

Atelicity and Cross-Categorial Measure Phrase Licensing Conditions

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1 Introduction

Two empirical questions normally considered separately:

- Why is it that certain temporal adverbials can normally be predicated only of atelic eventualities?
- Why is it that measure phrases can occur with some APs and PPs but not with others?

THE FIRST QUESTION (FAMILIAR) Certain temporal adverbials are possible with atelic VPs, but not (normally) with telic ones:

- (1) a. Floyd walked *for 20 minutes*.
b. Gladys slept *several hours*.
- (2) a. #Floyd sank the pirate ship *for 20 minutes*.
b. #Gladys died *several hours*.

THE SECOND QUESTION (LESS FAMILIAR) AP- and PP-modifying nominal measure phrases are possible with some adjectives and prepositions but not with others:

- (3) a. Herman is *37 years* old.
b. The bird is *20 yards* above the barn.¹
c. Gladys threw her dirty laundry *several feet* behind the bed.

¹This sentence is a version of a recurring one in Winter (2001, 2005).

- (4) a. #Herman is *37 years* young.
b. #The bird is *20 yards* on the barn.
c. #Gladys threw her dirty laundry *several feet* beside the bed.

Goals:

- relate these two questions, primarily by giving them the same (partial) answer
- namely: that Aktionsart restrictions imposed by a particular class of temporal adverbials are a special case of a more general restriction on measure-phrase modification, the Modification Condition of Winter (2001), Zwarts and Winter (2000), and Winter (2005)

The agenda:

- examine how APs and PPs interact with measure phrases and the Vector Space Semantics approach toward these phenomena (Zwarts 1997, Faller 2000, Zwarts and Winter 2000, Winter 2001, 2005)
- argue that a class of temporal adverbial DPs are simply VP-modifying measure phrases (Morzycki 2001, 2004)
- propose introducing vectors into the ontology underpinning temporal semantics as a means of laying the foundation for a connection between VP measure phrases and their more familiar counterparts in AP and PP
- show that, with assumptions such as these in place, the atelicity requirement can (at least in many cases) be made to follow from the independently-motivated Vector Space Semantics account of restrictions on measure phrases
- briefly consider some broader consequences of the proposal

2 MPs, Vector Space Semantics, and the Modification Condition

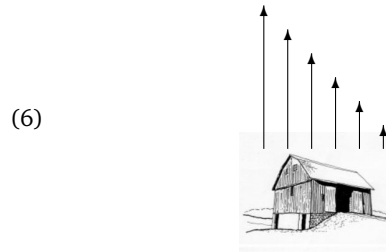
2.1 Vector Space Semantics: Locative Prepositions

Some of the key ideas:

- introduce vectors as primitives into the ontology
- spatial PPs denote properties of vectors (Zwarts 1997, Zwarts and Winter 2000) representing spatial relationships
- APs denote properties of vectors (Faller 1998, 2000, Winter 2001, 2004) that play roughly the role of degrees (especially in interval/‘extent’ theories of degree such as Kennedy 1997, 2001 or Schwarzschild and Wilkinson 2002)

A PP such as *above the barn*, for example, is true of vectors that start at the barn and point upward (i.e., that end at some point above it), like those in (6):²

- (5) $\llbracket \text{above the barn} \rrbracket = \lambda v . v \text{ starts at the location of the barn} \wedge v \text{ points upward}$



For (7), for example, to be true, it must be the case that the bird is located at the *end* of one of the vectors in (6)—that is, of a vector of which *above the barn* holds:

- (7) $\llbracket \text{The bird is above the barn} \rrbracket =$

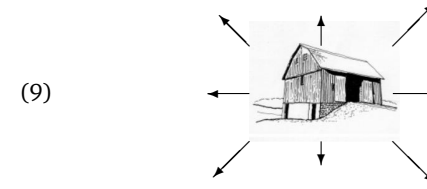
$$\exists v \left[\begin{array}{l} v \text{ starts at the location of the barn} \wedge \\ v \text{ points upward} \wedge \\ v \text{ ends at the location of the bird} \end{array} \right]$$

Mildly ugly assumption: To go from (6) to (7) compositionally, a type-shift is necessary by which a property of vectors is mapped to a property of individuals located at the endpoints of those vectors.

