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TWIGS, SEQUENCES AND THE TEMPORAL CONSTITUTION OF PREDICATES*

1. INTRODUCTION

Several accounts of aspectual composition, like Dowty's (1979), Hinrichs's (1985), Krifka's (1986, 1989, 1992), and Moltmann's (1991), converge on the idea that the contrast in acceptability between (1) and (2)

(1) John drank wine for an hour

(2) ??John drank a bottle of wine for an hour

is somehow to be related to properties of the predicates *drink wine* and *drink a bottle of wine* which, in event talk, may be stated as follows: an event of drinking wine may have a proper part which is also an event of drinking wine, but an event of drinking a bottle of wine cannot have a proper part which is an event of drinking a bottle of wine. In Krifka's account, these properties are described by saying that the predicate *drink a bottle of wine*, unlike the predicate *drink wine*, is *quantized*.[1]

The fact that several accounts converge on the same idea may be taken as an indication of the fruitfulness of the idea in explaining the phenomena that are being investigated. Yet, as we will show, the claim that contrast (1)–(2) is related to the fact that the predicate *drink a bottle of wine*, unlike the predicate *drink wine*, is quantized runs into some problems concerning indefinite NPs like *a sequence*, *a twig*, *a quantity of N*, and *some Ns*.

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[1] The accounts proposed by Moltmann, Hinrichs and Krifka agree that contrast (1)–(2) is related to these properties, but differ on how the restriction of *for*-adverbs to non-quantized predicates is to be derived. Krifka simply assumes that such a restriction is a condition of applicability of *for*-adverbs, while Moltmann and Hinrichs derive it from their quantificational nature. In Dowty's account, events play no part, but, as Moltmann shows, a reformulation of his account in a Davidsonian framework would have these properties as consequences.

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One possible reaction to these problems is to give up the idea that (1)–(2) have anything to do with quantization. This is not what we propose to do here. The aim of this paper is to present the problems and to explore some strategies to solve them, *while holding on to the idea that quantization is at stake in (1)–(2)*. Our discussion will be couched in the event framework proposed by Krifka to account for aspectual composition, but we will argue that the problems we raise, as well as the solutions we propose, can be stated for other accounts as well, in particular for quantificational analyses of *for*-adverbs.

In Sections 2–3, we present Krifka's analysis of the influence of different NP kinds on aspect and we raise some problems for this analysis regarding the treatment of indefinite NPs of the forms *an N* and *some Ns*. In Section 4, we argue that the same problems also arise for quantificational analyses of *for*-adverbs. Section 5 discusses a first attempt to avoid the problems, an attempt that we argue to be inadequate. Section 6 presents an account that we regard as a viable solution to the problems posed by indefinites of forms *an N* and *some Ns*. We call this *the Kamp-Heim account*, as it is based on the Kamp-Heim analysis of indefinites. In Section 7, we raise more problems for current analyses of aspectual composition, concerning NPs of the forms *most Ns, less than half of the Ns, more than one quarter of the Ns*, etc. On these problems, the account in 6 has little to say. We suggest that they can be solved by introducing what we call *maximal participants* into the NP interpretations. This technique may either be used to supplement the account in 6 or it may be developed to produce an alternative account of the data treated in 6, as we do in 8. Thus, we end up with two possible analyses of the quantizing effects of different NP-types. On one analysis, the Kamp-Heim account of indefinites explains the quantizing effects of *an N* and *some Ns* and the behavior of quantificational NPs of forms *most Ns, less than half of the Ns*, etc. is explained *via* maximal participants. The other analysis uses maximal participants throughout (we reserve the name *maximal participants account* for this second option). We should say at the outset that we will not try to choose between these analyses. If the Kamp-Heim account of indefinites is correct, we should not necessarily expect uniformity in dealing with the quantizing effects of indefinites and the quantizing effects of quantifiers like *most Ns*, etc. Thus, given the present state of the field, both the mixed analysis and the uniform one seem to us to be viable accounts of the quantizing effects of NPs. We sum up the main results and consequences of our investigation in Section 9.

2. KRIFKA ON ASPECTUAL COMPOSITION

Krifka (1986, 1989, 1992) has proposed an explicit model-theoretic account of the influence of the reference types of NPs (mass nouns, count nouns, plurals, etc.) on the temporal constitution of verbal predicates (activities, accomplishments and achievements). This influence is illustrated by the fact that, while the sentences in (4) are perfectly natural, the sentences in (3) are not acceptable, unless they are understood iteratively:

(3)a. ??John found a flea for ten minutes
b. ??John wrote a letter for an hour
(4)a. John found fleas for an hour
b. John drank milk for an hour
c. John wrote letters for an hour

Krifka's account is based on the following assumptions. The domain of entities contains both objects and events. An entity may be combined with another entity to form their join (the model structure of individual objects and events is a lattice, as in Link (1983)). Once the domain of entities is structured in this way, we can define the notion 'quantized predicate' as follows:

$$\forall P[QUA(P) \leftrightarrow \forall x \forall y[(P(x) \wedge P(y)) \rightarrow \neg y \subset x]]$$

[a predicate P has quantized reference iff no P-entity can be a proper part of a P-entity]

Krifka's claim is that the distribution of *for*-adverbs follows from Assumption 1:

A1. The domain of application of *for*-adverbs is restricted to non-quantized event predicates.

In order to derive facts (3)–(4) from this assumption, one needs to provide a compositional semantics by which *find a flea* and *write a letter*, unlike *find fleas*, *drink milk* and *write letters*, turn out to be quantized. To see how this task is accomplished by Krifka, let's consider some of the translations given in Krifka (1992) for different NP types and different predicate types:

$$\text{write}_{[subj,ag][obj,pat]} \rightarrow \lambda e[write'(e)]$$
$$\text{find}_{[subj,ag][obj,pat]} \rightarrow \lambda e[find'(e)]$$
$$\text{drink}_{[subj,ag][obj,pat]} \rightarrow \lambda e[drink'(e)]$$
$$\text{push}_{[subj,ag][obj,pat]} \rightarrow \lambda e[push'(e)]$$

a $\text{letter}_{[obj,pat]} \rightarrow \lambda P \lambda e \exists x[P(e) \wedge Pat(e,x) \wedge letter'(x)]$

a $\text{cart}_{[obj,pat]} \rightarrow \lambda P \lambda e \exists x[P(e) \wedge Pat(e,x) \wedge cart'(x)]$

$\text{milk}_{[obj,pat]} \rightarrow \lambda P \lambda e \exists x[P(e) \wedge Pat(e,x) \wedge milk'(x)]$

$\text{letters}_{[obj,pat]} \rightarrow \lambda P \lambda e \exists x[P(e) \wedge Pat(e,x) \wedge letters'(x)]$

write a letter $\rightarrow \lambda e \exists x[write'(e) \wedge Pat(e,x) \wedge letter'(x)]$

drink milk $\rightarrow \lambda e \exists x[drink'(e) \wedge Pat(e,x) \wedge milk'(x)]$

write letters $\rightarrow \lambda e \exists x[write'(e) \wedge Pat(e,x) \wedge letters'(x)]$

push a cart $\rightarrow \lambda e \exists x[push'(e) \wedge Pat(e,x) \wedge cart'(x)]$

The different behavior of predicates like *write a letter*, *drink milk*, *write letters* and *push a cart* with respect to durational adverbs is expected once we assume that the predicates of the translation language meet the following properties (we differ from Krifka (1992) in stating mapping to objects only for non-iterative predicates):

QUA($letter'$)

¬ QUA($letters'$)

¬ QUA($milk'$)

Mapping to Objects for non-iterative predicates (applied to $drink'$ and $write'$):[2]

$\forall e \forall e' \forall x[(write'(e) \wedge Pat(e,x) \wedge e' \subset e) \rightarrow$
$\exists x'[x' \subset x \wedge Pat(e',x')]]$

$\forall e \forall e' \forall x[(drink'(e) \wedge Pat(e,x) \wedge e' \subset e) \rightarrow$
$\exists x'[x' \subset x \wedge Pat(e',x')]]$

[If x is the patient of a writing/drinking event e and e' is a proper part of e, there is a proper part x' of x that is the patient of e']

Uniqueness of Objects (applied to drink' and write'):

$\forall e \forall x \forall x'[(write'(e) \wedge Pat(e,x) \wedge Pat(e,x')) \rightarrow x = x']$

$\forall e \forall x \forall x'[(drink'(e) \wedge Pat(e,x) \wedge Pat(e,x')) \rightarrow x = x']$

[If x is the patient of a writing/drinking event e and so is x', x is the same as x']

An immediate consequence of these assumptions is this:

C1. The predicate *write a letter* is quantized.

[2] In Krifka (1998), this property is called mapping to subobjects.

To see why this consequence holds, consider the following reasoning. If *write a letter* is not quantized, there are two events e and e' that are both in the denotation of this predicate and $e' \subset e$. Since e and e' are in the denotation of *write a letter*, there is an x that is a letter (i.e., x is in the denotation of $letter'$) and e is a writing event that has x as a patient and there is a y that is a letter and e' is a writing event that has y as a patient. As the patient role of $write'$ has the property of mapping to objects and $e' \subset e$, there must be an x' such that $x' \subset x$ and $Pat(e', x')$. Given that it is not possible for the same writing event to have two different patients (uniqueness of objects), $x' = y$. Thus, y is a letter and x is a letter and $y \subset x$. But this contradicts the hypothesis that $letter'$ is quantized. In other words, given that $write'$ meets both uniqueness of objects and mapping to objects, if e is an event of writing a letter, a proper part of e must be an event of writing part of a letter. As *letter'* is quantized, a letter part can't be a letter. So, no proper part of an event of writing a letter can be an event of writing a letter. Thus, *write a letter* is quantized. More generally, assuming that count nouns are quantized, Krifka can prove consequence C2 [by Th. 10, Krifka (1992)]:

C2. A non-iterative event predicate V whose object role R has the properties of mapping to objects and uniqueness of objects yields a quantized predicate when combined with an object of the form *a(n) N*.

Notice that, in this theory, predicates like *write letters* and *push a cart* are not predicted to be quantized, which leads us to expect that they should be able to occur with *for*-adverbs. The reason why *write letters* doesn't turn out to be quantized is that the predicate $letters'$ is not quantized, and thus a proper part of an event of writing letters may still be an event of writing letters. The reason why *push a cart* is not predicted to be quantized is that *push* lacks mapping to objects for non-iterative predicates (a proper part of an event of pushing a cart may still be an event of pushing the whole cart).

3. Some Problems for Krifka

3.1. *The Puzzle of Twigs, Sequences and Quantities of Milk*

Krifka's assumption that count nouns are quantized, on which consequence C2 is based, is problematic with nominal predicates like *sequence*, *twig* and *quantity of milk*. This fact was originally pointed out by B. Partee (p.c. to Krifka) and by Mittwoch (1988: fn. 24). For example, the sequence of numbers 1,2,3,4,5 is a proper part of the sequence of numbers

1,2,3,4,5,6,7,8,9,10. Thus 1,2,3,4,5,6,7,8,9,10 is a sequence that has a proper part which is also a sequence. A similar case can be constructed for the NPs *a twig* and *a quantity of milk*: if x is a twig, x may have a proper part which is also a twig and if x is a quantity of milk, x may have a proper part which is also a quantity of milk. Thus, the NPs *a sequence*, *a twig* and *a quantity of milk* should not introduce quantized predicates in the logical representation. Yet, the predicates *write a sequence*, *find a twig* and *drink a quantity of milk* are no better than *write a letter* with *for*-adverbs:

(3)b. ??John wrote a letter for an hour

(5) ??John wrote a sequence for ten minutes

(6) ??John found a twig for ten minutes

(7) ??John drank a quantity of milk for an hour

3.1.1. *The Hard Line Approach*

A radical reaction to the puzzle of the twigs is this: we should simply give up the assumption that sequences, twigs and quantities of milk may have proper parts that are sequences, twigs and quantities of milk. As this view seems to avoid the problem at the cost of giving up a natural intuition, it must be supported with some argument showing that this intuition should be abandoned. One such argument was suggested by M. Krifka at the sixth meeting of SALT.

Suppose a student is given a test and that this test requires that he write a sequence with a certain property P. For example, the test might require the student to write a sequence of prime numbers. Now, suppose that the student writes a sequence *s* which lacks P, although a proper part of *s* meets P. For example, he writes 2,3,5,7,10,11, which is not a sequence of prime numbers, although it contains the sequence of prime numbers 2,3,5,7 as a proper part. In this case, the instructor will conclude that the student did not pass the test and will give him an F. This shows that the proper parts of a sequence are not themselves sequences, otherwise the student could claim that he passed the test because a part of *s* meets P.

While we agree with the instructor that the student failed the test in the case described above, we think, however, that the argument fails to establish that the proper parts of a sequence can’t be themselves sequences. Even if the sequence the student writes as an answer to the test consists of smaller sequences, there are perfectly good reasons for the instructor to disregard these subsequences in evaluating the answer. In order to make sure that the student does not give the right answer accidentally, a test of this type presupposes that there is a convention by which the instructor can single out the sequence the student means as the answer to the test.

A reasonable convention in this case is that the sequence meant as an answer is the maximal sequence that the student writes. This convention is reasonable, since it assumes that the student will not give irrelevant information in answering the test; after all, any convention that singles out the relevant sequence as a subsequence of the sequence written by the student would assume that the student will give irrelevant information in answering the test. So, the assumption that the sequence the student writes consists of smaller sequences is consistent with the behavior of the instructor. In other words, a theory that takes seriously the intuition that an event of writing a sequence may have proper parts that are also events of writing a sequence can also account for the intuition that the student failed the test. We conclude that Krifka's example fails to support the hard line view.

