Indefinite *time* Phrases, *in situ* Scope, and Dual-Perspective Intensionality

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Abstract

This paper is concerned with expressions like *three times* in *Dafna jumped three times*. These expressions look like bare noun phrases in adverbial position, and one could, at first sight, think of them as PPs with an empty preposition. Such an analysis, however, would leave two major properties of these expressions unexplained: 1. They show definiteness effects in interpretation. 2. They don't show wide-scope, or very-wide scope interpretations.

I will argue that the crux to explaining these facts lies in Doetjes 1997's assumption that the expression *time(s)* does not pattern with nouns, but with classifiers/measures. Using a semantic interpretation inspired by Categorial Grammar, and the Adjectival Theory of indefinites from Landman 2004, I argue that indefinite time phrases, and only **indefinite** time phrases, have an interpretation directly as modifiers; and this will, in essence, account for the definiteness effects.

I then argue that this analysis treats indefinite *time* phrases on a par with intensional adverbial modifiers. At first sight, this seems problematic, because these *time* phrases don't show the intensionality of, say, modal adverbials. But I argue that the intensionality of modals and of the indefinite *time* phrases are instances of a deeper form of intensionality, **dual-perspective intensionality**.

I then argue that the intensionality involved in indefinite *time* phrases is what we can call **gridding**. Indefinite *time* phrases count pluralities in a set of pluralities of events. Following the theory of plurality of Landman 1989a,b, pluralities cannot be counted directly, only atoms can be counted. The interpretation of the indefinite *time* phrase as an intensional modifier induces the operation of **gridding:** gridding shifts a set of pluralities, which cannot be counted, to a set of corresponding singularities, group atoms, which can be counted.

I show that gridding has precisely the effects on scope that we observe for indefinite *time* phrases: gridding creates scope, but not wide scope and 'very wide scope' interpretations.

This paper is concerned with the semantics of indefinite *time* phrases like *three times* in (1):

(1) Dafna jumped *three times*.

These phrases have been discussed under the name ‘bare NP-adverbs’ by Larson (1985) and Rothstein (1995). Rothstein (1995) shows that these phrases have, besides temporal interpretations, event interpretations. The present paper focuses on event interpretations and takes Rothstein's paper as its starting point.

1. The empty preposition analysis and its problems

The grammatical puzzle concerning these expressions, first raised by Larson (1985), is: how can a noun phrase like *three times* in (1) occur in adverbial position, when normally noun phrases cannot? The answer that Rothstein (1995) gives is that these phrases only look like noun phrases, but are in fact prepositional phrases with an empty preposition:

$[_{PP}\ [_{p}\ Ø]\ [_{DP}\ \textit{three times}\ ]]$

The phrase is a PP, and hence can occur unproblematically in adverbial position. In this PP, *three times* is a DP, which is in the normal complement position of an empty preposition. Rothstein's paper is concerned with the semantics of this empty preposition.

I am going to argue in this paper that this analysis is problematic, and in the bulk of the paper, I will develop an alternative analysis.

The problem with the empty-preposition analysis can be stated quite simply. If *three times* is a normal DP in a normal DP-argument position - the complement of an empty preposition - one would expect it to behave like other argument DPs in similar argument positions. The problem is that these *time* phrases differ from normal argument DPs in several ways:

1. The *time* phrases show **definiteness effects** that argument DPs in similar positions do not.
2. The *time* phrases interact in **scope dependencies**, but not in the same way as argument DPs:
2a. The scope mechanism for argument DPs doesn't apply to *time* phrases: indefinite *time* phrases cannot be given **wide scope** in the way normal DPs in argument position can.
2b. The 'very-wide-scope'-mechanism for indefinite argument DPs doesn't apply to *time* phrases. This means that, unlike normal indefinite argument DPs, indefinite *time* phrases inside the complement of intensional verbs cannot be given ***de re* interpretations.**

The co-occurrence of properties (1) and (2) is suggestive, because properties 2a and 2b are typical for indefinites in positions where they show definiteness effects, as argued in Landman 2004, and I have argued there that this cluster of properties can be explained naturally if we assume that those positions are not, semantically, argument positions.

Thus, if the data are as I suggest, there is good reason to assume that *three times* in (1) is not, semantically, in argument position, and hence not in the complement position of an empty preposition (at least not if we follow the standard assumption that the latter position is a normal argument position).

2. Discussing the data

In this section I will argue that the indefinite *time* phrases indeed have the properties (1) and (2) listed above.

2.1. Definiteness effects

I start with an uncontroversial observation, namely that for indefinite *time* phrases, the event interpretation can be paraphrased by an explicit *there*-insertion construction: (2a) is equivalent to (2b):

(2) a. Dafna jumped *a few times* / *three times* / *many times* / *no times*.
b. There were *a few* / *three* / *many* / *no* jumpings of Dafna.

Secondly, I assume Keenan's principle, discussed in Keenan 1987:

Keenan's principle:
[*There are* **D** *noun pred*] is equivalent to [**D** *noun pred*] iff **D** is indefinite.

Keenan's principle (formulated for normal *there*-insertion constructions) works very well (as long as we keep in mind the well-known caveat that for context dependent deteminers, like *many*, the equivalence only holds if the context dependent element is kept constant). Keenan's principle tells us that (3b) and (3c) are truth conditionally equivalent (*pace* the caveat for *many*):

(3) b. There were *a few* / *three* / *many* / *no* boys in the garden.
c. *A few*/ *three*/ *many*/ *no* boys were in the garden.

For indefinite *time* phrases, Keenan's principle tells us that (2b) and (2c), and hence all of (2a)-(2c), are equivalent (with the same caveat about context dependent determiners). And this too, is, I think, perfectly reasonable:

(2) a. Dafna jumped *a few times* / *three times* / *many times* / *no times*.
b. There were *a few* / *three* / *many* / *no* jumpings of Dafna.
c. *A few* / *three* / *many* / *no* jumpings were (jumpings) of Dafna.

For definite *time* phrases, like the ones in (4), Keenan's principle says that (4b) and (4c) are **not** equivalent. Indeed, the cases in (4b) are generally regarded as infelicitous:

(4) a. Dafna jumped *every time* / *most times* / *the three times*.
b. #There was/were *every* / *most* / *the three* jumping(s) of Dafna.
c. *Every* / *most* / *the three* jumping(s) was a jumping/were jumpings of Dafna.

So far we have seen that for indefinite *time* phrases (2a), (2b) and (2c) are equivalent, while for definite (and quantificational) *time* phrases, (4b) and (4c) are not equivalent. The central observation that I want to draw attention to now, is that there is a **further** difference between the indefinite and definite (and quantificational) *time* phrases: for definite and quantificational *time* phrases, (4a) and (4c) are **not** equivalent.

Compare indefinite (5a) and definite (5b/c):

(5) a. Dafna jumped exactly three times.
b. Dafna jumped every time.
c. Dafna jumped most times.

For indefinites we find the following. On its most natural interpretation, (5a) counts indeed just how many jumpings of Dafna there were. If she jumped three times when it was her turn, and twice when it wasn't, we would say that (5a) is false.

Of course, we can, in context, massage *jumpings* by domain restriction into *jumpings when it was her turn*, and get , in context, a weaker effect, but this is what you can do, of course, for any normal indefinite noun phrase as well. Out of the blue, we directly count jumpings, just as for *three boys*, out of the blue we directly count boys. This means that, for indefinite *time* phrases, it is completely appropriate to base the semantics on the equivalences in (2).

For definite and quantificational cases we find the following. If (6a) were, out of the blue, equivalent to (6b), then it would be, out of the blue, equivalent to (6c). Similarly, (7a) would be equivalent to (7b) and hence to (7c):

(6) a. Dafna jumped every time.
b. Every jumping was a jumping of Dafna.
c. Only Dafna jumped.

(7) a. Dafna jumped most times.
b. Most jumping were jumpings of Dafna.
c. Dafna jumped more than anybody else.

But, out of the blue, (6a) is not equivalent to (6c), and (7a) is not equivalent to (7c).

In a most natural situation, Dafna has wiggled herself in with the big kids, who allow her five turns, and she dares to jump on each turn (and I say 6a), or on four out of five (and I say 7a). The big kids themselves jump of course much more often: (6c) and (7c) are false.

Again, in context, you **can** get the effect of the c-reading: in a context where turns are not jumping turns assigned to Dafna, but jumping turns assigned to any kid, and only one kid can jump at a time, you get the effect of the c-readings, and Dafna can say: I jumped most times, meaning, more than anybody else. But again, out of the blue you get the weaker interpretation.

I think the point I am making becomes even clearer if we look at cases where we only get event-interpretations, and eliminate the possibility of assigning purely temporal interpretations.

