

THE FELICITY OF ASPECTUAL *FOR*-PHRASES

PART 2: INCREMENTAL HOMOGENEITY

ABSTRACT

This paper is the second in a series of two papers presenting recent developments concerning the interaction between aspectual classes of predicates and the semantics of aspectual *for*-phrases. Aspectual *for*-phrases must modify predicates which are homogeneous - meaning that the predicate spreads appropriately to subintervals. For eventive predicates the relevant notion of homogeneity should be a dynamic notion – sensitive to the arrow of time.

We present a recently developed semantic framework in which eventive predicates are *incrementally homogenous*, meaning that the predicate characteristics are preserved for each event from its onset through all incremental development stages.

We show how *incremental homogeneity* deals with the felicity facts concerning aspectual *for*-phrases, and discuss complex-activity forming operations which turn heterogeneous predicates into homogeneous ones, in particular, as triggered by bare arguments and by iteration.

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PART 2: INCREMENTAL HOMOGENEITY

1. The notions of cross-temporal identity and initial stage.

In this part of the paper, we define *incremental homogeneity* and explain its relevance in the licensing of aspectual *for*-phrases. We begin by defining two notions which will be central to the following discussion, *cross-temporal identity* and *initial stage*. We assume, in line with the literature on events since Link 1987 (which introduced the temporal trace function τ), that eventualities are temporal particulars: an eventuality goes on at one and only one running time. We also assume that eventualities have aspectual substructure: the state of *Ronya being in Amsterdam* holding at a certain interval i has implications about what goes on at subintervals j of i : ‘the same state’ of Ronya being in Amsterdam should hold at j . Of course, given the assumption that eventualities are temporal particulars, it cannot be literally ‘the same state’. What goes on at j and i are two states of Ronya being in Amsterdam that *count as one*. The same holds for events: I ran once yesterday, from three till four. Of course, I also ran from three till three fifteen, but that was, of course, ‘the same’ running.

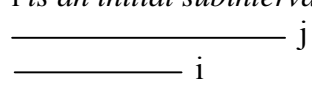
To express the relation between events with different running times that count as ‘the same event’ we assume, following Landman 2008, an equivalence relation of cross-temporal identity:

e_1 is *cross-temporally identical to* e_2 : $e_1 \sim e_2$ iff e_1 and e_2 count as ‘one and the same event’, i.e. for counting purposes e_1 and e_2 count as *one* event.

One natural constraint on \sim is that two events that are cross-temporally identical and have the same running time are identical. More constraints are discussed in Landman 2008.

The temporal relation between intervals that will play a major role in the discussion to follow is the *initial subinterval relation* \preceq :

Let i and j be intervals.
 i is an *initial subinterval of* j , $i \preceq j$ iff $i \subseteq j$ and $\forall k$ [if $k < i$ then $k < j$]



We lift \preceq from a relation between intervals to a relation between cross-temporally identical eventualities:

Let e_1 and e_2 be events.
 e_1 is an *initial stage of* e_2 , $e_1 \preceq e_2$ iff $\tau(e_1) \preceq \tau(e_2)$ and $e_1 \sim e_2$

Thus, e_1 is an initial stage of e_2 if e_1 and e_2 are cross-temporally identical, and the running time of e_1 is an initial subinterval of the running time of e_2 .

2. Onsets and incremental homogeneity.

In this section we introduce more formally the two oppositions that are going to be relevant for our analysis: *onset/no onset* and *homogenous/heterogeneous*. We stress here that while these two oppositions by and large neatly partition predicates into the four standard verb classes, we do not assume that the contrasts discussed here *define* the aspectual verb classes. In fact, they do not. We assume that the stative-eventive contrast is a sortal distinction: stative predicates (and probably also achievement predicates) are predicates of states, while activity and accomplishment predicates are predicates of events, and this sortal distinction will have a role to play below, beyond the *onset/no onset* opposition. Similarly, we do not think that the differences between states/activities versus accomplishments/achievements are exhaustively characterized by the *homogenous/heterogeneous* distinction. Nevertheless, we obviously believe that the two oppositions introduced here *are* semantically active.

