FRIEDERIKE MOLTMANN

MEASURE ADVERBIALS*

Measure adverbials are a class of adjunct modifiers that include elements like those in (1)a–b.

(1)a. John drank wine *for two hours*.
b. Mary drew pictures *until noon*.
c. Children suffer from hunger *worldwide*.
d. *Throughout the country* women protested against the abortion laws.

I will defend and generalize an analysis of measure adverbials in which measure adverbials are part quantifiers ranging over the parts of some measuring entity. This analysis was first proposed for temporal measure adverbials by Dowty (1979).[1] In this account, the PP *for two hours* in (1a) quantifies over subparts of an interval of two hours. The analysis can be generalized to spatial measure adverbials as in (1c) and (1d) so that, for example, *worldwide* in (1c) quantifies over geographical subregions of the globe. I will show that together with some simple assumptions about the event structure of verbs, this analysis correctly predicts that in general, measure adverbials apply only to predicates that denote atelic (undelimited) events or ones having homogeneous extensions. Thus, this homogeneity requirement need not be stipulated as it is in accounts which treat measure adverbials as event predicates rather than quantifiers. I argue that the homogeneity restriction for a number of reasons cannot be cast as a sortal restriction on an event predicate. The analysis of measure adverbials as part quantifiers illuminates a variety of semantic and syntactic facts about the interaction of measure adverbials with negation, other quantifiers, 'nonhomogeneous' vague predicates like *few*, *little* or *often*, and binding phenomena with definite NPs, indexical expressions like away and *same/different*. Independent evidence for measure adverbials as part quantifiers comes from the fact that measure adverbial constructions in

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[1] For a quantificational analysis of certain temporal adverbials see also Verkuyl (1973). For the generalization of the quantificational analysis of temporal measure adverbials to spatial measure adverbials see also Moltmann (to appear), which is based on my 1987 Master's thesis (University of Munich).

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many languages show up as overt part quantifiers. Since overt part quantification is involved in a large number of quantificational constructions in natural languages, it turns out that measure adverbials constitute only a special instance of a very general semantic operation of universal part quantification. The analysis implies that Vendlerian categories such as achievements and accomplishments (bounded or telic events) on the one hand and activities and states (unbounded or atelic events) on the other hand are not required for the semantics of measure adverbials.[2]

In Section 1, I introduce the quantifier analysis of measure adverbials, the notion of part, and some elementary event semantic assumptions, and in Section 2, I show how these combine to enforce a 'homogeneity requirement'. In Section 3, I present a variety of phenomena involving measure adverbials that are explained by this analysis: phenomena of negation and quantifier scope interactions, phenomena of binding (in a broad sense) and the behavior of measure adverbials with different kinds of nominalizations. In Section 4, I discuss phenomena of overt part quantification with adjuncts and with arguments in English and other languages such as Russian and German, showing that overt part quantification with adjuncts defines measure adverbials and overt part quantification with arguments imposes the same restrictions on the scope as measure adverbials, namely the homogeneity requirement.

1. Measure Adverbials as Part Quantifiers

1.1. *Measure Adverbials and Adverbial Event Predicates*

According to Davidson (1980), certain adverbials such as *in the morning* or *slowly* are predicates of the event argument of the verb. This might suggest that measure adverbials are also predicates of the event argument of the verb. Any restriction measure adverbials pose on the verb they modify then would have to be formulated as a sortal restriction on the event argument or maybe on the extension of the event predicate. However, measure adverbials have characteristic properties that set them apart from adverbial event predicates. First, measure adverbials impose certain restrictions on the event predicate that cannot be formulated as restrictions on the type of event or event predicate that is modified. One of the restrictions consists in what I call the *homogeneity requirement* of measure adverbials. This requirement states that the event predicate modified by

[2] Verkuyl (1989) argues that temporal measure adverbials are in fact the only phenomenon that accurately exibits this distinction. Then, if the analysis given in this paper is correct, the Vendlerian distinction does not seem to be linguistically relevant at all.

a measure adverbial be homogeneous, and is satisfied, for instance, by an atelic intransitive verb (in Vendler's (1967) terminology, an activity or state verb) or by a verb phrase containing bare plural or mass NPs (in certain argument positions). The homogeneity requirement holds for both temporal and spatial measure adverbials, as seen in (2) and (3). '#' here and in later examples means that the sentence is unacceptable, if the verb is not interpreted iteratively or in reading in which, for example, the last sentence of (3a) is equivalent with 'the totality of the children in the world suffering from hunger is one thousand'.

(2)a. John played/slept for an hour.
b. #John died/crossed the line for an hour.
c. John ate apples/rice/# the apples/# an apple/# a bowl of rice for an hour.

(3)a. Worldwide children/# a child/# one thousand children suffer from hunger.
b. Throughout the garden John found hay/# that hay/# a bunch of hay.

However, measure adverbials allow for a variety of exceptions to the homogeneity requirement. First, measure adverbials are always allowed if they modify a negated clause, as in (4).

(4)a. Throughout the night John did not sleep/saw nobody.
b. Worldwide no scientist managed to explain the sudden darkness.
c. Throughout the forest John could not find Mary.

Second, measure adverbials allow for apparently nonhomogeneous event predicates, for instance vague quantifiers or predicates such as *few*, *little*, *often* or *seldom* in (5).

(5)a. Throughout his life John drank very few bottles of wine/very little wine.
b. In his youth, John played this sonata seldom/often/for a very long time.

Finally, measure adverbials allow for nonhomogeneous event predicates if certain elements receive an interpretation dependent on the measure adverbial, for instance definite NPs as in (6a), indexicals such as *away* as in (6b), and *same* as in (6c).

(6)a. Throughout the country the people are happy.

b. Throughout the country the people want to go away for vacation.
c. Mary played the same minuet for several hours.

(6a) in the only possible interpretation describes a situation in which for every region in the country the people in that region are said to be happy. (6b) may have the interpretation in which for every region in the country the people in that region want to go away from that region for vacation. (6c) allows for a bound reading of *same* in which at any relevant interval t during the several hours, Mary played at t the same minuet that she played at any other time during these hours.

These binding phenomena indicate that measure adverbials have the status of quantifiers, rather than event predicates. This is confirmed by phenomena of scope interactions of measure adverbials with each other, as in (7), or with other quantifiers, as in (8) and (9).

(7)a. John listened to Mozart all the time for ten weeks.
b. #All the time John listened to Mozart for ten weeks.

(8)a. John worked rarely for a long time.
b. John worked for a long time (only very) rarely.

(9)a. A lot of students initiated protests for several weeks.
b. For several weeks a lot of students initiated protests.

(7a) describes a situation in which at any subinterval t of a period of ten weeks John listened to Mozart during all of t. In contrast, (7b) does not have any acceptable interpretation at all. (8a) may be true in either of two situations: There were few occasions on which John worked for a long time, and within a long period of time there were only few occasions on which John worked. In contrast, (8b) may only be true in the former situation. In the preferred reading in (9a) *a lot of students* has wider scope than *for several weeks*, in (9b) it has narrower scope. Thus (9a) implies that there is one group of a lot of students that engaged for several weeks in intitiating protests, whereas (9b) can be true in a situation in which at different subintervals of several weeks different students were engaged in initiating protests. (7)–(9) show that the scope of measure adverbials is, as with other quantifiers, syntactically determined.

1.2. *The Analysis*

I take measure adverbials not to be event predicates at all, but rather quantifiers, namely universal quantifiers over the parts (subintervals or

subregions) of some time interval (cf. Dowty 1979) or some spatial region. On this proposal temporal and spatial measure adverbials, as in (10a) and (10b), are accounted for in exactly the same way.

(10)a. John played piano for two hours.
b. Throughout the country people are starving.

(10a) then means the following. For every subinterval *t* of some interval of two hours there is an event of playing piano by John which takes place at *t*. Similarly, (10b) can be paraphrased as: For every subregion *r* of the country there is an event of starving by some people which takes place at *r*.