Imagine a rich person in front of a panel of light bulbs, who tells you that usually when a light goes up, he gets $20,000 in his bank account. Three lights going up simultaneously usually means $60,000, so we are not counting times but events of lights going up. Now, this person tells you (8a), with an indefinite. The truth conditions of (8a) can be adequately paraphrased as (8b), and also as (8c) (so the case is similar to that in 2):

(8) a. In the last hour, I got $20,000 in my bank account seven times.
b. In the last hour, there were seven events of me getting $20,000 in my bank account.
c. In the last hour, seven events of someone getting $20,000 in his bank account were events of me getting $20,000 in my bank account.

Now suppose the person says (9a), with a quantificational *time* phrase:

(9) a. In the last hour, I got $20,000 in my bank account every time.
b. In the last hour, I got $20,000 in my bank account every time a light went up.
c. In the last hour, every event of someone getting $20,000 in his bank account was an event of me getting $20,000 in his bank account.
d. In the last hour, nobody but me got $20,000 in his bank account.

The point I am making is this. In the context given, (9b) is obviously the most natural interpretation for (9a). If it were the case that the quantificational *time* phrase in (9a) has the same interpretation possibilities as the indefinite one in (8a), we predict that (9c), and hence (9d), is an **equally** possible reading of (9a) in this context. However, the observation is that (9d) is not easily available **at all** as an interpretation of (9a). (And note that there is nothing **incoherent** about (9d), it's the kind of gleeful thing that this kind of rich person would enjoy saying at any time, so it is contextually relevant in any context.)

But this strongly suggests that (9d) is not a reading of (9a): its effect, when present, is easily derived contextually from the basic reading for (9a), which is the one that out of the blue gets you (9b). This basic reading is the interpretation that Rothstein assumes:

(10) Every event in a contextually given set is matched with an event of me getting $20,000 in my bank account. (e.g. $20,000 per light bulb lighting)

On this reading, events of him getting $20,000 are, so to say, counted **indirectly** though the matching with contextually given events.

But, as we have seen, this interpretation is **too weak** for the indefinite cases: their basic reading is much stronger. In (8a) we count events of getting $20,000 **directly**, though the equivalences in (8).

What all this means is that there are indeed definiteness effects here, but **definiteness effects that concern available interpretations**: indefinite time adverbials directly count main clause events (which suggests that they modify the main clause verb directly), while definite and quantificational time adverbials count main clause events indirectly through matching (which suggests that their relation to the main clause verb is more indirect, as it is in Rothstein's analysis).

2.2. Scope dependencies

I take it to be uncontroversial that *time* phrases engage in scope dependencies, with each other, and with noun phrases:

(11) a. Three times Dafna kissed Susan twice.
b. Twice Dafna kissed three girls.

(11a) means that there were three events, each being a complex of two events of Dafna kissing Susan. Similarly, (11b) means that there were two groups of events, each being a complex event of Dafna kissing three girls.
The same holds, by the way, for (12):

(12) Twice Dafna kissed Susan twice.

In (12), a scopeless interpretation would not be inconsistent, but it doesn't exist: (12) postulates four kisses, not two (as a scopeless reading would predict). So, *time* phrases do interact in scope dependencies.

2.2.1 Lack of wide scope for indefinite time phrases

What I want to argue, though, is that we **don't** get scope ambiguities stemming from assigning the *time* phrases wide scope. We see that in (11a) above. We cannot give *twice* wide scope over *three times*. That is, (11a) allows situation I, but not II:

I: e_1: kiss-kiss e_2: kiss-kiss e_3: kiss-kiss (three groups of two kisses)

II: e_1: kiss-kiss-kiss e_2: kiss-kiss-kiss (two groups of three kisses)

Let's make the argument a bit more precise. It is not controversial that (13) allows a wide scope interpretation for the object argument DP *three boys*, besides the natural narrow scope interpretation:

(13) Every girl kissed three boys.

I think that (14), with indefinite *time* phrase *three times*, actually has the same two interpretations:

(14) Every girl kissed Dafna three times.

This can mean that every girl gave Dafna three kisses, but also there were three event-complexes in which **every** girl kissed Dafna once. At first sight, this suggests that the *time* phrase has the same scope possibilities as the noun phrase in argument position. But there is another explanation of the effect. The ambiguity can be explained naturally in terms of the adjunction possibilities for the *time* phase. While *time* phases in this position prefer adjunction to a position lower than the subject, we can assume that the other possibility of adjoining it higher is not excluded. That would naturally give us two interpretations, without invoking a scope mechanism at all.

We can control for this problem by sandwiching the *time* phrase between two adjuncts that do not allow high adjunction. One would expect that in such a case adjoining the middle one higher than the subject is a marginal to non-existent option. Such a case is (15):

(15) Every girl kissed Dafna softly three times on the lips.

The observation is that, unlike (14), (15) does not allow a wide scope interpretation of *three times* at all: (15) only has the three-kisses-per-girl interpretation. This shows two things. First that the explanation for why (14) has both readings is probably the correct one. Secondly - and this is the point that this section is all about - the absence of the wide scope reading in (15) is unexplained if *three times* is an argument noun phrase, the complement of an empty preposition: in that case the same scope mechanism that gives *three boys* wide scope in (13), should be able to give *three times* wide scope in (15). This is evidence, then, that indeed the scope mechanism doesn't apply to *three times*.

2.2.2. lack of 'very wide scope' for indefinite time phrases

For those of us who believe that 'very wide scope' phenomena use the same scope mechanism as normal (clause-bound) wide scope phenomena (a dwindling minority to which I belong), the fact that the normal scope mechanism doesn't apply to the indefinite *time* phrase means that you wouldn't expect to find 'very-wide-scope' readings either. For the majority who believes that the two are different phenomena, I point out here that indefinite *time* phrases differ from indefinite noun phrases in argument position in that the first do not allow 'very-wide-scope' interpretations.

***De re* readings for argument indefinites**:

(16) Bill believes that *exactly three girls in Dafna's class* are hyper-intelligent.

Let us assume that Bill believes that 10 girls are hyper-intelligent, and he believes all of them to be in Dafna's class. In fact only three of them are in Dafna's class. He has just told you that Dafna is in such a superclass, ten hyper-intelligent girls… And I tell you, *sotto voce*:

> Well, he actually only believes that exactly three girls in Dafna's class are hyper-intelligent.

In this context, I give *exactly three girls* a *de re* interpretation, and that is perfectly possible.

Lack of *de re* readings for indefinite *time* phrases:

(17) Bill believed that Dafna jumped *exactly three times*.

Suppose that Bill thinks (*de dicto*) that Dafna jumped ten times. Well, he actually saw only three of them, but he thinks she continued. In fact, she didn't, she only jumped those three times. Now it is true that there are exactly three real events of which Bill believes that they are jumpings of Dafna. This means that, **if** (17) has a *de re* reading for *exactly three times*, (17) should be true in the above sketched situation (on the *de re* reading). But clearly, (17) is **not** true in this situation. In this situation, I couldn't really, *sotto voce*, tell you:

> Well, he actually only believes that she jumped exactly three times.

That is just not true. Hence *exactly three times* cannot get a *de re* intepretation in (17).

2.3. Conclusion

Landman 2004 argues that definiteness effects concern indefinites that are not in argument position. Given this, indefinite *time* phrases differ from indefinite argument DPs in that they show definiteness effects (*time* phrases have a direct counting reading only when they are indefinite), they differ further from indefinite argument DPs in that they lack wide scope, and very-wide-scope readings. All of these properties are unexplained on the empty preposition analysis.

3. An outline of my analysis

My own analysis starts with an observation by Jenny Doetjes (Doetjes 1997).
In Dutch, like in English, nouns show number agreement with determiners/numericals:

(18) #Drie meisje/ Drie meisjes
Three **girl** Three **girls**

But, unlike in English, many **measures** in Dutch show **optional** number agreement, with the non-agreeing form actually preferred:

(19) a. Drie liter water / Drie liters water
Three **liter** water/ Three **liters** water
b. Drie pond gerookte knoflook worst /
Three **pound** smoked garlic sausage/
Drie ponden gerookte knoflook worst
Three **pounds** smoked garlic sausage

And Doetjes observes that in Dutch *keer/maal* (*time*) patterns with measures in allowing optional number agreement in the Dutch adverbial *time* phrases:

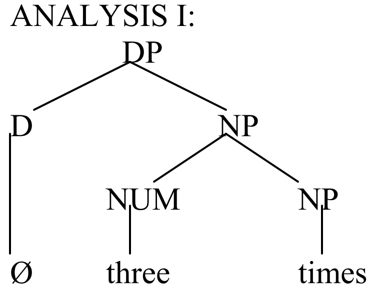
(20) Dafna sprong drie keer / drie keren.
Dafna jumped three **time**/ three **times**.