We come to the first opposition. We assume that the domain of eventualities is sorted into a domain of states and a domain of events. We assume, with Taylor 1977 and Dowty 1977, that one way in which events are different from states is that events take time to get established, while states do not take time. With Dowty 1979, we propose to characterize this in terms of *onsets*:

Events have onsets: an event of waltzing takes time to establish itself as waltzing.
States do not have onsets: states do not take time and are true at points.

We formulate this as an onset postulate for eventive predicates:

Let P be an eventive predicate, interpreted as event type α .
Let V be the verbal head of P, interpreted as event type V_α .

Onset postulate for eventive predicates:

Every event $e \in \alpha$ has a V_α -onset.

We define the notion of a V_α -onset as follows:

e has a V_α -onset iff there is an event $O(e, V_\alpha) \in V_\alpha$ such that
 $O(e, V_\alpha) \leq e$ and $\tau(O(e, V_\alpha))$ is not a point and $\forall e'$ [if $e' \prec O(e, V_\alpha)$ then $e' \notin V_\alpha$]

Eat a mango is an eventive predicate with verbal head *eat*. Let α be the set of all events of eating a mango and V_α the set of all eating events. The postulate says that each event of eating a mango has an EAT-onset.

Let e be an event of eating a mango. The EAT-onset of e is the event $O(e, \text{EAT})$. This onset is an initial stage of e , which means that it is cross-temporally identical to e – it counts as the same event – and goes on at a running time which is an initial subinterval of the running time of e . The running time of $O(e, \text{EAT})$ is bigger than a point, which is the Dowty-Taylor assumption that events take time to get established. And $O(e, \text{EAT})$ is *minimal* in the verbal event type EAT: any *proper* initial stage of $O(e, \text{EAT})$ is too small to count itself as eating. the onset is the most initial bit of eating, like the bit where your

teeth enter the first bit of mango and the juices start running into your mouth. Note that this onset is by definition in the interpretation of the verbal predicate *eat*, but it is not itself an event which is in the interpretation of the interpretation of the predicate *eat a mango*.

Activities like *waltzing* similarly have onsets: if *e* is an event of waltzing, then $O(e, \text{WALTZ})$ is the smallest initial event in $\tau(e, w)$ that is big enough to count *both* as waltzing *and* as cross-temporally identical to *e*. The very beginning of the waltzing event (start lifting one foot from the floor, ...) is cross-temporally identical to the waltzing, but doesn't yet itself count as waltzing. In context, the onset could be the sequence consisting of the first three steps. Note that in this case, the onset event is actually in the interpretation of the VP (since the VP has the same interpretation as its verbal head).

We come to homogeneity. We assume that stative predicates and activity predicates are homogenous, which, rephrasing the intuition from Part 1, means that an event in the denotation of a stative or activity predicate has enough cross-temporally identical parts which are also in the denotation of the predicate. Not only is homogeneity a lexically imposed constraint on lexically stative and activity predicates, it also constrains the output of operations that form stative and activity predicates. We have already discussed homogeneity for stative predicates. We repeat the definition from part one, only changing it to impose cross-temporal identity of states:

A stative predicate *P* is *homogeneous* if its interpretation event type α is homogenous.

Stative event type α is *homogenous* iff every state in α is homogenous with respect to α .

State *s* in stative event type α is *homogenous with respect to α* iff if $\tau(s, w)$ is defined then for every subinterval $i \subseteq \tau(s, w)$, there is a state $s' \in \alpha$ such that $s' \sim s$ and $\tau(s', w) = i$

This is the subinterval property: a state *s* of Ronya living in Amsterdam that is realized in *w* is homogenous with respect to the type of states of living in Amsterdam, and this means that at every subinterval of the running time of *s*, there is a state of Ronya living in Amsterdam going on that counts as 'the same state' as *s*.