3.1.2. *The Material Part Approach*

In his (1989) paper, Krifka sketches another solution to the puzzle of the twigs based on Link's (1983) idea that in the domain of objects we must distinguish between the domain of individuals and the domain of quantities of matter that make up these individuals. This distinction is independently motivated by the following type of reasoning. Brancusi's egg is a marble sculpture Brancusi did in 1924. If this egg and the marble of which it is made are the same thing, we should expect (8) below to be a contradiction, as it is impossible for the same thing to be both P and not-P. On the other hand, if the egg and the marble are distinct entities, the fact that (8) is non-contradictory is expected.

(8) Brancusi's egg came into existence in 1924, but the marble of which the egg is made didn't come into existence in 1924.

The distinction between individuals and quantities of matter comes with a distinction between two part-of relations: the part-of relation between individuals $\subseteq_I$ and the part relation between quantities of matter $\subseteq_Q$. Moreover, individuals and quantities of matter are related in Link's theory by a function h that associates to each individual the quantity of matter that makes it up. Having introduced these distinctions, we may restate the notion 'quantized predicate' in this way (where I is the domain of individuals and Q the domain of quantities of matter):

$$\forall P[QUA(P) \leftrightarrow \forall x(P(x) \rightarrow x \in I) \wedge \forall x \forall y[(P(x) \wedge P(y)) \rightarrow \neg y \subset_I x)]]$$

[a predicate P has quantized reference iff P is a predicate of individuals and no P-object can be a proper individual part of a P-object]

We may now claim that the predicate *is a sequence* is quantized in the sense that, if x is a sequence, no y such that $y \subset_I x$ is a sequence (i.e., no individual part of x is itself a sequence). However, a sequence may have other sequences as proper parts in the sense that it may happen that x is a sequence, y is a sequence and $h(y) \subset_Q h(x)$ (i.e., the matter that makes up y is part, relative to the part-of relation between quantities of matter, of the matter that makes up x). The same solution may also apply to the nominal predicates *twig* and *quantity of milk*, if we assume that they are both predicates of individuals.

Notice that this way out of the sequence puzzle is different from the one proposed in the hard line approach. The hard line approach calls into question the idea that a proper part of a sequence (however we understand the notion part) can be itself a sequence. This approach does not dispute that the first four numbers of a sequence of six numbers may also be a sequence. It denies instead that the first four numbers are an individual part of the sequence of six numbers (it claims that they are a material part). This is compatible with assuming that the first four numbers are also a sequence.[3]

Thus, Krifka's way out allows us to keep the view that *is a sequence*, *is a twig* and *is a quantity of milk* are quantized, while allowing for a sense in which a sequence, a twig and a quantity of milk may have proper parts that are also sequences, twigs and quantities of milk. But, as White (1994) has observed, this solution to the sequence problem leaves a question open (which is not addressed by Krifka). How do we do justice to the intuition that events of writing a sequence, finding a twig, drinking a quantity of milk may have proper parts that are also events of writing a sequence, finding a twig and drinking a quantity of milk? Suppose John drank a quantity of milk, let's call this event e. The first half of the quantity of milk he drank is also a quantity of milk. Let e' be the part of e in which John drinks the first half of the quantity of milk. Then, e and e' stand in the proper part relation and they are both events of drinking a quantity of milk. If this is true, however, the predicate *drink a quantity of milk* is not quantized. Yet, it's unacceptable with *for*-adverbs.

3.2. *More Irritating Exceptions and the Puzzle of Some*

Even conceding that nouns like *sequence* and *twig* are problematic for Krifka's analysis, one might wonder how general a problem they pose.

3 Indeed, in sketching the material part approach, Krifka (1989:87) says this about twigs (the same observation is also meant to apply to sequences): "... consider a twig x_1 which contains another twig x_2 as a part. This relation can be captured by claiming that x_2 is a material part of x_1 and x_2 is not an individual part of x_1."

Do these nouns really indicate that there is something amiss with Krifka's account of the quantizing effect of NPs of the form *an N* or are they simply irritating, isolated lexical exceptions? Perhaps, one might dismiss these cases by claiming that, as count nouns are quantized by and large, nouns like *sequence* and *twig* are not prototypical instances of count nouns. One might suggest that the behavior of count nouns with temporal *for*-adverbs depends on the inferences that we draw from the prototypical members of the class of count nouns, and thus nouns like *sequence* and *twig* may be ignored.

Complex nouns of the form *quantity of N* show, however, that we are not facing few isolated exceptions, as we can generate lots of non quantized complex count nouns of this form. Moreover, even if we restrict our attention to lexical nouns, the exceptions are less isolated than it might seem. To name a few more, a segment may be part of another segment, an arc may be part of another arc, a bush may have a part that is a bush, a rock may be part of another rock, a cavity may be part of a larger cavity, a chamber may be part of another chamber. More non-quantized complex count nouns can also be found: a chunk of something may be part of another chunk of the same thing, and a part of something may be part of a part of the same thing. The reader that gets the hang of it may find more examples. As some of these non-quantized count nouns are commonly used, the idea of basing the prototypicality of a count noun on whether it is quantized or not is doubtful.

Finally, the trouble with indefinites for Krifka's account doesn't end with NPs with the determiner *a*. Another problem for Krifka is posed by contrast (9)–(10):[4]

(9) ??John found some fleas on his dog for an hour

(10) John found fleas on his dog for an hour

Intuitively, an event of finding some fleas may have proper parts that are also events of finding some fleas. Suppose, for example, that John finds ten fleas one after the other. The event of finding these ten fleas is an event of finding some fleas that has other events of finding some fleas as proper parts. Yet, (9) contrasts in acceptability with (10). According to Krifka, NPs like *a flea* introduce quantized predicates in the translation, since the predicate $flea'$ is assumed to apply to individuals that consist of just one flea. However, it's implausible to assume that *some fleas* fixes the

[4] M. Krifka informs us that this problem was also raised in conversation by F. Landman around 1990.

cardinality of the plural individuals that occur in the denotation of *fleas*. So, how does Krifka account for contrast (9)–(10)?

4. THE PUZZLES AND THE QUANTIFICATIONAL ANALYSIS OF *for*-ADVERBS

Before we proceed to examine some ways of dealing with these puzzles, let's ask another question: are these cases only problematic for Krifka's theory or do they pose a problem also for other accounts of temporal *for*-adverbs? The answer is that they pose a problem for other theories as well, in particular for the quantificational analysis of *for*-adverbs proposed in Dowty (1979) and Moltmann (1991).

Dowty (1979) proposed the following translation rule for temporal *for*:

$$\text{for} \Rightarrow \lambda P_t \lambda P \lambda x[P_t\{n\} \wedge \forall t[t \subseteq n \rightarrow AT(t, P\{x\})]]$$

In the case of sentence (11), this analysis yields the following translation:

(11) John ran for an hour

$$[_S \text{ John ran for an hour}] \Rightarrow$$
$$\exists t_1[PAST(t_1) \wedge an - hour'(t_1) \wedge$$
$$\forall t_2[t_2 \subseteq t_1 \rightarrow AT(t_2, run'(j))]]$$

This translation says that (11) is true if there is a past one hour interval such that John runs at every subinterval of that interval. As Dowty points out, the universal quantification over subintervals of the interval measured by the adverb must be restricted to a contextually given set of relevant subintervals. Indeed, if we required that, in order for (11) to be true, John must run at literally every subinterval of a past one-hour period, we would predict (11) to be false, since no running event can occur at instantaneous intervals. As different activities may involve minimal subintervals of different sizes to be performed, we need to assume that the universal quantification in the translation of durational *for* is implicitly restricted to subintervals of the appropriate size. This problem is known as the *minimal parts problem*.

An event-based version of this analysis that makes this contextual restriction explicit is given in Moltmann (1991):

$$[_S \text{ John ran for an hour}] \Rightarrow$$
$$\exists t(an - hour'(t) \wedge \forall t'(t'Pt \rightarrow$$
$$\exists e(run'(e, John) \wedge at(e, t') \wedge past(t))))$$

This translation says that (11) is true if there is a past one hour interval such that at every relevant part of this interval there is an event of John's running. As the interpretation of the relevant part relation P is contextually determined, the choice of the relevant subintervals may be made according to the type of events under consideration, thus allowing for the possibility that intervals that are too small are disregarded.[5]

Moltmann claims that the restriction of *for*-adverbs to non-quantized event predicates, as far as this restriction actually holds, may be derived from the quantificational analysis in this way.[6] Consider sentences (3b) and (4c) again:

(3)b. ??John wrote a letter for an hour

(4)c. John wrote letters for an hour

In Moltmann's analysis these sentences are translated as follows:

$$\begin{array}{l}\text{John wrote a letter for an hour} \Rightarrow \\ \exists t(an - hour'(t) \wedge \forall t'(t'Pt \rightarrow \\ \exists e \exists x(write'(e, x, John) \wedge letter'(x) \wedge at(e, t') \wedge past(t))))\end{array}$$

$$\begin{array}{l}\text{John wrote letters for an hour} \Rightarrow \\ \exists t(an - hour'(t) \wedge \forall t'(t'Pt \rightarrow \\ \exists e \exists x(write'(e, x, John) \wedge letters'(x) \wedge at(e, t') \wedge past(t))))\end{array}$$

Consider the translation of (3b) first. For this translation to be true there must be some past one-hour interval i such that the formula

$$\exists e \exists x(write'(e, x, John) \wedge letter'(x) \wedge at(e, t'))$$

is true for every assignment that maps t' on a relevant subinterval of i. Under the plausible assumption that the set of relevant subintervals of i contains also proper subintervals of i, this formula must be true relative to at least two assignments g and g' such that $g(t') = i$ and $g'(t') = i'$, where $i' \subset i$. This means that the following conditions must be met: (a) there is an event e of John's writing a letter occurring at the interval i and (b) there

[5] Since Moltmann does not tell us much about what *relevant* parts are, it is unclear to what extent her formulation actually solves the minimal parts problem. We will return to this issue in Section 7.

[6] More precisely, Moltmann claims that the quantificational analysis of *for*-adverbs explains their restriction to predicates that have both cumulative reference and divisive reference. A predicate P has cumulative reference iff the sum of two P-entities is still a P-entity. A predicate P has divisive reference iff every relevant part of an event in the denotation of P is also in the denotation of P. For predicates whose denotation includes non-atomic events, the property of being non-quantized follows from the property of being divisive (given a suitable choice of the relevant part relation).

is an event e_1 of John's writing a letter occurring at the interval $i' \subset i$. However, as the predicate

$$\lambda e \exists x (write'(e, x, John) \wedge letter'(x))$$

is quantized, no proper part of an event of writing a letter can be an event of writing a letter. Thus, the existence of an event e of John's writing a letter occurring at a one-hour interval i does not guarantee that condition (b) is met. This leads us to the correct prediction that (3b) cannot mean simply that there is a one-hour long event of John's writing a letter. This problem does not arise for (4c), since the predicate

$$\lambda e \exists x (write'(e, x, John) \wedge letters'(x))$$

is not quantized, thus the existence of an event of John's writing letters occurring at a one-hour interval i does not preclude there being subevents of John's writing letters occurring at all relevant intervals subintervals i' of i.

In her paper Moltmann argues, moreover, that temporal *for*-adverbs are best treated as universal quantifiers over time intervals rather than as predicates of events, as Krifka analyzes them. We will not try to address this issue here.[7] It is our concern, however, to show that our puzzles do not simply pose problems for Krifka's account, but for the quantificational analysis of *for*-adverbs as well. In Moltmann's analysis, sentences (5) and (9) may be translated as follows:

(5) ??John wrote a sequence for ten minutes

(9) ??John found some fleas on his dog for an hour

John wrote a sequence for ten minutes $\Rightarrow$
$$\exists t (10 - minutes'(t) \wedge \forall t'(t' P t \rightarrow \exists e \exists x (write'(e, x, John) \wedge sequence'(x) \wedge at(e, t') \wedge past(t))))$$

John found some fleas on his dog for an hour $\Rightarrow$
$$\exists t (an - hour'(t) \wedge \forall t'(t' P t \rightarrow \exists e \exists x (find'(e, x, John) \wedge fleas'(x) \wedge on'(John's - dog', x) \wedge at(e, t') \wedge past(t))))$$

As the predicates

$$\lambda e \exists x (write'(e, x, John) \wedge sequence'(x))$$

$$\lambda e \exists x (find'(e, x, John) \wedge fleas'(x) \wedge on'(John's - dog', x))$$

[7] See Moltmann's paper for discussion.

are not quantized, by Moltmann's reasoning we should expect (5) and (9) to be acceptable on a par with (4c), but they are no better than (3b).

(3)b. ??John wrote a letter for an hour

(4)c. John wrote letters for an hour

A similar objection may also be raised for Dowty's account. Indeed, if sentence (9) is assigned the translation below,

$$[_S \text{ John found some fleas on his dog for an hour}] \Rightarrow$$
$$\exists t_1[PAST(t_1) \wedge an - hour'(t_1) \wedge \forall t_2[t_2 \subseteq t_1 \rightarrow AT(t_2,$$
$$\exists x(fleas'(x) \wedge find'(x, John) \wedge on'(John's - dog'(x))]]$$

we should expect (9) to be acceptable for the same reason that (11) is acceptable,

(11) John ran for an hour

since a one hour interval of John's finding some fleas on his dog may properly include intervals at which John also finds some fleas on his dog. The same reasoning holds for (5).

5. A SCOPE ACCOUNT

In view of the discussion in Section 3, it's clear that we cannot derive the quantizing effect of NPs of the form *an N* and *some Ns* from the assumption that count nouns are quantized. This assumption is incorrect in the case of nouns like *sequence* and it does not apply to plural nouns in NPs of the form *some Ns*.[8] But then, why are (3b), (5) and (9) awkward?