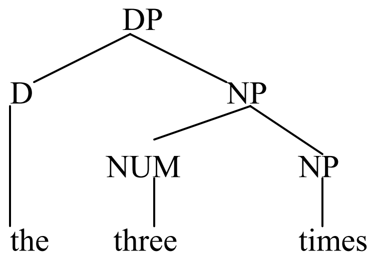
Thus, *time(s)* does not pattern with normal nouns but with measures.

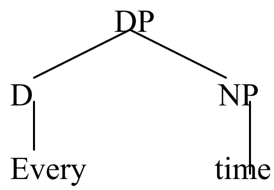
I will use in this paper d for the type of individuals and e for the type of events. Standardly, we assume that the semantic type of **noun phrases** is <d,t> (predicates of individuals), whereas that of **measures** is <<d,t>,<d,t>>: the measure takes a noun phrase complement (of type <d,t>) and forms a complex noun phrase (also of type <d,t>). Now, Rothstein, in her paper, assumed that *time(s)* is a **noun phrase** of type <e,t> (a predicate of events). The starting idea of my analysis (to be modified shortly) is that *time* is a **measure** of type <<e,t>,<e,t>>, mapping sets of events onto sets of events.

If *time* were a normal noun, we could base our semantics of the *time* phrases on the following syntactic structures:

ANALYSIS I:







The semantics of these structures would be standard: you use functional application to build up the interpretations of the complex expressions:

APPLY[α,β] = (α(β)), if the types fit, otherwise make them fit by type shifting.

Thus the semantics of these noun phrases is derived by:

APPLY[**det**, APPLY[**three**, APPLY[**plural**, **time**]]]

In this, **plural** is the standard pluralization operation *, **three** is λe.|e|=3, the set of sums of events that consist of three atomic events. In the application, this latter interpretation shifts to a modifier interpretation with intersective type shifting rule ADJUNCT[α] = λPλe.P(e) ∧ α(e). **det**, finally, is the determiner meaning. The output is a generalized quantifier of type <<e,t>,t>. Rothstein's empty preposition would map this onto a modifier interpretation for the whole phrase.

But *time* isn't a normal noun: it combines semantically with a predicate of events (type <e,t>) to give a predicate of events. For clarity, I will encode this syntactically in the category label, in the way it is done in categorial grammar:

ANALYSIS II:

The category of *time* is not NP, but NP/PRED (of type <<e,t>,<e,t>>)

Now, I don't assume a different semantics for the categories NUM and DET, and that means that I cannot use functional application to build up the complex interpretations. Instead, I follow the standard assumption in categorial grammar that, when slashes are involved, the semantic combination operation is **function composition**:

COMP[α,β] = λe.(α(β(e))) if the types fit, otherwise make them fit by type shifting

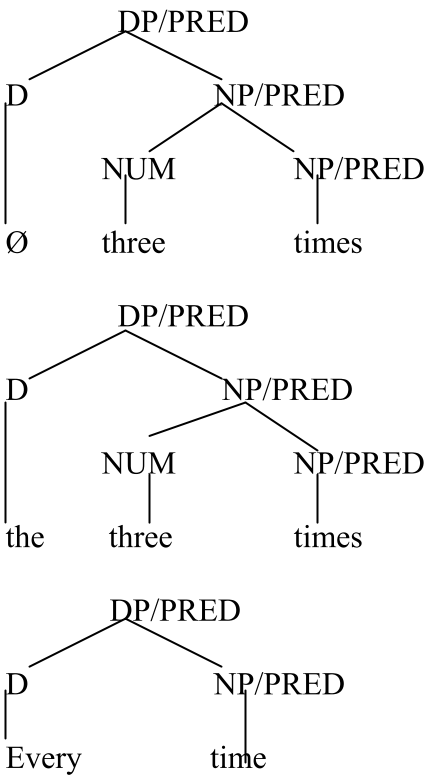
Thus, the semantics of these noun phrases is derived by function composition:

COMP[**det**, COMP[**three**, **time**]]

Note that plurality is not separately semantically encoded in this analysis, because I assume, following Doetjes' observations, that *time* is not semantically specified for plurality.

Now, the output of the function composing **three** and **times** is not of type <e,t>, but again of type <<e,t>,<e,t>>. Once again, I will, for clarity encode this in the category label, and assume that the output category is not NP, but NP/PRED. The same holds at the next level, hence our tree is not a DP-tree, but a DP/PRED tree. So, the syntactic structures I assume are:

ANALYSIS II:



We now come to the semantics of the determiners. I assume what I have called in Landman 2004 **the Adjectival Theory of indefinites**. On this analysis, indefinites, definites, and quantificational DPs are interpreted at the three different types of the Partee Triangle (Partee 1987):

-**Quantificational DPs** are interpreted at the type of generalized quantifiers, in the case of event phrases that is type **<<e,t>,t>**

$[_{D[GQ]}\ \textit{every}\ ] \quad \rightarrow \quad \lambda Q \lambda P.\mathrm{ATOMIC}(Q) \wedge \forall e[Q(e) \rightarrow P(e)]$

(the relation that holds between Q and P if Q is a set of atoms and every Q is a P)

-**Definite DPs** are interpreted at the type of individuals, for event phrases that is type **e**.

$[_{D[IND]}\ \textit{the}] \quad \rightarrow \quad \lambda Q.\sigma(Q)$

(the function that maps Q onto the sum of Q if that is in Q)

-**Indefinite DPs** are interpreted at the type of predicates, for event phrases that is type **<e,t>**.

$[_{D[PRED]}\ \textit{Ø}] \quad \rightarrow \quad \lambda Q.Q$

(the identity function on predicates)

This means that the above three trees get interpretations at different types:

DP[GQ]/PRED: *every time* TYPE: <<e,t>,**<<e,t>,t>**>
(*every time* denotes a function from predicates into generalized quantifiers)
DP[IND]/PRED: *the three times* TYPE: <<e,t>,**e>**
(*the three times* denotes a function from predicates into individuals)
DP[PRED]/PRED: *Ø three times* TYPE: <<e,t>,**<<e,t>**>
(*three times* denotes a function from predicates to predicates).

We see here that, on the assumption that *time* is semantically a measure, the Adjectival Theory of indefinites (which I have motivated at length in Landman 2004) predicts that the semantic type of **indefinite** *time* phrases, i.e. the type corresponding to category **DP[PRED]/PRED,** is a **modifier type** of the form **<a,a>.** Moreover, it predicts that **only indefinite *time* phrases** have an interpretation at a modifier type.

Now, in categorial grammar, modifier categories, like PRED/PRED are legitimate **syntactic** categories used for modifiers. For instance, intensional adjectives are assumed to be interpreted at modifier type <<s,<d,t>>,<s<d,t>>>; intensional adverbials are interpreted at modifier types, like <<s,<e,t>>,<s,<e,t>>> or <<s,t>,<s,t>> and they are assumed to be of syntactic categories that look like PRED/PRED (e.g. CN/CN, IV/IV, S/S in Montague's work, e.g. Montague 1970, 1973). Thus, in categorial grammar a PRED/PRED combines with a PRED to give a PRED.

While the introduction of categorial grammar labels so far was only meant to have heuristic value, the crux of my proposal is a linguistic proposal about the category DP[PRED]/PRED: I propose that **DP[PRED]/PRED is a legitimate syntactic modifier category,** i.e. DP[PRED]/PRED can count as PRED/PRED.

With this assumption, we derive the following. Indefinite DP/PREDs, and only indefinite DP/PREDs, can form legitimate syntactic adverbial modifiers. This means that, on this analysis, **indefinite *time* phrases, and only indefinite *time* phrases, can form legitimate syntactic adverbial modifiers**.

Thus, we solve the 'grammar puzzle' in a different way from Rothstein: *three times* can occur in adverbial position, because it is a DP[PRED]/PRED, which is a legitimate adverbial category.

What about the differences between indefinite *time* phrases and argument DPs?

1. Definiteness effects.

The semantics that I will give shortly for the DP[PRED]/PREDs will be a semantics of **direct counting**. Indefinite *time* phrases have this semantics, because they can be DP[PRED]/PREDs. Definite and quantificational *time* phrases cannot have this semantics, since their category is not an adverbial modifier category with the direct counting interpretation. In other words, when definite and quantificational *time* phrases occur in adverbial position, they are something else, **a different construction**.

Of course, one needs to explain the distribution and semantics of that construction as well, but that is not what this paper is about. In Landman 2004 I analyze them as degree phrases with an empty degree head and assign them, through the degree head, an indirect counting interpretation.