The perspective of the subinterval property is an appropriate interpretation of homogeneity for stative predicates, because it is essentially a stative perspective: you look at a state that maximally counts as one state of Ronya being in Amsterdam and inspect in the interval structure what goes on at the subintervals. This inspection can take place in any direction, down, left, up, right, ... Thus, we take a static perspective on states and this is encoded in the relevant notion of homogeneity: the subinterval property is preservation of the event type at all subintervals; the notion has no temporal direction to it, it only looks *down* at interval segments.

But, as argued in Landman 1992 in the context of the semantics of the progressive, events and processes are dynamic, they are things that happen, things that develop; they are things that we follow *as they develop incrementally* through bigger and bigger stages. The static, temporally undirected perspective – which is natural for states – doesn't make the same sense for events. If we want to express that events are homogenous, it will not do to impose the static perspective on them, they have to be

homogenous in a way that makes sense for *them*. This is what *incremental homogeneity* is about.

Incremental homogeneity is incremental preservation of the event type between the onset of an event and the event itself. This kind of homogeneity is sensitive to the arrow of time: it follows cross-temporally identical development stages of an event from its onset through bigger and bigger initial stages until the event itself is reached, requiring preservation of the event type at all intervals that are passed through *in that way*. The differences with stative predicates come in because incremental homogeneity has nothing to say about what has to hold at intervals that you do not come across in the process as described. In particular, it says nothing about what holds at initial intervals that are smaller than the running time of the onset (cross-temporally identical events may go on there, but they are too small to be in the event type α), nor at intervals that are not initial subintervals.

Our claim is, of course, that not only is this a natural perspective on eventive predicates – that they are constrained by incremental rather than segmental homogeneity – but that this perspective resolves the problems for modification of eventive predicates by aspectual *for*-phrases that we have discussed in part one of this paper. We impose:

Homogeneity postulate for activity predicates:

Activity predicates are homogeneous

And we define for eventive predicates *homogeneity* as *incremental homogeneity*:

Let P be an eventive predicate, interpreted as event type α .

Let V be the verbal head of P, interpreted as event type V_α .

P is *homogenous* iff α is homogenous.

α is *homogenous* iff every event in α is incrementally homogenous with respect to α and V_α .

e in α is *incrementally homogeneous* with respect to α and V_α iff:

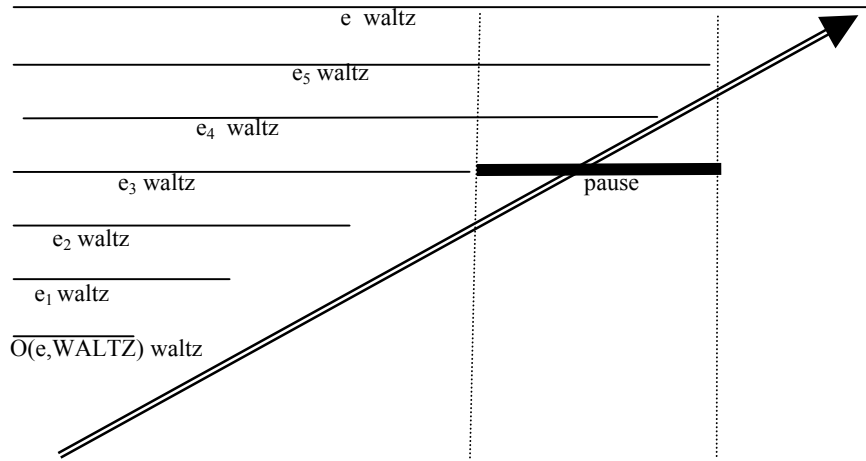
if $\tau(e,w)$ is defined then for every interval i such that $\tau(O(e,V_\alpha),w) \preceq i \prec \tau(e,w)$, there is an event $e' \in \alpha$ such that $\tau(e',w) = i$ and $e' \sim e$

e is incrementally homogenous with respect to α and V_α if for every *proper* initial subinterval i of $\tau(e,w)$ which is *incrementally in between* the running time of the V_α -onset of e and the running time of e, there is an event ***in event type*** α cross-temporally identical to e and with i as running time.

