root. In Section 3, we argue against Irwin (2012) that all VIDM are to be decomposed in the syntax. Using sub-lexical modification, we show that different sub-classes of VIDM behave differently with *again* and temporal modification, suggesting that there must be a root-sensitive approach to lexical decomposition of VIDM and that not all VIDM can be lexically decomposed. In Section 4, we lay out the root-sensitive approach to the class of VIDM by providing an analysis of three distinct classes of VIDM. Section 5 concludes the paper.

2. Background

2.1. Verbs of Inherently Directed Motion (VIDM)

VIDM express change in the location of a theme along a path, whereby there is a comparison of the location of the theme along a path at the beginning with its location at the end of the event (Rappaport Hovav, 2014). The path along which the theme traverses is built with the help of a reference object, with the location of the theme at the beginning of the motion event being the lower bound of the path. Rappaport Hovav (2014) distinguishes between three classes of VIDM. The first is a class that lexicalizes a two point path built with the help of a reference object, which is not encoded in the verb and must be expressed as either a direct object or a PP, or otherwise highly salient in the context. This class includes *arrive, enter, reach, leave, depart*. For our purposes, the most important aspect of these verbs is that they encode the theme being at a particular location expressed by the reference object at the end of the event for *arrive, enter* and *reach*, or not being at a particular location expressed by the refernce object for *leave* and *depart*.

(2) a. Mary arrived (at the meeting).
b. Mary entered (the room).
c. Mary reached *(the meeting).
d. Mary left (the room).
e. Mary departed (Los Angeles).

The second class of VIDM expresses that the theme is traversing along the path built by the reference object, but specifies that the theme does not traverse the entirety of the path, or otherwise makes no specification of whether it does. Likewise, this class requires the path to be built from a reference object, specified either in the sentence or recoverable from context. For example, verbs like *come* and *go* have the deictic center, expressed in the sentence or recoverable from context, as the upper bound of the path, differing in the directionality in which the path is traversed by the theme. These verbs do not specify whether the entire path is traversed and are hence compatible with both readings (Rappaport Hovav, 2014).

(3) a. John came (into the room). (reached the deictic center)
b. Mary came towards John in a hasty manner. (did not the deictic center)

Other verbs like *advance, approach,* and *near* explicitly encode that the theme does not traverse the entirety of the path to the reference object. These verbs are compatible with a telic reading where the theme reaches a particular point on the path specified by the reference object only if there is a distance specified for the portion of the path the theme traverses.

(4) a. The army advanced slowly toward the border wall for two months.
(atelic, advancing toward reference object)
b. The army advanced three miles in 6 weeks (toward the front line).
(telic, traversed some portion of the path)

The final class of VIDM are those that lexicalize all components of the path traversed, namely those that express movement along a vertical axis like *ascend, descend, rise,* and *fall*. These verbs specify the direction of movement along a path, and the reference object here is best thought of as the source of gravity or the Earth (Rappaport Hovav, 2014). Verbs like *ascend* and *rise* specify that the theme moves away from the reference object forming the lower bound of the path, with the upper end of the path unbounded. *Fall* and *drop* express that the theme moves toward the reference object. Again, these verbs are compatible with both telic readings where a certain height was reached or with atelic readings where the theme traverses a portion of the path without reaching either the lower or upper bound of the path.

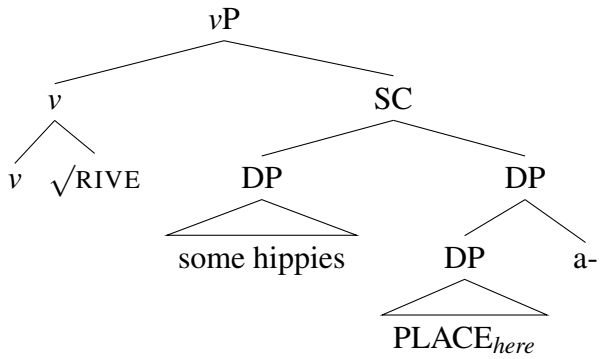
(5) a. The plane descended to 20,000 feet in 2 minutes.
b. The plane descended for two minutes.

For our purposes, we focus on the first and third class of VIDM. These either lexicalize a two-point path where there is a change-of-location of the theme, or which lexicalize traversal of a non-bounded path along a vertical axis, and most clearly show the different kinds of readings available with presupposition triggers like *again* and durative *for*-phrases specifying duration, in particular, the duration of a stative constituent denoting a state of being at a particular location on the traversed path.

2.2. Decomposing VIDM

Focusing on the first class of VIDM that specifies the theme is at a location denoted by the reference object at the end of the event, a recent proposal by Irwin (2012) (see also Irwin 2018, to appear), drawing on Moro (1997), argues that the change of location entailed by verbs like *arrive* comes from a functional projection. More specifically, Irwin (2012) argues that VIDM of the *arrive* sort syntactically decompose into a root, i.e., $\sqrt{\text{RIVE}}$, and a locative morpheme, i.e., *a-*, following the proposal by Moro (1997) for simlar verbs in Italian. Moro argued that verbs like *arrivare* 'arrive' "involve a predicate within a SC [small clause] that incorporates into a V node higher up" (Irwin 2012: 107).[3] Drawing on Moro, Irwin extends the analysis to English, syntactically decomposing *arrive* into a root $\sqrt{\text{RIVE}}$ and a locative morpheme *a-*, as shown below.[4]

(6) Some hippies arrived. (Irwin 2012: 107)

