DETERMINERS IN ASPECTUAL COMPOSITION

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A difficulty for leading theories of aspectual composition (Krifka 1992; Verkuyl 1993) is that they make incorrect predictions when verbs of gradual change combine with certain kinds of noun phrases. Consider, for instance, the sentences in (1) and (2), which all describe accomplishments, as is confirmed by the acceptability of the time-span *in*-adverbials.

(1) a. Rebecca ate an apple (in five minutes).
b. Rebecca ate the apple (in five minutes).
c. Rebecca ate (exactly) three apples (in fifteen minutes).

(2) a. Rebecca ate at least three apples (in fifteen minutes).
b. Rebecca ate more than three apples (in fifteen minutes).
c. Rebecca ate some apples (in fifteen minutes).
d. Rebecca ate a number of apples (in fifteen minutes).
e. Rebecca ate at most three apples (in fifteen minutes).
f. Rebecca ate less than three apples (in fifteen minutes).

In Krifka's approach, the verb phrases and sentences in (1)—or more precisely, their corresponding event predicates, though I will often speak loosely—are predicted to be *quantized*. The definition of quantized reference for one-place predicates P is given in (3), where a, b are unsorted variables for individuals and $\sqsubset$ stands for the proper part relation.

(3) $\mathsf{QUA}(P) \stackrel{\text{def}}{=} \forall a \forall b[(P(a) \wedge P(b)) \rightarrow \neg(a \sqsubset b)]$ (P is quantized)

The verb phrases and sentences in (1) are quantized because the noun phrases *an apple*, *the apple*, and *(exactly) three apples*, which are treated as nominal predicates in Krifka's framework, are all quantized, and this leads to the result (given the thematic properties of verbs of gradual change) that the corresponding verb phrases and sentences are also quantized. If *in*-phrases require a quantized verb phrase to combine with, then the acceptability of the sentences in (1) is accounted for.

In contrast, the acceptability of the sentences in (2) is problematic. The noun phrases *at least three apples*, *more than three apples*, *some apples*, and *a number of apples* in (2a)–(2d) are apparently[1] *cumulative*, hence not quantized, which pre-

[1] I write 'apparently' because on an intuitively straightforward analysis of these noun phrases as nominal predicates they are cumulative. Of course, there may be other (arguably, less intuitively straightforward)

dictably results in event predicates that are cumulative and not quantized. The definition of cumulative reference for one-place predicates P is shown in (4), where $\oplus$ designates the sum operation.

(4) $\textsc{cum}(P) \stackrel{\text{def}}{=} \exists a \exists b[P(a) \wedge P(b) \wedge \neg(a = b)] \wedge \forall a \forall b[P(a) \wedge P(b) \rightarrow P(a \oplus b)]$
(P is cumulative)

Furthermore, *at most three apples* and *less than three apples* in (2e) and (2f) are apparently neither cumulative or quantized,[2] which means that the corresponding event predicates are also neither cumulative nor quantized. If *in*-phrases select for a quantized event predicate, then they should not be compatible with the sentences in (2), and yet they are. Observe that the same difficulty arises with noun phrases such as *many apples* (cumulative, hence not quantized) and *few apples* (neither cumulative nor quantized).

This difficulty becomes even more acute in light of the following contrast:

(5) a. Rebecca ate at least one apple in ten minutes.
b. #Rebecca ate apples in ten minutes.

Assuming that singular apples are the minimal elements in the extension of *apples*, then *apples* and *at least one apple* have the same extensions, and both are cumulative. In fact, they even have the same intensions, because it is impossible for a number of apples to satisfy one of these predicates without also satisfying the other.[3] Yet if correct, then this suggests that Krifka's strategy of looking solely at the reference properties of the nominal predicates in question is insufficiently general and really only succeeds with 'well-behaved' predicates such as *an apple*, *the apple*, and *(exactly) three apples*.[4]

Although Krifka's theory is formulated in an event semantic framework, this difficulty arises in Verkuyl's approach as well, which dispenses with events. Since the latter also relies on extensions, it is not feasible to distinguish *apples* from *at least one apple* in an aspectually relevant way. Verkuyl's claim that *apples* is $[-\text{SQA}]$ and *at least one apple* is $[+\text{SQA}]$ (SQA = 'specified quantity of A, where A is the denotation of the head noun') is effectively to postulate a difference without a difference, because at the level of set theory there is no difference—in both cases, the set of apples in question has an unspecified positive cardinality. (Verkuyl 1993, sects. 4.3, 6.3) is clearly a bit troubled by this problem, but his ultimate appeal (on my reading) is to a difference in *representations*, a move that is strikingly incongruous with his

analyses, e.g., the one proposed in (Zucchi and White 2001), on which they are not cumulative.