We assume that a verb like *waltz* is lexically specified as an activity predicate. The two postulates we have imposed on activity predicates require every event in the event type that is the interpretation of *waltz*, i.e. every waltzing event, to have a waltzing-onset and to be incrementally homogenous. The latter means that if e is a waltzing event realized in w we find, for each proper subinterval of $\tau(e,w)$ *incrementally extending* the running time of the waltzing-onset of e, an event cross-temporally identical to e, which is *itself* a waltzing event.

The waltzing requirement is incremental. This means that it allows for pauses in activities: as long as we are willing to assume that, *incrementally*, cross-temporal

identical events of waltzing continue to go on, we can stand still on the dance floor, rocking to and fro, catching our breath. When the dancing proper continues, we have carried the dancing cross-temporally over a pause. The following picture shows some of the stages of waltzing event e , with its onset and a pause:



We will call events like e_4 and e_5 , that consist of waltzing followed by a pause, *inertia events*: they derive their *waltz* characteristics solely from their earlier stage e_3 and only count as waltzing because *we* decide in context that this particular process of waltzing hasn't finished yet, so *we* decide that they are cross-temporally identical to e_3 . It is the inertia events that make it possible for our waltzing event e to satisfy incremental homogeneity (postulating a cross-temporally identical stage at *every* initial subinterval between the onset of e and e) and allow, segmentally, for pauses: what has happened before (incrementally) has, so to say, enough *schwung* to continue to call what goes on waltzing. (More discussion of this can be found in Landman 2008.)

3. The felicity of aspectual *for*-phrases with eventive predicates.

We repeat the semantics proposed for aspectual *for*-phrases in part one of this paper.

$$\mathbf{for\ an\ hour}(\alpha) = \lambda e. \alpha(e) \wedge \mathbf{duration}(\tau(e)) = \langle 1, \mathbf{hour} \rangle$$

the set of events in α with duration one hour

For an hour

$$\lambda \alpha \left\{ \begin{array}{ll} \mathbf{for\ an\ hour}(\alpha) & \text{if every eventuality in } \mathbf{for\ an\ hour}(\alpha) \text{ is non-trivially} \\ & \text{homogenous with respect to the event type } \alpha. \\ \text{undefined} & \text{otherwise} \end{array} \right.$$

The function that maps an event type α onto the set of eventualities in α that have a running time of an hour's length, *if* every eventuality in that set is non-trivially homogenous with respect to event type α .

Obviously, since for eventive predicates homogeneity means incremental homogeneity, and we have imposed incremental homogeneity as a constraint on the events in the denotation of activity predicates, it doesn't come as a surprise that aspectual *for*-phrases are felicitous with activity predicates (without requiring absence of pauses).

We are now interested in the different ways in which eventive predicates can *fail* to satisfy the felicity requirements for aspectual *for*-phrases. Given the above felicity conditions for the aspectual *for*-phrases and the definition of incremental homogeneity, there are such ways.

In all the following cases we assume that P is an eventive predicate with interpretation α and V its verbal head with interpretation and V_α .

3.1. The onset is not preserved.

Suppose that there is an event $e \in \alpha$ such that $e \in \text{for an hour}(\alpha)$, but $O(e, V_\alpha) \notin \alpha$. In that case e is not incrementally homogeneous with respect to α , because α is not incrementally preserved: α already doesn't hold at the onset. This means that the predicate P is not homogeneous, and hence *for an hour P* is not felicitous.

This is what happens in most accomplishment event types. All the cases in (1) are predicted to be infelicitous:

- (1) a. #Fred ate *a/every/each* mango for an hour.
- b. #Fred ate *some/various/at least thirty/thirty/exactly thirty/all/most many/mangos* for an hour.

Let us consider (2) as an example:

- (2) #Fred ate a mango for an hour.

The predicate *eat a mango* is an eventive predicate, interpreted as event type α , with verbal event type V_α :

- $\alpha = \lambda e. \text{EAT}(e) \wedge \text{Th}(e) \in \text{MANGO}$
The set of all eating events with theme a mango
- $V_\alpha = \lambda e. \text{EAT}(e)$
The set of all eating events

Let $e \in \text{for an hour}(\alpha)$. This means that e is an event of eating a mango with duration an hour. The EAT-onset of e , $O(e, \text{EAT})$ is the smallest initial part of the eating a mango event big enough to count as eating. This onset is an event of eating, but not itself an event of eating a mango. This means that the e is not incrementally homogeneous with respect to the event type α , and this means that the definedness condition for *for an hour* is not satisfied. Hence (2) is infelicitous.