2. Lack of wide and widest scope.

DP[PRED]/PREDs are **not** argument DPs, but true adverbial modifiers.
Since the scope mechanism and the very wide scope mechanism are restricted to argument DPs, we don't expect them to apply to DP[PRED]/PREDs.

As we will see, in some ways, DP[PRED]/PREDs are similar to intensional verbs: like intensional verbs, they engage in scope dependencies, but like intensional verbs, they cannot themselves be given higher scope (the scope mechanism doesn't 'move' intensional verbs).

A remark: In Landman 2003, I assumed a slightly different syntactic structure for *three times*. I assumed there that *time*, which semantically needs a complement, actually takes an empty syntactic complement [Ø *three times* Ø], which, following categorial grammar, I assumed to be of category PRED/PRED (interpreted as the identity function). As it turns out, the semantic proposal I am making is actually completely neutral between these two syntactic analyses. So, if you prefer *time* to take an empty complement in the syntax, this is perfectly compatible with the analysis.

4. Dual-perspective intensionality

In this section, I take a step back and express some thoughts on different types of modifiers and different types of intensionality.

I assume (following Landman 2000, 2004 and much other literature) the following semantics for **intersective modifiers**: intersective modifiers are interpreted at the predicate type (<d,t> or <e,t>) and shift, when combining with a head, to the modifier type with intersective type shifting rule ADJUNCT: $\text{ADJUNCT}[\alpha] = \lambda P \lambda x.P(x) \wedge \alpha(x)$.

Putting intersectivity in the type shifting rule has obvious advantages: it gives a unified account of predicative and pre-nominal adjectives, and a unified account of different intersective modifiers: that is, in the nominal domain, it doesn't just apply to adjectives, but also straightforwardly to prepositional phrases and relative clauses.

For **degree adjectives/adverbials**, I assume that, though they seem at first sight non-intersective, these effects are due to contextual shifts in the standard of comparison that their semantics refers to: semantically, they are just intersective modifiers (some of the standard arguments for this analysis are discussed in Landman 2000, Ch. 1).

The most prominent type of clearly **non-intersective modifiers** are intensional modifiers, like *potential*, *former*, etc. These are inherently modificational, they are generally assumed to be generated at intensional modifier types **<<s,a>,<s,a>>**, and there are good semantic arguments that they cannot be generated at lower (non-modifier) types.

The question now is: where are indefinite *time* phrase?
Clearly, indefinite *time* phrases cannot be analyzed as intersective modifiers. As an intersective modifier, the obvious interpretation for *three times* would be the one given above: $\lambda e.|e|=3$, the set of all sums of events with three atomic parts, of type <e,t>.

It cannot have this interpretation, because intersective interpretations are scope-less interpretations, and indefinite *time* phrases do not have scopeless interpretations:

(21) Twice, Dafna kissed Susan twice.

The intersective analysis derives an interpretation which just gives the same specification twice: there is a sum of Dafna-kissing-Susan events which consists of two atomic events and which consists of two atomic events. This interpretation is wrong: (21) requires four kisses, not two.

The analysis that I have given so far, analysis II, says: indefinite *time* phrases are generated directly at type <<e,t>,<e,t>> (and not at type <e,t>).

There is a bit of a problem here too: this analysis introduces a third type for modifiers (besides <e,t> and <<s,<e,t>>,<s,<e,t>>>), and it introduces this only for the indefinite *time* phrases. It seems to me that this misses a generalization. And it leads to the question that interests me in this section: can we reduce indefinite *time* phrases to intensional modifiers?

There is a trivial, technical, sense in which the answer to this is yes: we can trivially express an extensional interpretation from type <<e,t>,<e,t>> at an intensional type (just as we can find the right extensional interpretation for *find* at the intensional type for *seek*, as we know from Montague 1973).

I want to pose a more interesting question: Is there a real sense in which these indefinite *time* phrases are intensional?

As a first answer, it is quite obvious that indefinite *time* phrases are surely not modal: they do not make reference to extensions across possibilities like modals do.

Nevertheless, I **will** assume that indefinite *time* phrases are in fact intensional modifiers. What we need to rethink is our notion of intensionality.

As we all know, the notion 'intensionality' in semantics is used for two different notions. In the study of modals, we mean by intensionality variation of extension across possible alternatives (possible worlds). Intensional operators, here, are operators that are sensitive to the pattern of variation of extension across alternatives (and not just the extension). But in the foundation of our field, the mathematics of the type theory used, there is a different notion of intensionality, which I call **dual-perspective intensionality**. With this notion, we distinguish, for instance, between an extensional and an intensional notion of function.

-Extensionally, the operations of Addition on the natural numbers and Addition on the real numbers are different functions (different sets of ordered pairs). But in mathematical practice we think of these as one and the same operation, operating on different domains: an operation whose essential properties (like commutativity) are specified independenly of the particular domain it operates on. This is an intensional notion of function.

-Extensionally, there are infinitely many countable atomless Boolean Algebras, but, they are provably identical up to isomorphism. In mathematical practice we talk about **the** countable atomless Boolean Algebra, again an intensional notion.

And it is not that we just talk about it as one. It is actually mathematically useful and fruitful to think about it as one, even as you accept an extensional theory in which the intensionality, strictly speaking, plays no role.

Importantly, I am not claiming here that in the foundations of mathematics we **must** recognize intensional functions. Mathematicians can decide that for themselves. I am just claiming that this intensionality is typically not eliminated from mathematical practice (even if it can). Dual-perspective intensionality is what abstraction is about. You abstract away from the actual extensional set of pairs that a function is, lift, so to say, the function out of its original structure, and treat it as an object in its own right, an object which has properties in its own right. And that means: you put **it** in a different (more abstract) mathematical structure, where **it** has, say, the property of commutativity: **Addition** is commutative.

Again, the dual perspective of a function as an extensional object inside a structure and an intensional object lifted so to say out of the structure doesn't necessarily play a role in anybody's foundations of mathematics (though it does in constructive approaches), but it does play a role in the practice of mathematics.

So, dual-perspective intensionality is concerned with abstraction and primitives. It involves a switch between an **extensional perspective**, where an object is treated extensionally inside a structure where it is the sum of its parts (which is what extensionality means) and an **intensional perspective**, where the object is lifted from that structure, treated as an object in its own right, more than the sum of its parts (which is what intensionality means): as an intensional entity it can have properties and stand in relations relatively independently from its parts.

Dual-perspective intensionality can not be reduced to the intensionality of modality. It involves abstraction, but not over alternatives in the sense of possible world semantics.

But the intensionality of modality **can** and **has** been regarded as a special case of dual-perspective intensionality.

In fact, historically, Possible World Semantics came into existence through dual-perspective intensionality. In Carnap 1947, possible worlds were maximally consistent sets of facts (i.e. models), which, algebraically, can be regarded as extensional objects in the partially ordered structure of consistent sets of facts. One of the problems with this idea was that this allowed for only one notion of modality, logical modality. Kripke lifted possible worlds out of this structure (e.g. Kripke 1963), and regarded them as objects in their own right, **primitives**, no longer completely determined by the facts that make them up. In this way, they can stand in accessibility relations, independently of the (non-modal) facts that make them up.

Dual-perspective intensionality has been assumed in the semantics of a variety of linguistic constructions, by various authors. A far from complete list is the following.

-Frege 1892's notion of function is a dual-perspective notion: we switch between functions as (saturated) objects in their own right (intensional) and (unsaturated) objects identified with their value ranges (extensional). Chierchia 1984 (and later works) uses this in his semantics of nominalization and predication.

-Thomason 1980, Chierchia 1984, and other authors working on Property Theories discuss hyper-intensionality. The upshot of hyper-intensional theories is that the general case of intensionality is dual-perspective intensionality (hyper-intensionality). In these theories, modal intensionality is regarded as a special instance of that. That is, the modal intensionality operator ^ can be regarded as built by means of dual-perspective intensionality: you go from α to $^\wedge\alpha$ by lifting α out of its extensional structure (type a) (creating an intensional object in the dual-perspective sense), and then putting it into a domain of its own, in this case, type <s,a> (see e.g Thomason 1980).

-Another case is the stage-individual distinction from Carson 1977, used, among others, in the semantics of generics: we switch between an extensional concept of individuals and kinds as the sums of their stages - their spatio-temporal realizations- and an intensional concept, where the individuals and kinds are just objects in their own right.

-Most relevant for the present paper: dual-perspective intensionality is discussed in Link 1984 and Landman 1989 in the context of notions of plurality and groups: we switch between an extensional notion of pluralities as the sums of their atomic parts and an intensional notion of the same as groups, atomic individuals in their own right, more than the sums of their parts.