Crucial in this analysis is a general notion of part. The analysis requires a quantifier that ranges over both parts of time intervals (subintervals) and parts of regions (subregions).[3] I will designate this part relation by 'P'. P has to be understood not as a part relation in a strict mereological sense, but rather as a contextually determined relation that may be coarser than the mereological part relation, as the relation 'is relevant part of' (cf. Moltmann 1990a,b,c). One and the same entity may have different part structures depending on the respective context.[4] For instance, a time interval may be conceived of as consisting of smallest subintervals of different length in different contexts – depending, for instance, on the type of events that are under consideration. We will come back to this contextual determination of the part relation later.

Let me introduce another notion that holds for both times and regions, the relation 'at'. The relation 'at' is a relation between events and time intervals or regions. It holds between an event *e* and an interval *t* or a

[3] L. Carlson (1981), who adopts Dowty's (1979) analysis of measure adverbials, observes that the analysis can be carried over to spatial measure adverbials and moreover that the same semantic rule of universal part quantification also applies to nominal quantifiers such as the predeteminer *all* in *all the wood*. Carlson also appeals to contextually determined part structures, which however have to be partitions, a decision that takes away most of the explanatory power of the part quantificational analysis. If part structures are partitions, then the homogeneity requirement, in particular cumulativity, cannot be derived. In fact, Carlson appeals to game-theoretical rule-orderings in order to rule out certain non-homogeneous predicates in the scope of measure adverbials.

[4] The part relation P that I am assuming differs from other formal part relation employed in the semantic literature (for instance the lattice-theoretical or mereological part relation as, for instance in Link, 1983, and set theoretical part relations such as set membership and the subset relation). Most importantly, P is a uniform relation applying to all types of entities and lacks strict formal properties such as transitivity and closure. The same notion of part covers the natural parts of individuals (referents of singular nouns), quantities (referents of mass nouns), groups (referents of plural nouns) and events (which may arguments of verbs). Further empirical motivations and formal properties are discussed more explicitly in Moltmann (1990a,b,c).

region r just in case e coincides temporally or spatially with t or r. Now the meaning of (10a) can in the relevant respects be represented as in (11a) and the meaning of (10b) as in (11b), where 'throughout' is taken as a predicate that holds of a region and the country just in case the region covers the country.

(11)a. $\exists t(\text{two hours}(t) \;\&\; \forall t'(t' \text{P} t \rightarrow \exists e(\text{play piano}(e, [\textit{John}]) \;\&\; \textit{at}(e, t') \;\&\; \text{past}(t))))$

b. $\exists r(\text{throughout}(r, [\textit{the country}]) \;\&\; \forall r'(r' \text{ Pr} \rightarrow \exists ex(\text{starve}(e, x) \;\&\; \textit{at}(e, r') \;\&\; \text{people}(x) \;\&\; \text{present}(e))))$

(11a) states that there is an interval of two hours such that for every part t' of t there is an event of playing piano by John at t' in the past. (11b) states that there is a region covering the country such that for every subregion r' of r there is a group of people involved in an event of starving at r' in the present.[5] We will see that this very simple analysis can account for the characteristics of measure adverbials mentioned above. It implies the homogeneity requirement of measure adverbials and immediately explains the phenomena of negation, the possibility of nonhomogeneous event predicates, scope and binding.

1.3. *The Homogeneity Requirement*

In this section, I briefly discuss how the homogeneity requirement would have to be accounted for if measure adverbials were treated as event predicates. I show that any such account cannot properly characterize this requirement.

A typical paradigm exemplifying the homogeneity restriction imposed

[5] I assume that verbs that take n complements generally denote $(n + 1)$-place relations between events and n participants. Often (recently for instance by Parsons 1985, 1990) it is suggested that verbs only denote sets of events and that the relation of participants to the event should be represented in sentence meanings by predicates for thematic relations. On this view the sentence (1a) has the representation in (1b).

(1)a. John kicked a ball.

b. $\exists e \exists x(\text{kick}(e) \;\&\; \text{agent}(e, \text{John}) \;\&\; \text{theme}(e, x))$

Though this does not bear on the discussion of this paper, I find this kind of representation incomprehensible and the idea of a lexical decomposition of lexical verb meanings in sentence meanings unnecessary and undermotivated. I cannot understand what it should mean that an event is per se a kicking without there being an object kicked and an agent kicking. Even if we just abstract away from the agent, what should it mean that an event is a kicking of a ball ? How could we say anything more than it is an event in which the ball moves. Any classification of an event as a kicking requires a relation to an agent.

by measure adverbials is (12) and (13) (where *drink* has its standard sense of totally consuming a quantity of liquid).

(12)a. For two hours John drank.
b. #For two years John died for the first time.

(13)a. For two hours John drank wine.
b. #For two hours John drank a bottle of wine.
c. #For two hours John drank the wine.

The examples in (13) show that the restriction imposed by measure adverbials cannot be a condition on the ontological type of the event that a measure adverbial is predicated of – even though such an approach is often taken (recently for instance by Pustejovsky 1988 and Jackendoff 1990). An event of drinking a bottle of wine or of drinking the wine might have exactly the same internal structure (in fact arguably may be the same event) as an event of drinking wine. Thus, the condition on measure adverbials cannot be stated as a property of individual events, but rather must take into account the entire extension of the event predicate.

The required move then within an account of measure adverbials as event predicates is to formulate the restriction of measure adverbials not as a condition on the type of event, but rather as a condition on the extension of the event predicate to which the adverbials applies. This is roughly the view taken in Krifka (1989). Other approaches that are similar in spirit are Hinrichs (1985) and Verkuyl (1987, 1989).[6] In such an ap-

[6] Both Hinrichs (1985) and Krifka (1989) actually do not assume homogeneity as defined below, but only cumulativity plus a condition that has the effect of requiring at least two events in the extension of the event predicate (since divisivity certainly is not required in a strict sense). Furthermore, Hinrichs (1985) in fact does not state the condition in terms of properties of the extension of an event predicate, but rather as a property of a (complex) event: an event *e* modified by a *sang arias for two hours* must have the following property. For any subinterval *t* of the two hours there is a part *e'* of *e* which is an event of singing arias and temporally includes *t* and *e* has at least two parts that are singings of arias. This account is in fact an event predicational as well as a quantificational account of measure adverbials. Depending of how the complex event predicate may be construed, Hinrich's account is not necessarily exposed to the criticism of the event predicational view put forward in this paper, namely the argument from scope, negation, and binding.

All the arguments given in this paper against the homogeneity condition as the proper restriction of measure adverbials apply nonetheless to Krifka's account. The condition that the event predicate has at least two elements in Krifka's and Hinrich's account should meet a general requirement that the event predicate denote 'sufficiently many' events (which I come to later). But one will certainly find evidence that the threshold 'at least two' is not correct. Concerning divisivity, the analysis of measure adverbials as part quantifiers that I will present requires only that the parts of the measuring entity, e.g. an interval or a region, be 'matched' with appropriate events. Thus, divisivity of the even predicate is only induced by the divisivity of the part structure of the measuring entity, e.g. the divisivity of the part

proach, the generalization drawn from data such as (12) and (13) is something like the following. A measure adverbial can modify an event predicate Q only if Q is homogeneous (i.e. cumulative and divisive), as stated in (14)

(14) Meaning Postulate on (temporal) *for*
For any event predicate Q, if *for* NP(Q) is true, then Q is homogeneous.

Homogeneity, cumulativity, and divisivity of a predicate are defined in (15), where '$x \vee y$' denotes the sum (formally, the supremum or the least upper bound) of x and y with respect to the part relation P.