²For ease of exposition, I take a number of significant liberties here in characterizing this (very well-formalized) framework informally. (Zwarts and Winter 2000 and Winter 2005 in particular spell things out quite fully.) I’m indicating vectors with the variables v, v', v'', v''', \dots

Near the barn can be interpreted in the same spirit:

- (8) $\llbracket \text{near the barn} \rrbracket = \lambda v . v \text{ starts at the location of the barn} \wedge v \text{ is short}$



2.2 Vector Space Semantics: Adjectives

Adjectives are a bit more complicated, since unlike locative prepositions they inherently involve sensitivity to contextually supplied standards. One way to initially avoid this complication is to first consider comparatives, which do not manifest this sensitivity. Faller (2000) proposes denotations roughly like (10a) and (10b):

- (10) a. $\llbracket \text{taller than Clyde} \rrbracket = \lambda v . v \text{ is on the scale of height} \wedge v \text{ starts at the (maximal) location of Clyde on the scale of height} \wedge v \text{ points upward}$
b. $\llbracket \text{shorter than Clyde} \rrbracket = \lambda v . v \text{ is on the scale of height} \wedge v \text{ starts at the (maximal) location of Clyde on the scale of height} \wedge v \text{ points downward}$

Absolute (i.e., non-comparative) forms can be understood in broadly similar terms, with the additional ingredient of a contextually-provided standard. Winter (2001, 2005) proposes denotations along the lines of (11), where s indicates the standard, construed as a vector starting at the bottom of the scale:³

- (11) a. $\llbracket \text{tall}_s \rrbracket = \lambda v . v \text{ is on the scale of height} \wedge v \text{ starts at the bottom of the scale of height} \wedge v \text{ points upward} \wedge v \text{ is at least as long as } s$

³The analyses of Faller (2000) and Winter (2005) begin to diverge here. In (11) I hew closer to the Winter approach (though I’m continuing to simplify in several ways).

- b. $\llbracket short_s \rrbracket = \lambda v . v$ is on the scale of height $\wedge v$ starts at the bottom of the scale of height $\wedge v$ points upward $\wedge v$ is shorter than s

2.3 Measure Phrases

One of the really nice properties of the Vector Space approach to these constructions is that they make possible an intersective and very intuitive analysis of measure phrase modification. Zwarts (1997) proposes an analysis of modified locative PPs roughly as in (12–13):

$$(12) \quad \llbracket two\ feet \rrbracket = \lambda v . v \text{ measures } 2 \text{ feet}$$

$$(13) \quad \begin{aligned} \llbracket two\ feet\ above\ the\ barn \rrbracket &= \lambda v . \llbracket two\ feet \rrbracket (v) \wedge \llbracket above\ the\ barn \rrbracket (v) \\ &= \lambda v . v \text{ measures } 2 \text{ feet} \wedge v \text{ starts at the location of the barn} \wedge v \text{ points upward} \end{aligned}$$

Faller (2000) extends this to adjectives roughly as in (14):

$$(14) \quad \begin{aligned} \llbracket two\ feet\ taller\ than\ Clyde \rrbracket &= \lambda v . \llbracket two\ feet \rrbracket (v) \wedge \llbracket taller\ than\ Clyde \rrbracket (v) \\ &= \lambda v . v \text{ measures } 2 \text{ feet} \wedge v \text{ is on the scale of height} \\ &\quad \wedge v \text{ starts at the (maximal) location of Clyde on the scale of height} \wedge v \text{ points upward} \end{aligned}$$

2.4 The Modification Condition

None of this yet explains contrasts like those in (15):

- (15) a. The bird is two feet $\left\{ \begin{smallmatrix} \text{above} \\ \#_{\text{near}} \end{smallmatrix} \right\}$ the barn.
 b. Gladys threw her dirty laundry several feet $\left\{ \begin{smallmatrix} \text{behind} \\ \#_{\text{beside}} \end{smallmatrix} \right\}$ the bed.
 c. Floyd is six feet $\left\{ \begin{smallmatrix} \text{tall} \\ \#_{\text{short}} \end{smallmatrix} \right\}$.