(3)b. ??John wrote a letter for an hour

(5) ??John wrote a sequence for ten minutes

(9) ??John found some fleas on his dog for an hour

A possible answer is that *for*-adverbs are forced to take narrow scope with respect to the object NP. In this case, the event predicates to which the *for*-adverb applies in (3b), (5) and (9) are predicates of forms (i)–(ii):[9]

[8] Notice that we are not claiming here that these NPs are non-quantized, we are simply claiming that their quantizing effect cannot be derived from the quantized nature of the noun.

[9] If we adopt Krifka's view that verbs are one-place predicates of events, the translation of *John wrote a letter for an hour* would be derived as follows in Krifka's framework:

(i) $\lambda e[write'(e) \wedge Pat(e, x)]$

(ii) $\lambda e[find'(e) \wedge Pat(e, x)]$

While an event of writing a sequence, unlike an event of writing a letter, may have an event of writing a sequence as a proper part, no proper part of an event of writing a particular object x, be it a sequence or a letter, can be an event of writing x. Assuming that the definition of quantized predicate requires us to keep the assignment fixed and that *for*-adverbs require the predicates they combine with to be non-quantized in this sense, we are led to expect that (3b), (5) and (9) should be anomalous, as the predicates (i)–(ii) are quantized. The required definition of quantized predicate may be stated in this way (where individuals include events besides ordinary individuals):

(Q) QUA(P) iff for every model M, assignment g, and individual a, b, if $\|P\|_{M,g}(a) = 1$ and $\|P\|_{M,g}(b) = 1$, then a is not a proper part of b.

How is the acceptability of (4c) explained in this account?

(4)c. John wrote letters for an hour

Let's assume that in deriving the translation of (4c) the *for*-adverb applies to a predicate of form (iii), where the patient of the event is a kind, as proposed in Carlson (1977):[10]

(iii) $\lambda e[write'(e) \wedge Pat(e, x^k)]$

If the predicate *wrote letters* expresses a relation to kinds, it's also plausible to assume that the predicates *write'* and *letters'* meet principles (a)–(b)

write$_{[subj,ag][obj,pat]} \Rightarrow \lambda e[write'(e)]$

a letter$_{[obj,pat]} \Rightarrow \lambda P \lambda e \exists x[P(x)(e) \wedge Pat(e, x) \wedge letter'(x)]$

write it$_i \Rightarrow \lambda e[write'(e) \wedge Pat(e, x_i)]$

write it$_i$ for an hour $\Rightarrow \lambda e[write'(e) \wedge Pat(e, x_i) \wedge 1-hour(e)]$

write a letter for an hour $\Rightarrow \lambda P \lambda e \exists x[P(x)(e) \wedge Pat(e, x) \wedge letter'(x)]$ $(\lambda x_i \lambda e[write'(e) \wedge Pat(e, x_i) \wedge 1-hour(e)])$ (by quantifying in)

write a letter for an hour $\Rightarrow \lambda e \exists x[write'(e) \wedge Pat(e, x) \wedge 1-hour(e) \wedge Pat(e, x) \wedge letter'(x)]$ (by λ-conversion)

[10] The idea of using Carlson's theory to account for the behavior of *for*-adverbs with accomplishment/achievement predicates with bare plural arguments was suggested in Dowty (1979) and further pursued in Hinrichs (1985) and White (1994). We discuss in more detail our commitment to the kind-based analysis of bare plurals in 9.

below, where x is a variable ranging over individuals, x^k a variable ranging over kinds, letters^k denotes the kind letters and R denotes the realization relation that holds between kinds and their individual instances:

(a) $\forall e \forall x^k [write'(e) \rightarrow (Patient(e, x^k) \leftrightarrow \exists x (R(x, x^k) \wedge Patient(e, x)))]$

[if e is a writing event, then kind x^k is a patient of e just in case there is an individual realizing x^k which is the patient of e]

(b) $\forall x [letters'(x) \leftrightarrow R(x, letters^k)]$

[x is a collection of letters just in case x realizes the kind letters]

From these principles, it follows that predicate (iii), namely the predicate to which the *for*-adverb applies in (4c), is not quantized. Indeed, suppose that e_1 is a writing event whose patient is the collection of letters l_1, l_2 and l_3, and that e_2 is a writing event whose patient is the collection of letters l_1 and l_2. In this case, e_2 is a proper part of e_1 and $l_1 + l_2$ is a proper part of $l_1 + l_2 + l_3$. Thus,

(c) i. $write'(e_1)$
ii. $write'(e_2)$
iii. $letters'(l_1 + l_2 + l_3)$
iv. $letters'(l_1 + l_2)$
v. $Patient(e_1, l_1 + l_2 + l_3)$
vi. $Patient(e_2, l_1 + l_2)$
vii. $e_2 \subset e_1$
viii. $l_1 + l_2 \subset l_1 + l_2 + l_3$

By (b), it follows from (c)iii–iv that the two collections of letters realize the kind letters, namely

(d) $R(l_1 + l_2 + l_3, letters^k) \wedge R(l_1 + l_2, letters^k)$

By (a) and (c)i-ii, it follows that

(e) i. $Patient(e_1, letters^k) \leftrightarrow \exists x (R(x, letters^k) \wedge Patient(e_1, x))$
ii. $Patient(e_2, letters^k) \leftrightarrow \exists x (R(x, letters^k) \wedge Patient(e_2, x))$

Given (c)v-vi and (d), it follows from (e) that

(f) $Patient(e_1, letters^k) \wedge Patient(e_2, letters^k)$

Given (c)i–ii, vii, it follows from (f) that the predicate in (iii) is not quantized,

(g) $\neg QUA(\lambda e[write'(e) \wedge Pat(e, x^k)])$

which leads us to expect that (4c) should be acceptable.

(4)c. John wrote letters for an hour

This account also leads us to expect contrast (12), as the object NP in (12a), unlike the object NPs in (12b)–(12c), lacks a kind reading (example (12c) is from Verkuyl (1993)):[11]

(12)a. *John drank the whole bottle of beer for ten minutes
b. John drank the beer that Bill recommended for hours (before admitting that he hated it)
c. Bill sold this *(type of) vase for years

5.1. *Problems*

At first blush, this account runs into two types of problems. One problem is that it raises the following question: why should *for*-adverbs always take narrow scope with respect to quantifiers? This question doesn't show that the account is wrong, but it certainly calls for an answer. If we do not explain why the narrow scope readings are excluded, we don't have much of an account. The other problem is that there is evidence that quantifiers do occur in the scope of *for*-adverbs. Consider sentence (13a):

(13)a. John wrote no letters for a year

If *no letters* in (13a) must take wide scope with respect to the *for*-adverb, (13a) should only have the following anomalous reading: no letters are such that John wrote them for a year. In fact, (13a) is acceptable and means that at no time during a year period did John write letters.

[11] An anonymous referee observes that further evidence for the idea that *letters* in (4c) denotes a kind instead of being simply a predicate of plural entities comes from the acceptability of (i):

(i) I'm very discouraged. I wrote letters of recommendation all morning, and I only got one done.

We'd like to agree with the judgement on (i), but, as we are not sure, we'll leave this issue open. Some further possible evidence that *letters* in (4c) denotes a kind instead of being simply a predicate of plural entities is discussed in Hinrichs (1985, pp. 295–301).

It may be objected that the problem posed by *no* disappears if, as it has been suggested in some recent work on negative concord,[12] the determiner *no* is not to be interpreted locally, but it identifies a negation higher up in the tree. Following this view, we might suppose that *no letter* in (13a) has the same meaning as the NP *letters* and *no* is simply a syntactic indicator of a higher negation operator. If this is correct, the acceptability of (13a) is to be explained on a par with the acceptability of (14) (where *not* should be understood in the scope of the *for*-adverb):

(13)a. John wrote no letters for a year

(14) John didn't write letters for an hour

Under the account of bare plurals we sketched, the acceptability of (14) is consistent with the assumption that the object NP *letters* has wide scope with respect to the *for*-adverb. In this case, (14) is expected to mean that the kind letters is such that for a year John didn't write any instance of it, which accounts for the interpretation of (14) correctly.[13]

The negative concord analysis assumed to reconcile (13a) with the scope account, however, has some problems of its own. For example, how does this analysis deal with cases like (15)?

(15) John wrote three postcards and no letters

It would seem that the analysis predicts that this sentence should have a reading synonymous with (16), which is incorrect.

(16) John didn't write three postcards and letters

But, even if we adopt a negative concord analysis of (13a), there is independent evidence that indefinites must also be allowed in the scope of *for*-adverbs. The sentences in (17) provide evidence to this effect:

(17)a. John pushed a cart every day for a year

b. John found a flea on his dog every day for a year

Sentence (17a) allows for a reading according to which for every day, there is a cart John pushed that day (possibly, a different cart each day) and this daily pushing went on for a year. However, if indefinite NPs must take

[12] See Ladusaw (1992), for example.

[13] To see how negation can be dealt with consistently with the treatment of *for*-adverbs assumed here, see Krifka's semantics for negation reported in Section 6.2.1 of this paper.

wide scope with respect to *for*-adverbs, we should only expect a reading that says that John pushed the same cart every day for a year.

5.2. *A Pragmatic Story*

A possible reaction to these *prima facie* problems for the scope account is that they only show that our formulation of the account is problematic. Our initial version assumes that *for*-adverbs are always forced to take narrow scope with respect to the object NP. In this 'strong' version, we have seen that the theory is not tenable, since it is not clear why the grammar should be unable to generate readings in which NPs occur in the scope of *for*-adverbs, and, moreover, there is evidence that some NPs are capable of taking narrow scope with respect to these adverbs. M. Krifka (p.c.) suggested to us that there is another version of the scope account, based on pragmatic considerations, that may be immune to these objections. Let's discuss this alternative version.

First of all, let's suppose that the grammar allows quantifiers and *for*-adverbs to take scope freely with respect to each other. Even if this is true, one might claim that there are still good reasons why (5), (3a) and (18), unlike (17), should be anomalous:

(17)a. John pushed a cart every day for a year
b. John found a flea on his dog every day for a year

(5) ??John wrote a sequence for ten minutes
(3)a. ??John found a flea for ten minutes
(18) ??John found three fleas on his dog for an hour

Here's why. Suppose that, as Dowty and Moltmann suggest, the *for*-adverb expresses a contextually-restricted universal quantification over parts of an interval. If the object NP in these sentences is given wide scope with respect to the *for*-adverb, this proposal leads us to expect an anomalous reading, since John is required to write the same sequence, find the same flea or group of three fleas at an interval and also at a proper part of it. But there is an equally good reason why the narrow scope reading of the object NP should also be anomalous. In this reading, sentences (5), (3a) and (18) would mean something like this: for every contextually relevant part t' of a past one hour interval t, John writes a sequence/finds a flea/finds three fleas at t'. However, as the size of t' is undetermined (we quantify over large parts, small parts, etc.), it is unmotivated to specify a particular number of fleas or sequences. This pragmatic consideration would thus predict that the narrow scope readings of (5), (3a) and (18) should be anomalous.[14] On the other hand, in the case of (17), the size of the parts over which the *for*-adverb quantifies is determined by the adverb of quantification *every day*, thus the pragmatic consideration blocking the narrow scope reading of the object NP in (5), (3a) and (18) would not apply here. As a consequence, the quantified NP in object position can take narrow scope with respect to the *for*-adverb and sentence (17b), like sentence (17a), is expected to be acceptable (since it may be true at a one year interval and also at proper parts of that interval that John finds a flea on his dog every day).

In the case of (9), however, something else needs to be said. Indeed, the pragmatic considerations blocking the narrow scope readings of the object NPs in (5), (3a) and (18) do not apply here, as *some fleas* does not specify a particular number:

(9) ??John found some fleas on his dog for an hour

Krifka's suggestion is the following. English has a specialized form to express the reading of (9) in which *some fleas* has narrow scope with respect to the *for*-adverb, namely sentence (10):

(10) John found fleas on his dog for an hour

As (10) conveys the narrow scope reading of the NP object in (9), the use of (9) instead of (10) is taken to indicate that the object NP in (9) has wide scope. Thus, (9) is correctly predicted to be odd. It follows that a scope account supplemented with the pragmatic considerations presented here would correctly predict the patterning of *for*-adverbs with indefinites of the forms *an N* and *some Ns* while avoiding the objections raised in 5.1.

While a pragmatic account of this sort may be desirable, as it would dispose of the puzzles we raised for the available analyses of the distribution of *for*-adverbs, the account runs into problems with the proposed treatment of indefinite NPs of the form *some Ns*:

(9) ??John found some fleas on his dog for an hour

By the logic of Krifka's reasoning, the presence of a specialized form for the narrow scope reading of a quantifier should force the quantifier to take wide scope with respect to the *for*-adverb, even if the wide scope

[14] As we understand it, if this claim is correct, it would also provide an additional reason to reject the wide scope reading of the object in (5), (3a) and (18). But this is irrelevant for the purpose of the account, since this reading is also anomalous for independent reasons.

reading is anomalous. However, there is evidence that quantifier scope is not determined in this way. Consider, for instance, sentence (19):

(19) Every guest ate some muffins

By the logic of Krifka's reasoning, (19) should only have the odd reading that every guest ate the same muffins. We should expect this, since we have a specialized form to convey the narrow scope reading of (19), namely sentence (20), and thus the use of (19) in place of (20) should be taken as an indication that the object NP *some muffins* in (19) is to be given wide scope with respect to the universal quantifier.