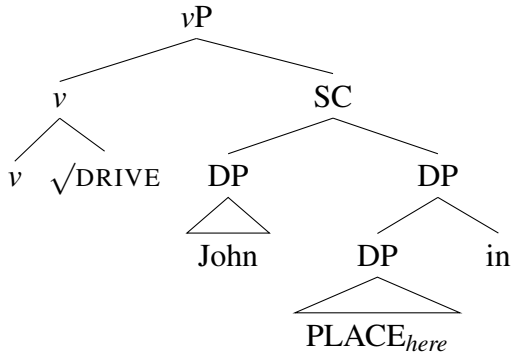


In Irwin's analysis, the root $\sqrt{\text{RIVE}}$ is merged as a modifier to little *v*, whereas the locative morpheme *a-* further specifies the PLACE$_{here}$, which is responsible for introducing the result state, i.e., being in some location, and *a-* moves to prefix to $\sqrt{\text{RIVE}}$. Irwin (2012) notes that the morpheme *a-* is similar to the particles in so-called particle verb constructions such as *drive in* or *pull up*. On Irwin's account, both $\sqrt{\text{RIVE}}$ and $\sqrt{\text{PULL}}$ are merged as modifiers to little *v* describing the manner by which the theme ends up on the new location and provides the manner of action that brings about the result state (see McIntyre 2004; Harley 2005; Mateu and Acedo-Matellán 2012). The result state is structurally introduced by the small clause predicate, where a particle, e.g., *in*, provides further specification about it.

[3]Moro further suggests that other VIDM in Italian may be analyzed in this way, i.e., as being syntactically decomposed, e.g., *discendere* 'descend', *pervenire* 'reach'.

[4]Irwin (2012: 108) notes that roots such as $\sqrt{\text{RIVE}}$ are necessarily bound morphemes as they never appear without *a-*.

(7) John drove in. (adapted from Irwin 2012: 110)

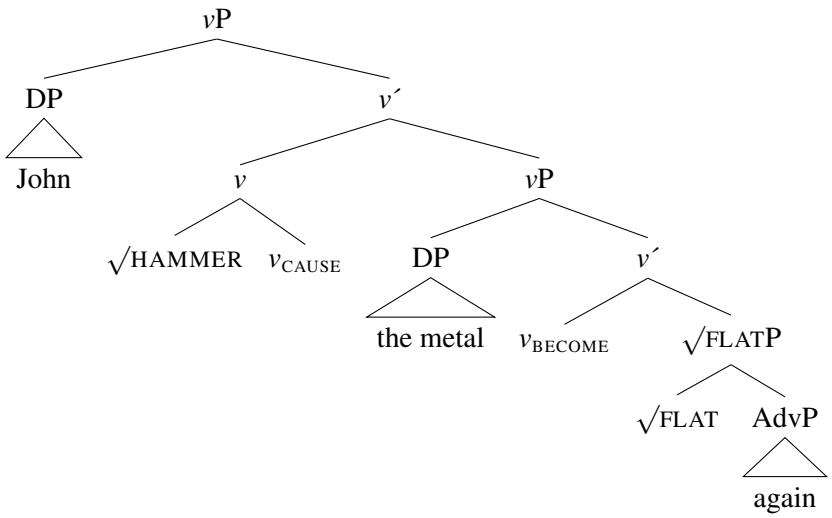


Irwin (2012) hence gives VIDM of the *arrive* sort and particle verb constructions the same syntactic analysis: in both cases, the root is adjoined to *v* acting as an event modifier, providing the manner of action that brings about the result state.

3. Not all verbs of inherently directed motion can be decomposed

Irwin's analysis of *arrive*-type verbs (also Moro, 1997) makes the prediction that sub-lexical modifiers should be able to pick out solely the state of the theme being at a particular location. For example, *again* should be able to produce a restitutive reading with *arrive* where there is a previous state of the theme being in a particular location, parallel to cases where *again* can scope over the result to the exclusion of the manner when they are named by different roots in resultative constructions, e.g., *hammer the metal flat* (McCawley, 1968; Dowty, 1979; von Stechow, 1996; Beck and Johnson, 2004). As Beck and Snyder (2001) and Beck and Johnson (2004) show, in resultative constructions sub-lexical modification with *again* can scope over just the result state, excluding the manner root adjoined to *v*, which is predicted if manner and result meanings are contributed by two different predicates (see also Marantz, 2007; Beavers and Koontz-Garboden, 2020). In the context below, the sheet of metal was made flat and never previously hammered flat; that *again* is licensed here means there must be a previous state of the sheet of metal being flat that is independently available for *again* to modify, producing a presupposition that the metal was previously flat regardless of how it came to be flat.

(8) Mary made a sheet of metal that is flat, but it later accidentally became bent. Fortunately, John hammered the metal flat again. (Beavers and Koontz-Garboden 2012: 259)



Decomposing particle verb constructions like *drive in* in a manner analogous to resultative constructions predicts that sub-lexical modification with *again* can scope over the result state to the exclusion of the manner, generating restitutive presuppositions (Harley, 2005; Folli and Harley, 2005; Irwin, 2012). This is illustrated in the examples below, in which the manner that caused the state of being at a location is different from the sentence modified with *again*. This rules out a repetitive interpretation and forces a restitutive one, where *again* attaches to the stative constituent denoted by the particle.

(9) a. CONTEXT: John previously walked here, but he later left. After a while ...
John drove here again. (Restitutive OK)

b. CONTEXT: The dog previously walked into the room, but it later ran out. After a while ...
The dog bounced in again. (Restitutive OK)

c. CONTEXT: Tom had previously walked out of the room, but he later came in. After a while ...
Tom ran out again. (Restitutive OK)

The availability of restitutive presuppositions with *again* suggests that decomposing particle verb constructions appears to be on the right track; the restitutive presuppositions that *again* generates is predicted if *again* can attach to the small clause predicate to the exclusion of the manner contributed by the verbal root, which is higher up in the structure, as a modifier to *v*.

However, not all VIDM generate restitutive presuppositions when modified with *again*. Focusing on Rappaport Hovav's (2014) first class of VIDM, we see that individual verbs behave differently even within the class. In particular, *arrive* generates clear contradictions in contexts where the only possible readings are restitutive. The contexts below involve the predicate *born here*, such that there was no causing event that caused the subject of *arrive* to be at a location previously. In these contexts, the sentences with *arrive* and *again* are unacceptable. This shows that *arrive* systematically disallows restitutive presuppositions regardless of the attachment site of *again*, contra what Irwin's analysis predicts.