[2] Since quantized and cumulative reference form contraries and not contradictories, a predicate may be neither quantized nor cumulative.

[3] On the assumption that the minimal elements are sums consisting of two apples, just replace *at least one apple* in (5a) with *at least two apples*.

[4] Note that if the *semantics* of *three apples* is really 'at least three apples', as is sometimes assumed (with the sense of 'exactly' derived as an implicature), then *three apples* would really be cumulative and not quantized. In this case, *three apples* and comparable noun phrases with a numeral would not be so 'well-behaved' and would pose basically the same problem as the object noun phrases in (2a)–(2d).

otherwise strict model-theoretic regimen.[5]

A New Analysis: Alternatives for Determiners The leading idea behind the new analysis is that the exact determiner chosen in constructing a verb phrase should not necessarily affect the 'quantized character' of the verb phrase as long as there is an alternative in the focus semantic value of the determiner that entails it and that would have yielded a quantized verb phrase. Here, 'alternative' and 'focus semantic value' are used as in alternative semantics for focus, as described in (Rooth 1992). It is this consideration of alternatives that distinguishes the present approach from the purely extensional approaches to aspectual composition advocated by Krifka and Verkuyl.

To set the stage informally, recall the sentence in (2a) with the object noun phrase *at least three apples*. Granting that this noun phrase is cumulative (hence not quantized), then it follows that the verb phrase is also cumulative. However, since the *in*-phrase is acceptable, we need to account for what distinguishes this case from the one in (5b), where the *in*-phrase is not acceptable even though the bare plural *apples* is cumulative as well. Adopting the speaker's perspective, the crucial choice is whether or not to use a determiner to express information about cardinality (or more generally, about quantity). If a determiner is used, then the (positive) choice is to express information about cardinality; if no determiner is used, then the (negative) choice is not to. But even if the choice is positive, the speaker may or may not know the precise cardinality of the set in question, and even if she knows it, in a given context it may not be relevant for her to express it precisely. However, the vital point is that the aspectual value of the verb phrase *should not depend on* whether or not the speaker is able to or decides to express the precise cardinality as long as she chooses to express information about cardinality in the first place. Thus, in choosing *at least three apples* in (2a), the speaker opts to use a determiner to express information about cardinality, but she might well have chosen *(exactly) four apples* had she known the precise cardinality and had it been relevant for her to express it.

In what follows, I will sketch the implementation of the new analysis in an event semantic framework similar in spirit to Krifka's. The first step is to assign determiners a much more prominent role than they play in his approach. In an event semantics, determiners are of the type $\langle\langle e,t\rangle,\langle\langle e,\langle\varepsilon,t\rangle\rangle,\langle\varepsilon,t\rangle\rangle\rangle$, where e is the type of ordinary individuals and ε is the type of events. The determiner applies first to a predicate P of ordinary individuals and then to a relation R between events and ordinary individuals, yielding an event predicate, e.g.:

(6) a. a(n) $\rightsquigarrow \lambda P\lambda R\lambda e[\exists x[R(e,x)\wedge P(x)\wedge |x|=1]]$
b. (exactly) three $\rightsquigarrow \lambda P\lambda R\lambda e[\exists x[R(e,x)\wedge P(x)\wedge |x|=3]]$
c. at least three $\rightsquigarrow \lambda P\lambda R\lambda e[\exists x[R(e,x)\wedge P(x)\wedge |x|\geq 3]]$
d. at most three $\rightsquigarrow \lambda P\lambda R\lambda e[\exists x[R(e,x)\wedge P(x)\wedge |x|\leq 3]]$

The second step is to define notions of quantized and cumulative reference for de-

[5] Unfortunately, due to the lack of space, I cannot review the various proposals in (Krifka 1998; Zucchi and White 2001; Rothstein 2004; Borer 2005) for this difficulty, but I hope to do so on another occasion.