(20) Every guest ate muffins

But this is false: sentence (19) is wholly appropriate to assert, and indeed naturally understood as saying, that every guest ate muffins. The pairs (21) and (22) provide other cases in which the existence of specialized forms to convey narrow scope readings of the existential quantifier, like the ones attested in (b), fails to block the narrow scope readings of the existential quantifier in the (a)-forms:

(21)a. John gave some muffins to every guest
b. John gave muffins to every guest

(22)a. John drove some golf balls past every distance marker
b. John drove golf balls past every distance marker

These facts indicate that English is quite flexible in allowing narrow scope readings of quantifiers for sentences in which both scopes are possible, although the language may have a more specialized way to express these narrow scope readings. In particular, cases like (19), (21a) and (22a) show that, despite the presence of specialized structures that express the narrow scope readings of the existential quantifier, these readings of (19), (21a) and (22a) are selected anyhow since they are more plausible. We conclude that the pragmatic version of the scope account presented here is not adequate, as it brings us back to one of the two puzzles that originally motivated the search for an alternative account to the one proposed in Krifka (1989).

6. A KAMP–HEIM ACCOUNT

6.1. *The Kamp-Heim Analysis of Indefinites and the Sequence Problem*

The outcome of the discussion in the previous section may be summarized in this way. We have seen some data showing that indefinite NPs are allowed in the scope of *for*-adverbs (the data in (17)). As we lack good reasons to assume that the object NPs are forced to take wide scope with respect to *for*-adverbs in (5) and (9), we conclude that an account of (5) and (9) must allow indefinites to be interpreted *in situ*.

(5) ??John wrote a sequence for ten minutes

(9) ??John found some fleas on his dog for an hour

In this section, we present a solution to the problem posed by (5) and (9) based on the Kamp-Heim analysis of indefinites. In this account, indefinite NPs are allowed to stay in the scope of *for*-adverbs, but the free variables they introduce are bound from the outside.

Let's come back to the case of the predicate *write a sequence*. If the predicate can be translated as in (i′) below, we are back to the sequence problem.

(i′) write a sequence $\Rightarrow \lambda e \exists x[write'(e) \wedge Pat(e,x) \wedge sequence'(x)]$

If the existential quantifier introduced by the indefinite *a sequence* is outside the scope of the *for*-adverb, then the predicate to which the *for*-adverb applies is (i) and (i) can plausibly be assumed to be quantized once we require that the variable assignment be kept fixed in checking for quantization.

(i) write $t_i \Rightarrow \lambda e[write'(e) \wedge Pat(e,x_i)]$

However, the presence of the existential quantifier in translation (i′) prevents us precisely from keeping the sequence fixed in checking whether *write a sequence* is quantized. By the definition of quantized predicate in (Q), the result of allowing translation (i′) is that *write a sequence* is not quantized. Indeed, if e is an event of writing 1,2,3,4,5 and e' is the part of e in which the sequence 1,2,3 is written, then $\|\lambda e \exists x[write'(e) \wedge Pat(e,x) \wedge sequence'(x)]\|_{M,g}(e) = 1$ and $\|\lambda e \exists x[write'(e) \wedge Pat(e,x) \wedge sequence'(x)]\|_{M,g}(e') = 1$, and e' is a proper part of e.

A way out of this dilemma is possible if we turn to a Kamp-Heim account of the semantics of indefinite NPs. According to the analysis of NPs of the form *an N* and *some Ns* proposed in Heim (1982) and Kamp (1981), these NPs do not have inherent existential force; instead they introduce free variables (discourse referents) in the translation language and these variables get bound *via* closure rules. This approach to the semantics of indefinites naturally predicts the fact that (5)–(7) are odd, while allowing for the relative scope of NPs and *for*-adverbs to be free.

(5) ??John wrote a sequence for ten minutes
(6) ??John found a twig for ten minutes
(7) ??John drank a quantity of milk for an hour

We can illustrate how this works by assuming the translation rules below for NPs of forms *an N* and *some Ns*, which reflect the view that these NPs are not inherently quantificational (we are departing from Krifka in assuming that verbs denote relations between events and individuals). It should be emphasized that, while these rules allow us to describe this approach by staying close to Krifka's notation, the same story can be told in other formulations of the Kamp-Heim analysis, like, for example, those proposed in Asher (1993) and Muskens (1996).

T_{an} $[_{NP}$ a(n) $[_{N'}\ \alpha]] \Rightarrow \lambda P \lambda e[P(z)(e) \wedge \alpha'(z)]$

$\mathrm{T}_{some_{pl}}$ $[_{NP}$ some$_{pl}$ $[_{N'}\ \alpha]] \Rightarrow \lambda P \lambda e[P(Z)(e) \wedge \alpha'(Z)]$

Example:
sequence$_N \Rightarrow \lambda x[sequence'(x)]$
$[_{\mathrm{NP}}$ a sequence$] \Rightarrow \lambda P \lambda e[P(z)(e) \wedge sequence'(z)]$ by T_{an}

Let's now assume the following VP-translation rule for VPs containing transitive verbs:

$\mathrm{T}_{VP[tr]}$ $[_{VP}\ [_V\ \alpha\ ]\ [_{NP}\ \beta\ ]] \Rightarrow \lambda y[\beta'(\lambda x[\alpha'(x)(y)])]$

Example:

write$_V \Rightarrow \lambda x \lambda y \lambda e[write'(e) \wedge Ag(e, y) \wedge Pat(e, x)]$

find$_V \Rightarrow \lambda x \lambda y \lambda e[find'(e) \wedge Ag(e, y) \wedge Pat(e, x)]$

drink$_V \Rightarrow \lambda x \lambda y \lambda e[drink'(e) \wedge Ag(e, y) \wedge Pat(e, x)]$

$[_{VP}$ write a sequence$] \Rightarrow \lambda y \lambda e[write'(e) \wedge Ag(e, y) \wedge Pat(e, z) \wedge sequence'(z)]$ by $\mathrm{T}_{VP[tr]}$

Derivation:

$[_{VP}$ write a sequence$] \Rightarrow \lambda y[\lambda P \lambda e[P(z)(e) \wedge sequence'(z)]$
$(\lambda x[\lambda x \lambda y \lambda e[write'(e) \wedge Ag(e, y) \wedge Pat(e, x)](x)(y)])]$
by $\mathrm{T}_{VP[tr]}$

$\Rightarrow \lambda y[\lambda P \lambda e[P(z)(e) \wedge sequence'(z)](\lambda x \lambda e[write'(e) \wedge Ag(e, y) \wedge Pat(e, x)])]$ by λ-conv.

$\Rightarrow \lambda y[\lambda e[\lambda x \lambda e[write'(e) \wedge Ag(e, y) \wedge Pat(e, x)](z)(e) \wedge sequence'(z)]]$ by λ-conv.

$\Rightarrow \lambda y \lambda e[write'(e) \wedge Ag(e, y) \wedge Pat(e, z) \wedge sequence'(z)]$ by λ-conv.

The sentence *John write a sequence* is thus translated in this way:

$[_S$ John write a sequence$] \Rightarrow \lambda e[write'(e) \wedge Ag(e, John') \wedge Pat(e, z) \wedge sequence'(z)]$

Let's assume that phrases like *an hour* denote properties of intervals and that τ denotes a function that assigns to each event *e* the interval *e* takes up. The translation rule for (S-level) *for*-adverbs may now be stated as follows:

for $\alpha \Rightarrow \lambda P \lambda e[P(e) \wedge \alpha'(\tau(e))]/\neg QUA(P)$

The well-formedness condition after / indicates that the function denoted by the *for*-adverb applies only to non-quantized event predicates. The result of combining the *for*-adverb with the translation of *John write a sequence* is now this:

$[_S$ John write a sequence for ten minutes$] \Rightarrow \lambda e[write'(e) \wedge Ag(e, John') \wedge Pat(e, z) \wedge sequence'(z) \wedge 10 - minutes(\tau(e))]$

Finally, as a consequence of applying existential closure, we get the following translation:

John write a sequence for ten minutes $\Rightarrow \exists z \exists e[write'(e) \wedge Ag(e, John') \wedge Pat(e, z) \wedge sequence'(z) \wedge 10 - minutes(\tau(e))]$

The penultimate step in this derivation is the illegitimate one. Given the definition of quantized predicate in (Q),

(Q) QUA(P) iff for every model M, assignment g, and individual a, b, if $\|P\|_{M,g}(a) = 1$ and $\|P\|_{M,g}(b) = 1$, then a is not a proper part of b.

the event predicate to which the *for*-adverb applies in this step is quantized, thus the *for*-adverb should not be able to combine with it. (The predicate $\lambda e[write'(e) \wedge Ag(e, John') \wedge Pat(e, z) \wedge sequence'(z)]$ is quantized as, for any assignment g, no event a which is an event of John's writing the sequence assigned by g to z can have as a proper part an event b of writing the same sequence.)

Given the translation we assumed for plural NPs of the form *some N* the same account can also be given for (9). On the other hand, the following translation rules for the bare plural NP *letters* and the mass NP *milk* together with lexical principles (a)–(b) predict that no such problem should arise in the derivation of *John wrote letters for an hour* and *John drank milk for an hour*:[15]

$[_{NP}$ milk$] \Rightarrow \lambda P \lambda e[P(e)(milk^k)]$

$[_{NP}$ letters$] \Rightarrow \lambda P \lambda e[P(e)(letters^k)]$

(a) $\forall e \forall x^k[write'(e) \rightarrow (Patient(e, x^k) \leftrightarrow \exists x(R(x, x^k) \wedge Patient(e, x)))]$

[if e is a writing event, then kind x^k is a patient of e just in case there is an individual realizing x^k which is the patient of e]

(b) $\forall x[letters'/milk'(x) \leftrightarrow R(x, letters^k/milk^k)]$

[x is a collection of letters/a quantity of milk just in case x realizes the kind letters/milk]

Before we proceed, let's pause to make two comments on this account. The account is compatible with the assumption that nouns like *sequence* and predicates of plural individuals like *fleas* in *some fleas* are non-quantized. This fits with our intuitions about sequences and with the semantics which is usually assumed for predicates of plural entities. On the other hand, according to this account, by combining indefinite NPs of the forms *an N* and *some Ns* with predicates like *write* or *find* we obtain quantized predicates (thus accounting for the fact that predicates like *write a sequence* and *find some fleas* are anomalous with *for*-adverbs). The key to obtain this result is the fact that, according to the Kamp-Heim analysis of indefinites, these NPs, even if they are interpreted *in situ*, fail to introduce an existential quantifier in the scope of *for*-adverbs. As a consequence, the underlying predicates to which *for*-adverbs apply when they combine with *write a sequence* and *find some fleas* are predicates like *the property of being an event of x's writing sequence z* and *the property of being an event of x's finding group of fleas y*.[16] And, these predicates *are* quantized, since,

[15] This account of the aspectual effect of bare plurals and mass terms is thus still based on Carlson's theory, as outlined in Section 5 above.

[16] An anonymous referee objects that an obvious problem for this approach is that it doesn't seem to allow for the sloppy reading of (i):

(i) Mary wrote a sequence and Jane did too

Assuming that the predicate copied in this reading is the following although sequences and groups of fleas may have proper parts that are sequences and groups of fleas, an event of writing a particular sequence cannot have as a proper part an event of writing the same sequence and an event of finding a particular group of fleas cannot have as a proper part an event of finding that group of fleas.

The second observation is that, while the account proposed here assumes Krifka's semantics of *for*-adverbs, it does not crucially depend on it and can also be adopted in the quantificational analysis. Assuming that the free variable introduced by the indefinite gets bound after the application of the *for*-adverb, the DRT approach we described, applied to a Moltmann-style analysis of *for*-adverbs, yields the following translations for (5) and (9) (prior to the application of existential closure):

John wrote a sequence for ten minutes $\Rightarrow$
$\exists t(10 - minutes'(t) \wedge \forall t'(t'Pt \rightarrow$
$\exists e(write'(e, x, John) \wedge sequence'(x) \wedge at(e, t') \wedge past(t))))$

John found some fleas on his dog for an hour $\Rightarrow$
$\exists t(an - hour'(t) \wedge \forall t'(t'Pt \rightarrow$
$\exists e(find'(e, x, John) \wedge fleas'(x) \wedge on'(John's - dog', x) \wedge$
$at(e, t') \wedge past(t))))$

These translations require that, in evaluating *John write a sequence* and *John find some fleas* at different subintervals of a past one hour interval, we keep the sequence and the group of fleas fixed. This correctly predicts that (5) and (9) cannot be verified by parts of the same event of writing a sequence and by parts of the same event of finding some fleas.

$$\lambda e[write'(e) \wedge Ag(e, John') \wedge Pat(e, z) \wedge sequence'(z)]$$

it is predicted that Mary and Jane must write the same sequence, which is incorrect. A possible way to avoid this problem that comes to mind is that, in the case of the sloppy reading, the predicate in the translation of *Mary did too* contains a different variable with respect to the one introduced in the translation of the first clause (see Hardt (1999) for a treatment along these lines). In any case, it should be noticed that the problem of how the sloppy readings of sentences like (i) are to be derived in the Kamp-Heim analysis of indefinites arises independently of the problem posed by sequences and of issues of quantization, since one can ask the same question about sentences like (ii):

(ii) John pushed a cart and Mary did too

For this reason, we think that the issue raised by (i) should be addressed in developing a Kamp-Heim account of VP-anaphora, a task which is outside the scope of this paper.

6.2. *Some Extensions*

In Section 5.1, we introduced the data in (17b) and (13a):

(17)b. John found a flea on his dog every day for a year

(13)a. John wrote no letters for a year

Both types of data were claimed to be problematic for the version of the scope account presented in 5.[17] How can we account for these facts in the Kamp-Heim approach we outlined? We take up this task in the next two sections.