(10) a. CONTEXT: John was born here, and stayed here until he left when he grew up. After some years ...

#John arrived again. (#Restitutive)

b. CONTEXT: John was born in Chicago, and stayed there until he left for Boston when he grew up. After some years ...
#John arrived in Chicago again. (#Restitutive)

In a similar vein, Irwin's account also predicts that *arrive* should permit temporal modification of its syntactically decomposed result state (McCawley, 1968, 1976; Dowty, 1979). This prediction is also not borne out, since a *for*-phrase is unacceptable with *arrive* when understood as specifying the duration of its result state. This again contrasts with particle verbs like *drive in*. If verbs like *arrive* syntactically decompose in the same way as particle verb constructions, it would be mysterious why restitutive readings as well as temporal modification of the syntactically decomposed result state are unavailable.

(11) a. CONTEXT: John's plane landed in NYC, and he stayed there for around an hour, so ...
#John arrived (in NYC) for an hour. (#Temporal modification)

b. CONTEXT: John needed to finish some work at the lab, so ...
He drove in for an hour. (Temporal modification OK)

On the other hand, other verbs within Rappaport Hovav's (2014) first class of VIDM, in particular verbs like *enter*, appear to freely allow restitutive readings and temporal modification of the result state, as illustrated below.[5] Here, as before, we use the predicate *was born* in the prior event to force a restitutive reading of *again*.

(12) a. CONTEXT: John was born in a cave high in the mountains and had never left the cave. When he grew up, he finally left the cave to visit the city at the foot of the mountain. After a while, finding that he did not like the hustle and bustle of the city ...
John entered the cave again.

b. CONTEXT: John walked into the room and stayed there for an hour, so ...
John entered the room for an hour.

Likewise, VIDM like *descend* and *ascend* show restitutive and repetitive readings when modified by *again*.[6]. On the restitutive reading, the individual was lower/higher than it was prior to the event, and returns to a lower/higher position at the end of the event. Note that in the contexts below, the final point on the scale in the prior event is *different* from the event in the assertion, demonstrating that the stative component of the verbs meaning is comparative, rather than a return to a specific height.

(13) a. CONTEXT: An airplane was cruising at an altitude of 30,000 feet. Due to turbulence, the pilots descended to 20,000 feet. An hour later, the pilots brought the plane up to 25,000 feet so ...
The plane ascended again.

[5] A similar contrast between *arrive* and *enter* is observed in Greek in regards to additive presuppositions introduced by *ke* 'also', providing cross-linguistic evidence that the two verbs differ in terms of whether there is a syntactically accessible result state (Spathas and Michelioudakis, 2020).

[6] These readings are sometimes called *counterdirectional* and *successive change presuppositions* on analyses that prefer to analyze ambiguities with *again* by appealing to an ambiguity in the meaning of *again* itself, rather than decomposing the syntax into distinct eventive and stative layers (Fabricius-Hansen, 2001; Pedersen, 2015)

b. CONTEXT: An airplane was cruising at an altitude of 20,000 feet. Due to turbulence, the pilots ascended to 30,000 feet. An hour later, the pilots brought the plane down to 25,000 feet so ...
The plane descended again.

These verbs also allow for a repetitive presupposition where there is simply a previous event of change without a reversal in an intermediate time period (Pedersen, 2015).

(14) a. CONTEXT: An airplane was cruising at 20,000 feet. It encountered air turbulence so the pilot brought the plane's altitude up to 25,000 feet. Despite that, turbulence persisted and the pilot brought the plane's altitude up further to 30,000 feet so ...
The plane ascended again. (Repetitive with successive increase)

b. CONTEXT: An airplane was cruising at 30,000 feet. It encountered air turbulence so the pilot brought the plane's altitude down to 25,000 feet. Despite that, turbulence persisted and the pilot brought the plane's altitude down further to 20,000 feet so ...
The plane descended again. (Repetitive with successive decrease)

With respect to modification with *again*, *ascend* and *descend* behave like degree achievements, which are verbs that denote changes in properties on open scales like *widen* (Beavers, 2008; Kennedy and Levin, 2008; Pedersen, 2015: a.o.). As Pedersen (2015) shows, *widen* exhibits the same range of readings when modified by *again*.

(15) a. CONTEXT: The river widened from 10 feet to 20 feet. After the monsoon rains ...
The river widened (to 30 feet) again. (Repetitive)

b. CONTEXT: The river was previously 20 feet. It narrowed to 10 feet. After a bout of torrential rain, the width of the river increased to 15 feet so ...
The river widened again. (Restitutive)

The behavior of different verbs within the class of VIDM when modified with *again* suggests that there must be a verb-sensitive approach to their lexical semantics and whether they can be decomposed into separate manner and result components.

4. A root-sensitive approach

In this section, we lay out a syntax and semantics interface for the VIDM that we examined in the previous section. Namely, (a) *enter*-type verbs which allow for a restitutive presupposition with *again* as well as temporal modification of its decomposed state, (b) *arrive*-type verbs which systematically disallow restitutive presuppositions and temporal modification of the result state and (c) *ascend/descend*-type verbs, which behave similarly to degree achievements derived from adjectival roots that have open scales in allowing counterdirectional presuppositions.

4.1. Event decomposition with *enter*-type verbs

We begin first with verbs like *enter*, which allow restitutive presuppositions with *again*, as previously illustrated by (12). This motivates an analysis similar to Irwin's for *arrive*, such that there is a stative constituent denoting a state of being at a particular location that is syntactically accessible for *again* to attach. We adopt a standard analysis of *again* as an event modifier that takes a predicate of events as an argument, and introduces a presupposition that an identical

event had happened previously (Dowty, 1979; von Stechow, 1996; Beck and Johnson, 2004, lexical entry adapted from Bale, 2007).