In the Vector Space framework, though, all the expressions that allow a measure phrase have denotations that share the same characteristic: they are all both upward and downward monotonic in that they *include vectors of every non-zero length*.

Examples:

- bird is *above the barn* ...
 - move the bird higher; it's still *above the barn*
 - move it lower; still *above the barn*
 - but not so for *near the barn*
- clothes are thrown *behind the bed* ...
 - throw them farther past the bed; they're still thrown *behind the bed*
 - throw them less far past the bed; they're still thrown *behind the bed*
 - but not so for *beside the bed*
- Floyd is *tall* ...
 - CRUCIAL ADDITIONAL ASSUMPTION: evaluate this in a context in which the standard for height is 0⁴
 - increase the amount by which he exceeds the standard for tallness; he's still *tall*
 - decrease the amount by which he exceeds the standard for tallness; he's still *tall*
 - but not so for *short* (the vectors in the extension of *short* are all shorter than the standard)

⁴This would be, of course, a pretty weird context. Winter (2001, 2005) spells out the details of how this works (in a somewhat reassuring way). This assumption is necessary to account for the so-called 'neutralizing effect' of measure phrases (see Seuren 1973, von Stechow 1984, Kennedy 1997 and references there). What *requires* this to be the case in the presence of a measure phrase is (16) itself. In the absence of a measure phrase, such a trivial standard would presumably be ruled out for a purely pragmatic reason—namely, that it would render anything that has any height at all *tall* and thereby make it almost completely uninformative.

(16) **MODIFICATION CONDITION** (Winter 2005)
An expression that is associated with a set of vectors W can be modified by a measure phrase only if W is non-empty, upward and downward monotone and does not contain zero vectors.

(17) Floyd is two feet $\left\{ \begin{array}{c} \text{taller} \\ \text{shorter} \end{array} \right\}$ than Clyde.

This also predicts—again, correctly—that for certain adjectives, both opposing pairs should both support measure phrases even in the absolute:

(18) Floyd's flight was two hours $\left\{ \begin{array}{l} \text{early} \\ \text{late} \end{array} \right\}$.

3 Measure Phrases in VP

The Modification Condition is intended as a deep and cross-categorial property of measure-phrase modification. We should therefore expect that if VPs could support measure phrases, they should be constrained by it here just as in PP and AP.

Point of this section: To argue that certain adverbial DPs *are* VP measure phrases (Morzycki 2004, and less directly Pereltsvaig 2000 and Morzycki 2001).

(19) a. He slept $\left\{ \begin{array}{l} \textit{several hours} \\ \textit{eight hours} \\ \textit{two days} \end{array} \right\}$.
 b. It had been raining $\left\{ \begin{array}{l} \textit{an hour} \\ \textit{a month} \\ \textit{several weeks} \end{array} \right\}$.

Not all adverbial DPs are VP measure phrases, of course:

But some adverbial DPs—the ones that are plausible measure phrases—do manifest a constellation of characteristics that identify them as a natural class.

SCOPE One puzzling property identifies certain adverbial DPs as a natural class is obligatory low scope. This can usually be observed by comparing them to their *for* PP paraphrases, which are not subject to this constraint.