With all this in the back of our mind, I make the following proposal about modifiers: There are two classes of modifiers: **intersective** modifiers and **intensional** modifiers**. But intensional means dual-perspective intensional**.

This makes modals one class of dual-perspective intensional operators. My proposal for indefinite *time* phrases is that they are interpreted as direct counters, and direct counters are dual-perspective intensional operators.

The theory developed in the next sections is based on the theory of plurality and groups that I developed in Landman 1989a,b. The basic idea is as follows. The indefinite *time* phrase counts events. But it does not count events as they are sitting in their extensional structure: in order to count them, it lift the events out of their structure and **then** counts them. This is dual-perspective intensionality.

What I will argue is that what the dual-perspective intensionality triggered by *time(s)* does is **gridding**: We want to count a set of pluralities; following Landman 1989a,b, we don't count pluralities directly, because counting is semantically counting of singularities, atoms, and we would wrongly count the atoms of the pluralities, rather than the pluralities themselves. To count the pluralities in a set of pluralities, we impose a **grid** on that set: we map the set of pluralities onto the set of **corresponding** singularities, group atoms. It's the latter groups that are counted, and it is this gridding that gives the *time* phrase scope. Indefinite *time* phrases can justifyably be called intensional modifiers, because gridding is an intensional notion: it introduces a perspective on the pluralities as objects in their own right, atoms. I will now formalize this idea.

5. Formalizing dual-perspective intensionality

I will use as background the group formation operation from Link 1984, Landman 1989 and Landman 2000. I will not reformulate this operation itself as a dual-perspective intensional operator in the formal sense introduced below (though that is easy enough to do).

I assume that the domain of type e forms a complete atomic Boolean algebra with set of atoms ATOM: D_e = <B,ATOM>. The set of atoms is sorted into individual atoms (IND), group atoms (GROUP), and group of group atoms (G-GROUP).

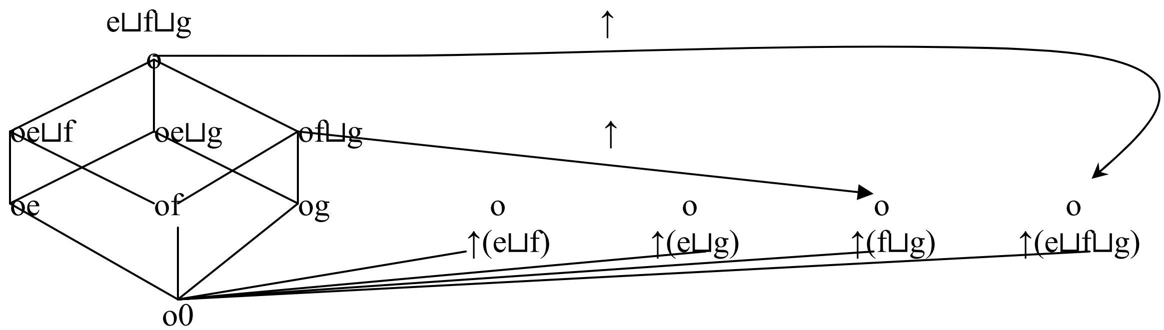
So ATOM = IND $\cup$ GROUP $\cup$ G-GROUP.

The operation of group formation, ↑, maps pluralities (sums) onto group atoms:

If $\alpha \in$ *IND − IND, then $\uparrow(\alpha) \in$ GROUP
If $\alpha \in$ IND, then $\uparrow(\alpha) = \alpha$

If $\alpha \in$ *GROUP − GROUP, then $\uparrow(\alpha) \in$ G-GROUP
If $\alpha \in$ GROUP, then $\uparrow(\alpha) = \alpha$

A partial picture:



The first part of this operation is the operation as it is given in Landman 2000.
The difference is, that I assume, with Landman 1989, that the operation of group formation is iterative, that we can also apply ↑ to sums of groups and get a group of groups. I have only specified it here up to the level of G-GROUP, because that is as far as I need it in this paper.

With the help of the group operator, I will introduce two **dual-perspective intensionality operators**: $^{\uparrow}$ and $^{\downarrow}$**.**

The idea is as follows. Modal modifiers are of type:

<<s,<e,t>>,<s<e,t>>> (s-et, s-et).

I will assume that counter modifers are of a new type:

<<↑e,t>, <↑e,t>> (up-e t, up-e t).

So what is the type <↑e,t>?

The idea of dual-perspective intensionality is the following:

-You lift **a set of sums** out of its extensional environment (type <e,t>).

This I interpret as:

you put a set of sums in store as a set of intensional objects at type <↑e,t>.

-Then you put this set of intensional objects back into a new extensional environment.

This I interpret as:

You move the set of intensional objects derived at type <↑e,t> into type <e,t>.

On this interpretation, type <↑e,t> is the type where the set of extensional objects occurs as a set of intensional objects, **the type of the store**.

In the store, the set of intensional objects is screened off from the extensional operations, it is just in store. In order to apply the extensionally defined operations, you put it into a new extensional environment, which in our case I can take to be the very same old extensional environment, because I already have individuals and groups in my domain of type e (i.e. the distinction between individuals and groups is treated as a sortal distinction, not as a type distinction).

This suggests two operations, which I will call $^{\uparrow}$ (little-up) and $^{\downarrow}$ (little-down):

$^{\uparrow}$: <e,t>	→ <↑e,t>	From **e-t** to **up-e-t**
$^{\downarrow}$: <↑e,t>	→ <e,t>	From **up-e-t** to **e-t**

I add to the type logic for type e a new type ↑e, the type of the store of e. The domain of type ↑e, $D_{\uparrow e}$, is defined as follows:

D_e = <B,ATOM>, a complete atomic Boolean algebra.

$D_{\uparrow e}$ = ATOM

This means that $D_{<\uparrow e,t>}$ = (ATOM → {0,1}), or set-theoretically:

$D_{<\uparrow e,t>}$ = pow(ATOM)

Thus, an expression of the store type <↑e,t> denotes a set of atoms.

With this, I define the dual-perspective intensionality operators as follows:

The dual-perspective intensional operator $^{\uparrow}$.
If α is of type <e,t>, $^{\uparrow}\alpha$ is of type <↑e,t>
$[\![^{\uparrow}\alpha]\!]_{M,g} = \{\uparrow(e){:}\ e \in [\![\alpha]\!]_{M,g}\}$ (reformulated for characteristic functions)

$^{\uparrow}$ takes a set of sums (in the domain of type <e,t>), and lifts each of the elements of that set out of its extensional environment: its output is the set of the groups corresponding to the sums in the input (in the domain of type <↑e,t>).

We treat type <↑e,t> as a store, and this means that the normal extensional operations like sum-formation ⊔ and plurality * are not defined on this type. This means that, if α is an expression of type <e,t>, *α is an expression of type <e,t>, but $*^{\uparrow}\alpha$ is not a well-formed expression, even though $D_{<\uparrow e,t>}$ is a subset of $D_{<e,t>}$.

But with $^{\downarrow}$ we put the stored elements back into an extensional domain, and the operations are available again. This is in fact **all** that the operation $^{\downarrow}$ does: semantically it doesn't do anything at all:

The dual-perspective intensional operator $^{\downarrow}$.
If β is of type <↑e,t>, $^{\downarrow}\beta$ is of type <e,t>
$[\![^{\downarrow}\beta]\!]_{M,g} = [\![\beta]\!]_{M,g}$ (reformulated for characteristic functions)

This means that, when we have shifted α to $^{\uparrow}\alpha$, it is a **frozen** expression. We thaw it with $^{\downarrow}$: $^{\downarrow\uparrow}\alpha$ is of type <e,t>, and we can apply all the extensional operations to it. This means that, though $*^{\uparrow}\alpha$ is not a well-formed expression, $*^{\downarrow\uparrow}\alpha$ **is** a well-formed expression of type <e,t>.

It is important not to be mislead by the analogy with caps and cups:
If α denotes a set of atoms, then $^{\downarrow\uparrow}\alpha = \alpha$. But, if α denotes a set of sums, $^{\downarrow\uparrow}\alpha \neq \alpha$.
In that case, $^{\downarrow\uparrow}\alpha$ denotes $\{\uparrow x;\ x \in [\![\alpha]\!]_{M,g}\}$ the set of group-atoms corresponding to the sums in $[\![\alpha]\!]_{M,g}$.
Also note the difference between ↑ and $^{\uparrow}$: the first is an operation on objects, the second on sets of object. Also, the operation on sets of objects $^{\downarrow}$ has nothing to do with the operation on objects ↓ that I use in Landman 2000, 2004.
In the rest of the paper I will leave out the indices M,g from $[\![\alpha]\!]_{M,g}$.