The very same argument can be made for all the cases in (1), so all these cases come out as infelicitous.

3.2. The event is quasi-punctual.

If e is quasi-punctual, then for all contextual purposes e is identified with its onset: $e = O(e, V_\alpha)$. In that case, the condition of incremental homogeneity can only be *trivially* satisfied. This is, because incremental homogeneity constrains all the *proper subintervals* of $\tau(e, w)$ extending the running time of the onset, but if e is its own onset, there obviously are no such intervals.

The definedness condition requires the events in **for an hour**(α) to be *non-trivially* incrementally homogenous with respect to α , and – as we see now – that excludes quasi-punctual events. Arguably, this is what we find in (3):

(3) #The old woman swallowed a fly for a second. (Perhaps she'll die.)

In this case, arguably, in a natural context, an event $e \in$ **for a second**(α) is identical to its onset: in a natural context we do not assign to a swallowing event (slow motion-) stages of swallowing. This makes the event e satisfy incremental homogeneity with respect to α , but only trivially so. The definedness constraint on *for a second* requires e to be *non-trivially* homogenous, hence (3) is predicted to be infelicitous.

If we reinterpreted (3) and give it a slow-motion interpretation, the onset is reinterpreted as only the beginning of the swallowing, (3) is reinterpreted as an accomplishment, and the new onset is not itself a swallowing event, hence (3) is also infelicitous on a slow-motion interpretation.

3.3. Eventive event types without onsets.

These are cases where we have an eventive predicate for which the notion of onset is not properly defined. We propose that this is what happens in downward entailing cases like (4):

(4) #Fred ate at most fifteen mangos for a week.

It is beyond the scope of this paper to provide an analysis of such downward entailing cases (see Landman 2000, 2004). But, whatever the required event type α for (4) is, we assume that V_α is not the event type EAT, but EAT^\downarrow :

The *downward closure* of EAT: $EAT^\downarrow = \{e_1 \preceq e : e \in EAT\} \cup \{0_e\}$

EAT^\downarrow is the set of all eating eventualities, plus their cross-temporally identical parts that are too small to count as eating, plus the *null event* 0_e . The inclusion of the null event is to make (4) compatible with Fred eating no mangos, see Landman 2004. The null-event itself is the minimal event which satisfies the VP predicate, but it is only cross-temporally identical $>$ to itself, and thus cannot count as the onset of any non-null event in EAT^\downarrow . We take our semantics to be neutral with respect to the issue of density: whether downward-going chains of cross-temporally identical events have minimal elements or can go infinitely down. Given that, we cannot impose on EAT^\downarrow the requirement that every

event in EAT^\downarrow has an onset in EAT^\downarrow , and in fact we assume: the notion of EAT^\downarrow -onset is not defined.

This predicts that the definedness condition for *for a week* can once again only be satisfied trivially, because the definition of incremental homogeneity makes reference to the onsets of the events, which in this case would be the EAT^\downarrow -onsets, and these do not exist, by the postulate. Consequently, downward entailing cases like (4) are predicted to be infelicitous.

The rationale of the proposed analysis is the following. Downward entailing eventive predicates are in many, but not all, respects like stative predicates. (In this respect they differ from negative predicates, which allow true stative interpretations.) Like stative predicates, the notion of onset doesn't make sense for downward entailing eventive predicates: events need time to get started (the onset), but *absence of events* doesn't need time to get started. However, downward entailing eventive predicates are *not* predicates of states, but of events. This means that the notion of homogeneity which applies to them is not the subinterval property, but incremental homogeneity.

This brings in the conflict: the semantics relates to a reinterpreted verbal event type that is like statives in that the notion of onset is not defined for it. The definedness condition of *for a week* requires non-trivial incremental homogeneity, and that in its turn requires onsets. The conflict between the two makes downward entailing cases like (4) infelicitous.