(21) a. Clyde didn't sleep an hour.
 ($\neg \prec$ *an hour*; **an hour* $\prec \neg$)
 b. Clyde didn't sleep for an hour.
 ($\neg \prec$ *an hour*; *an hour* $\prec \neg$)

- (22) a. Greta couldn't stay a day. ($\neg \prec a \text{ day}; *a \text{ day} \prec \neg$)
 b. Greta couldn't stay for a day. ($\neg \prec a \text{ day}; a \text{ day} \prec \neg$)

Scope with respect to negation:

- (23) a. Few chiropractors waltzed ten minutes.
 (*few chiropractors* \prec *ten minutes*;
 **ten minutes* \prec *few chiropractors*)
 b. Few chiropractors waltzed for ten minutes.
 (*few chiropractors* \prec *ten minutes*;
 ten minutes \prec *few chiropractors*)

Scope with respect to aspect:

- (24) a. Clyde swam a year. (GEN $\prec a \text{ year}; *a \text{ year} \prec$ GEN)
 b. Clyde swam for a year. (GEN $\prec a \text{ year}; a \text{ year} \prec$ GEN)

Scope with respect to embedding verbs:

- (25) a. Greta wanted to talk a few minutes.
 (*wanted* $\prec a \text{ few minutes}; *a \text{ few minutes} \prec$ *wanted*)
 b. Greta wanted to talk for a few minutes.
 (*wanted* $\prec a \text{ few minutes}; a \text{ few minutes} \prec$ *wanted*)

LOW STRUCTURAL POSITION The same measure-phrase-like adverbial DPs are restricted to low structural positions:

- (26) a. Clyde slept an hour every day.
 b. *Clyde slept every day an hour.
 (27) a. Clyde usually slept less than six hours for a year.
 b. *Clyde usually slept for less than six hours a year.

NO HEAD NOUN RESTRICTION Many adverbial DPs are subject to idiosyncratic restrictions on what their head noun can be (Larson 1985), as in (28):

- (28) Floyd played the ukulele $\left\{ \begin{array}{l} \text{the wrong way} \\ * \text{the wrong manner} \end{array} \right\}$.

The adverbial DPs identified in this section, though, can grammatically occur with any head noun with the appropriate lexical semantics.

QUANTIFICATIONAL FORCE All the the adverbial DPs identified in this section are quantificationally weak. Strong ones don't manifest the same properties—for example, they can scope high:

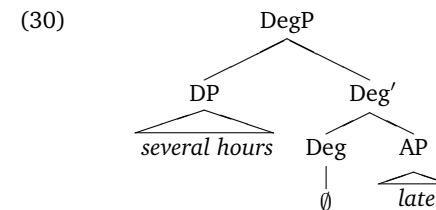
- (29) Clyde didn't sleep the whole day.
 ($\neg \prec \text{the whole day}; \text{the whole day} \prec \neg$)

AKTIONSART EFFECT And notably, of course, all these adverbial DPs impose an atelicity requirement. (Though they are hardly unique in this.)

3.3 Adverbial DPs as Measure Phrases

The obligatorily low scope—even with respect to embedding verbs—and low structural position of these adverbial DPs suggests that they occupy a fixed position on a left branch. (This is because English VPs are right-branching, so attachment ambiguities don't occur on left branches.)

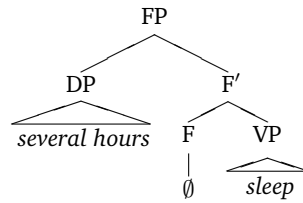
This sort of left-branch position is exactly what would be expected if these were measure phrases. One standard structure for measure phrases in AP and PP (though not the one Zwarts 1997 and Zwarts and Winter 2000 adopt) places them in a specifier position—in contemporary incarnations, typically to a functional head as in (30) (this version is that of Kennedy 1997, who is following Abney 1987, Corver 1990, Grimshaw 1991, and others):



So it is natural that measure phrases in VP should similarly occupy a specifier position (to parallel (30), I assume the schematic functional-head structure in (31), but this is not crucial at this point):⁶

⁶This kind of structure does, however, have some advantages. One of

(31)



But this, of course, is not the surface order in English. Assuming verb movement in English is present though short (Johnson 1991, Runner 1995 among others), though, this structure will independently lead to the surface order without anything further being said:

(32) $\text{sleep}_i \text{ } [_{\text{FP}} \text{ several hours } [\text{F}] [_{\text{VP}} t_i]]$

Thus on this view, the only reason these expressions do not appear more obviously to be VP measure phrases is that their true nature is obscured by verb movement and so can be observed only indirectly.