6. The analysis

In a way, the whole of my analysis is the following almost (but not quite) trivial semantics for *time* (because all the rest follows from general principles):

> ***time*** **→ λP.P** **where P is a variable of type <↑e,t>**
> **So *time* denotes the identity function of type <<↑e,t>,<↑e,t>>**

The indefinite *time* phrases are formed with function composition. I assume that, just as for functional application, some semantic adjustment (type shifting) can take place in the process of function composition. What I assume is the following:

COMPa. If $\alpha \in EXP_{<<\uparrow e,t>,<\uparrow e,t>>}$ and $\beta \in EXP_{<<\uparrow e,t>,<\uparrow e,t>>}$ then:
$COMP[\alpha,\beta] = \lambda \mathbf{P}.\alpha(\beta(\mathbf{P}))$

COMPb. If $\alpha \in EXP_{<<e,t>,<e,t>>}$ and $\beta \in EXP_{<<\uparrow e,t>,<\uparrow e,t>>}$ then:
$COMP[\alpha,\beta] = \lambda \mathbf{P}.{}^{\uparrow}(\alpha({}^{\downarrow}(\beta(\mathbf{P})))$

COMPc. If $\alpha \in EXP_{\mathbf{<e,t>}}$**[plural]** and $\beta \in EXP_{<<\uparrow e,t>,<\uparrow e,t>>}$ then:
$COMP[\alpha,\beta] = \lambda \mathbf{P}.{}^{\uparrow}(ADJUNCT[\alpha](*{}^{\downarrow}(\beta(\mathbf{P})))$

In each case the output is of type <<↑e,t>,<↑e,t>>.
COMPa says that when you compose two intensional functions, you get just function composition:

> you apply the one function to a variable, then apply the other function to the result, and abstract over the variable.

COMPb says that when you compose an extensional function with an intensional one, you get function composition with the normal adjustments for intensional function composition:

> you apply the intensional function to a variable, *bring the result down to the extensional type*, then apply the extensional function to the result, *bring the result up to the intensional type*, and abstract over the variable.

COMPc is the only addition special to the present context. COMPc is for the case where an intersective plural adjunct like *three* combines with an intensional function.

I mentioned above that I assume that, for measures, semantic plurality is not specified on the measure itself. What COMPc says is that semantic plurality on the measure can nevertheless be triggered to resolve a semantic mismatch in the combination with a plural numerical (like *three*).
Thus COMPc says:

> you apply the intensional function to a variable, *bring the result down to the extensional type*, ***and apply pluralization.*** Call this A. *Lift the set-interpretation of the plural modifier to the intersective modifier interpretation.* Call this F. Apply F to A, *bring the result up to the intensional type*, and abstract over the variable.

The semantic derivation for *three times*.
I assume the following interpretations:

Measure: *time(s)* $\rightarrow$ $\lambda\mathbf{P}.\mathbf{P}$ of type $<<\uparrow e,t>,<\uparrow e,t>>$
Numeral: *three* $\rightarrow$ $\lambda e.|e|=3.$ of type $<e,t>$
Determiner: Ø $\rightarrow$ $\lambda P.P$ of type $<<e,t>,<e,t>>$

We build the interpretation of the NP/PRED *three times* by composing the interpretation of *three* with that of *time*. The version of composition that does this is COMPc. This gives:

NP/PRED: *three times* $\rightarrow$ $\lambda\mathbf{P}.{}^{\uparrow}(\lambda e.[*{}^{\downarrow}\mathbf{P}](e) \wedge |e|=3)$ of type $<<\uparrow e,t>,<\uparrow e,t>>$.

We build the interpretation of the DP/PRED Ø *three times* by composing the interpretation of the empty determiner Ø with the above interpretation for the NP/PRED *three times*. The version of composition that does this is COMPb. This gives:

> **DP[PRED]/PRED**: Ø *three times* $\rightarrow$ $\lambda\mathbf{P}.{}^{\uparrow}(\lambda e.[*{}^{\downarrow}\mathbf{P}](e) \wedge |e|=3)$
> of type $<<\uparrow e,t>,<\uparrow e,t>>$
>
> *Three times* takes as input a set of group events and outputs the set of all group events that correspond to a sum of three input group events.

I claim that this is a counter. But how does it count? There is a trick to that. Normally in a derivation, we will **apply** the interpretation of *three times* to an expression α of type $<e,t>$, which denotes a **set of sums of events**. In this application, there is a **type mismatch**: *three times* requires an input of type $<\uparrow e,t>$, but is given an input of type $<e,t>$. This type mismatch is **resolved** by lifting α to ${}^{\uparrow}\alpha$ at type $<\uparrow e,t>$, denoting $\{\uparrow(x): x \in [\![\alpha]\!]\}$, the set of groups of events corresponding to the sums in α.

We see here the rationale for the interpretation of *time(s)* as $\lambda\mathbf{P}.\mathbf{P}$ of type $<<\uparrow e,t>,<\uparrow e,t>>$: The interpretation $\lambda\mathbf{P}.\mathbf{P}$ of *times* **triggers intensionalization on its complement**. Exactly the same assumption is standardly made for the interpretation of complementizer *that*: we assume that it denotes the identity function $\lambda p.p$ of type $<<s,t>,<s,t>>$, and when combining this with a complement φ of type t, it triggers intensionalization, and the final result is what we want: ${}^{\wedge}\varphi$.

Now, in the nominal domain, I assume that *three boys* counts atomic boys in the following way: you count atoms in the atomic predicate BOY, by intersecting its pluralization *BOY with $\{x: |x|=3\}$, the set of all plural objects that have three atoms. This gives: $\{x \in *BOY: |x|=3\}$ the set of those sums of boys which are made up of three atomic boys.

I assume that *three times* counts events in essence in exactly the same way: **you count atoms in the atomic predicate $\{\uparrow(x): x \in [\![\alpha]\!]\}$**, and you do this by intersecting its pluralization $*\{\uparrow(x): x \in [\![\alpha]\!]\}$ with $\{e: |e|=3\}$, the set of plural events that have three atoms. This gives: $\{e \in *\{\uparrow(x): x \in [\![\alpha]\!]\}: |e|=3\}$, the set of those sums of 'groupifications' of the elements in $[\![\alpha]\!]$ which are made up of three atomic groups.

I need to make one further important remark, before showing that this way of counting makes the right predictions about the semantics of indefinite *time* adverbials. The application of modifier *three times* to α triggers a shift from α to $^{\downarrow\uparrow}\alpha$, denoting $\{\uparrow x;\ x \in [\![\alpha]\!]\}$. But it is important to point out that, in line with my earlier work (eg. Landman 1989, 2000), I assume that **in a normal context**, the predicate $^{\downarrow\uparrow}\alpha$ is actually contextually restricted to those groups corresponding to the sums in α, of which the group-nature is contextually salient. Thus, really, I assume that, in context c, $^{\downarrow\uparrow}\alpha$ denotes $\{\uparrow x;\ x \in [\![\alpha]\!]$ and $CR(\uparrow x,c)\}$, where $CR(\uparrow x,c)$ means that in context c, $\uparrow x$ is contextually salient as a group. We will see below that this assumption plays an important role in deriving the correct readings.

7. The analysis predicts the correct scope dependencies

To show how the analysis works, I will use (22):

(22) Dafna kissed three girls twice.

I assume that this example is ambiguous. On one reading it expresses that there were two groups of kissings by Dafna, each involving three girls being kissed, hence possibly a total of six girls. On the other reading, it expresses that there were three girls who each received two kisses from Dafna. I will sketch the grammatical derivations, rather than filling in all the details precisely.

DERIVATION 1: *TWICE* IS ADJOINED HIGHER THAN *THREE GIRLS*.
In this case we derive an event type (of type <e,t>) for *Dafna kissed three girls*

$\boldsymbol{\beta} = \quad \lambda e.{*}KISS(e) \wedge {*}Ag(e)=DAFNA \wedge {*}GIRL({*}Th(e)) \wedge |{*}Th(e)|=3$

The set of sums of kissing events that have Dafna as plural agent and a sum of three girls as plural theme (as in Landman 2000)

This means that each event e in **β** is a sum of single kissing events; for each event e in **β**, the single kissing events that are part of e all have Dafna as agent; and for each event e in **β**, if you sum together the themes of the single kissing events that are part of e, you get a sum of three girls. **β** is the set of all sum events with those three properties.