6.2.1. *The Case of no*

Krifka gives no analysis of *no*, but his analysis of negation can be adapted to this quantifier to provide an account of (13a). Krifka defines the notions maximal event and maximal event at a time t in this way:

$$\forall e \forall t[MXT(e,t) \leftrightarrow e = FU(\lambda e[\tau(e) \subseteq t])]$$

[a maximal event at a time t is the fusion of all events that occur at subintervals of t]

$$\forall e[MXE(e) \leftrightarrow \exists t[e = FU(\lambda e[\tau(e) \subseteq t])]]$$

[a maximal event is the fusion of all events that occur at subintervals of some interval]

Negation is then translated as follows:

do not $\Rightarrow \lambda P \lambda e[MXE(e) \wedge \neg\exists e'[P(e') \wedge e' \subseteq e]]$

The way this rule works is illustrated by the following example:

John did not arrive (ignoring tense) $\Rightarrow$
$\lambda e[MXE(e) \wedge \neg\exists e'[arrive'(e') \wedge Ag(e', j) \wedge e' \subseteq e]]$

[an event of John's not arriving is an e such that, for some time t, e is the fusion of all events that occur at subintervals of t and e does not contain an event of John's arriving as a part]

A consequence of this way of translating negation is that negated event predicates are not quantized and thus *for*-adverbs are correctly licensed with them:

(13)b. ??John arrived for three hours

c. John did not arrive for three hours

[17] However, as it was shown in 5.2, sentence (13a) is no longer a problem for this account under a negative concord analysis of *no*. The treatment we present here is based instead on the assumption that *no* is a negative quantifier.

Intuitively, the reason why this consequence holds is that, if e is the fusion of all events temporally included in some interval and e does not contain any event of John's arriving, any proper part of e which is the fusion of all events temporally included in a subinterval of the interval at which e occurs will also fail to include events of John's arriving.

Although Krifka does not discuss the quantifier *no*, a similar analysis may be extended to this quantifier to ensure that *write no letters* is not quantized. Here's how the relevant translation rule should be formulated:

T_{no}. $[_{NP}$ no $[_{N'}\ \alpha]] \Rightarrow \lambda P \lambda e[MXE(e) \wedge \neg\exists e'\exists z[P(z)(e') \wedge \alpha'(z) \wedge e' \subseteq e]]$

Example:

$[_{NP}$ no $[_{N'}$ letters$]] \Rightarrow \lambda P \lambda e[MXE(e) \wedge \neg\exists e'\exists z[P(z)(e') \wedge letters'(z) \wedge e' \subseteq e]]$ by T_{no}

$[_{VP}$ write no letters$] \Rightarrow \lambda y[\lambda P \lambda e[MXE(e) \wedge \neg\exists e'\exists z[P(z)(e') \wedge letters'(z) \wedge e' \subseteq e]](\lambda x[\lambda x \lambda y \lambda e[write'(e) \wedge Ag(e, y) \wedge Pat(e, x)](x)(y)])]$ by $T_{VP[tr]}$

$\Rightarrow \lambda y[\lambda P \lambda e[MXE(e) \wedge \neg\exists e'\exists z[P(z)(e') \wedge letters'(z) \wedge e' \subseteq e]] (\lambda x \lambda e\ [write'(e) \wedge Ag(e, y) \wedge Pat(e, x)])]$ by λ-conv.

$\Rightarrow \lambda y[\lambda e[MXE(e) \wedge \neg\exists e'\exists z[\lambda x \lambda e[write'(e) \wedge Ag(e, y) \wedge Pat(e, x)](z)\ (e') \wedge letters'(z) \wedge e' \subseteq e]]]$ by λ-conv.

$\Rightarrow \lambda y \lambda e[MXE(e) \wedge \neg\exists e'\exists z[write'(e') \wedge Ag(e', y) \wedge Pat(e', z) \wedge letters'(z) \wedge e' \subseteq e]]$ by λ-conv.

This translation predicts correctly that *for*-adverbs should be acceptable with the predicate *write no letters*, since, when the quantified NP *no letters* is in the scope of the *for*-adverb, the predicate to which the adverb applies is not quantized.[18]

6.2.2. *The Aspectual Effect of Frequency Adverbs*

Sentence (17b) shows that frequency adverbs can combine with quantized event predicates and yield non-quantized event predicates:

(17)b. ??John found a flea on his dog every day for a year

[18] An anonymous referee objects to our use of the word 'quantifier' here and claims that, in our analysis, *no letter* is no quantifier. Our reason to classify *no* as a quantifier in this analysis is that it introduces a negative existential quantifier over letters in the translation. Indefinite NPs like *a letter* or *some letters* in the Kamp-Heim account are not quantificational in this sense since they introduce no quantifier over letters in the translation.

In the approach we are pursuing, this result can be achieved in this way. Let's assume that frequency adverbs may carry syntactic indices $j, \ldots, k$ and that the translation of *every day* is specified as follows:

$$[_{NP_{j,\ldots,k}} \text{every day}] \Rightarrow \lambda P \lambda e[MXE(e) \wedge \forall t[(day'(t) \wedge t \subseteq \tau(e)) \rightarrow \exists e', v_j, \ldots, v_k[\tau(e') \subseteq t \wedge P(e') \wedge e' \subseteq e]]]$$

By combining this frequency adverb with the translation of *John find a flea*,

$$[_S \text{ John find a flea}] \Rightarrow \lambda e[find'(e) \wedge Ag(e, John') \wedge Pat(e, x_i) \wedge flea'(x_i)]$$

the following translation is generated for the sentence *John find a flea every day*:

$$\text{John find a flea}_i \text{ every day}_i \Rightarrow \lambda e[MXE(e) \wedge \forall t[(day'(t) \wedge t \subseteq \tau(e)) \rightarrow \exists e', x_i[\tau(e') \subseteq t \wedge find(e') \wedge Ag(e', John') \wedge Pat(e', x_i) \wedge flea'(x_i) \wedge e' \subseteq e]]]$$

[*e* is an event of John's finding a flea every day iff *e* meets (i)–(ii): (i) *e* is the fusion of all events temporally included in some interval, (ii) for every day *t* temporally included in *e* there is an event e' of John's finding a flea which is temporally included in *t* and is part of *e*]

This analysis of frequency adverbs predicts that the predicate *is an event of John's finding a flea every day* is not quantized. Indeed, suppose that *t* is a month-long interval such that every day in *t* John finds a flea on his dog. Let t' be a proper subinterval of *t* that contains only ten days. Then, the fusion of all events temporally included in *t* and the fusion of all events temporally included in t' meet conditions (i)–(ii) above. Thus, both these fusions are in the denotation of the predicate *is an event of John's finding a flea every day* and they stand in the proper part relation. Thus, this predicate is not quantized and we should expect the *for*-adverb in (17a) to be acceptable.[19]

[19] Since the translation of the atemporal sentence *John find a flea every day* is a predicate of events, an anonymous reviewer asks how (i) can be accommodated:

(i) John found a flea every day last week

One possibility is this. The tense node introduces a λ-abstraction over a reference time that is available for modification by time adverbs like *last week* and this reference time ends up being existentially quantified over by the same rule of existential closure responsible for existentially binding the event variable. Here's how the tense rule can be formulated:

$$[_{TP[past]} \text{ S}] \Rightarrow \lambda e \lambda t_r[t_r < now \wedge \tau(e) \subseteq t_r \wedge S'(e)]$$

7. MORE PUZZLES AND SOLUTIONS

In Section 3, we presented some puzzles for Krifka's account of the quantizing effects of indefinite NPs of the form *an N* and *some Ns*. We have now seen a way of deriving this effect based on the Kamp-Heim analysis of indefinites. But there are also other NP types whose quantizing effect is problematic for Krifka's account (and, in general for accounts based on a standard semantics for these NP types) and for which the Kamp-Heim analysis of indefinites seems to be of little help. In the next section, we take up the case of the determiner *most* and we present an account of its quantizing effect with accomplishment-achievement predicates.

7.1. *The Problem of* most

The quantifier *most* yields quantized predicates when it combines with accomplishment/achievement verbs:[20]

(23)a. ??John found most of the fleas for an hour
b. John found most of the fleas in an hour

Since NPs like *most fleas* are inherently quantificational in the Kamp-Heim analysis, they do not introduce free variables, and thus we cannot extend to (23) the account suggested for (5)–(7). But then, how do we derive the fact that the VPs in (23) are quantized?

Krifka (1989) proposes the following analysis of *most*. Let's define the function max in this way:

> the function max maps a relation between numbers and entities to the highest number for which the relation holds

The translation of *most fleas* may now be stated thus:

John found a flea every day $\Rightarrow \lambda e \lambda t_r[t_r < now \wedge \tau(e) \subseteq t_r \wedge [MXE(e) \wedge \forall t[(day'(t) \wedge t \subseteq \tau(e)) \rightarrow \exists e', x_i[\tau(e') \subseteq t \wedge find'(e') \wedge Ag(e', John') \wedge Pat(e', x_i) \wedge flea'(x_i) \wedge e' \subseteq e]]]]$

[20] G. Carlson pointed out to us that there is a contrast between (23b) and (i) (which we had noticed too):

(23)b. John found most of the fleas in an hour

(i) ??John found most fleas in an hour

We don't know how to account for this fact. As it doesn't seem to affect our point, we'll ignore it.

most fleas$_{[obj,pat]}$ $\Rightarrow \lambda P \lambda e[MXE(e) \wedge max(\lambda n \lambda x \exists e'[P(e') \wedge flea'(x,n) \wedge Pat(x,e') \wedge e' \subseteq e]) > 1/2max(\lambda n \lambda x[flea'(x,n)])]$

find most fleas $\Rightarrow \lambda e[MXE(e) \wedge max(\lambda n \lambda x \exists e'[find'(e') \wedge flea'(x,n) \wedge Pat(x,e') \wedge e' \subseteq e]) > 1/2max(\lambda n \lambda x[flea'(x,n)])]$

According to this translation, an event e is an event of finding most fleas iff e meets these conditions:

(i) e is the fusion of all events included in some interval;

(ii) the number of found fleas in e is greater than one half the number of fleas.

The problem with this analysis is that it fails to predict that *find most fleas* is quantized. Suppose that there are only ten fleas and that during the interval i John found nine fleas, while during the interval $i' \subset i$ he found seven fleas. Now, consider the fusion e of all events temporally included in i and the fusion e' of all events temporally included in i'. Presumably, $e' \subset e$. But in both e and e' the number of found fleas is greater than one half the number of fleas. Thus, both e and e' are in the denotation of *find most fleas*. Thus, Krifka's interpretation of *most* does not guarantee that *find most fleas* is quantized. Yet, (23a) is anomalous (barring iterative readings).

M. Rooth observed at the 6th meeting of SALT that the problem raised by *most*, rather than pointing at an inadequacy of Krifka's translation of *most*, may indicate instead that the assumption that *for*-adverbs apply to non-quantized predicates is insufficient to account for their distribution. For example, the problem posed by *most* for Krifka would disappear if we imposed a stricter condition on the domain of application of *for*-adverbs:

A2. A predicate P can combine with *for*-adverbs if some event in the denotation of P is the sum of two disjoint events that are also in the denotation of P.

As no event of finding most fleas can be the sum of two disjoint events of finding most fleas, the predicate *find most fleas* is correctly predicted to be unacceptable with *for*-adverbs by this condition. However, notice that, while restating the condition on the domain of applicability of *for*-adverbs may help in accounting for the behavior of certain NP-types, the condition just mentioned, besides failing to account for predicates like *write some letters* (which seems to meet A2 and yet is odd with *for*-adverbs), also fails to account for the behavior of proportional quantifiers other than *most*, like for example the quantifier *less than half*. Indeed, the predicate *find less than half of the fleas* seems to meet A2, although (23c) is anomalous:[21]

(23)c. ??John found less than half of the fleas for an hour

Furthermore, while A2 would resolve the problem posed by *most*, it would fail with variations such as *more than one quarter*, as distinct subevents of finding one third of the fleas would satisfy *find more than one quarter of the fleas*, as would the whole event of finding two thirds of the fleas. While one might consider ways of generalizing A2, we do not consider it obvious how to do so without running into the minimal parts problem. For these reasons, we will go on assuming that the problem posed by the behavior of proportional quantifiers with *for*-adverbs calls for restating the interpretations of these quantifiers rather than the condition on the domain of applicability of *for*-adverbs.