Importantly, this sort of structure has independent motivation for certain adverbial DPs. Pereltsvaig (2000) argues that accusative-marked adverbial DPs in Slavic and Finnish have a structure like (31), chiefly on the basis of facts about case.

4 Vectors in the Ontology of Time

Next: If there are VP measure phrases, then, are they subject to the Modification Condition? What would it mean for them to be, exactly?

In order to address this, it is necessary to develop a way of talking about temporal semantics using vectors.

these is that the presence of such a functional head—about whose identity more would have to be said, of course—would provide an additional bit of morphology to do the semantic work that in the standard Vector Space model is done by a large family of type-shifts (from a property of vectors to a property of individuals located at the ends of those vectors, for example), all of which somewhat mysteriously seem to occur in only one structural position.

This would be a pretty significant change to the standard conception—not a trivial move. I know of no independent argument for using vectors in this domain apart from any benefits it might have with respect to measure phrases.⁷ But the parallelism in how measure phrases work seems reason enough to explore this possibility. And there *are* some grammatical connections between space, time, and degree:

- (33) a. Floyd slept a lot.
b. Floyd likes sashimi a lot.

- (34) a. Clyde walked an hour.
b. Clyde walked a mile.

But there is an issue here about to what extent vectors are genuinely necessary to pursue the ends sought here.

The first step: Suppose that time is a scale, essentially like the scale of height, say. Just as degree intervals/extents can be reconceptualized as vectors, so too temporal intervals can.

It is not possible, though, to just straightforwardly extend the analogy from PPs and APs. Locative PPs could denote sets of vectors because their meaning essentially doesn't contribute anything *but* spatial information. APs could denote sets of vectors because adjectives could still be distinguished from each other on the basis of what *scale* or dimension (Kennedy 1997, 2001) the vectors in its extension are located on.

But for VPs, the situation is more complicated. It wouldn't be plausible to simply think of the V *sleep* as having a denotation like (35), for example:

- (35) $\llbracket \text{sleep} \rrbracket$
 $= \lambda v . \exists e [e \text{ is a sleeping} \wedge \text{the running time of } e = v]$

If *sleep* has an event argument at all, it would need to remain free inside its denotation. If it did not, it would be impossible for adverbials higher in the tree to be predicated of it. So at a minimum, what would be required is something like (36):

- (36) $\llbracket \text{sleep} \rrbracket = \lambda v \lambda e . e \text{ is a sleeping} \wedge \text{the running time of } e = v$

⁷It'd be interesting to discover one.

It's not obvious this is desirable either, though—depending on one's other assumptions, this may interfere with the standard intersective interpretation of manner adverbials, for example.

The issue here is really no different from one that is raised independently of vectors—namely, of how intervals and events fit together in the compositional semantics. One answer is to suppose, following Kratzer (1998) (who is building broadly on Klein 1994), that the mapping from properties of events to properties of intervals is brought about by aspect morphology.

Translating this to vectors, then, one might assume that part of an aspect morpheme's denotation—represented here very schematically, drained of the parts of meaning that distinguish one aspect morpheme from another—is as in (37):⁸

$$(37) \quad \llbracket Asp \rrbracket = \lambda f_{\langle s, t \rangle} \lambda v . \exists e [f(e) \wedge [\text{the running time of } e] = v]$$

The verb itself, then, could continue to have its standard denotation, and no novel predictions are made about its behavior with respect to modifiers that occur below this level in the tree.

Something like (35) would now be built up compositionally. At the level immediately above the aspect node, the denotation would be a property of vectors:

$$(38) \quad \llbracket Asp [Floyd sleep] \rrbracket = \lambda v . \exists e [e \text{ is a sleeping (by Floyd)} \wedge \text{the running time of } e = v]$$

This could combine with a measure phrase intersectively.⁹

5 The Modification Condition and Atelicity

In the preceding section, the denotation of aspect morphology was represented schematically by taking it to map properties of events to

properties of their running-time vectors. In general, though, this is not the sort of thing actual aspect morphemes do.