(16) $[\![again]\!]$: $\lambda P \lambda e{:}\exists e' \exists e''[e' \succ e'' \succ e \wedge P(e') \wedge \neg P(e'')].P(e)$

Putting aside the possibility of morphological decomposition, we can give the root for *enter* the following lexical entry. $\sqrt{\text{ENTER}}$ will be a simple predicate of states, without any eventive component that denotes change. The meaning of change will be introduced by functional heads like v_{BECOME}, which also verbalizes the root under the assumptions of Distributed Morphology (Halle and Marantz, 1993; Marantz, 1997; Harley, 2005; Pylkkänen, 2008: a.o.).[7] We adopt here the meaning of v_{BECOME} from Dowty (1979), whereby the result state does not hold at the beginning of the change event *init*(e) but holds at the end of the event *fin*(e).

(17) $[\![\sqrt{\text{ENTER}}]\!]$: $\lambda y \lambda x \lambda s[\textit{be-at'}(x, y, s)]$

(18) Mary entered the room.
   a. [$_{vP}$ v_{BECOME} [$_{RootP}$ [*Mary* [$\sqrt{\text{ENTER}}$ *the room*]]]
   b. $[\![\sqrt{\text{RootP}}]\!]$: $\lambda s[\textit{be-at'}(m, r, s)]$
   c. $[\![v\text{P}]\!]$: $\lambda e[\neg \textit{be-at'}(m, r, \textit{init}(e)) \wedge \textit{be-at'}(m, r, \textit{fin}(e)]$

Restitutive presuppositions with *again* and durative modification of a state with *for*-phrases are hence produced when these modifiers attach to $\sqrt{\text{RootP}}$, which is a predicate of states denoting that the theme is at a particular location, as illustrated previously in (12).

4.2. Root encoded states in *arrive*

Moving on to verbs like *arrive*, we see that it systematically disallows restitutive presuppositions and temporal modification of a result state, as illustrated in (10) and (11a). We propose that the root of *arrive* entails change as part of their truth-conditional content (Beavers and Koontz-Garboden, 2020; Spathas, 2019; Spathas and Michelioudakis, 2020). This is in contrast to theories that assume a division of labor between functional structure and roots like Embick's (2009) Bifurcation Thesis for Roots, where entailments of change are introduced by functional heads like v_{BECOME}. One way of implementing this is to follow Beavers and Koontz-Garboden (2020) in suggesting roots can be states but also contain a relation BECOME relating an event and a state (cf. Dowty, 1979). Formally, such roots predicate a state s of being located in some place z as a result of a change. The place argument is either specified in the sentence syntactically or recoverable from context, in which case it can be existentially closed or simply contextually filled (Rappaport Hovav, 2014).[8]

(19) $[\![\sqrt{\text{ARRIVE}}]\!]$: $\lambda y \lambda x \lambda s[\textit{be-at'}(x, y, s) \wedge \exists e'[\textit{become'}(e', s)]]$

(20) Mary arrived in Chicago.
   a. [$_{vP}$ v [$_{RootP}$ [$_{Root'}$ *Mary* $\sqrt{\text{ARRIVE}}$] [$_{PP}$ *in Chicago*]]][9]

[7]Following Alexiadou et al. (2015), we assume that in English, *v*Ps encoding BECOME lack VOICE, the external argument and accusative case assigning head (Kratzer, 1996). This triggers raising of the subject of the small clause to the higher subject position.

[8]We use the *become* relation as a placeholder for the meaning expressed in (18c).

[9]We remain agnostic on whether *v* still contributes eventive meanings like BECOME with roots that we propose already entail them, since it is not crucial for our purposes here and we are only concerned with the semantics of RootP. For simplicity, we also assume that the preposition *in* is semantically inert.

b. ⟦RootP⟧: $\lambda s[\textit{be-at'}(m, c, s) \wedge \exists e'[\textit{become'}(e', s)]]$

Such a lexical entry for *arrive* correctly predicts that no restitutive presuppositions should be possible. This is because even if *again* attaches to RootP, a predicate of states, the predicate of states entails an event of change represented by BECOME (Beavers and Koontz-Garboden, 2020). *Again*'s presupposition would therefore include the event of change, producing a *repetitive presupposition* even when attaching to a predicate of states and not a restitutive presupposition. Restitutive contexts hence cannot satsify *again*'s presupposition, as shown previously in (10), repeated below as (21).

(21) a. CONTEXT: John was born here, and stayed here until he left when he grew up. After some years ...
#John arrived again. (#Restitutive)

b. CONTEXT: John was born in Chicago, and stayed there until he left for Boston when he grew up. After some years ...
#John arrived in Chicago again. (#Restitutive)

One undesirable prediction of such an approach, however, is that we expect temporal modification to still be able to target the state *excluding the event of change*, if temporal modifiers simply need to access a state variable. Because the event is represented by a separate variable from the state variable and BECOME relates them in a change event, even if there is no syntactic decomposition of a change event and a result state, durative *for*-phrases should still be able to target the duration of the state. As shown in (11a), repeated below as (22), independent modification of the state of being in a location is unavailable, suggesting that the event variable of the change event should not be represented separately from the state variable such that the state variable can be independently accessed.

(22) CONTEXT: John's plane landed in NYC, and he stayed there for around an hour, so ...
#John arrived (in NYC) for an hour.

Following Spathas and Michelioudakis (2020), we propose instead to locate the meaning of change directly within the encyclopedic content (in the Distributed Morphology sense) of the root. As a formal shorthand, we use the meta-language relation *come-to-be-at* to represent an event that is interpreted to result in a change, while having no state variable representing the state of being in a location (cf. Kratzer, 2000; Beavers and Koontz-Garboden, 2020; Spathas and Michelioudakis, 2020).