The interpretation of *twice* derived in the previous section is:

twice $\rightarrow \lambda \mathbf{P}.^{\uparrow}(\lambda e.[{*}^{\downarrow}\mathbf{P}](e) \wedge |e|=2)$

The grammar forms the interpretation of *Dafna kissed three girls twice* by **applying** the interpretation of *twice* to **β**.

$$\begin{array}{ll} APPLY[\lambda \mathbf{P}.^{\uparrow}(\lambda e.[{*}^{\downarrow}\mathbf{P}](e) \wedge |e|=2), & \boldsymbol{\beta} \quad] \\ \quad\quad\quad <<\uparrow e,t>,<\uparrow e,t>> & <e,t> \end{array}$$

Since $\boldsymbol{\beta}$ is of the extensional type <e,t>, we have exactly the type mismatch I discussed above, and this mismatch is resolved by intensionalizing $\boldsymbol{\beta}$ with $^{\uparrow}$:

$$(\lambda \mathbf{P}.^{\uparrow}(\lambda e.[*^{\downarrow}\mathbf{P}](e) \wedge |e|=2) (^{\uparrow}\boldsymbol{\beta}))$$

λ-conversion gives:

$$^{\uparrow}(\lambda e.[*^{\downarrow\uparrow}\boldsymbol{\beta}](e) \wedge |e|=2) \qquad \text{of type } <\uparrow e,t>$$

At the next stage of the derivation, we get an interpretation of type t by existential closure. I assume that if $\alpha \in EXP_{<\uparrow e,t>}$, Existential Closure gives: $\exists e_1[[^{\downarrow}\alpha](e_1)]$.
So we get as a first interpretation of (22):

(22a) $\exists e_1[^{\downarrow\uparrow}(\lambda e.[*^{\downarrow\uparrow}\boldsymbol{\beta}](e) \wedge |e|=2) (e_1)]$

Rather than making the formula even more unreadable than it already is by filling in $\boldsymbol{\beta}$, I will show that (22a) is true in a situation where there are two groups of kissing events each involving Dafna and three girls, in total six girls.

Let us start with six kissing events, involving Dafna and six girls:

e_1 is an event of Dafna kissing Nomi
e_2 is an event of Dafna kissing Shira
e_3 is an event of Dafna kissing Ronnie

e_4 is an event of Dafna kissing Netta
e_5 is an event of Dafna kissing Bee
e_6 is an event of Dafna kissing Nina

Then $e_1 \sqcup e_2 \sqcup e_3$ and $e_4 \sqcup e_5 \sqcup e_6$ are events which are in $[\![\boldsymbol{\beta}]\!]$:
$e_1 \sqcup e_2 \sqcup e_3 \in [\![\boldsymbol{\beta}]\!]$ because:
1. the atomic parts, e_1,e_2,e_3 of $e_1 \sqcup e_2 \sqcup e_3$ are all single kissing events.
2. Dafna is the agent of e_1, of e_2 and of e_3.
3. The sum of the themes of e_1, e_2, and e_3 is Nomi ⊔ Shira ⊔ Ronnie, which is a sum of three girls.
A similar argument shows that $e_4 \sqcup e_5 \sqcup e_6 \in [\![\boldsymbol{\beta}]\!]$.

Now, we make a next assumption, namely that we are dealing with a context c in which $CR(\uparrow(e_1 \sqcup e_2 \sqcup e_3),c)$ and $CR(\uparrow(e_4 \sqcup e_5 \sqcup e_6),c)$. Thus, $\uparrow(e_1 \sqcup e_2 \sqcup e_3)$ and $\uparrow(e_4 \sqcup e_5 \sqcup e_6)$ are not arbitrary groupings in c (Nomi, Shira, and Ronnie are sisters, and so are Netta, Bee, and Nina , and Dafna usually meets each set of sisters in circumstances that makes spatio-temporal clustering of kissings salient).
Then, since $[\![^{\downarrow\uparrow}\boldsymbol{\beta}]\!] = \{\uparrow e: e \in [\![\boldsymbol{\beta}]\!] \text{ and } CR(\uparrow x,x)\}$, and $e_1 \sqcup e_2 \sqcup e_3 \in [\![\boldsymbol{\beta}]\!]$ and $e_4 \sqcup e_5 \sqcup e_6 \in [\![\boldsymbol{\beta}]\!]$, it follows that:
$\uparrow(e_1 \sqcup e_2 \sqcup e_3) \in [\![^{\downarrow\uparrow}\boldsymbol{\beta}]\!]$ and $\uparrow(e_4 \sqcup e_5 \sqcup e_6) \in [\![^{\downarrow\uparrow}\boldsymbol{\beta}]\!]$.

Since for any X *X is the closure of X under sum, it then follows that:
$\uparrow(e_1\sqcup e_2\sqcup e_3) \sqcup \uparrow(e_4\sqcup e_5\sqcup e_6) \in [\![*^{\downarrow\uparrow}\boldsymbol{\beta}]\!]$.

For any e: $|e| = |\{a \in ATOM: a \sqsubseteq e\}|$, hence
$|\uparrow(e_1\sqcup e_2\sqcup e_3) \sqcup \uparrow(e_4\sqcup e_5\sqcup e_6)| = 2$, since $\uparrow(e_1\sqcup e_2\sqcup e_3)$ and $\uparrow(e_4\sqcup e_5\sqcup e_6)$ are the two atomic parts of this sum.
This means that :
$\uparrow(e_1\sqcup e_2\sqcup e_3) \sqcup \uparrow(e_4\sqcup e_5\sqcup e_6) \in [\![(\lambda e.[*^{\downarrow\uparrow}\boldsymbol{\beta}](e) \wedge |e|=2)]\!]$

That means - and here is where I use the group of groups - that:
$\uparrow(\uparrow(e_1\sqcup e_2\sqcup e_3) \sqcup \uparrow(e_4\sqcup e_5\sqcup e_6)) \in [\![^{\downarrow\uparrow}(\lambda e.[*^{\downarrow\uparrow}\boldsymbol{\beta}](e) \wedge |e|=2)]\!]$
(since it is unproblematic to assume that this group of groups is contextually relevant, simply because the two atomic groups the corresponding sum is made out of are contextually relevant).

Now, the interpretation derived for (22a) expresses that the set $[\![^{\downarrow\uparrow}(\lambda e.[*^{\downarrow\uparrow}\boldsymbol{\beta}](e) \wedge |e|=2)]\!]$ is not empty. Since we have showed that, in the situation sketched, $\uparrow(\uparrow(e_1\sqcup e_2\sqcup e_3) \sqcup \uparrow(e_4\sqcup e_5\sqcup e_6))$ is in that set, it follows that (22a) is true in this situation.

The concerns about contextual relevance of groups-formation tell us that the step from $e_1\sqcup e_2\sqcup e_3 \in [\![\boldsymbol{\beta}]\!]$ to $\uparrow(e_1\sqcup e_2\sqcup e_3) \in [\![^{\downarrow\uparrow}\boldsymbol{\beta}]\!]$ is **only** valid, if the event grouping $\uparrow(e_1\sqcup e_2\sqcup e_3)$ is contextually salient. This means that, in a normal context, it is not enough for (22a) to be true that Dafna kisses six girls in six events: **these events must partition into two salient groups of events**. With this caveat we see that:
Reading (22a) expresses that there are two salient groups of events, and in each group Dafna kisses three girls.

Thus the semantics of *time(s)*, in combination with standard assumptions about the grammatical derivation, derives the correct truth conditions for the first reading of (22).

DERIVATION 2: GIVE *THREE GIRLS* WIDE SCOPE.
On the second derivation, we use the scope mechanism to give *three girls* wide scope. This means that we derive, *in situ*, the following event type:

> $\boldsymbol{\beta} = \lambda e.KISS(e) \wedge Ag(e)=DAFNA \wedge Th(e)=a_n$
> The set of kissing events with Dafna as agent and $g(a_n)$ as theme.
> (with a_n a free variable over atomic individuals, and g the assignment function)

and we use the interpretation of *three girls* later in the derivation (which we can represent by storing $<a_n, \lambda P.\exists x[*GIRL(x) \wedge |x|=3 \wedge P(x)]>$).

Next we **apply** *twice* to **β,** exactly as we did in the first derivation, and get:

> $^{\uparrow}(\lambda e.[*^{\downarrow\uparrow}\boldsymbol{\beta}](e) \wedge |e|=2)$

Now, $[\![\boldsymbol{\beta}]\!]$ is a set of atomic events. This means that $[\![^{\downarrow\uparrow}\boldsymbol{\beta}]\!] = [\![\boldsymbol{\beta}]\!]$.
This means that we can simplify the above expression to:

$^{\uparrow}(\lambda e.{*}\boldsymbol{\beta}(e) \wedge |e|=2)$

Filling in **β**:

$$^{\uparrow}(\lambda e.[{*}KISS(e) \wedge {*}Ag(e)=DAFNA \wedge {*}Th(e)=a_n \wedge |e|=2])$$

The set of all salient groups of events each of which corresponds to a sum of two kissing events with agent Dafna and theme $g(a_n)$.