3.4. Events that go through a stage that doesn't preserve the event type.

From our perspective this is the most interesting case, because it relates directly to the most salient part of our notion of incremental homogeneity: incremental preservation of the event type *between* the onset of the event and the event.

The case we are interested in is a case where we have an aspectual *for*-phrase *for n minutes*, an eventive predicate with interpretation α and event $e \in \alpha$ such that $e \in \mathbf{for\ n\ minutes}(\alpha)$, the V_α -onset of e and e itself are both in α , but for some interval i incrementally between the onset and e there is no event e' such that $\tau(e',w)=i$ and $e' \sim e$ and $e' \in \alpha$. This, of course, violates incremental homogeneity directly and α *for n minutes* is predicted to be infelicitous.

Let us assume the following scenario. We have a solution into which we drip iodine to create a certain chemical effect. The effect is only there when the amount of iodine in the solution reaches value k . We say that the amount of iodine in the solution is *inactive* up to k . Above k , we get the effect, and the amount of iodine in the solution is active. However, when after that the amount reaches value m , the effect disappears again, and above m , the amount of iodine in the solution is once again inactive.

In our setup, we are dripping iodine into the solution, and we reach amount k after 20 minutes, and amount m after 40 minutes. We stop after an hour. e_{20} is the stage we reach at 20 minutes, and $e_{20} \preceq e_{40} \preceq e_{60}$.

We consider the mass expressions: *an active amount of iodine* and *an inactive amount of iodine* in (5):

- (5) a. ✓ We dripped *an inactive amount of iodine* into the solution for twenty minutes.
 b. # We dripped *an active amount of iodine* into the solution for forty minutes..
 c. # We dripped *an inactive amount of iodine* into the solution for sixty minutes.

We start with (5a). $O(e_{20}, \text{DRIP})$ is itself an event of dripping an *inactive* amount of iodine into the solution, and, since *drip* is an activity, we find such events at every interval between the running time of the onset and e_{20} .

Let α be the event type of dripping an inactive amount of iodine into the solution. $e_{20} \in \text{for twenty minutes}(\alpha)$, and e_{20} is incrementally homogeneous with respect to α , because between $O(e_{20}, \text{DRIP})$ and e_{20} we find cross-temporally identical events of dripping an inactive amount of iodine into the solution. Hence, the definedness condition for *for 20 minutes* is satisfied, and (5a) is felicitous.

Not surprisingly, we predict that (5b) is infelicitous: $O(e_{40}, \text{DRIP}) = O(e_{20}, \text{DRIP})$, and this is an event of dripping an *inactive* amount of iodine into the solution, and, of course, *not* itself an event of dripping an *active* amount of iodine into the solution. For this example we let α be the type of events of dripping an *active* amount of iodine into the solution. $e_{40} \in \text{for forty minutes}(\alpha)$, but e_{40} is not incrementally homogeneous with respect to α , because $O(e_{40}, \text{DRIP}) \notin \alpha$. (5b) is infelicitous.

The case that relates most directly to the notion of incremental homogeneity is (5c). In this case, $O(e_{60}, \text{DRIP}) = O(e_{20}, \text{DRIP})$ and the event type α is the very same event type α as used in (5a), the set of events of dripping an *inactive* amount of iodine into the solution, and $e_{60} \in \alpha$.

The difference with (5a) is that $e_{60} \notin \text{for twenty minutes}(\alpha)$ but $e_{60} \in \text{for sixty minutes}(\alpha)$. Thus, e_{60} played no role in evaluating the felicity of (5a), but it does, of course, play a role in evaluating the felicity of (5c). And e_{60} is *not* incrementally homogeneous with respect to α : $O(e, e_{60}) \preceq e_{40} \preceq e_{60}$, and $e_{40} \notin \alpha$ (the amount of iodine is active in e_{40}), so α is not incrementally preserved between the onset of e_{60} and e_{60} itself. Thus the notion of incremental homogeneity correctly predicts that (5c) is infelicitous.