(23) ⟦$\sqrt{}$ARRIVE⟧: $\lambda y \lambda x \lambda e[\textit{come-to-be-at'}(x, y, e)]$

This thus achieves the same effect; even though *again* can attach directly to the RootP formed by $\sqrt{}$ARRIVE-type roots, these encyclopedically encode that an event leads to a change and hence, a strictly restitutive presupposition will never be available. Temporal modifiers will also never be able to modify the result state of being in a particular location, since such a constituent is not syntactically available and there is no semantic variable that represents such a result state excluding the event of change; the variable *e* represents the event of a change causing a state, rather than a pure state.

4.3. States and decomposition in *ascend* and *descend*

Finally, we discuss *ascend* and *descend*, which we showed previously to behave like degree achievements built out of adjectival roots that have open scales with respect to modifcation with *again*. The literature on degree achievements is vast and we cannot do full justice to the works here. Instead, we concentrate on recent proposals that have examined the interaction of sub-lexical modifiers with degree achievements, such as Pedersen (2015), Spathas (2019), and Spathas and Michelioudakis (2020). The core of recent analyses is that the roots of degree achievements denote *measure functions*, which are functions that take an individual argument and return the degree to which an object holds the particular property denoted by the root and hence of semantic type $<e,d>$ (Kennedy and Levin, 2008; Pedersen, 2015).[10] Measure functions do not denote properties of individuals and events and hence do not produce truth evaluable expressions, requiring degree morphology like POS, comparative morphology, or degree morphology to produce truth-evaluable expressions (e.g., Kennedy and Levin, 2008; Pedersen, 2015: a.o.).

Adopting a measure function analysis, Pedersen (2015) suggests that *again*-ambiguities are due to the fact that *again* is polysemous. The *-en* morpheme in *widen*, for example, coverts the measure function denoted by the root $\sqrt{}$WIDE into a *degree vector*, consisting of an ordered pair of degrees where the first member of the pair is the degree held by the object at the start of an event and the second member the degree held at the end of an event. A verbal version of POS introduces a standard of change set based on the kind of scale that the root lexicalizes (Kennedy, 2007; Kennedy and Levin, 2008; Pedersen, 2015). These standard sets are *sets of degree vectors*, whose members are regulated by global interpretive principles like INTERPRETIVE ECONOMY (Kennedy, 2007). With a root like $\sqrt{}$WIDE, which denotes a property on an open scale with no lower and upper bound, the standard of change set consists of the set of all degree vectors where the second member of the pair is larger than the first (Pedersen, 2015). Verbal POS introduces this standard of change set, enforces the condition that the degree vector produced is a member of the standard set, and also converts the degree vector into a predicate of individuals and events (based on the discussion in Spathas (2019), who integrates a scalar approach with events).

(24) a. $[\![\sqrt{}\text{WIDE}]\!]$: $\lambda x \lambda e.wide'(x)(e)$
b. $[\![\text{-}en_v]\!]$: $\lambda g \lambda x \lambda e.<g(x)(init'(e)), g(x)(fin'(e))>$
c. $[\![widen_v]\!]$: $\lambda x \lambda e.<wide'(x)(init'(e)), wide'(x)(fin'(e))>$
d. Standard-of-change set for *widen* $S_{MOCwiden}$: $\{<d, d'>: d <_{width} d'\}$
e. $[\![\text{POS WIDEN}_v]\!]$: $\lambda x \lambda e.<wide'(x)(init'(e)), wide'(x)(fin'(e))> \in S_{MOCwiden}$

For Pedersen (2015), the successive change presupposition is derived when repetitive *again* (an event modifier) attaches to the constituent in (24e). A counterdirectional reading, however, requires a dedicated counterdirectional *again* that attaches to the constituent in (24c), which operates directly on a degree vector and produces a presupposition where the two degrees in the degree vector are reversed; with *widen again*, the presupposition is hence that the object must have previously possessed a greater degree of width at the start of an event than at the end of the event i.e., the object narrowed before.[11] Hence, the presupposition produced is counter-

[10] In fact, measure functions require a time argument, since they measure the degree to which an object holds a property at a point in time. We omit the time argument here for simplicity.

[11] We focus on the intuition of such a counterdirectional *again* and do not give the full logical translation of

directional and not restitutive, since what licenses counterdirectional *again* is not repetition of a state but a prior change in the opposite direction of the property scale.

There are, however, two reasons why postulating a polysemous *again* might be undesirable. First, as has been observed by von Stechow (1996), Beck and Johnson (2004), and Bale (2007), there are word order effects, where placing *again* in particular positions allows only a repetitive or restitutive/reversal reading with closed scale predicates like *open*. This is also the case with *widen*. For example, placing *again* pre-verbally but following the subject only produces repetitive readings and not the reversal reading. That is, the river must have undergone a previous event of widening, rather than simply that it must have narrowed prior to widening.

(25) a. CONTEXT: Mary previously opened a closed door to enter a room. The wind blew the door shut. After an hour, Mary got up and opened the door to leave the room so ...
Mary again opened the door.

b. CONTEXT: There was a door that was installed open and had never been closed. The wind blew the door shut. Later, Mary opened the door to enter the room so ...
#Mary again opened the door.

(26) a. CONTEXT: The river previously widened from 25 feet to 30 feet. Then, it widened from 30 feet to 35 feet so ...
The river again widened.

b. CONTEXT: The river was previously 25 feet. Then, a drought narrowed it from 25 feet to 20 feet. The monsoon rains came and filled the river with rainwater such that it became 30 feet wide so ...
#The river again widened.

This is unexpected under Pedersen's (2015) analysis, which can be given the structural representation below using *widen* as an example. In principle, scalar *again* should be able attach leftward to the constituent denoting a degree vector, producing the surface linear order and a counterdirectional presupposition. That it does not, as shown in (26b), does not receive a straightforward explanation and would seem to need to be stipulated (von Stechow, 1996; Beck and Johnson, 2004; Bale, 2007; Lechner et al., 2015).

(27) $[_S$ The river [again $[_{VP}$ [#again $[_v$ wide -EN] again] POS]]]

Second, other kinds of non-scalar modifiers also seem to target a result state without requiring that there be a difference in degrees of a property that an object holds at two different times (Lechner et al., 2015; Spathas, 2019; Spathas and Michelioudakis, 2020). In particular, additive particles like *too* can produce a *stative presupposition*, where what is presupposed is that another object held the same property as what is being asserted without there ever being difference in degrees of the property that it holds.