terminers, because the ones in (3) and (4) are not directly applicable to determiners. The notion of quantized reference for determiners is *quantized**, a predicate of (the meanings of) determiners $\mathscr{D}$:

(7) $\mathsf{QUA}^*(\mathscr{D}) \stackrel{\text{def}}{=} \forall e \forall R \forall P \forall x [$
$\mathscr{D}(e,R,P) \wedge \mathsf{GRAD}(R) \wedge \neg \mathsf{ITER}(e,x,R) \wedge \mathsf{SUM}(R) \wedge \mathsf{CUM}(P) \rightarrow$
$\mathsf{QUA}(\lambda e'[\mathscr{D}(e',R,P)])]$ ($\mathscr{D}$ is quantized*)

A determiner $\mathscr{D}$ is quantized* just in case for every e, R, P, and x the following holds: if $\mathscr{D}$ applies to e, R, and P, R is *gradual* (GRAD), not *iterative* (ITER) with respect to e and x, and *summative* (SUM), and P is cumulative, then the event predicate resulting from the application of $\mathscr{D}$ to R and P is quantized. Less formally, $\mathscr{D}$ is quantized* just in case it yields a quantized event predicate when applied to a gradual relation R that is summative but not iterative and a cumulative nominal predicate P.[6] The notions of graduality, iterativity, and summativity are taken from (Krifka 1992, pp. 42, 40, 39) and characterize two-place relations between events and incremental patients that are summative but such that no part of the patient is affected more than once. In (6), the determiners *a(n)* and *(exactly) three* are quantized* but *at least three* is not.

The corresponding notion of cumulative reference for determiners (*cumulative**) is defined as follows:

(8) $\mathsf{CUM}^*(\mathscr{D}) \stackrel{\text{def}}{=} \exists e \exists R \exists P \exists e' [\mathscr{D}(e,R,P) \wedge \mathscr{D}(e',R,P) \wedge \neg(e = e')] \wedge$
$\forall e \forall R \forall P [(\mathscr{D}(e,R,P) \wedge \mathsf{SUM}(R) \wedge \mathsf{CUM}(P)) \rightarrow \mathsf{CUM}(\lambda e'[\mathscr{D}(e',R,P)])]$
($\mathscr{D}$ is cumulative*)

A determiner $\mathscr{D}$ is cumulative* just in case there are at least two events e and e' in its extension and for every e, R, and P the following holds: if $\mathscr{D}$ applies to e, R, and P, R is summative, and P is cumulative, then the event predicate resulting from the application of $\mathscr{D}$ to R and P is cumulative. In (6), *at least three* is cumulative*, whereas *a(n)* and *(exactly) three* are not. Observe that if a determiner is cumulative*, then it is not quantized*, but that a determiner may also be neither cumulative* nor quantized* (e.g., *at most three* in (6d)).

If a determiner δ is focused (with a syntactic representation as $[_{\mathrm{D}}\ \delta]^{\mathrm{f}}$), then its focus semantic value is the (typically contextually restricted) set of alternatives of the same type as its ordinary semantic value and from which its ordinary semantic value is drawn. If δ is focused and its ordinary semantic value is represented by $\mathscr{D}$, then let's designate its focus semantic value by $\mathsf{ALT}(\mathscr{D})$, where ALT is a function that maps $\mathscr{D}$ to the set of its alternatives. In this case, a natural subset of $\mathsf{ALT}(\mathscr{D})$ is the one consisting of those alternatives $\mathscr{D}'$ that entail $\mathscr{D}$:

(9) $\mathsf{ALT}_{\subseteq}(\mathscr{D}) \stackrel{\text{def}}{=} \{\mathscr{D}' | \mathscr{D}' \in \mathsf{ALT}(\mathscr{D}) \wedge \mathscr{D}' \subseteq \mathscr{D}\}$
(the set of alternatives of $\mathscr{D}$ that entail $\mathscr{D}$)

[6] The idea is that the nominal predicates P are all cumulative and it is the determiner that adds the information about cardinality. Similarly, the verbal relations R are all taken to be summative (summativity is simply cumulativity for two-place relations).

For example, if *at least three* is focused, then the set of its alternatives that entail it include *(exactly) four* and *at least five* but not *(exactly) two* or *less than three* even though the latter two are included in the set of its alternatives. Note that if a determiner δ is not focused and its ordinary semantic value is represented by $\mathscr{D}$, then its focus semantic value is simply the singleton consisting of its ordinary semantic value, namely, $\{\mathscr{D}\}$.