(15) Definition of Homogeneity, Cumulativity, and Divisivity
Q is homogeneous iff Q is cumulative and divisive
Q is cumulative iff $\forall xy(\mathrm{Q}(x) \,\&\, \mathrm{Q}(y) \rightarrow \mathrm{Q}(x \vee y))$
Q is divisive iff $\forall xy(\mathrm{Q}(x) \,\&\, y\mathrm{P}x \rightarrow \mathrm{Q}(y))$

Divisivity, of course, is meant to hold only in a restricted way – posing the well-known problem of minimal parts: not every part of furniture need to be furniture in order for *furniture* to be homogeneous in reference. Homogeneity as a condition on event predicates gives the right results for (12) and (13). Consider the simple representations of the event predicates in (12a), (13a), and (13c) given in (16)

(16)a. $\{e \mid \mathrm{drink}(e, [\mathrm{John}])\}$
b. $\{e \mid \exists x(\mathrm{wine}(x) \,\&\, \mathrm{drink}(e, x))\}$
c. $\{e \mid \exists x(\text{bottle of wine}(x) \,\&\, \mathrm{drink}(e, [\mathit{John}], x))\}$[7]

The sets (16a) and (16b), i.e. the extensions of event predicates in (12a) and (13a), are certainly cumulative and – to an extent – divisive. The sum of two acts of drinking by John are again an act of drinking by John and so for any subevent of an event of drinking by John. Similarly, the sum of two events $e1$ and $e2$ of drinking wine quantities $x1$ and $x2$ by John is again an event of drinking wine by John, namely an event of drinking the wine quantity $x1 \vee x2$. The set (16c), the extension of the

structure of an interval or a region. Generally, there seems to be sufficient evidence that natural language semantics deals with contextually determined part structures, which are coarser than the part structures a physicist would ascribe to an interval or a region. Therefore arguably, divisivity is required and – in the acceptable cases – satisfied – relative to the contextual individuation of parts.

[7] In this analysis, I differ from Carlson's (1977) approach to bare plurals in that I assume that indefinite plural (and mass) NPs may have a function in which they are to be represented by existential quantifiers over groups and quantities respectively.

event predicate in (13b), is certainly not cumulative. This is due to the fact that *bottle of wine* does not have a cumulative extension. The sum of two distinct events $e1$ and $e2$ where $e1$ is a drinking of a bottle of wine $x1$ and $e2$ is a drinking of a bottle of wine $x2$ is, in the natural course of events, not an event of drinking a bottle of wine, but rather an event of drinking *two* bottles of wine.

NPs in certain argument positions such as the direct arguments in (13) must themselves consist of a nominal with a homogeneous extension and be indefinite if the event-predicate in which they occur should be homogeneous. We will come back to this requirement later.

Now what about the homogeneity of (12b)? *Die for the first time* being an achievement VP need not have proper parts at all, that is, parts that are *perceived as* parts. So divisivity is trivially satisfied. Cumulativity is trivially satisfied, as well. The sum of two events of John's dying for the first time is certainly an event of John's dying for the first time again, since two such dying events are necessarily identical. The same can be said about (13a). Any two events of John's drinking the wine (once) are certainly events of John's drinking the wine again, since any two such events are identical. Divisivity in this case generally holds. From this we see that homogeneity as stated in (15) cannot account for why achievement predicates (in a non-repetitive reading) cannot cooccur with measure adverbials. In order to disallow achievement predicates and predicates that denote a unique event, we must adopt a condition to the effect that the predicate modified by a measure adverbial must denote 'sufficiently many' events.

1.4. *The Derivation of the Homogeneity Requirement with* for *Measure Adverbials*

The analysis of measure adverbials given in Section 1.2 can account for the homogeneity requirement as well as the requirement that there be 'sufficiently many events' denoted by the event predicate.[8] In this account, (13a) is analysed as in (17).

(17) $\exists t(\text{two hours}(t) \;\&\; \forall t'(t'Pt \rightarrow \exists ex(\text{wine}(x) \;\&\; \text{drink}(e, [John], x) \;\&\; at(e, t'))))$

[8] Dowty (1979) gives an analysis of measure adverbials both as quantifiers over points of time and over intervals. However, he motivates the analysis only with the first account and as a consequence is unable to derive the homogeneity requirement from the homogeneity of the quantification domain.

The homogeneity and the indefiniteness requirement – as far as they actually hold – can be derived from this analysis. First, let us derive cumulativity. Suppose that for two parts $t1$ and $t2$ of an interval of two hours t there are events $e1$ and $e2$ and quantities of wine $x1$ and $x2$ so that drink($e1$, [*John*], $x1$), *at*($e1$, $t1$), drink($e2$, [*John*], $x2$), and *at*($e2$, $x2$). The sum of $t1$ and $t2$, $t1 \vee t2$, is certainly part of t again. So we must find for $t1 \vee t2$ a wine drinking event e by John which is '*at*' $t1 \vee t2$. Of course, the sum of $e1$ and $e2$, $e1 \vee e2$, satisfies this condition, since for $e1 \vee e2$ there is a wine quantity x such that drink($e1 \vee e2$, [*John*], x), namely $x1 \vee x2$. Now deriving divisivity (as far as it holds), consider a part $t1$ of a part $t2$ of the interval t with the following property. There is an event e and a wine quantity x such that drink(e, [*John*], x) and *at*(e, $t2$). Since, by the transitivity of the part relation, $t1$ is a part of t, we must find an event $e1$ such that drink($e1$, [*John*], $x1$) and *at*($e1$, $t1$) for a wine quantity $x1$. But such an $e1$ certainly exists in the general case, since if $e1$ is at $t1$, there will be a part of x, say x', such that wine(x') and e' is a drinking of x' by John.

We see that in the analysis given in (17) the required homogeneity of the event predicate, as well as the required homogeneity and indefiniteness of certain arguments follows directly from the analysis of measure adverbials as part quantifiers. Crucial for deriving homogeneity from this analysis is the fact that measure adverbials quantify over a homogeneous domain, a domain of subintervals (or subregions) which is cumulative and divisive.

We are also able to derive the requirement that the event predicate denote 'sufficiently many' events. According to (17), for every (relevant) part t of the interval there must be an event e at t. Thus, there must be as many events as there are relevant subintervals, that is, parts of the interval in the sense of P.[9]

The part structure of an interval cannot be taken as being strictly divisive in a mathematical or physical sense. Rather, it appears that semantics involves a coarser part structure and a notion of relevant or contextually determined part, namely the relation P. Depending on the type of event, the part structure of the interval must have smallest subintervals of a

[9] There is independent evidence that the coarseness of the part structure of an interval is contextually determined. Consider (1).

(1)a. For one hour John drew pictures.
b. For ten hours John drew pictures.

Given that John draws two pictures per hour, (1a) seems less acceptable than (1b). Apparently, the partition of the interval into smallest parts in (1a) and (1b) depends on the relative size of the interval.

certain minimal length. This is required, for instance, when the event is a process such as writing (not any physical part of a writing event is considered as writing) or a repetitive event (not any part of a repetitive revolving is a revolving). Therefore, the intended meaning of 'P' is the relation 'is a relevant part of', a relation which does not involve any subinterval of the measuring interval.[10]

1.5. *Other Temporal and Spatial Measure Adverbials*

Other temporal measure adverbials besides *for* NP are found in English. For instance, *until* and *since* form measure adverbials. Adverbials with *until* and *since* exhibit the same restrictions as adverbials with *for*, as (18) indicates.

(18)a. John painted pictures/# a picture/# the pictures until noon.
b. John painted pictures/# a picture/# the pictures since noon.

The measure adverbials in (18) can be analysed in exactly the same way as those with *for*, with the measuring entity now an interval that starts or ends at the time denoted by the NP.

Besides temporal measure adverbials there are spatial measure adverbials, for instance, *worldwide*. This can be shown by applying the homo-

[10] Measure adverbials with *for* exhibit the indefiniteness effect, as seen in **for these two hours*, **for every hour*. Other prepositions forming measure adverbials lack the indefiniteness effect, for instance *until*, *throughout*. Interestingly, German has a systematic measure adverbials construction with the indefiniteness effect. It has the form indefinite temporal or spatial NP – dimensional adjective. Their behavior as measure adverbials is illustrated in (1).