(28) John opened [the door]$_F$ too.
a. John opened the window and the door. (eventive presupposition)
b. The window is open and John opened the door as well. (stative presupposition)

Pedersen (2015).

In particular, Spathas (2019) and Spathas and Michelioudakis (2020) observe that a stative presupposition is possible even with predicates built on roots that lexicalize open scales like *get expensive* in Greek (examples (27) and (28) from Spathas, 2019).[12]

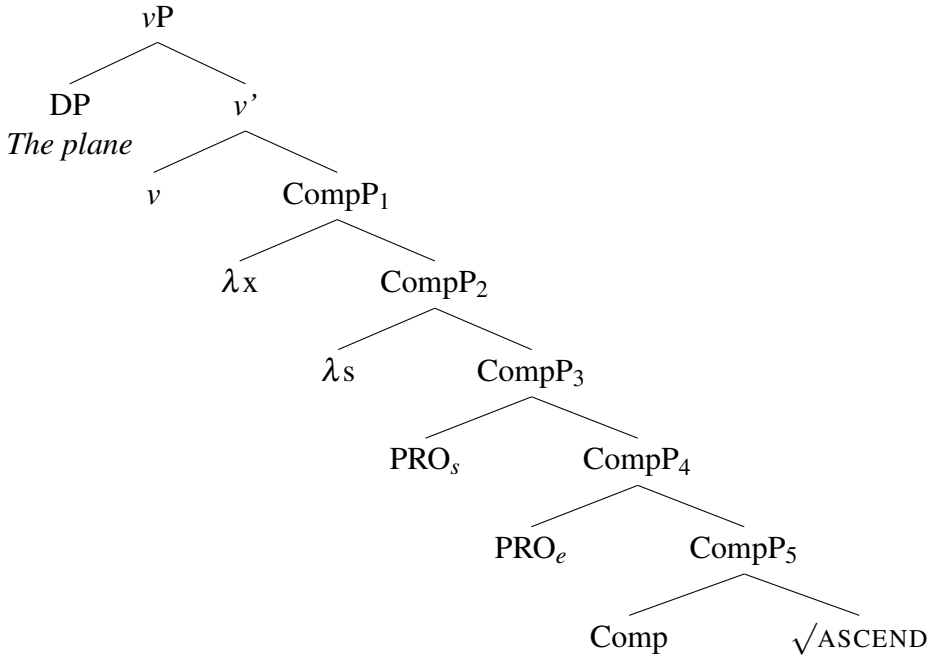
(29) CONTEXT: Bread and milk are expensive if they cost more than 1 euro per kilo. John opened a bakery in January and set the price of milk to 1.20 euros and that of bread to 0.80 euros. In February, he raised the price of bread to 1.10 euros, so that ...
Akrivine ke to [psomi]$_F$.
expensive.V also the BREAD
'The bread got (more) expensive too.'

We take these considerations to mean that it is desirable to have a representation of states in the semantics of degree achievements. In particular, we propose that the roots of *ascend* and *descend* denote states of having some height, and are simply predicates of states of type $<s,t>$.[13] The relevant result state that we propose is created by a COMP operator that compares the degree to which an object manifests a property in two different states via a measure function μ, a function that takes a state variable and returns its measure, i.e., a degree. Note that these two states are not ordered temporally and hence do not produce the meaning where the object possesses different degrees of height at the beginning and end of an event. We take this to be the contribution of *v*, which introduces an event variable and specifies that the two states produced by combining COMP with the root is equivalent to the beginning and end of an event of change. The full semantic syntactic structure and semantic derivation os provided below; in essence, we concur with the original comparative analysis in von Stechow (1996) for predicates like *fall* in German, and we give a compositional analysis.

[12]We note that the same reading does not seem to be available for *widen* in English. Intuitively, for all three authors, *The river widened too* does not seem to produce the kind of stative presupposition where another object is considered wide; hence, we do not adopt Spathas's (2019) analysis involving an adjectival POS that sets a contextual standard for a measure function.

[13]We assume no type-theoretic difference between events and states and assign them the same semantic type *s*.

(30) The plane ascended.[14]



(31) a. $[\![\sqrt{\text{ASCEND}}]\!]$: $\lambda x \lambda s.height(s) \wedge theme(s) = x$
b. $[\![\text{COMP}]\!]$: $\lambda P_{s,t} \lambda x \lambda s \lambda s'[P(x)(s) \wedge P(x)(s') \wedge \mu(s') > \mu(s)]$
c. $[\![\text{CompP}_3]\!]$: $\lambda s'[height(s) \wedge theme(s) = x \wedge height(s') \wedge theme(s') = x \wedge \mu(s') > \mu(s)]$
d. $[\![v]\!]$: $\lambda R_{e,s,st} \lambda x \lambda e.[R(x)(init(e))(fin(e))]$
e. $[\![v\text{P}]\!]$: $\lambda e[height(init(e)) \wedge theme(init(e)) = the\ plane \wedge height(fin(e)) \wedge theme(fin(e))) = the\ plane \wedge \mu(fin(e)) > \mu(init(e))]$

Attaching *again* to the constituent in (31c) produces a presupposition where at some earlier time the object was at a height greater than at the start of the asserted change event (von Stechow, 1996). Attaching to the eventive constituent in (31e) produces a presupposition where there was a previous event of ascending in height such that the object is higher at the end of the event than at the start of the event. For concreteness, we calculate the presupposition produced for what Pedersen (2015) calls counterdirectional *again*; given its presupposition, any context whereby there was previous degree of width that is greater than the beginning of the asserted event and then not greater than the beginning of the asserted event in an intervening time, will license the use of *again*.