Note the contextual salience requirement. This could be satisfied naturally by assuming that we are concerned with situations where $g(a_n)$ gets a **sequence** of two kisses from Dafna: kiss-kiss.

At the next stage of the derivation, Existential Closure takes place, and we get:

$$\exists e_1[^{\downarrow\uparrow}(\lambda e.[{*}KISS(e) \wedge {*}Ag(e)=DAFNA \wedge {*}Th(e)=a_n \wedge |e|=2])\ (e_1)]$$

There is a salient group of events which corresponds of a sum of two kissing events with agent Dafna and theme $g(a_n)$.

Now, for the purposes of this example, we can assume the mechanism of distributive quantifying-in given in Landman 2000, which from interpretation φ of type t derived so far and from stored interpretation $<a_n,\beta>$ forms the full interpretation:

$$APPLY[\ \lambda x.\forall a_n \in ATOM(x){:}\ \varphi,\quad \beta\ ]$$

With this mechanism (and the type shifting operations specified in Landman 2000), we derive the second interpretation for (22), (22b):

(22b) $\exists x[{*}GIRL(x) \wedge |x|=3 \wedge \forall a_n \in ATOM(x){:}$
$\exists e_1[^{\downarrow\uparrow}(\lambda e.[{*}KISS(e) \wedge {*}Ag(e)=DAFNA \wedge {*}Th(e)=a_n \wedge |e|=2])\ (e_1)]\ ]$

There is a sum of three girls and for each of these three girls there is a salient group of events corresponding to a sum of two kissing events with Dafna as agent and that girl as theme.

With the same caveat about contextual relevant groupings as above, (22b) is true in a situation where there are three girls, say, Nomi, Shira and Ronny, and six events:

e_1: Dafna kissed Nomi
e_2: Dafna kissed Nomi

e_3: Dafna kissed Shira
e_4: Dafna kissed Shira

e_5: Dafna kissed Ronnie
e_6: Dafna kissed Ronnie

and where groupings $\uparrow(e_1 \sqcup e_2)$ and $\uparrow(e_3 \sqcup e_4)$ and $\uparrow(e_5 \sqcup e_6)$ are all contextually relevant, for instance, because they are kiss-kiss groups.
Reading (22b) expresses that there are three girls, and for each of those girls there is a salient group of two events of Dafna kissing that girl. So indeed, each girl gets kissed twice.

Thus the semantics of *time(s)*, in combination with standard assumptions about the grammatical derivation, derives the correct truth conditions for the second reading of (22) as well.

8. Conclusion

What the dual-perspective intensionality triggered by *time(s)* does is **gridding**:
We want to count a set of sums, but we don't count sums in a set of sums directly, instead, we impose a **grid** on that set: we map the set of sums onto the set of corresponding groups atoms. It's the latter groups that are counted (or more precisely, the ones among them that are contextually salient), and it is this gridding that gives the *time* phrase scope. Indefinite *time* phrases can justifyably be called intensional modifiers, because gridding is an intensional notion: we take a perspective on the sums as objects in their own right, atoms.

When we take a first look at indefinite *time* phrases, it may look as if they have the same scope dependencies as normal argument DPs. But I have argued in this paper that scope dependencies in the grammar can come in in more than one way, and that the scope dependencies in indefinite *time* phrases do not come in in the same way as those of argument noun phrases.
-**noun phrases (DPs)** have scope, and the scope mechanism regulates their mutual scope dependencies.
-**modals and standard intensional verbs** have scope, because they trigger intensionalization ($^\wedge$) on their complement, and what is inside the $^\wedge$ (and hence inside the scope of the modal) is, so to say, screened off from what is outside.
-**indefinite *time* phrases** have scope in exactly the same way as modals, but it looks, at first sight, more like what you find for noun phrases. Nevertheless, what goes on is just what goes on in modals: indefinite *time* phrases trigger intensionalization on their complement ($^\uparrow$), and what is inside the $^\uparrow$ (and hence inside the scope of the *time* phrase) is so to say screened off from what is outside. And this is so, because the operation $^\uparrow$ is a gridding operation. Gridding, then, gives us a scope mechanism, which –like the scope mechanism of intensional verbs and modals – is an *in situ* scope mechanism.

In sum:
-We find **definiteness effects**, because only indefinite *time* phrases are interpreted as direct counting adverbials.
-We find **scope dependencies**, because direct counting involved gridding, which is an *in situ* scope mechanism.
-We don't find **wide scope** or **very wide scope** for indefinite *time* phrases, since they are not DPs in argument position, and the scope mechanism or scope mechanisms for DPs in argument position do not apply to them.

Turning the wheel the other way round:
What these data (and similar data for *time* phrases in the nominal domain, like gridded interpretations of *Dafna kissed three times four girls*.) show is that gridding (shifting from sums to groups) is not an optional feature tagged on to the semantic theory of plurality in my peculiar version of it, to be ignored at leasure. Gridding is an integral part of natural language semantics, and an expression of a fundamental aspect of human cognition: dual perspective intensionality.

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This paper shares its plot and story line with the last chapter of Landman 2004, though it is not a rewritten version of the latter: it was freshly written for the conference on indefinites organized at the Institut Marie Haps and the Belgium Acedemy of Sciences in Brussels in January 2005, and it improves in many ways over the version in Landman 2004, in particular in the technical details of the analysis, and in the focus on the notion of gridding as a form of dual-perspective intensionality.

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References

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

Carnap, R. 1947. *Meaning and Necessity*. Chicago: University of Chicago Press.

Chierchia, G. 1984. *Topics in the Syntax and Semantics of Infinitives and Gerunds*. Ph.D. Dissertation. University of Massachusetts, Amherst. Published by Garland, New York.

Doetjes, J. 1997. *Quantifiers and Selection: The Distribution of Quantifying Expressions in French, Dutch and English*. Ph.D. Dissertation. University of Leiden.

Frege, G. 1892. "Über Begriff und Gegenstand". *Vierteljahrschrift für Wissenschaftliche Philosophie* 16: 192-205. Reprinted in G. Patzig (ed) (1962), *Funktion, Begriff, Bedeuting: Fünf Logische Studien*. Göttingen: Vanderhoek.

Keenan, E. 1987. "A semantic definition of *indefinite NP*". In E. Reuland and A. ter Meulen (eds), *The Representation of (In)definiteness*, Cambridge, Mass.: MIT Press, 286-317.

Kripke, S. 1963. "Semantical considerations on modal logic". In *Acta Philosophica Fennica* 16, 83-94. Reprinted in L. Linsky (ed), (1971) *Reference and Modality*. Cambridge: Cambridge University Press.

Landman, F. 1989. “Groups 1 and 2”. *Linguistics and Philosophy* 12: 559-605, 723-744.
Landman, F. 2000. *Events and Plurality*. Dordrecht: Kluwer.
Landman, F. 2004. *Indefinites and the Type of Sets*. Oxford: Blackwell.
Larson, R. 1985. “Bare NP-adverbs”. *Linguistic Inquiry* 16: 595-621.
Link, G. 1984. “Hydras. On the logic of relative clause constructions with multiple heads”. In F. Landman and F. Veltman (eds), *Varieties of Formal Semantics*. Dordrecht: Foris, 245-257.
Montague, R. 1970. “English as a formal language”. In B. Visentini et al. (eds), *Linguaggi nella Societa e nella Technica*. Milan: Edizione di Communita, 189-224. Reprinted in R. Thomason (ed), (1974) *Formal Philosophy*. New Haven: Yale University Press.
Montague, R. 1973. “The proper treatment of quantification in ordinary English”. In J. Hintikka, J. Moravcsik, and P. Suppes (eds), *Approaches to Natural Language*. Dordrecht: Kluwer, 221-242. Reprinted in R. Thomason (ed), (1974) *Formal Philosophy*. New Haven: Yale University Press.
Partee, B. 1987. “Noun phrase interpretation and type shifting principles”. In J. Groenendijk, D. de Jongh, and M. Stokhof, (eds), *Studies in Discourse Representation Theory and the Theory of Generalized Quantifiers*. Dordrecht: Foris, 115-143. Reprinted in B. Partee (2004). *Compositionality in Formal Semantics*. Oxford: Blackwell.
Rothstein, S. 1995. “Adverbial quantification over events”. *Natural Language Semantics* 3: 1-31
Thomason, R. 1980. “A model theory for propositional attitudes”. *Linguistics and Philosophy* 4: 47-70.