(1)a. Drei Jahre lang las Franz Bücher/# ein Buch/# die Bücher/# alle Bücher.
'Three years long Franz read books/a book/the book/all books.'
b. Zwei Kilometer weit tanzte das Paar Walzer/# einen Walzer/# hundert Walzer.
'Two kilometers far the couple danced waltzes/a waltz/hundred waltzes.'
c. Zehn Quadratmeter weit breitete Maria Zeitungen/# eine Zeitung/?? hundert Zeitungen/keine einzige Zeitung aus.
'Ten square square meters far Mary spread newspapers/a newspaper/hundred newspapers/not a single newspaper.'

I do not know whether the indefiniteness restriction with certain measure adverbials has any bearance on the semantic analysis. One might analyse the indefinite NPs with English *for* or German dimensional adjectives, like predicates, as referring to properties, rather than to referential arguments. Thus more accurately than in the text, one would analyse *for two hours* P, where P is the event predicate modified as in (2) and 'for' holds between an interval t and a property of two hours just in case t is of two hours length.

(2) $\exists t(\text{for}(t, \lambda t'[\text{two hours}(t')]) \ \& \ \forall t''(t'\text{P}t \rightarrow \exists e(\text{P}(e) \ \& \ at(e, t''))))$

geneity test to *worldwide* as a diagnostic for the status of an adverbial as a measure adverbial, as in (19) and (20).

(19)a. Worldwide children suffer from hunger.
b. #Worldwide a child suffers from hunger.

(20)a. Worldwide the book received great attention.
b. #Worldwide the book received this amount of attention.

(19a) can be given an analysis exactly parallel to the one in (17) only with the '*at*'-relation now interpreted as a relation that holds between an event and a spatial region (namely in case the event coincides with the spatial region). So (19a) has the representation in (21), where 'worldwide(r)' means r covers the world.

(21) $\exists r(\text{worldwide}(r) \;\&\; \forall r'(r' \text{P} r \rightarrow \exists ex(\text{children}(x) \;\&\; \text{suffer-from-hunger}\ (e, x) \;\&\; at(e, r'))))$

As before, the part structure of the region that is 'worldwide' is to a large extent contextually determined.

Throughout is a spatial (and temporal) preposition in English that forms measure adverbials. (22) and (23) show the results of the homogeneity test.

(22)a. Throughout the country women protested against the abortion law.
b. #Throughout the country a woman/hundred women protested against the abortion law.

(23) Throughout the country the increased air pollution caused protests/# a protest/# the protests.

Throughout the country can be considered a quantifier over the parts of a region 'across' the country. (22) and (23) show that not only totally affected arguments are subject to the homogeneity and indefiniteness requirement. Arguments that denote agents, as in (23), or effected objects, as in (23), may be sensitive to this requirement, too.

For spatial measure adverbials, cumulativity and divisivity of the event predicate and the requirements of indefiniteness and homogeneity of certain arguments are explained in the same way as with temporal measure adverbials. Parts of the region must be matched with events, which again require appropriate participants. Correspondingly, sums of parts of the region and parts of parts of the region must be matched with events and participants. For these cases generally, one might have to choose sums and parts of events or participants already chosen. This again requires

that the corresponding predicates of events and participants must be cumulative and divisive.

Spatial measure adverbials again show that the restrictions characteristic of measure adverbials are not specific to the actionsart of the event predicate they apply to. Rather it is just the homogeneity of the part structure of the interval or the region that requires (in the general case) the homogeneity of the extension of the event predicate and, with certain arguments, the homogeneity of the extension of the argument. In addition, measure adverbials as part quantifiers require that there be 'sufficiently many' events and participants in order to cover the part structure of the region.

1.6. *Varieties of Homogeneous Event Predicates*

Event predicates can satisfy homogeneity in different ways. *Run* and *stay* denote events that satisfy these conditions. Predicates denoting repetitions of events satisfy the condition, too, given that verbs may denote groups of events. A verb like *revolve* would then denote the closure under sum formation of the set of single events of revolving. The contextual determination of part structures allows the minimal parts of an interval of repetitive revolvings for (24) to have at least the length of atomic events of revolving.

(24) For two hours the wheel revolved.

Measure adverbials that quantify over parts of a region require that there be events denoted by the event predicate that cover the homogeneous part structure of the region. In the general case this condition is satisfied if the event predicate is homogeneous with respect to the relation 'is a spatial part of'. The present analysis predicts that the event predicate need not be homogeneous with respect to the relation 'is a temporal part of'. This is illustrated by (25a), which contains a spatial measure adverbial and an event predicate that is non-homogeneous with respect to the relation 'is a temporal part of'. The same event predicate is unacceptable with a temporal measure adverbial as in (25b).

(25)a. Throughout the country people woke up at seven o'clock.
b. #For two hours people woke up at seven o'clock.

If telicity of an event predicate is taken to be homogeneity with respect to temporal parts (as is usually assumed in the literature), then the examples in (25) show that telicity is not specific to measure adverbials.

Measure adverbials allow for verbs in the present perfect regardless of

whether they denote a homogeneous or non-homogeneous set of events (see also Dowty 1979 for discussion). Consider (26).

(26)a. Mary has given her baby to her grandmother for two days.
b. Mary has opened the store for two hours.

In (26a) *for two days* does not measure out an event of giving the baby to the grandmother, but rather the state that results from such a transaction. This state is limited. After two days Mary will take her baby back. We therefore can say that *for two hours* in (26a) measures out the consequent state of the event of giving. The consequences of an event of giving can be reversed, namely by Mary's taking the baby back. The consequences of the transaction event, namely Mary's grandmother having the baby, therefore delimit the consequent state, and we can say that *for two days* measures out this consequent state by correlating parts of two days with parts of the consequent state. Thus, if we let R be the relation of 'being consequent state of', (26a) has the representation given in (27).[11]

(27) $\exists t(\text{two days}(t) \ \& \ \forall t'(t' \text{P} t \rightarrow \exists e e'(e \text{R} e' \ \& \ \text{give}(e', [\textit{Mary}], [\textit{her baby}], [\textit{her grandmother}]) \ \& \ \textit{at}(e, t')))$

Apparently, measure adverbials can apply to verbs in the present perfect only if the consequent states that they denote are well-individuated. For instance, the consequent state must be reversible. If the consequences of an event are not reversible, such as for instance the consequences of finding a solution, a measure adverbial is not applicable, as in (28).

(28) #John has found a solution to this problem for two hours.[12]

1.7. *The Influence of Arguments on the Acceptability of Measure Adverbials*

We have seen above that the category of certain arguments can influence the acceptabilty of measure adverbials. The requirement that these argu-

[11] For an analysis of the past perfect in terms of consequent states see also Moens/Steedman (1987).

[12] Related to the acceptability of measure adverbials with the present perfect is the fact that English measure adverbials may apply to the culminating state of an event rather than to the event itself, as in (1) (cf. Pustejovsky 1988).

(1) Mary gave her baby to her grandmother for two hours.

This might be traced to a systematic lexical ambiguity of accomplishment verbs in English of either denoting accomplishment events or the culminating state of an accomplishment event.

ments have to meet is that they must be indefinite plural or mass NPs. This section addresses the following questions. First, which syntactic arguments are or can be sensitive in this respect. Second what is it exactly that makes these arguments sensitive in this respect.

This interaction between the homogeneity of the argument and the homogeneity of the event predicate has received a lot of attention in the semantic literature.[13] Arguments that can influence the homogeneity of the event argument – for instance, their definiteness or indefiniteness – include consumed, produced or performed objects. These arguments are generally called 'totally affected objects'. They characteristically 'measure out' the event. This measuring out relation can formally be considered as a 1–1 homomorphism from the part structure of the event into the part structure of the participant. However, it appears that the requirement that an argument in the scope of a measure adverbial be of a certain category can show up with almost all syntactic functions or thematic relations, as the following examples in (29) indicate.