We could make sure that *find most fleas* is quantized by using Krifka's relation *maximal event at a time t* (MXT) in place of the relation MXE in the translation of *most*:

$$\text{most fleas}_{[obj,pat]} \Rightarrow \lambda P\lambda e[MXT(e,t) \wedge max(\lambda n\lambda x\exists e'[P(e') \wedge flea'(x,n) \wedge Pat(x,e') \wedge e' \subseteq e]) > 1/2max(\lambda n\lambda x[flea'(x,n)])]$$

In this case, *find most fleas* turns out to be quantized, as no proper part of the fusion of all events temporally included in t can also be the fusion of all events temporally included in t. The reason why this won't do, however, is that it predicts that activity predicates should also be quantized when they combine with *most*. This prediction is incorrect, as the acceptability of (23d) shows:

(23)d. John ruled most of the committees for ten years

7.2. *A Solution to the Problem of* most*: Maximal Participants*

An account of the behavior of *most* with activity predicates and accomplishment/achievement predicates can be obtained by summing individuals instead of summing events. Intuitively, this solution may be stated in this way: an event of John's writing most of the letters is a writing event whose patient is (the plural individual which is) the sum of all the letters written

[21] Examples like (23c) are also problematic for the quantificational analysis, since if John found less than half of the fleas during a one hour interval, it will also be true that John found less than half of the fleas during all (relevant) sub-intervals of that one hour interval.

by John at a reference time t_r and the cardinality of this plural individual must be greater than one half the number of the letters. To see why this way of handling *most* yields the desired result, let's see what the translations of *most* and of the relevant predicates look like in this account. Let's define the relation Max in this way:

$$\forall x[Max(P, x) \leftrightarrow P(x) \wedge \neg\exists y[P(y) \wedge x \subset y]]$$

[an individual is a maximal P iff it is P and it is not a proper part of another P]

Let's assume that, while the predicate of the translation language $letter'$ contains only atomic letters, the predicate $letters'$ contains in its denotation all the objects that are either individual letters or plural individuals obtained by summing these letters:

$\|letter'\|_M = \{x \in U|\ x$ is a letter$\}$

$\|letters'\|_M = \{x \in U|\ x \in \|letter'\|_M$ or x is the sum of individuals belonging to $\|letter'\|_M\}$

We can now state the translation of *most letters* in this way:

most letters $\Rightarrow \lambda P\lambda e\exists x[P(x)(e) \wedge Max(\lambda z\exists e'[P(z)(e') \wedge letters'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| > 1/2\Sigma(\lambda z[letter'(z)])]$

The predicate *write most letters* will be thus translated as follows:

write most letters $\Rightarrow \lambda y\lambda e\exists x[write'(e) \wedge Ag(e, y) \wedge Pat(e, x) \wedge Max(\lambda z\exists e'[write'(e') \wedge Ag(e', y) \wedge Pat(e', z) \wedge letters'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| > 1/2\Sigma(\lambda z[letter(z)])]$

[an event of writing most letters is a writing event whose patient is the sum of all the letters written by the agent at the reference time t_r and the cardinality of this plural individual must be greater than one half the number of the letters]

According to this translation, the predicate which results from saturating the subject argument of *write most letters* is quantized. Here's why. Given that the object role of *write* has the property of mapping to objects, a proper part e' of an event e in the denotation of *write most letters* should affect a proper part of the sum of all letters written at the reference time t_r by the agent. But this means that e' is not in the denotation of *write most letters*, since by definition events in this denotation must have the sum of all letters written by the agent at t_r as patients.

The restriction introduced by the mention of the reference time in the translation of the NP is needed as it would be clearly incorrect to require that the patient of an event of writing most letters be the sum of all letters ever written by the agent. It may be true that, on a given occasion, John wrote most letters although the group of letters that John wrote on that occasion is not the sum of all letters that John ever wrote. The variable t_r is a selected variable identical to the one introduced by the tense node which identifies the reference time of the sentence. In the simple case, this variable will thus end up being bound by the same existential quantifier binding the variable for the reference time introduced by the tense node.[22] The option of using the same variable (discourse marker) for the reference time at various stages during the construction of the semantic representation of the sentence is common in DRT treatments of tenses.[23] We assume that a similar option is available here.[24]

The translation of activity predicates like *rule most countries* will be this:

$$\text{rule most countries} \Rightarrow \lambda y \lambda e \exists x[rule'(e) \wedge Ag(e, y) \wedge Pat(e, x) \wedge Max(\lambda z \exists e'[rule'(e') \wedge Ag(e', y) \wedge Pat(e', z) \wedge countries'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| > 1/2\Sigma(\lambda z[country'(z)])]$$

The predicate which results from saturating the subject argument of *rule most countries* is not quantized. Indeed, suppose that e is an event of ruling most countries. Then, e is an event whose patient is the sum of all the countries ruled at the reference time t_r. But, as *rule* doesn't have the property of mapping to objects for non-iterative predicates, the set of countries ruled at t_r may also be the set of countries ruled during a proper part e' of e. This means that both e and e' may be in the denotation of *rule most countries*. If this is correct, this way of stating the semantics of *most* achieves the desired result that this quantifier yields quantized predicates when combined with achievement/accomplishment verbs and yields non-quantized predicates when combined with activity verbs.[25]

7.3. *The Case of* less than n

A problem similar to the one described for *most* arises also for Krifka's translation of quantifiers like *less than n*. His translation for *less than ten fleas* does not ensure that predicates like *find less than ten fleas* are quantized, while they should be by the *for*-adverb test:

[22] Cf. footnote 19. We need to qualify this as the simple case, since in 8.4 we suggest that a frequency adverb intervening between the tense node and the NP may bind the time variable introduced by the maximality clause.

[23] See, for example, Partee (1984).

[24] In this sense, this proposal involves the same limited departure from strict compositionality of DRT treatments of tenses.

[25] We point out that the account behaves properly in the case of *rule most countries* as the move considered in 7.1 to account for the quantizing effect of *most* doesn't.

less than ten fleas$_{[obj,pat]}$ $\Rightarrow \lambda P \lambda e[MXE(e) \wedge max(\lambda n \lambda x \exists e'[P(e') \wedge flea'(x,n) \wedge Pat(x,e') \wedge e' \subseteq e]) < 10]$

(24)a. ??John found less than ten fleas for an hour

b. John found less than ten fleas in an hour

Indeed, given the above translation of *less than ten fleas*, the predicate *find less than ten fleas* would be translated thus:

find less than ten fleas $\Rightarrow \lambda e[MXE(e) \wedge max(\lambda n \lambda x \exists e'[find'(e') \wedge flea'(x,n) \wedge Pat(x,e') \wedge e' \subseteq e]) < 10]$

Again, in the scenario described in 7.1 (John finds nine fleas during the interval i and finds seven fleas during the interval $i' \subset i$), there are two events that stand in the proper part relation and that are both in the denotation of the predicate.

The problem posed by *less than n* is similar to the one described for *most*, but dealing with *less than n* poses an additional problem. Suppose that we translate *less than ten fleas* roughly in the same way as we translated *most*, with the difference that we require instead that the cardinality of the fleas found at the reference time t_r must now be less than ten. This would amount to adopting these translations for *less than ten fleas* and *find less than ten fleas*:

less than ten fleas $\Rightarrow \lambda P \lambda e \exists x[P(x)(e) \wedge Max(\lambda z \exists e'[P(z)(e') \wedge fleas'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| < 10]$

find less than ten fleas $\Rightarrow \lambda y \lambda e \exists x[find'(e) \wedge Ag(e,y) \wedge Pat(e,x) \wedge Max(\lambda z \exists e'[find'(e') \wedge Ag(e',y) \wedge Pat(e',z) \wedge fleas'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| < 10]$

The problem with this proposal is that it requires that an event of finding less than ten fleas must have a group of some fleas as a patient and this prediction is not right. Indeed, sentence (25) does not entail that John found some fleas, as shown by the fact that there is no contradiction in continuing an utterance of (25) by saying that, in fact, John found no flea at all.

(25) John found less than ten fleas

A possible way to solve this problem is the following. Intuitively, what we need to say in order to account for (25) is this: an event of finding less than ten fleas is *either* a finding event whose patient is the maximal group of fleas found at the reference time t_r and the cardinality of this group is smaller than ten *or* an event of finding no flea at all. Our translation above for *find less than ten fleas* spells out what an event of the first kind is. What we need to find is a way of introducing the other disjunct in the translation of *find less than ten fleas*, the clause that says that an event in the denotation of the predicate may be an event in which no flea is found.

$$\text{find less than ten fleas} \Rightarrow \lambda y \lambda e[\ldots \vee \exists x[find'(e) \wedge Ag(e, y) \wedge Pat(e, x) \wedge Max(\lambda z \exists e'[find'(e') \wedge Ag(e', y) \wedge Pat(e', z) \wedge fleas'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| < 10]]$$

In filling in the missing part, however, we have to exercise some care. It will not do to require that such an event must simply be an event of the type we find in the denotation of *find no flea* according to the translation rule for *no* in Section 6.2.1. This rule was designed to make *find no flea* a nonquantized predicate and, if we used it to fill the missing clause in the translation of *find less than ten fleas*, we would get as a consequence that the predicate *find less than ten fleas* is no longer quantized, as the events in the denotation of the predicate that satisfy the first disjunct could have proper parts that still satisfy the first disjunct and thus are also in the denotation of the predicate.

What we need for the purpose of stating the meaning of *less than n* is a way of expressing negation which does not have this effect of making the predicate non-quantized. Help to deal with this problem comes from Krifka's (1989) treatment of negation. Krifka introduces two translations for negation. One translation, which we have seen in 6.2.1, makes use of the notion of fusion of all events that occur at subintervals of some interval (MXE) and is designed to account for the acceptability of (13c).

(13)c. John did not arrive for three hours

The other translation is needed to account for the fact that sentence (26) is true only if the non-laughing of John lasted the whole day:

(26) John did not laugh yesterday

This translation makes use of the notion of fusion of all events that occur at subintervals of the reference time (MXT) and has the effect of quantizing the predicate to which it applies. This type of negation, then, is the one we need to complete our translation of *find less than ten fleas*. Here's how we proceed. Recall how the notion MXT was defined by Krifka:

$$\forall e \forall t[MXT(e, t) \leftrightarrow e = FU(\lambda e[\tau(e) \subseteq t])]$$

[a maximal event at a time t is the fusion of all events that occur at subintervals of t]

By using MXT, we may now translate *find less than ten fleas* in this way:[26]

find less than ten fleas $\Rightarrow \lambda y \lambda e[(MXT(e, t_r) \wedge \neg\exists e' \exists z[find'(e') \wedge Ag(e', y) \wedge Pat(e', z) \wedge fleas'(z) \wedge e' \subseteq e]) \vee \exists x[find'(e) \wedge Ag(e, y) \wedge Pat(e, x) \wedge Max(\lambda z \exists e'[find'(e') \wedge Ag(e', y) \wedge Pat(e', z) \wedge fleas'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| < 10]]$

This translation requires now that an event in the denotation of *find less than ten fleas* must be an event that is either of kind (a) or of kind (b):

(a) an event which is the fusion of all events that occur at subintervals of the reference time t_r and which does not contain an event of finding fleas;

(b) a finding event whose patient is a group, the sum of all fleas found at the reference time t_r and the cardinality of this group is less than ten.

This leads us to expect that the predicate *find less than ten fleas* is quantized, as neither events of kind (a) nor events of kind (b) can have proper parts of the same kind.[27] Moreover, the translation correctly predicts that (25) does not entail that John found some flea, since an event in the denotation of *find less than ten fleas* may be an event of type (a). Our final translation for the determiner *less than n fleas* on which the translation of the predicate is based is the following:

less than ten fleas $\Rightarrow \lambda P \lambda e[(MXT(e, t_r) \wedge \neg\exists e' \exists z[P(z)(e') \wedge fleas'(z) \wedge e' \subseteq e]) \vee \exists x[P(x)(e) \wedge Max(\lambda z \exists e'[P(z)(e') \wedge fleas'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| < 10]]$

8. THE MAXIMAL PARTICIPANTS ACCOUNT

In the Kamp-Heim approach we sketched, we have accounted for the quantizing power of NPs of the form *an N* by assuming that these NPs are not inherently quantificational and we have accounted for the quantizing power of NPs of the form *most Ns* by appealing to maximal participants. We do not necessarily expect uniformity here, as it would certainly be

[26] Notice that we are not claiming here that there is a translation of *find no fleas* which makes use of this negation. We are only claiming that this type of negation is the one needed to spell out the meaning of downward entailing quantifiers like *less than n*.

[27] Notice that this analysis also leads us to expect that *rule less than ten countries* is non-quantized by our definition in (Q) as some model may contain, for example, events of ruling two countries that have as proper parts events of ruling two countries.

possible that the quantizing effect of indefinites of the form *an N* and *some Ns* and of NPs of the form *most Ns* and *less that n Ns* is due to different underlying devices. Yet, now that we have seen how to deal with NPs of the latter forms by means of maximal participants, a natural question to ask is whether maximal participants provide an alternative strategy for explaining the behavior of quantizing NPs in general, included the indefinites we discussed at the outset. In the next section, we explore this possibility.

8.1. *Extending the Account to Indefinites*

By appealing to maximal participants, we can account for the fact that accomplishment/achievement verbs are quantized when they combine with NPs of the form *an N* and *some Ns* compatibly with the view that these NPs are quantificational (a view which is held, for example, by DMG accounts of anaphora).[28] Applied to NPs of this type, the maximal participant approach amounts to assuming translation rules of the following kind:

$[_{NP}$ some$^{pl.}$ $[_{N'}\ \alpha]] \Rightarrow \lambda P \lambda e \exists x[P(x)(e) \wedge Max(\lambda z \exists e'[P(z)(e') \wedge \alpha'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| > 1]$

$[_{NP}$ a(n) $[_{N'}\ \alpha]] \Rightarrow \lambda P \lambda e \exists x[P(x)(e) \wedge Max(\lambda z \exists e'[P(z)(e') \wedge \alpha'(z) \wedge \tau(e') \subseteq t_r], x)]$

some letters $\Rightarrow \lambda P \lambda e \exists x[P(x)(e) \wedge Max(\lambda z \exists e'[P(z)(e') \wedge letters'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| > 1]$

a letter $\Rightarrow \lambda P \lambda e \exists x[P(x)(e) \wedge Max(\lambda z \exists e'[P(z)(e') \wedge letter'(z) \wedge \tau(e') \subseteq t_r], x)]$

The predicates *write a letter* and *write some letters* are thus assigned these translations:

write some letters $\Rightarrow \lambda y \lambda e \exists x[write'(e) \wedge Ag(y, e) \wedge Pat(x, e) \wedge Max(\lambda z \exists e'[write'(e') \wedge Ag(y, e') \wedge Pat(z, e') \wedge letters'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| > 1]$

[an event of writing some letters is a writing event whose patient is maximal among the plural individuals that are letters written at the reference time t_r]

write a letter $\Rightarrow \lambda y \lambda e \exists x[write'(e) \wedge Ag(y, e) \wedge Pat(x, e) \wedge Max(\lambda z \exists e'\ [write'(e') \wedge Ag(y, e') \wedge Pat(z, e') \wedge letter'(z) \wedge \tau(e') \subseteq t_r], x)]$

[an event of writing a letter is a writing event whose patient is maximal among the individuals in the denotation of *letter written at the time* t_r]

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[28] See Groenendijk and Stokhof (1990), Groenendijk and Stokhof (1991).