The next step is to introduce a notion of quantized reference for determiners that is sensitive to their alternatives. A determiner $\mathscr{D}$ is *f-quantized** just in case there is an alternative in the set of its alternatives that entail it which is quantized*:

(10) $\textsf{F-QUA}^*(\mathscr{D}) \stackrel{\text{def}}{=} \exists \mathscr{D}'[\mathscr{D}' \in \textsf{ALT}_{\subseteq}(\mathscr{D}) \wedge \textsf{QUA}^*(\mathscr{D}')]$ ($\mathscr{D}$ is f-quantized*)

Clearly, if $\mathscr{D}$ is quantized*, then it is f-quantized*, even if its syntactic correspondent is not focused (in which case $\mathscr{D}$ is the sole element of $\textsf{ALT}_{\subseteq}(\mathscr{D})$). However, the converse does not hold, because $\mathscr{D}$ may be f-quantized* without being quantized*, provided that its syntactic correspondent is focused. For example, if *at least three* is focused, then it is f-quantized* but not quantized*—indeed, it is cumulative* whether focused or not. In fact, all of the other 'problematic' determiners in (2) are similarly f-quantized* if focused but not quantized*.

The following definition provides a corresponding notion of f-quantized reference for one-place predicates P:

(11) $\textsf{F-QUA}(P) \stackrel{\text{def}}{=} \exists P'[P' \in \textsf{ALT}_{\subseteq}(P) \wedge \textsf{QUA}(P')]$ (P is f-quantized)

A predicate P is f-quantized just in case there is an alternative in the set of its alternatives that entail it which is quantized. For example, the verb phrase *eat* $[_{\text{D}}$ *at least three*$]^{\text{f}}$ *apples*, although not quantized is f-quantized, precisely because $[_{\text{D}}$ *at least three*$]^{\text{f}}$ is f-quantized*.

We can now finally state the selectional requirement of *in*-adverbials:

(12) An *in*-adverbial selects for a verb phrase that is represented by an event predicate which is f-quantized.

Let's consider how this requirement accounts for the data in (1), (2), and (5). Since the verb phrases in (1) are all quantized (due to the fact that the respective determiners are quantized*), they are perforce f-quantized and no appeal to focus is necessary. In contrast, since none of the verb phrases in (2) or (5a) are quantized (due to the fact that none of the respective determiners are quantized*), the only way for them to be f-quantized is for the respective determiners to be f-quantized*, which means that the determiners have to be focused. Indeed, the natural way of uttering the sentences in (2) and (5a) (especially in conjunction with the *in*-adverbials) is with an intonational focus on the respective determiners.

This analysis has the nice consequence that if the noun phrase lacks a determiner (or at least an overt determiner), as in the case of bare plurals (e.g., *apples* in (5b)), then there is no determiner to focus and so only the contribution of the bare (cumulative) noun phrase can be considered, which yields a cumulative verb phrase.

A similar consequence holds for languages with an overt determiner that cannot be focused, e.g., French *des*, as in *des pommes* 'apples'. Since *des* is cumulative* (assuming that we want to interpret *des*), it would need to be focused in order to be f-quantized*, but since it cannot be focused, it cannot be f-quantized*, and thus it contributes to a verb phrase that is cumulative and not f-quantized. This correctly predicts that such verb phrases will be incompatible with *en*-adverbials (the French equivalent of *in*-adverbials), as seen in (13a) (cf. (5b)). In constrast, the determiner *quelque* 'some', although cumulative* as well, can nevertheless be focused and hence f-quantized*, which would predictably contribute to a verb phrase that is f-quantized (despite being cumulative), thereby satisfying the requirement of *en*-adverbials, as shown in (13b) (cf. (2c)).

(13) a. #Juliette a mangé des pommes en dix minutes.
Juliette has eaten ∅ apples in ten minutes
b. Juliette a mangé quelques pommes en dix minutes.
Juliette has eaten some apples in ten minutes

In sum, in its appeal to alternatives for determiners, the new analysis aims to capture the intuition that the 'problematic' determiners in (2) are merely less precise ways of expressing information about cardinality that could have been made more precise, and that the aspectual value of the verb phrase (in terms of f-quantized reference) is not necessarily affected by whether a less or more precise determiner is chosen.[7]

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