(32) $\exists s' \exists s''[s' \succ s'' \succ init(e) \wedge [height(s') \wedge theme(s') = the\ plane \wedge height(init(e)) \wedge theme(init(e))) = the\ plane \wedge \mu(s') > \mu(init(e))] \wedge \neg[height(s'') \wedge theme(s'') = the\ plane \wedge height(init(e)) \wedge theme(init(e))) = the\ plane \wedge \mu(s'') > \mu(init(e))]]$

The stative analysis we present above also has another desirable prediction. Since there is a stative constituent that denotes a state of being higher than at the start of the asserted change event, we predict that durative *for*-phrases can modify this state. The following contexts, according to our judgments, are possible and hence, support the existence of such a state.

(33) a. CONTEXT: A plane was parked at an airport at 500 feet above sea level. It took

[14] *Descend* will receive the same analysis, but with the stative constituent denoting a state of being *lower* in degree of height than at the start of the change event.

off on a test flight and reached 30,000 feet in 30 minutes, staying there for two hours before returning to the airport so ...
The plane ascended for two hours (then came back down).

b. CONTEXT: A plane was cruising at 30,000 feet. It encountered turbulence so its pilots dropped its altitude down to 20,000 feet in 10 minutes. The plane stayed there for 2 hours to wait out the turbulence before returning to 30,000 feet so ...
The plane descended for two hours (then went back up).

5. Conclusion

In this paper, we observed that verbs that fall into the class of VIDM (Levin, 1993; Rappaport Hovav, 2014) do not behave alike with respect to sub-lexical modification. We distinguished three broad classes: *enter*-type which permit sub-lexical modification of a result state of being in a location, *arrive*-type which disallow such modification, and *ascend/descend*-type which behave like degree achievements that lexicalize properties with open scales. This classification shows that Rappaport Hovav's (2014) categorization in particular, which groups *enter*-type and *arrive*-type VIDM together, is not fine-grained enough with respect to the syntax and semantics of these two sub-classes.

We analyzed these classes in three different ways: the first involves a decompositional analysis consisting of an event template with stative roots (*enter*-type), the second being an event that entails a result state that is encoded in the root and not in a separate functional head (*arrive*-type), and a decomposed comparative structure where roots are simple states and there is a derived comparative state of being higher/lower on a scale (*ascend/descend*-type). We hence concur with Spathas and Michelioudakis (2020) that event decomposition, root-encoded change, and scalar analyses are all necessary for dealing with different kinds of VIDM. In particular, we demonstrated that these can all be required for verbs that are, semantically speaking, considered to be within the same class, here VIDM.[15] We hence contribute to a more fine-grained classification of VIDM with respect to sub-lexical modification, at the same time raising implications for theories of verb meaning that postulate that the meanings of verbs can be decomposed into a combination of roots and event templates defined by functional heads, and those that seek to constrain the lexical semantic entailments of verb roots by excluding entailments associated with event structure templates.

References

Acedo-Matellán, V. and J. Mateu (2014). From syntax to roots: A syntactic approach to root interpretation. In A. Alexiadou, H. Borer, and F. Schäfer (Eds.), *The Syntax of Roots and the Roots of Syntax*, pp. 259–281. Oxford: Oxford University Press.

Alexiadou, A., E. Anagnostopolou, and F. Schäfer (2006). The properties of anticausatives crosslinguistically. In M. Frascarelli (Ed.), *Phases of interpretation*, pp. 187–211. De Gruyter Mouton.

Alexiadou, A., E. Anagnostopolou, and F. Schäfer (2015). *External arguments in transitivity alternations: a layering approach*. Oxford: Oxford University Press.

Arad, M. (2005). *Roots and Patterns: Hebrew Morpho-Syntax*. Dordrect: Springer.

[15] Spathas and Michelioudakis (2020) consider four broader classes of verbs: change of state verbs, incremental theme verbs, degree achievements, and ditransitive verbs, concluding that each class shows different behavior with respect to the presuppositions generated with additive particles in Greek, but also note internal variation within each class.

Bale, A. C. (2007). Quantifiers and verb phrases: An exploration of propositional complexity. *Natural Language and Linguistic Theory 25*(3), 447–483.

Beavers, J. (2008). Scalar complexity and the structure of events. In J. Dölling, T. Heyde-Zybatow, and M. Schäfer (Eds.), *Event structures in linguistic form and interpretation*, pp. 245–265. Walter de Gruyter.

Beavers, J. and A. Koontz-Garboden (2012). Manner and result in the roots of verbal meaning. *Linguistic Inquiry 43*(3), 331–369.

Beavers, J. and A. Koontz-Garboden (2020). *The Roots of Verbal Meaning*. Oxford: Oxford University Press.

Beck, S. and K. Johnson (2004). Double objects again. *Linguistic Inquiry 35*(1), 97–123.

Beck, S. and W. Snyder (2001). The resultative parameter and restitutive *again*. In W. Sternefeld and C. Féry (Eds.), *Audiatur Vox Sapientiae: A Festschrift for Arnim on Stechow*, pp. 48–69. Berlin: Akademia Verlag.

Borer, H. (2003). Exo-skeletal vs. endo-skeletal explanations: Syntactic projections and the lexicon. In J. Moore and M. Polinsky (Eds.), *Explanation in linguistic theory*, pp. 31–67. Standford: CSLI.

Borer, H. (2005a). *Structuring Sense: In Name Only*, Volume 1. Oxford: Oxford University Press.

Borer, H. (2005b). *Structuring Sense: The Normal Course of Events*, Volume 2. Oxford: Oxford University Press.

Dowty, D. (1979). *Word meaning and Montague grammar*. Dordrecht: D. Reidel Publishing.

Dunbar, E. and A. Wellwood (2016). Addressing the "two interface" problem: Comparatives and superlatives. *Glossa 1*(1), 1–29.

Embick, D. (2009). Roots, states, stative passives. Talk given at the 2009 Roots Workshop, University of Stuttgart.