Let's consider the case of *write some letters* first. According to the above translation, the predicate *is an event of John's writing some letters* is quantized for the following reason. Given that $letters'$ is cumulative, there is exactly one element which is maximal in the denotation of the predicate $\lambda z \exists e'[write'(e') \wedge Ag(John, e') \wedge Pat(z, e') \wedge letters'(z) \wedge \tau(e') \subseteq t_r]$ and this element is the sum of all letters written by John at t_r. An event of John's writing some letters must thus have as a patient the sum of all letters written by John at the reference time t_r. As the object role of *write*$'$ has the property of mapping to objects, a proper subevent e' of an event in the denotation of *is an event of John's writing some letters* must have as a patient a proper part of the sum of all the letters written at t_r. But this means that e' is not in the denotation of *is an event of John's writing some letters*.[29]

Now, consider the translation of the predicate *write a letter*. As the predicate $letter'$ is not cumulative, there may be more than one maximal element in the denotation of $\lambda z \exists e'[write'(e') \wedge Ag(John, e') \wedge Pat(z, e') \wedge letter'(z) \wedge \tau(e') \subseteq t_r]$. In particular, any singular letter written by John in the interval t_r counts as maximal. So, an event of John's writing a letter is an event whose patient is a singular letter written at the interval of reference t_r. Since the object role of *write* has the property of mapping to objects, a proper subevent e' of an event in the denotation of *is an event of John's writing a letter* must have as a patient a proper part of a single letter. But a proper part of a letter isn't a letter, so e' is not an event of writing a letter.[30]

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[29] An anonymous reviewer raises the following objection to this account of *some*. Suppose I wrote some letters yesterday morning and that I also wrote some letters yesterday afternoon. Then, these events are both events of writing some letters with respect to different reference times. These events are also parts of a larger event which is an event of writing some letters with respect to the reference time yesterday. Thus, we have an event of writing some letters that includes as parts two events of writing some letters. How can it be then that *for*-adverbs are not acceptable with predicates like *write some letters*? The answer is that, in this account, predicates like *write some letters* are always relative to some reference time at an underlying level, whether or not this reference is made explicit on the surface. This is what the time variable in the translation of the predicate indicates. The conclusion that, in the example at hand, we have an event of writing some letters that includes as parts two events of writing some letters should thus be spelled out formally in this way: we have a writing event e whose patient is the maximal group of letters written at t (yesterday) that includes as proper parts writing events e' and e'' whose patients are the maximal group of letters written at t' (yesterday morning) and the maximal group of letters written at t'' (yesterday afternoon). This is true, of course, but it does not show that the predicate *is a writing event e whose patient is the maximal group of letters written at t* is not quantized, as e' and e'' are not in the denotation of the predicate.

[30] Notice, by the way, that the relation Max we use in the translation of *a*, *some*, etc. is the one defined at the beginning of Section 7.2. According to this definition, an individual is maximal relative to a predicate P if it is P and there is no proper part of it that is P. This

By extending the maximal participants account to NPs of the form *an N* and *some Ns* in the way suggested above, we thus derive the facts in (3b) and (9):

(3)b. ??John wrote a letter for an hour

(9) ??John found some fleas on his dog for an hour

How does this account fare with respect to the problem posed by predicates like *sequence*, *twig* and *quantity of milk*? The account correctly predicts that the predicate *is an event of John's writing a sequence* is quantized.

write a sequence $\Rightarrow \lambda y \lambda e \exists x[write'(e) \wedge Ag(y,e) \wedge Pat(x,e) \wedge Max\ (\lambda z \exists e'[write'(e') \wedge Ag(y,e') \wedge Pat(z,e') \wedge sequence'(z) \wedge \tau(e') \subseteq t_r], x)]$

[an event of writing a sequence is a writing event whose patient is maximal among the individuals that are in the denotation of *sequence written at the time* t_r]

It makes this prediction, since, according to the translation of *write a sequence*, an event of writing a sequence is a writing event whose patient is the maximal sequence written at the reference time t_r. As the object role of *write* has the property of mapping to objects, a proper part of any such event cannot be an event of writing a maximal sequence written at t_r.

The acceptability of (4c) is explained in this account along the same lines suggested for the Kamp-Heim account.

(4)c. John wrote letters for an hour

If the *for*-adverb in (4c) applies to the predicate

$\lambda e[write'(e) \wedge Pat(e, letters^k)]$

where the patient of the writing event is a kind, lexical principles (a)–(b) predict that the predicate *write letters* should not be quantized.

(a) $\forall e \forall x^k[write'(e) \rightarrow (Patient(e, x^k) \leftrightarrow \exists x(R(x, x^k) \wedge Patient(e, x)))]$

[if e is a writing event, then kind x^k is a patient of e just in case there is an individual realizing x^k which is the patient of e]

(b) $\forall x[letters'(x) \leftrightarrow R(x, letters^k)]$

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predicts correctly that if John didn't write any letter at t_r, it is false that John wrote a letter at t_r, as there is no writing event by John whose patient is a letter written at t_r.

[x is a collection of letters/a quantity of milk just in case x realizes the kind letters/milk]

For sake of completeness, we end this section by stating the interpretation of the definite article *the* in the maximal participant approach ($At(x, t)$ means that x is in existence at t):[31]

$[_{NP}$ the $[_{N'}\ \alpha\ ]] \Rightarrow \lambda P\lambda e\exists x[P(x)(e) \wedge Max(\lambda z[\alpha'(z)], x) \wedge \forall y[Max(\lambda z\ [\alpha'(z) \wedge At(z, t_r)], y) \rightarrow x = y]]$

find the flea $\Rightarrow \lambda y\lambda e\exists x[find'(e)\wedge Pat(x, e)\wedge Ag(y, e)\wedge Max(\lambda z [flea'(z)], x)\wedge\forall y[Max(\lambda z[flea'(z)\wedge At(z, t_r)], y) \rightarrow x = y]]$

[an event of finding the flea is a finding event whose patient is the maximal element in the denotation of flea']

find the fleas $\Rightarrow \lambda y\lambda e\exists x[find'(e) \wedge Pat(x, e) \wedge Ag(y, e) \wedge Max(\lambda z\ [fleas'(z)], x) \wedge \forall y[Max(\lambda z[fleas'(z) \wedge At(z, t_r)], y) \rightarrow x = y]]$

[an event of finding the fleas is a finding event whose patient is the maximal element in the denotation of fleas']

8.2. *Maximal Participants and the Quantificational Analysis of for-Adverbs*

In this section, we show that the maximal participants account can also be stated in the quantificational analysis of *for*-adverbs. In particular, we will show how maximal participants can be introduced in Moltmann's analysis to account for the case of *a sequence* and the case of *some fleas* trusting that this will be sufficient to indicate to the reader how the extension to the other data we discuss may be achieved.

[31] A similar interpretation is also suggested in Krifka (1989). Notice, by the way, that, under the assumption that common nouns like *beer* may denote sets of kinds in addition to denoting sets of individuals, the acceptability of (12b) under the kind reading of the object NP is still expected by this interpretation of the definite article:

(12)b. John drank the beer that Bill recommended for hours (before admitting that he hated it)

Here's why. Suppose that Bill recommended bitter. Then, the kind bitter is the maximal element in the denotation of *beer that Bill recommended*. According to the above interpretation of the definite article, this means that an event of drinking the (kind of) beer that Bill recommended must be a drinking event whose patient is the kind bitter. But events of this sort may have proper parts that are also events of drinking bitter.

The maximal participants account can be incorporated into Moltmann's analysis by assuming the following translations for (5) and (9):[32]

John wrote a sequence for ten minutes $\Rightarrow$
$\exists t'(10 - minutes'(t') \wedge \forall t''(t'' P t' \rightarrow$
$\exists e \exists x(write'(e, x, John) \wedge Max(\lambda z \exists e'[write'(e', z, John) \wedge$
$sequence'(z) \wedge \tau(e') \subseteq t'], x) \wedge at(e, t'') \wedge past(t'))))$

John found some fleas on his dog for an hour $\Rightarrow$
$\exists t'(an - hour'(t') \wedge \forall t''(t'' P t' \rightarrow$
$\exists e \exists x(find'(e, x, John) \wedge Max(\lambda z \exists e'[find'(e', z, John) \wedge$
$fleas'(z) \wedge on'(John's - dog', z) \wedge \tau(e') \subseteq t'], x) \wedge$
$at(e, t'') \wedge past(t'))))$

According to the translation of (5), this sentence is true if at every subinterval of a past ten minute interval there is an event of John's writing a sequence which is maximal among the sequences written by John during that interval. Clearly, if e is an event occurring at a past ten minutes long interval t' and e is also an event of John's writing a maximal sequence relative to t', no event of writing a part of this sequence occurring at a subinterval of t' can be an event of John's writing a maximal sequence relative to t'. For example, suppose that e is a past ten minutes long event of John's writing the sequence 1,…,100 and that this sequence is maximal among the sequences John wrote during that interval. By the definition of maximality and the property of mapping to objects, no proper part of e can be an event of John's writing a maximal sequence relative to that ten minute interval. Indeed, if e' is a part of e in which John writes the sequence 1,…,50, e' is not an event of writing a maximal sequence relative to the past ten minute interval, since the sequence written in e' is part of a larger sequence written during that interval, namely the sequence 1,…,100. Again, this correctly predicts that (5) cannot be verified simply by the existence of a past ten minutes long event of writing a sequence and by the proper parts of this event. Similar considerations also apply to (9). Thus, both the Kamp-Heim approach and the maximal participants approach can be stated in the quantificational analysis to account for the puzzle of the sequence and the puzzle of *some*.

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[32] Moltman assumes that the reference time of the sentence is identical to the interval measured by the *for*-adverb. The way we introduce maximal participants into her analysis reflects this assumption. But introducing maximal participants into the quantificational analysis of *for*-adverbs is not dependent on this assumption.

8.3. *Numerals and Pragmatics*

The term maximal participants may generate a misunderstanding. In particular, it may suggest that we are locating in the semantics phenomena that have been traditionally regarded as belonging to the domain of pragmatics, like certain effects often observed with numerals. In fact, our approach allows one to account for the behavior of numerals in a way which is compatible with treating certain inferences about numerals as pragmatic implicatures, and it may contribute to a better understanding of the approach to see why it allows for that.

Imagine a context in which everyone who has three children gets a free ticket to the zoo. In this context, with no fear of contradiction, one may ask for a free ticket by declaring:

(27) I have three children. In fact, I have five.

One might conclude that therefore the NP *three children* in (27) is not maximal. But our account does not require that *three children* be maximal in the sense that to have three children means to have exactly three. In this account, the interpretations of *three children* and *have three children* may be stated in this way:

three children $\Rightarrow \lambda P \lambda e \exists x[P(x)(e) \wedge Max(\lambda z \exists e'[P(z)(e') \wedge children'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| \geq 3]$

have three children $\Rightarrow \lambda y \lambda e \exists x[have'(e) \wedge Ag(e, y) \wedge Pat(e, x) \wedge Max(\lambda z \exists e'[have'(e') \wedge Ag(e', y) \wedge Pat(e', z) \wedge children'(z) \wedge \tau(e') \subseteq t_r], x) \wedge |x| \geq 3]$

According to these translations, an event of having three children is a having event whose patient is the sum of all children the agent has at the reference time t_r and the cardinality of this plural individual must be greater than or equal to three. In this interpretation, therefore, having three children is consistent with having more than three.[33]

[33] An anonymous reviewer points out that we can have anaphoric reference to non maximal sets in the following discourse:

(i) John wrote at least two letters this morning. I know this because they are on the table waiting for Bill to take them to the post. He may have written more, but has not put them out to mail.

We find the anaphoric reference easier to get in (ii), where the discourse implicates that John wrote exactly two letters:

(ii) John wrote two letters. They are on the table waiting to be mailed.

Even so, one might wonder whether a maximality condition of the kind we introduced should not be regarded as an implicature, rather than be located in the semantics of the NPs, where we chose to locate it. The answer is negative, at least if maximal participants have to play a role in accounting for why the following sentences are anomalous:

(5) ??John wrote a sequence for ten minutes

(6) ??John found a twig for ten minutes

(7) ??John drank a quantity of milk for an hour

(9) ??John found some fleas on his dog for an hour

(23)a. ??John found most of the fleas for an hour

These data cannot be derived if maximality is simply a matter of pragmatic implicature. As the case of the *exactly three*-implicature in (27) shows, pragmatic implicatures are cancelable, i.e. they do not usually cause a sentence to be anomalous. If the maximal participants account predicts the above facts, it's because the maximality condition, as we stated it, is a semantic condition, not a pragmatic one.

8.4. *Frequency Adverbs with Maximal Participants*

The version of the maximal participants approach outlined so far still falls short of accounting for some of the data we dealt with in the Kamp-Heim approach. In particular, we have said nothing about how the maximal participants approach may handle the aspectual effects of frequency adverbs.