3.5. A fifth case: a naturalness requirement.

The notion of incremental homogeneity predicts a difference between accomplishment predicates with mass nouns and count nouns. We saw in section 3.1. that *eat a mango* is not incrementally homogeneous, because the onset of events of eating a mango is not itself an event of *eating a mango*, but only an event of *eating mango*. By the same token, the onset of *eating mango* is itself an event of *eating mango*. But by this argument, accomplishment predicates with *non-bare* indefinite *mass* arguments could be felicitous, at least they need not be of the type where the onset is not in the event type. And in fact, they sometimes are felicitous. (5a) above is an example.

On the other hand., these examples are often not as good as we might want them to be:

- (6) a. #Fred ate *a bit of mango* for an hour.
 b. ?Fred ate *a bit of mango* for a second

We think that the infelicity of these cases is not to do with the definedness condition, but with an independent contextual felicity condition: for full felicity the events have to sit contextually naturally inside the interval determined by the aspectual *for*-phrase.

By this condition, (6b) should be more natural than (6a), and we think it is. Even so it is not so clear to us that in English the cases always become *fully* felicitous. More generally, We point out here that this is open to contextual and cross-linguistic variation. In Dutch we find the following contrasts.

- | | | | |
|--|---|---|---|
| a.
b.
(7) Fred druppelde urenlang
c. Fred dripped for hours
d. | } | #300 ml jodium
#een flesje jodium
.
(?een beetje jodium
(?)wat jodium | .
in de oplossing
into the solution |
|--|---|---|---|

300 ml jodium		een flesje jodium		een beetje jodium		wat jodium
300 ml of iodine		a bottle of iodine		a bit of iodine		sm iodine

We predict straightforwardly that (7a) and (7b) are infelicitous, because the onset is not preserved: the first bit of iodine is not itself three hundred ml of iodine or a bottle of iodine. (7c) and (7d) are predicted to be defined, but maybe not completely natural, because *V a bit...for hours* is funny. It is not a secret that Fred always was awful at chemistry, that he was particularly bad at titration, and that in a normal context, Fred was always so clumsy and impatient that his drips always became squirts, and he would once again put in too much iodine to count as *a bit* fairly soon. Obviously, it is not natural to assume that he could be dripping *a bit of iodine* in for hours.

This is where the contrast in (8) comes in:

- (8) a. (?)Fred druppelde urenlang een beetje jodium in de oplossing.
 b. ✓De nano-titratie-machine druppelde urenlang een beetje jodium in de oplossing.

The nano-titration machine is invented here for the purposes of the example: the only relevant thing is that it is a precision instrument that can drip nano-amounts into solutions. And the Dutch example in (8b) becomes perfectly felicitous.

This indicates that what is at stake in these examples is not incremental homogeneity but contextual naturalness.

4. Inertia events and incremental homogeneity.

4.1. Iterations of semelfactives.

We discussed the cases in (9) in part one of this paper:

- (9) a. The tap dripped for three hours.
 b. Fred knocked on the door for an hour.

We argued, following Rothstein 2004, 2007, that predicates like *drip* and *knock* are accomplishments on their semelfactive reading, but activities on their iteration reading, and on the latter reading they are compatible with aspectual *for*-phrases. We also argued that these cases are counterexamples to static, segmental definitions of homogeneity which weaken the universal quantifier in the subinterval property to range over *reasonably large subintervals*: the examples in (9) can be true even though the ‘pause’ subintervals – the subintervals without actual dripping/knocking – are larger than the actual dripping/knocking intervals.

Incremental homogeneity maintains a universal quantifier over subintervals, but takes the arrow of time into account, it looks at the development of the dripping/knocking process over the course of the relevant interval, and in that, it only looks at incrementally larger time intervals. Since the perspective is incremental, at each stage you keep track of what you have accumulated so far. This, we assume, is the reason that we can maintain the truth of the activity predicate – the tap *is* dripping, Fred *is* knocking right now – despite the fact that we are in the middle of a gap. Our claim that the process is continuing is based on the pattern of dripping/knocking that we have accumulated *incrementally* so far. Thus, even though we are actually in a pause between two drips/knocks, we assume that the process of dripping/knocking is going on incrementally, that is, we assume that at the interval which starts at the beginning of evaluation and ends now, an inertia event of the dripping/knocking time is going on, and event that, regarded segmentally, has a pause at the end. This represents *our* contextual decision that the dripping/knocking process, ‘the same’ dripping/knocking process, isn’t over yet.