(29)a. For several hours John pointed the dean out to students/# a student/# the students.
b. For several hours children/# a child/# the children ran to the tree.
c. For several hours John ran against trees/# the trees/# a tree. (each running being against a different tree)

In (29a), indirect objects are sensitive in the relevant respect, in (29b) agents (denoted by external subjects) and in (29c) directional PPs.

The examples in (29) show that it is not a specific syntactic function that governs sensitivity of the category of an argument with respect to measure adverbials. Rather, the sensitivity must depend on some independent semantic or perhaps pragmatic property of the argument, namely on whether the relation that the argument bears to the events is a relation of biuniqueness in the relevant situation. Produced or consumed arguments generally stand in a 1–1 relation to the event. In the situation of running against trees in (29c), even directional arguments (here trees) may stand in a 1–1 relation to the events. It appears that the requirement of measure adverbials that certain arguments be indefinite NPs with homogeneous extensions arises in those and only those cases in which the referents of the NP stand in a 1–1 relation to the events. This biunique relation may

[13] The interaction between certain arguments and the homogeneity of a sentence or VP was first observed by Verkuyl (1972). Within event semantics, it is most recently discussed in Hinrichs (1985) and Krifka (1989).

be either semantically or pragmatically determined, that is, it may be due to the lexical semantics of the verb or to accidental properties of the described situation.

Often measure adverbials have been employed as a criterion for whether an argument 'measures out' an event (cf. Tenny 1987). Typical objects that measure out an event are, for instance, consumed or produced objects, as in (30).

(30) John ate apples for two hours.

The measuring out relation with eating as in (30) can be considered as an (injective) homomorphism from the part structure of the event into the part structure of the participant (as suggested in Hinrichs 1985 and Krifka 1989). However, the measuring out relation as intended in Tenny (1987) comprises also cases in which the part structure of the event corresponds to degrees of a property scale applied to a participant such as, for instance, the temperature of the water in (31).

(31) John heated the water.

It is easy to see that this 'measuring out' relation is completely independent from any conditions imposed by measure adverbials. Consider (32). (32) is licensed on one reading by the fact that the event quantifier of the verb quantifies over groups of boiling water.

(32) John boiled water for two hours.

Even though in (32) the temperature of any specific quantity of water measures out an event of boiling the water in Tenny's sense, the measure adverbial in (32) can be licensed by groups of such boilings which are correlated with groups of different water quantities. These groupings licence the measure adverbial simply on the basis of the part relation, not on the basis of the measuring out relation in Tenny's sense.

To summarize, measure adverbials are licensed just in case there are appropriate groups of events and groups or sums of participants that match with the parts of the measuring entity. Whether there are such groups depends on the semantic properties of the verb and the argument and specific properties of the described situation. For formulating the conditions under which the category of an argument influences the acceptability of a measure adverbial, it is not necessary to make reference to a specific thematic relation or a more abstract relation such as a mereological homomorphism. Rather it only depends on whether there are appropriate event groups to cover the interval specified by the measure adverbial.

2. Evidence for the Quantifier Status of Measure Adverbials

2.1. *Negation in the Scope of Measure Adverbials*

Negation as in (33) licenses measure adverbials regardless of whether the event predicate is homogeneous or not.

(33)a. John did not open his door for several days.
b. Worldwide the weather does not change any more.

There seems to be one possibility to describe the acceptability of measure adverbials in (33) in terms of homogeneity. One might say that negation in (33a) applies to the non-homogeneous event predicate *open his door* to form a negative state predicate. This state predicate would denote states that are characterized by the non-occurrence of an event of opening the door. This would certainly be a homogeneous predicate. This view assumes that negation as in (33a) operates on event predicates rather than negating existential quantification over an event in the sentence meaning. Therefore, on this view, one could still maintain that in (33) *for several days* acts as an event predicate with the homogeneity condition as its presupposition. However, this view becomes less plausible when we consider other cases of negation, for instance negated complements or adjuncts, as in (34) and (35).

(34)a. For several days nobody went out of his house.
b. For several years John never became sick.

(35)a. Throughout the country nothing changed.
b. Worldwide the people will never be in peace again.

It is quite implausible to assume that negation in (34) and (35) operates on the verbs or on complex event predicates such as *somebody went out of his house* and *became sick at some time*. In certain constructions, negation in fact can yield an event predicate that denotes states characterized by the nonoccurrence of a certain kind of event, for instance in *the nonarrival of the train*. However, there are general certain conceptual conditions that have to be satisfied, which cases like (34) and (35) are not subject to. The event description *the nonarrival of the train* is acceptable because it relates to an (unsatisfied) expectation, but *the nonexpectation of the train* is not (see also Asher 1990). If it is still not convincing that negation in (46) and (47) has wide scope over the event quantifier rather than operating on an event predicate, one might consider cases like (36).

In (36), the event quantifier *often* is most naturally interpreted as in the scope of the negator.

(36) For several years John did not swim often.

(34)–(36) receive a straightforward account in the quantificational analysis of measure adverbials. (35a) has the following paraphrase: For every part r of the country there is no nonhuman entity x such that x changed. This is formalized in (37).

(37) $\exists r(\text{throughout}(r, \text{the country}) \;\&\; \forall r'(r' \text{P} \; r \rightarrow - \exists xe(\text{non-human}(x) \;\&\; \text{change}(e, x) \;\&\; at(e, r'))))$

Phenomena with negation argue clearly in favor of the quantificational account of measure adverbials and against the event predicate approach. In particular, these phenomena show that homogeneity is not an appropriate condition on measure adverbials in all contexts.

2.2. *Scope Interactions of Measure Adverbials with Other Quantifiers*

Measure adverbials interact in scope with other quantifiers. For many speakers the examples in (38) present a contrast showing that *for several years* interacts in scope with the existential quantifier over groups of students.

(38)a. For several years a lot of students complained about the requirements.

b. A lot of students complained about the requirements for several years.

For these speakers, in (38a) one single group of students need not have complained during several years, in contrast to (38b). (38b) is true only if a single group of students complained about the requirements for several years. This is accounted for if in the analysis of (38a), the universal part quantifier representing *for several years* has wide scope over the quantifier representing *a lot of students*. In (38b), the converse scope relation holds. This scope interaction cannot be accounted for in an event predicate view of measure adverbials. In an event predicative treatment of measure adverbials both (38a) and (38b) would have a semantic representation as given in (39).

(39) $\exists txe(\text{several years}(t) \;\&\; \text{a lot of students}\ (x) \;\&\; \text{complain about}\ (e, x, [\textit{the requirements}]) \;\&\; at(e, t))$

(39) would account only for the meaning of (38b), but not of (38a).

Further scope interactions of measure adverbials with other quantifiers (including other measure adverbials) are illustrated in (40) and (41).

(40)a. For a long time John played the violin for several hours.
b. For several hours John played the violin for a long time.

(41)a. For a long time John smiled only seldom.
b. Seldom did John smile for a long time.

If a measure adverbial has wider scope than another quantifier as in (41a), something like a homogeneity condition must hold for the latter quantifier. *Seldom* as in (41a) satisfies this condition. *Twice* as in (42) does not satisfy this condition.

(42) #For a long time John played the violin twice.

This condition, which is satisfied by a vague quantifier such as *seldom*, but not by a numerical quantifier such as *twice*, is discussed in the next section.[14]

2.3. *Non-Cumulative Vague Quantifiers in the Scope of Measure Adverbials*

'Totally affected' arguments with vague quantifiers such as *a lot of*, *many*, *much*, *few* or *little* are allowed in the scope of measure adverbials. Consider the examples in (43) and (44).

(43)a. For several years John took a lot of pills/few pills.
b. #For several years John took those pills/all the pills.

(44)a. For several years John had a lot of success/little success.
b. #For several years John had that success/all success.