In the Kamp-Heim approach, the acceptability of (17) was derived by assuming that the frequency adverb can bind the variables introduced by the indefinite NPs *a cart* and *a flea*:

(17)a. John pushed a cart every day for a year

b. John found a flea on his dog every day for a year

If the indefinite article *a(n)* introduces its own existential quantifier, as we are assuming in the maximal participant analysis of *a(n)* repeated below,

To the extent to which (i) is acceptable, however, it may simply show that the pronoun *they* may pick out an individual whose salience is raised by the discourse (in the sense of Lewis (1979)), in this case the two letters that are the speaker's evidence for asserting (i). Pronouns of this sort may be involved in the following example by Partee cited in Heim (1982):

(iii) I glued two pieces of paper together and it flew the aspectual shift caused by the frequency adverb must be accounted for in a different way.

> $[_{NP}$ a(n) $[_{N'}\ \alpha]] \Rightarrow \lambda P \lambda e \exists x[P(x)(e) \wedge Max(\lambda z \exists e'[P(z)(e') \wedge \alpha'(z) \wedge \tau(e') \subseteq t_r], x)]$
>
> a flea $\Rightarrow \lambda P \lambda e \exists x[P(x)(e) \wedge Max(\lambda z \exists e'[P(z)(e') \wedge flea'(z) \wedge \tau(e') \subseteq t_r], x)]$
>
> $[_S$ John find a flea$] \Rightarrow \lambda e \exists x[find'(e) \wedge Ag(e, John') \wedge Pat(e, x) \wedge Max(\lambda z \exists e'\ [find'(e') \wedge Ag(e', John') \wedge Pat(e', z) \wedge flea'(z) \wedge \tau(e') \subseteq t_r], x)]$

The natural assumption in this case is that the reference time t_r in the translation of the indefinite can be bound by the frequency adverb. Here's how the translation rule for *every day* and the translation of the sentence *John find a flea every day* will look like:[34]

> $[_{NP}$ every day$] \Rightarrow \lambda P \lambda e[MXE(e) \wedge \forall t_r[(day'(t_r) \wedge t_r \subseteq \tau(e)) \rightarrow \exists e'[P(e') \wedge \tau(e') \subseteq t_r \wedge e' \subseteq e]]]$
>
> John find a flea every day $\Rightarrow \lambda e[MXE(e) \wedge \forall t_r[(day'(t_r) \wedge t_r \subseteq \tau(e)) \rightarrow \exists e' \exists x[find'(e') \wedge Pat(e', x) \wedge Ag(e', John') \wedge Max(\lambda z \exists e''\ [find'(e'') \wedge Pat(e'', z) \wedge Ag(e'', John') \wedge flea'(z) \wedge \tau(e'') \subseteq t_r], x) \wedge \tau(e') \subseteq t_r \wedge e' \subseteq e]]]$
>
> [an event of John's finding a flea every day is the fusion of all events temporally included in some interval such that for every day t_r temporally included in this fusion there is a finding event by John whose patient is maximal among the individuals in the denotation of *flea found by John at* t_r]

Again, the result of handling frequency adverbs in this way is that the event predicate translating *John find a flea every day* is not quantized. Indeed, if e is an event of John's finding a flea every day lasting for a period of ten days, the fusion of all events temporally included in a nine day subinterval of this period will belong to the denotation of the predicate *John find a flea every day*, since for every day included in this fusion there is an event of John's finding a flea occurring at some time included in that day.

[34] If the maximal participants approach is combined with a Kamp-Heim approach to indefinites, we also need appropriate conventions to bind the free variable introduced by the indefinite, which we won't try to spell out here. Notice also that this way of dealing with the free reference time variable in the translation of the indefinite *a flea* is consistent with the assumption in 6.2.2 that the tense node may abstract over the reference time of the fusion event e. In this case, the λ-abstraction over t_r introduced by the tense node will fail to bind the variable t_r introduced by the NP as this variable is no longer free.

9. CONCLUSIONS

The starting point of this paper was a problem posed by NPs like *a sequence* and *a quantity of milk*. The problem is to account for the quantizing effect of these NPs while preserving the following intuition: a sequence may have a part which is still a sequence and a quantity of milk may have a part which is still a quantity of milk. By current accounts of aspectual composition, these NPs should not yield quantized predicates when combined with verbs like *write* and *drink*, but they do, as the behavior of *for*-adverbs with predicates like *write a sequence* and *drink a quantity of milk* shows.

At first, this problem may seem like a technical problem concerning the semantics of the count predicates *sequence* and *quantity of milk*. However, the view that the quantizing effect of indefinite NPs of the form *an N* follows from the fact that the predicate N itself is quantized, besides being problematic for NPs like *a sequence* and *a quantity of milk*, is also problematic on other counts. Whatever the reason why indefinites of the form *an N* yield quantized predicates when they occur as objects of accomplishment/achievement verbs, the same reason should presumably explain why plural indefinites of the form *some Ns* yield the same effect. But plural predicates are not quantized, thus the behavior of *some Ns* cannot follow from the quantized character of the nominal predicate.

Indefinites of the form *an N* and *some Ns* are not the only NP-types that pose problems for available accounts of aspectual composition. NPs of the forms *most Ns*, *less than half of the Ns*, *less than n Ns* have also a quantizing effect when occurring as objects of accomplishment/achievement verbs. Yet, this effect is not predicted by current accounts.

In this paper, we explored two strategies to account for the influence of different NP-types on the aspectual class of predicates. These two accounts agree on appealing to maximal participants in analyzing non-cardinal quantifiers like *most* and *less than half*, but they differ on quantifiers like *a*, *some*, etc. Whereas the Kamp-Heim account relates the quantizing power of indefinites to the fact that they introduce free variables in the logical representation that are bound from outside the scope of *for*-adverbs, the maximal participants account lets indefinites introduce their own existential quantifier and assumes that, like *most*, they introduce maximal participants. Whether indefinites should be treated as quantificational or not is an open issue and addressing it would require evaluating different analyses of anaphora, a task that is beyond the scope of this paper. For this reason, we do not choose between the two accounts we presented.

A final observation is in order concerning our account of the aspectual effects of bare plural and mass NPs. In this account, we have assumed a version of the semantics proposed by Carlson for these NPs. As his theory has come under attack in recent years,[35] we should spell out precisely to what extent we are committed to it. What matters for our purposes is that (a) bare NPs do not have quantificational structure (more precisely, they should not be translated as existential quantifiers over individuals) and (b) the source of existential quantification is different for bare NPs and indefinites NPs of the form *an N* and *some Ns*. Assumption (a) means that, although in accounting for the aspectual effects of bare NPs we have assumed that they denote kinds, we have no crucial commitment to this aspect of the theory as long as bare NPs denote entities that can be exemplified. For example, we could have accounted for the facts we discussed by assuming that bare NPs denote properties and that a writing event has a property as a patient just in case there is an individual exemplifying that property which is the patient of a writing event. The reason why this is worth mentioning is that Krifka et al. (1995) have observed that bare plurals behave differently from kind-denoting definites. For example, in (28) below the definite NP *the horse* seems to refer to the kind horse. Thus, if the NP *horses* in (30) also denoted the kind horse, we should expect (29) to have a reading synonymous with (30). But this is not the case ((29) can only mean that a contextually salient horse was running through the gate).

(28) the horse is an animal

(29) the horse was running through the gate

(30) horses were running through the gate

This fact may be explained by assuming that taxonomic kinds, the entities denoted by singular definites like *the horse* in (28), are different from the entities denoted by bare plural NPs, which may be more property-like.[36] This view is consistent with the analysis proposed here.

Commitment (b) is also crucial for our account: if we are right, the source of existential quantification is different for bare NPs and for indefinites of the form *an N* and *some Ns*. This view is not consistent with analyses of bare plurals like the one proposed in Diesing (1992), according to which the existential quantification over individual letters in both (31) and (32) below is introduced by existential closure on the VP.

(31) John wrote a letter

(32) John wrote letters

[35] See, however, Chierchia (1998) for a version of Carlson's approach that avoids the objections raised against Carlson's original proposal.

[36] See Chierchia (1998) and Van Geenhoven (1996) for discussion of this point.

This analysis of bare plurals has been widely adopted and has achieved many important results. Yet, if the source of existential quantification for bare NPs and indefinites of the form *an N* and *some Ns* is the same, it's not clear to us how the different behavior of these NPs with durational adverbs could be explained.[37] What general consequences follow from this observation for theories of bare plurals, whether or not DRT accounts of bare plurals can be amended to deal with the data in (31)–(32), is an issue that we won't try to address here.

REFERENCES

Asher, N.: 1993, *Reference to Abstract Objects in Discourse*, Kluwer, Dordrecht

Carlson, G.: 1977, *Reference to Kinds in English*, Ph.D. Dissertation, University of Massachusetts, Amherst, published in 1980 by Garland, New York.

Carlson, G. and J. Pelletier (eds): 1995, *The Generic Book*, The University of Chicago Press, Chicago.

Chierchia, G.: 1998, 'Reference to Kinds Across Languages', *Natural Language Semantics* **6**, 339–405.

Diesing, M.: 1992, *Indefinites*, M.I.T. Press, Cambridge, Boston.

Dowty, D.: 1979, *Word Meaning and Montague Grammar*, Reidel, Dordrecht.

Groenendijk, J. and Stokhof, M.: 1990, 'Dynamic Montague Grammar', in L. Kalman and L. Polos, (eds), *Papers from the Second Symposium on Logic and Language*, Hungarian Academy of Sciences, pp. 3–48.

Groenendijk, J. and Stokhof, M.: 1991, 'Dynamic Predicate Logic. Towards a Compositional and Non-Representational Discourse Theory', *Linguistics and Philosophy*.

Hardt, D.: 1999, 'Dynamic Interpretation of Verb Phrase Ellipsis', *Linguistics and Philosophy* **22**, 185–219.

Heim, I.: 1982, *The Semantics of Definite and Indefinite Noun Phrases*, Ph.D. dissertation, University of Massachusetts, Amherst, published in 1989 by Garland, New York.

Hinrichs, E.: 1985, *A Compositional Semantics for Aktionsarten and NP Reference in English*, Ph.D. Dissertation, The Ohio State University.

Kamp, H.: 1981, 'A Theory of Truth and Semantic Representation', in J. Groenendijk, T. Janssen, and M. Stokhof (eds), *Formal Methods in the Study of Language*, Mathematisch Centrum Tracts, Amsterdam, pp. 277–322 (also in Groenendijk et al. (eds), *Truth, Interpretation and Information*, Foris, Dordrecht, pp. 1–41).

Kamp, H. and Reyle, U.: 1993, *From Discourse to Logic*, Kluwer, Dordrecht

Krifka, M.: 1986, *Nominalreferenz und Zeitkonstitution. Zur Semantik von Masstermen, Pluraltermen und Aspektklassen*. PhD. Dissertation, Universität München, published in 1989 by Fink Verlag, Münich.

[37] This observation was originally made by Carlson in his dissertation. As we understand it, the task Diesing's DRT analysis faces here is that of accounting for the fact that the existential quantifier binding bare plurals and mass terms has narrow scope with respect to *for*-adverbs. Any theory preserving this result would also fit our bill, since, as we saw in Section 5, it would entail that predicates like *write letters* and *drink milk* are non quantized.

Krifka, M.: 1989, ‘Nominal Reference, Temporal Constitution and Quantification in Event Semantics’, in R. Bartsch et al. (eds), *Semantics and Contextual Expressions*, Foris, Dordrecht, pp. 75–115.

Krifka, M.: 1992, ‘Thematic Relations as Links Between Nominal Reference and Temporal Constitution’, in I. A. Sag and A. Szabolcsi (eds), *Lexical Matters*, Stanford University, pp. 29–53.

Krifka, M. et al.: 1995, ‘Genericity: an Introduction’, in Carlson and Pelletier (1995).

Krifka, M.: 1998, ‘The Origins of Telicity’, in S. Rothstein (ed.), *Events and Grammar*, Kluwer, Dordrecht, pp. 197–235.

Ladusaw, W. A.: 1992, ‘Expressing negation’, in C. Barker and D. Dowty (eds), *Proceedings from the Second Conference on Semantics and Linguistic Theory*, The Ohio State University, Department of Linguistics, pp. 29–53.

Lewis, D.: 1979, ‘Score-Keeping in a Language Game’, in R. Bäuerle, U. Egli and A. von Stechow (eds), *Semantics from Different Points of View*, Springer, Berlin.

Link G.: 1983, ‘The Logical Analysis of Plurals and Mass Terms: A Lattice-Theoretic Approach’, in R. Bäuerle et al. (eds), *Meaning, Use and Interpretation of Language*, Mouton, Berlin, pp. 302–323.

Mittwoch, A.: 1988, ‘Aspects of English Aspect: on the Interaction of Perfect, Progressive, and Durational Phrases’, *Linguistics and Philosophy* **11**, 203–254.

Moltmann, F.: 1991, ‘Measure Adverbials’, *Linguistics and Philosophy* **14**, 629–660.

Muskens, R.: 1996, ‘Combining Montague Semantics and Discourse Representation’, *Linguistics and Philosophy* **19**, 143–186.

Partee, B. H.: 1984, ‘Nominal and Temporal Anaphora’, *Linguistics and Philosophy* **7**, 243–286.

Van Geenhoven, V.: 1996, *Semantic Incorporation and Indefinite Descriptions: Semantic and Syntactic Aspects of Noun Incorporation in West Greenlandic*, Ph.D. dissertation, University of Tübingen.

Verkuyl, H. J.: 1993, *A Theory of Aspectuality*, Cambridge University Press, Cambridge.

White, M.: 1994, *A Computational Approach to Aspectual Composition*, Ph.D. Dissertation, University of Pennsylvania.