Fabricius-Hansen, C. (2001). 'wieder' and 'again(st)'. In C. Féry and W. Sternefeld (Eds.), *Audiatur Vox Sapientiae: A festschrift for Arnim von Stechow*, pp. 101–130. Berlin: Akademie.

Folli, R. and H. Harley (2005). Flavors of *v*. In P. M. Kempchinsky and R. Slabakova (Eds.), *Aspectual Inquiries*, pp. 99–120. Dordrecht: Springer.

Goldberg, A. (1995). *Constructions. A Construction Grammar Approach to Argument Structure*. Chicago and London: The University of Chicago Press.

Hale, K. and S. J. Keyser (2002). *Prolegomenon to a Theory of Argument Structure*. Cambridge: MIT Press.

Halle, M. and A. Marantz (1993). Distributed morphology and the pieces of inflection. In K. Hale and S. J. Keyser (Eds.), *The View from Building 20*, pp. 111–176. Cambridge, MA: MIT Press.

Harley, H. (2005). How do verbs get their names? Denominal verbs, manner incorporation, and the ontology of verb roots in English. In N. Erteschik-Shir and T. Rapaport (Eds.), *The Syntax of Aspect: Deriving Thematic and Aspectual Interpretation*, pp. 42–64. New York, NY: Oxford University Press.

Harley, H. and R. Noyer (2000). Formal versus encyclopedic properties of vocabulary: Evidence from nominalizations. In B. Peters (Ed.), *The Lexicon-Encyclopedia Interface*, pp. 349–374. Amsterdam: Elsevier Press.

Irwin, P. (2012). *Unaccusativity at the Interfaces*. Ph. D. thesis, New York University.

Irwin, P. (2018). Existential unaccusativity and new discourse referents. *Glossa: a journal of*

general linguistics 3(1), 1–42.
Irwin, P. (To appear). Unaccusativity and theticity. In A. Werner, E. Leiss, and Y. Fujinawa (Eds.), *Thetics and categoricals*. Amsterdam: John Benjamins Publishing Company.
Kennedy, C. (2007). Vagueness and grammar: the semantics of relative and absolute gradable adjectives. *Linguistics & Philosophy 30*, 1–45.
Kennedy, C. and B. Levin (2008). Measure of change: The adjectival core of degree achievements. In L. McNally and C. Kennedy (Eds.), *Adjectives and Adverbs: Syntax, Semantics and Discourse*, pp. 156–182. Oxford: Oxford University Press.
Kratzer, A. (1996). Severing the external argument from its verbs. In L. Ann Zaring and J. Rooryck (Eds.), *Phrase Structure and the Lexicon*, pp. 109–137. Dordrecht: Kluwer.
Kratzer, A. (2000). Building statives. In L. J. Conathan et al. (Eds.), *Proceedings of the Annual Meeting of the Berkeley Linguistics Society*, Volume 26, Berkeley, CA, pp. 385–399. Berkeley, CA: University of California, Berkeley Linguistics Society.
Lechner, W., G. Spathas, A. Alexiadou, and E. Anagnostopoulou (2015). On deriving the typology of repetition and restitution. Talk given at GLOW 2015, Paris 8 and CNRS.
Levin, B. (1993). *English verb classes and alternations: a preliminary investigation*. Chicago:: University of Chicago Press.
Marantz, A. (1997). No escape from syntax: Don't try morphological analysis in the privacy of your own lexicon. In *University of Pennsylvania Working Papers in Linguistics*, Volume 4, pp. 201–225. Penn Graduate Linguistics Society.
Marantz, A. (2007). Restitutive re-, and the first phase syntax/semantics of the VP. Talk given at the University of Maryland.
Mateu, J. and V. Acedo-Matellán (2012). The manner/result complementarity revisited: A syntactic approach. In M. C. Cuervo and Y. Roberge (Eds.), *The end of argument structure? Syntax and Semantics*, pp. 209–228. New York, NY: Academic Press.
McCawley, J. (1968). Lexical insertion in a transformational grammar without deep structure. In *Proceedings of the Fourth Regional Meeting of the Chicago Linguistic Society*, Chicago, IL, pp. 71–80. Chicago Linguistic Society.
McCawley, J. (1976). *Grammar and Meaning: Papers on Syntactic and Semantic Topics*. New York: Academic Press.
McIntyre, A. (2004). Event paths, conflation, argument structure, and VP shells. *Journal of Linguistics 42*(3), 523–571.
Moro, A. (1997). *The raising of predicates: Predicative noun phrases and the theory of clause structure*. Cambridge: Cambridge University Press.
Pedersen, W. A. (2015). A scalar analysis of *again*-ambiguities. *Journal of Semantics 32*, 373–424.
Pesetsky, D. (1995). *Zero Syntax: Experiencer and Cascades*. Cambridge, MA: MIT Press.
Pylkkänen, L. (2008). *Introducing Arguments*. Cambridge, MA: MIT Press.
Ramchand, G. (2008). *Verb meaning and the lexicon*. Cambridge: Cambridge University Press.
Rappaport Hovav, M. (2014). Building scalar changes. In A. Alexiadou, H. Borer, and F. Schäfer (Eds.), *The Syntax of Roots and the Roots of Syntax*, pp. 259–281. Oxford: Oxford University Press.
Rappaport Hovav, M. and B. Levin (1998). Building verb meanings. In M. Butt and W. Geuder (Eds.), *The projection of arguments: Lexical and compositional factors*, pp. 97–134. Standford, CA: CSLI Publications.

Spathas, G. (2019). An ambiguity account of degree achievement predicates: Evidence from additive operators. In J. Baird and J. Pesetsky (Eds.), *Proceedings of the forth-ninth annual meeting of the Northeast Linguistics Society: Volume 3*, pp. 163–172.

Spathas, G. and D. Michelioudakis (2020). States in the decomposition of verbal predicates: Evidence from additive operators. *Natural Language & Linguistic Theory*.

von Stechow, A. (1996). The different readings of wieder 'again': A structural account. *Journal of Semantics 13*(2), 87–138.