A *lot of pills* in (43a) is obviously a cumulative predicate. If x is a group of many pills and y is a group of many pills, then the sum of x and y is a group of many pills. But *a lot of pills* is not a divisive predicate in a strict sense. If x is a group of many pills then a subgroup y of x need not be a group of many pills, but may rather be a group of few pills. Conversely, *few pills* is not a cumulative predicate. If x is a group of few pills and y is a group of few pills then the sum of x and y is not necessarily a group

[14] See Moltmann (1989) for further observations about the syntactic scope of measure adverbials and a discussion of some differences between the scopal behaviour of measure adverbials and frequency adverbials.

of few pills, but may instead be a group of many pills. However, *few pills* is certainly a divisive predicate.

The acceptability of 'totally affected' NPs with vague quantifiers in the scope of measure adverbials presents a general puzzle if the homogeneity condition is considered a semantic selectional requirement of measure adverbials as event predicates. However, consider how (43a) and (44a) can actually be interpreted. (43a) is true in the following situation: For every relevant part t of several years there are relative to the length of t many/few pills that John took at t. Similarly, (44a) is true in the following situation. For every part t of several years there is relative to the length of t much/little success that John had at t.

What is crucial in this interpretation is that quantities specified by the vague quantifiers *many/a lot*, *few*, *much/a lot* or *little* are determined relative to the length of the interval parts which the measure adverbial *several years* quantifies over. In general, the meaning of a vague quantifier such as *many/a lot* or *few* can be considered a two-place relation between groups x and (contextually determined) expectation values v such that the cardinality of the set of parts of x is higher than v (for *many/a lot*) or lower than v (for *few*). Accordingly, *many/a lot* and *few* denote the relations indicated in (45), where '<' and '>' are relations between numerical values.[15]

(45) Lexical Meaning of *many* and *few*

$[\textit{many/a lot}] = \lambda x v[\text{card}(\{y \mid y \text{P} x\}) > v \;\&\; v \text{ is an expectation value}]$

$[\textit{few}] = \lambda x v[\text{card}(\{y \mid y \text{P} x\}) < v \;\&\; v \text{ is an expectation value}]$

Similarly in this account, *much/a lot* and *little* denote relations between quantities and expectation values. Obviously, in the interpretation of (43a) and (44a) these expectation values are determined by the interval parts that the measure adverbial quantifies over. I will represent this dependence of expectation values on interval parts by a function which maps interval parts into expectation values. So (43a) and (43b) can be analysed as in (46a) and (46b), where 'f' is a parameter denoting the function in question. Note that the downward entailing quantifier *few* is analysed in (46b) as a predicate of sums whose parts satisfy a certain property, rather than as an existential quantifier like *many* in (46a).

[15] For different readings of the quantifier *many* and an analysis within a generalized quantifier framework see Westerstahl (1989).

(46)a. $\exists t(\text{several years}(t) \;\&\; \forall t'(t'\text{P}t \rightarrow \exists ex(\text{pills}(x) \;\&\; \text{many}\,(x, f(t')) \;\&\; \text{took}(e, [John], x) \;\&\; at(e, t'))))$

b. $\exists t(\text{several years}(t) \;\&\; \forall t'(t'\text{P}t \rightarrow \text{few}(\text{sum}_{\text{P}}(\{x \mid \exists e(\text{pills}(x) \;\&\; \text{took}(e, [John], x) \;\&\; at(e, t'))\}, f(t'))))$

The adverbial vague quantifiers *seldom* and *often* (as mentioned in the last section) are allowed in the scope of measure adverbials as well. Like nominal vague quantifiers (such as *few* and *many*), they contrast in that respect with numeral adverbial quantifiers such as *twice*. Consider the following examples.

(47)a. For several years John played chess very often.

b. Throughout his life John seldom went out.

c. #For several years John played chess twice.

(47a) has the interpretation in which for each part t' of several years John played chess many times – relative to t'. (47b) has an interpretation in which for each part t' of John's life John went out at t few times – relative to t'. Given that t is the entire time of John's life, we could still say that John went out at t only seldom, even though the number of events of going out by John at t might count as being frequent for a single week that is part of t. The point is that the value specified by *seldom* has to be relativized to t.

Analogously to *few*, the meaning of *often* can (in the relevant respect) be considered a relation between groups (of events) and context dependent expectation values. In the interpretation of (47a) these expectation values then are a function of the interval parts. That way, the requirements imposed by the quantifier *for several years* are met, i.e. the requirements imposed by the homogeneity of the quantification domain of *for several years*. The characteristic restriction of measure adverbials can be obeyed even by an event predicate such as *play chess often* (which is a predicate of groups of events) that is not homogeneous.

The event predicate *played chess twice* is, of course, not homogeneous, since any sum of two events in the extension of this predicate is an event group of playing chess four times and any proper part of an event in the extension is an event of playing chess once. Since *twice* is an absolute rather than a relative numerical predicate, the requirements imposed by

the quantifier *for several years*, which quantifies over a homogeneous domain, cannot be met.[16]

2.4. *Binding Phenomena with Measure Adverbials*

2.4.1. *Binding Phenomena with Definite NPs*

Definite 'totally affected' NPs in the scope of measure adverbials are allowed if they receive an interpretation that is dependent on parts of the interval specified by the measure adverbial. Consider (48).

(48)a. For several years John solved the problems in his firm.
b. Throughout the country the situation is desperate.
c. Until noon John measured the change of temperature.

The event predicate *solve the problems in his firm* in (48a) is certainly not homogeneous and does not denote 'sufficiently many' events. Similarly, the stative predicate *the situation is desperate* in (48b) is not homogeneous (with respect to the relation 'is a spatial part of') and the same holds for *measured the change of temperature* in (48c) with respect to the temporal part relation. Thus the examples in (48) cannot be accounted for if measure adverbials are considered event predicates with the homogeneity requirement.

Notice that if definite NPs are outside the syntactic scope of the measure adverbials as in (49), different interpretations may arise.

(49)a. The problems in his firm troubled John for several years.
b. For several years, the problems in his firm troubled John.
c. The situation is desperate throughout the country.
d. The change of temperature was measured until noon.

In (49a) *the problems* is most naturally understood as referring to only one group of problems – in contrast to (49b) where *the problems in his firm* can receive an interpretation dependent on the subintervals of the relevant years. Since problems stand in a 1–1 correlation to events of solving them, the stative predicate in *the problems in his firm troubled John* in (49a) is not homogeneous and thus makes (49a) unacceptable in

[16] There are other adverbials besides absolute numerical quantifiers which are disallowed in the scope of measure adverbials, for instance *completely*, as in (1).

(1) #For several years John solved the problem completely.

Completely in (1), roughly speaking, specifies an event of solving the problem as not being a proper part of a (conceived) event of solving the problem. So *completely* essentially does the inverse to the imperfect and thus induces a non-homogeneous event predicate.

this interpretation. (49c) describes the state of one and only one situation. Finally, (49d) is odd if the temperature changes constantly until noon.

The interpretation of the examples in (48) can easily be accounted for in the quantificational analysis of measure adverbials. (48a) actually means the following. For every relevant part t of several years the problems that were in his firm at t troubled John at t. Thus *the problems* in (48a) refers to the problems at a given subinterval t. Similarly, *the situation* in (48b) refers for each part r of the country to the situation in r. Those situations may be different from the situation holding in the country as a whole as in (48c).

I suggest that the definite NPs in (48) receive a definite interpretation relative to a domain of entities that are at an interval t or at a region r.[17] I will denote by '$D(t)$' the set of entities at t and by '$D(r)$' the set of entities in r. (48a) and (48b) then are interpreted as in (50a) and (50b) respectively, where the definite plural *the problems* denoting the supremum of the relevant groups of problems as suggested by Sharvy (1981).