A 'real-life' example (Klein 1994, Kratzer 1998):¹⁰

$$(39) \quad \llbracket \text{PERFECTIVE} \rrbracket = \lambda f_{\langle s, t \rangle} \lambda v . \exists e [f(e) \wedge [\text{the running time of } e] \subseteq v]$$

This ensures that after the application of perfective aspect morphology, an atelic predicate like *sleep* will have a denotation like (40):

$$(40) \quad \llbracket \text{PERFECTIVE} [Floyd sleep] \rrbracket = \lambda v . \exists e \left[\begin{array}{l} e \text{ is a sleeping (by Floyd)} \wedge \\ [\text{the running time of } e] \subseteq v \end{array} \right]$$

This kind of denotation satisfies the Modification Condition because it includes vectors of every length. This rests crucially on the fact that atelic verbs have the subevent property (Dowty 1979)—any part of a sleeping is itself a sleeping, so anytime there is an event of sleeping of a particular length, there are corresponding events of him sleeping for every shorter length as well.

A telic predicate such as *die*, however, does not have the subevent property. Any proper subevent of a dying is not itself a dying—it is at best a partial dying. Thus a denotation for *die* analogous to (40) will *not* satisfy the Modification Condition, because it will not include vectors of a length shorter than the dying:

$$(41) \quad \llbracket \text{PERFECTIVE} [Floyd sleep] \rrbracket = \lambda v . \exists e \left[\begin{array}{l} e \text{ is a dying (by Floyd)} \wedge \\ [\text{the running time of } e] \subseteq v \end{array} \right]$$

What about other aspects apart from perfective? Two answers:

- First, this suggests that there might need to be a kind of decomposition here, in which every predicate is, at the level at which measure phrases are interpreted, in some sense perfective (before its 'final' or 'real' aspect is imposed higher in the tree).

⁸The type of events here is *s*.

⁹This approach does raise a serious problem for the observation made in the previous section that VP measure phrases scope below aspect. In fact, it seems likely that this sort of intersective interpretation has to be sacrificed for a conception in which the measure phrase is an argument, which accords with what is often assumed about measure phrases in AP (by e.g. Kennedy 1997 or Heim 2000).

¹⁰This is a *highly* convenient selection of aspects—indeed, crucial.

- Second, well, maybe there is something to be gained by looking more closely at how other aspects interact with measure phrases—particularly in languages where aspect marked morphologically more transparently than in English. It does not seem self-evident that the distribution of measure phrases is completely free with respect to different aspects (in the sense distinct from Aktionsart, of course).

6 Final Words

The aim here was, above all, to simply relate the question of what licenses measure phrases in AP and PP to the question of how temporal modifiers impose Aktionsart restrictions on the predicates they modify. It was argued that certain adverbial DPs are actually VP measure phrases, and that Aktionsart restrictions they impose can be understood as a special case of the Modification Condition of Zwarts and Winter (2000) and Winter (2005), which constrains all measure phrases cross-categorially.

What has been suggested are of course only initial steps in this direction, and much remains to be done:

- The analysis is at this point fairly narrowly focused empirically—something more general is desirable.
- VP measure phrases are at first glance quite similar to *for* PPs, and both impose atelicity requirements. Does this reveal that these PPs should also be subject to the Modification Condition? Should all temporal modifiers that impose such a restriction be understood in (something like) these terms?
- To what extent is a vector space conception of these issues really necessary? Might more familiar ontological assumptions suffice, if appropriately supplemented?
- The Vector Space approach generally builds on a very simple syntax, and places heavy emphasis on intersective interpretations and type-shifts. Could examining the syntax more closely, and asking in more detail about how semantic labor is divided among syntactic nodes, change this picture?

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