(50)a. $\exists t(\text{several years}(t) \;\&\; \forall t'(t' \mathrm{P} t \rightarrow \exists e(\text{solve}(e, \text{John}, \sup_{\mathrm{P}}(\{x \mid \text{problems}(x) \;\&\; x \in D(t)\})) \;\&\; at(e, t'))))$

b. $\forall r'(r' \mathrm{P} \iota x[\text{country}(x)] \rightarrow \exists e(\text{is desperate}(e, \iota x[\text{situation}(x) \;\&\; x \in D(r')]) \;\&\; at(e, r')))$

Definite NPs as in (48) and (49) show clearly the quantificational status of measure adverbials, both syntactically (as the contrasts between (48a–c) and (49a–c) indicate) and semantically.

2.4.2. *Binding of* Same *and* Different *with Measure Adverbials*

One of the constructions *same* and *different* may enter is shown in (51).

(51) Everybody saw the same movie/a different movie.

In (51), *same* and *different* may receive an interpretation dependent on the quantifier *everybody*. This dependent interpretation of *same* and *different* is also allowed in the scope of measure adverbials, as shown by one of the interpretations of the examples in (52)–(53).

(52)a. Throughout his life John ate the same kind of bread.

[17] The idea that the evaluation of certain expressions in a sentence, for instance definite NPs, may be based on domains that depend on an object (in the quantification domain of a quantifier) can be found, for instance, in Hintikka/Kulas (1985) and Fauconnier (1985). See also Moltmann (to appear).

(52)b. For ten years John ate different kinds of bread, then he decided for the rest of his life on croissants.
c. For ten hours Mary sang different songs/the same song.

(53)a. Throughout the country people speak the same language.
b. Throughout the country different languages are spoken.

The examples in (54) show that true event predicates cannot trigger a internal bound interpretation of *same/different*.

(54)a. During his life John ate the same kind of bread.
b. Today Mary sang the same songs.
c. In this country different languages are spoken.

In (54), *same* can only have a deictic interpretation, and *different* can only act as a group predicate with the meaning 'various'. Notice that the homogeneity requirement shows up with *same/different*, as well. Thus, measure adverbials disallow singular NPs with the modifier *different* in the relevant interpretation, as seen in (55).

(55)a. #Throughout his life John ate a different kind of bread.
b. #Throughout the country people speak a different language.

It follows in the usual way, namely from the homogeneity of the quantification domain, that *different* must compare groups of objects not individual objects.

I suggest an analysis of *same/different* that is in some respects similar to the analysis given in Heim/Lasnik/May (1991) for *each other*.[18] In this account (51) is paraphrased in the following way. Let R be the relation that holds between x and y if y is a movie and x sees y. Then for every person x among the set of relevant persons X there is a movie y such that 'same'$(y, x, \mathrm{X}, \mathrm{R})$, where 'same' holds of y, x, X and R just in case y is identical to any z such that $\mathrm{R}(x', z)$ for any x' in X different from x. We can paraphrase sentences with binding of *same/different* by measure adverbials in a parallel way. For (52a) let R′ be the relation that holds between t and y just in case y is a kind of bread and at t John ate y. Then (52a) means for every part t among the set of parts T of ten years there are kinds of bread y such that 'SAME$(y, t, \mathrm{T}, \mathrm{R}')$. Formally, these analyses are given as in (56a) and (56b) respectively, where X is the set of contextually relevant persons and T the set of subintervals of an interval of ten years.

[18] For a different analysis of *same/different* see Keenan (1987).

(56)a. $\forall x \in X \exists ey(\text{movie}(y) \ \& \ \text{see}(e, x, y) \ \& \ \text{SAME}(y, x, X, R))$

b. $\forall t \in T \exists ey(\text{kinds of bread}(y) \ \& \ \text{eat}(e, \text{John}, y) \ \& \ \text{SAME}(y, t, T, R))$

2.4.3. *Argument Binding with Measure Adverbials*

Indexicals expressions such as *away* and *local* allow for a bound interpretation similar to the interpretation of bound pronouns (cf. Mitchell 1985). Like bound pronouns, binding of these indexicals is subject to syntactic constraints, in particular a condition like c-command by the antecedent seems to be required, as the contrast between (57b) and (57c) indicates.

(57)a. Every boy who saw his father drunk wanted to run away.

b. In every state the local government is in trouble.

c. The local government is in trouble in every state.

Measure adverbials show the same capacity to bind expressions like *away* and *local*. Also they exhibit syntactic constraints on this type of binding. This is illustrated in (58) and (59)

(58)a. Throughout this country the people want to move away.

b. The people want to move away throughout this country.

(59)a. Throughout this state the local salesmen are in trouble.

b. The local salesmen are in trouble throughout this state.

(58a) can have the following interpretation: In every (relevant) part r of the country the people at r want to move away from r. In (58b) this interpretation is (for many speakers) less available. Similarly, (59a) can have the interpretation: for every (relevant) part r of the state the salesmen in r are in trouble. For (59b) this interpretation is harder to get.

The binding relation involved with *local* and *away* can be considered an instance of argument binding. We may take *local* and *away* to have an indexical argument place that can either be satisfied by context or can be bound by a c-commanding quantifier. I suggest that *away* denotes a relation between events e (or other entities) and locations r or events e' such that e 'ends' far from r or e'. With these lexical meanings we can analyse (57a) as in (60a) and (58a) as in (60b).

(60)a. $\exists xe(\text{boy}(x) \ \& \ \text{see drunk}(e, x, x\text{'s father}) \rightarrow x \text{ wants: } \exists e'(\text{run}(e, x) \ \& \ \text{away}(e', e)))$

b. $\exists r(\text{throughout}(r, \text{the country}) \ \& \ \forall r'(r' \text{P} r \rightarrow \text{the people } y \text{ in } r \text{ want: } \exists e'(\text{move}(e', x') \ \& \ \text{away}(e', r'))))$

(57a) has the semantic structure of a *donkey*-sentence: The event quan-

tifier for *see drunk* has to be taken as a universal quantifier, not as an existential quantifier, since otherwise *away* cannot bind the event variable.

2.5. *A Syntactic Argument for Measure Adverbials as Quantifiers: Modification of Nominalizations*

Grimshaw (1986) discusses a distinction among deverbal nominalizations between what she calls process nominalizations and result nominalizations. The first type of nominalization preserves the argument structure of the verb, the second does not, i.e. process nominalizations denote a relation between events and participants, whereas result nominalizations denote only events or results of events.[19]

Grimshaw observes that adjectives like *frequent* or *constant* are possible with process nominalizations, but not with result nominalizations. This is illustrated in (61).

(61)a. The frequent/constant transmission of world news is desirable.
b. #The frequent/constant transmission was annoying.

Result nominalizations behave in this respect like underived (singular count) nouns, as seen in (62).

(62)a. #the frequent picnic
b. #the constant cry

Levin and Rappaport (1988) observe that a distinction parallel to the one between process and result nominalizations applies to agent nominalizations. Agent nominalizations show a difference in behavior with respect to adjectives like *frequent* and *constant*. Compare (63a) with (63b)

(63)a. John is a frequent transmitter of world news to head quarters.
b. #This machine is a frequent world news transmitter.

Frequent and *constant* are clearly event quantifiers rather than event predicates (except when applied to plurals or mass nouns, see below). For instance, in adverbial function, they induce scope interactions with other quantifiers, as the contrast between (64a) and (64b) shows.

(64)a. A man arrived frequently.
b. Frequently a man arrived.

[19] It is not clear whether the distinction between so-called process and result nominalizations is really an aspectual distinction that deserves the terminology that Grimshaw (1986) uses. In this paper, I adopt her terminology in order to refer to syntactic categories characterized by different argument structures.

From this observation we can conclude that the distinct behaviour of *frequent* and *constant* with respect to process and result nominalizations and underived nouns is due to their status as quantifiers. The underlying generalization is that quantifying attributes are possible only with process nominalizations, i.e. nominalizations that preserve the argument structure of the verb, but not with other nouns, including result nominalizations. The presence of a verbal argument structure seems to be a condition on the interpretability of attributes as quantifiers, as formulated in the following:

(65) Condition on the Interpretability of Attributes as Quantifiers
If X modifies a noun N, then X can be interpreted as a quantifier only if N has 'verbal status', i.e. has the argument structure of a verb from which it is derived.

As attributes, *frequent* and *constant* may act as event predicates only if they modify plural nouns. In that case they may modify both result nominalizations and underived nouns, as the examples in (66) show.

(66)a. The frequent transmissions were annoying.
b. Mary found the frequent picnics silly.

The generalization for *frequent* as an event predicate is as follows. *Frequent* as an attribute of a noun may act as an event predicate rather than as an event quantifier if and only if the noun denotes groups of events, rather than single events. Groups of events can only be denoted by plural nouns, not by singular count nouns.[20]

The important observation for our discussion of measure adverbials is that measure adverbials pattern together with adjectives like *frequent* and *constant* when they modify nouns. This is shown in (67)–(69).

(67)a. The examination of patients for an hour is productive.
b. #The examination for an hour was productive.

(68)a. John, a wheeler of the bicycle for an hour, cannot come to the phone.
b. #John, a bicycle wheeler for an hour, cannot come to the phone.

(69) #the picnic for an hour

If measure adverbials are quantifiers, they fall under condition (65). This explains the data in (67)–(69).

[20] Frequency expressions may also modify mass nouns, as in *the frequent rain*. For a discussion of *frequent* modifying event-denoting mass nouns, see Moltmann (1989 and 1990b,c).

3. Measure Adverbials and Overt Part Quantification

Adverbials that contain overt quantifiers may exhibit the same restrictions as measure adverbials. In English, NPs with *all of* act as universal quantifiers over the parts of an object. Consider the restrictions imposed by *during all of the performance* illustrated in (70).

(70)a. During all of the performance John made mistakes/many mistakes/# a mistake/# the mistake/# the mistakes/# ten mistakes.
b. During all of the performance John didn't any mistake.

(70) shows that the adverbial *during all of the performance* imposes exactly the same restrictions on its scope as other measure adverbials. Thus, we can assume that the *all of* construction in (70) is interpreted by universal quantification over the parts of the performance, which naturally form a homogeneous quantification domain. The *all of* construction arguably encodes universal part quantification directly, *all* being interpreted as a universal quantifier and *of* as the part of relation.

Other adverbials with overt part quantification in English are *all night* or *all over the world*. (71) illustrates the homogeneity restriction.

(71)a. All night John killed fleas/# a flea/# the fleas.
b. From all over the world people/# a man/# the men/# a hundred people came to congratulate John.

Quantification over parts with *all* in English is rather unsystematic. *All* can apply to singular count nouns only in temporal measure adverbials. Thus we get *all night*, but not *all surface*. Other languages, however, make fully systematic use of universal part quantifiers. Many languages have part quantifiers that attach to definite NPs (for instance Italian *tutto*, French *tous*, Spanish *todo*, Russian *ves'* and *celij*). In adverbials these part quantifiers may form measure adverbials as diagnosed by typical scope restrictions. For illustration consider the Russian examples with *ves'* in (72) and (73).

(72)a. Vo vsjem sadu rosli cvety.
'In the whole garden grew flowers.'
b. #Vo vsjem sadu ros odin cvetok.
'In the whole garden grew one flower.'

(73)a. Vo vsjem sadu rastut somjaki.
'In the whole garden grew weeds.'

(73)b. #Vo vsjem sadu rastjet somjak.
'In the whole garden grew a weed.'

These part quantifiers may also bind definite NPs, as in (74a). (74a) contrasts semantically with (74b), where the definite NP is outside the scope of the adverbial.

(74)a. Situacija byla ploxaja vo vsej strane.
'The situation was bad in the whole country.'
b. Vo vsej strane situacija byla ploxaja.
'In the whole country the situation was bad.'

There are other types of part quantifiers. German, for instance, has an adjectival part quantifier, namely *ganz* 'whole'. Its effect in forming measure adverbials is illustrated in (75).[21]

(75)a. Im ganzen See schwimmen Fische/viele Fische.
'In the whole lake swim fish/many fish.'
b. #Im ganzen See schwimmt ein Fisch/der Fisch.
'In the whole lake swims a fish/the fish.'
c. Im ganzen See schwimmt kein einziger Fisch.
'In the whole lake swims not a single fish.'

Part quantifiers in these languages, of course, occur also in arguments. In singular count and mass NPs they impose restrictions parallel to those of measure adverbials, as illustrated in (76) and (77).

(76) Das ganze Wasser enthält Salz/wenig Salz/# zwei Gramm Salz/# das Salz.
'The whole water contains salt/little salt/two grams of salt/the salt.'

(77) Die ganze Wand ist mit Ameisen/keinen Ameisen/vielen Ameise/# hundert Ameisen/# diesen tausend Ameisen bedeckt.

[21] Adjectival part quantifiers such as *ganz*, *whole* or *entire* allow for another reading beside the part quantificational reading. The examples in (1) are acceptable even though the event predicate does not satisfy homogeneity.

(1)a. Im ganzen See schwamm ein einziger Fisch.
'In the entire lake swam a single fish.'
b. During the whole/entire performance Mary made two mistakes.

In this reading (1a) means that the totality of fish swimming in the lake is one fish, and (1b) means that the totality of mistakes Mary made during the performance is two mistakes. Such a reading is not available with nonadjectival part quantifiers such as *all* and Russian *ves'* (see also Moltmann 1999a for discussion).

(77) 'The whole wall is covered with ants/no ants/many ants/hundred ants/these thousand ants.'

Part quantifiers in the languages mentioned also combine with plurals. However, part quantifiers with plurals do not require homogeneous predicates, as in the Russian examples (78) and (79).

(78) Vo vsex sadax rastjet sornak.
'In all the gardens grows a weed.'

(79) Vsej deti narisovali kartinu.
'All the children drew a picture.'

The explanation for the difference in the behaviour of plurals as opposed to singular count and mass NPs can be traced to general conceptual differences between the individuation of the part structure of groups and the part structure of other individuals, as is argued in Moltmann (1990a,b,c). Groups as referents of plurals do not naturally have a homogeneous part structure. It is a general tendency that proper subgroups and parts of group elements do not form natural parts of a group. Rather, the natural or preferred parts of a group are only the group elements. So the part structure of groups generally provides a quantification domain without cumulativity and divisivity. Therefore, no homogeneity requirement is imposed on the scope of a plural NP with a part quantifier.

The last observations show that the typical restrictions of measure adverbials are not at all specific to certain adverbials, but rather instantiate general properties of constructions involving part quantification over a homogeneous domain. When the domain is not homogeneous, as in the case of groups, no such restrictions result.[22] We can conclude that measure

[22] Besides measure adverbials and overt part quantification there are still other constructions that arguably involve quantification over parts. Vague quantifiers are arguably among them. Referential mass NPs, such as *the water* in (1), do not require a homogeneous predicate. They always allow for nonhomogeneous predicates, as for instance *contain the salt* or *contain two grams of salt* in (1).

(1)a. The water contains the salt.
b. The water contains two grams of salt.

However, mass NPs with vague quantifiers require that the predicate be homogeneous or that it be licensed by negation or binding, as illustrated in (2).

(2)a. A lot of water contained salt/# the salt/# two grams of salt.)
b. A lot of water contains no grain of salt/very much salt.
c. A lot of furniture is covered with different material/with the same material

Sentences with vague plural quantifiers involve quantification over the parts of a group instead of a quantity. Since, a group does not have a homogeneous part stucture, the homogeneity requirement does not hold, as seen (4) with the nonhomogeneous predicates

adverbials are not a special and isolated category, but rather an instance of a very general semantic operation of universal part quantification. Universal part quantifiers are implicit in measure adverbials such as *for two hours* and *worldwide*. But universal part quantification may be directly encoded in measure adverbials or other quantificational constructions by a lexical part quantifier.

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own a car and *own two cars*

(4) A lot of people own a car/two cars.

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