We assume that the iterative meaning of *knock* is formed by an *iteration operation*. This iteration operation grabs together single knocking events and builds a knocking process, a knocking activity out of that.

To illuminate the link with incremental homogeneity, we sketch a formalization of this operation here. We form an iterative process in two stages.

Let KNOCK be the set of single knocking events. For simplicity we take the knocks to be quasi-punctual. A sequence of knocks is a sequence $\langle \text{knock}_1, \dots, \text{knock}_n \rangle$, with $\tau(\text{knock}_1, w) < \dots < \tau(\text{knock}_n, w)$. We turn a sequence of knocks into a knocking process by adding inertia stages:

knock ₁		knock ₂		knock ₃		knock ₄		knock ₅		knock ₆
	pause ₁		pause ₂		pause ₃		pause ₄		pause ₅	

We start with knock₁ at $\tau(\text{knock}_1, w)$. For each interval *i* incrementally extending $\tau(\text{knock}_1, w)$ but ending before $\tau(\text{knock}_2, w)$ we add an inertia event *e* with $\text{knock}_1 \sim e$ and $\tau(e, w) = i$. By making knock₁ cross-temporally identical to *e*, we make hereby the (contextual) decision that knock₁ does not in this context count as one event in its own right, but is only a stage in a larger process, which counts as one as a whole.

Let *e_k* be the event in the process with running time up to $\tau(\text{knock}_2, w)$. We can then let the sum of *e_k* and knock₂, $e_k \sqcup \text{knock}_2$, be the next stage in the process, and we set $e_k \sim e_k \sqcup \text{knock}_2$, etc.

We let $\text{KNOCK}_{\text{iterate}}$ consist of all knocking processes defined in this way that have contextual coherence, and all stages used in their definition from the onset up. Concerning the onsets, we propose that in the knocking process $e \in \text{KNOCK}_{\text{iterate}}$ – built up from the sequence $\langle \text{knock}_1, \dots, \text{knock}_n \rangle$ – the onset of the knocking process is the stage from the first knock up to the second knock: $O(e, \text{KNOCK}_{\text{iterate}}) = e_k \sqcup \text{knock}_2$. Arguably, that is the first point where you know that you are dealing with an iteration process.

With these assumptions, the events in $\text{KNOCK}_{\text{iterate}}$ are incrementally homogenous with respect to the event type $\text{KNOCK}_{\text{iterate}}$, hence the event type $\text{KNOCK}_{\text{iterate}}$ is homogenous. As a consequence, the examples in (9) are felicitous on the iterative interpretation.

The requirement of contextual coherence tells us that the decision to generate more cross-temporally identical stages – in particular inertia stages – is a contextual decision: *you* decide that, even though there haven't been knocks for a while, the knocking isn't over yet, and *your* patience or impatience decides when the pause stretch is getting too long: if it is, you want another knock, or else you will terminate the cross-temporal identity, and put an end to what you count as one single knocking process.

4.2. Accomplishments in the scope of temporal quantifiers.

This analysis extends straightforwardly to cases of iteration with a period specification, like (10b):

- (10) a. #Susan drank half a glass of orange juice for five minutes.
 b. ✓ Susan drank half a glass of orange juice *every twelve minutes* for twenty five hours the Yom Kippur she was pregnant.

Let α be the event type:

$\lambda e. \text{DRINK}(e) \wedge \text{Ag}(e) = \text{SUSAN} \wedge \text{Th}(e) \in \text{ORANGE JUICE} \wedge \text{amount}(\text{Th}(e)) = \frac{1}{2}\text{-glass}$

This is an accomplishment event type: if $e \in \alpha$ then e is an event of Susan drinking half a glass of orange juice. The onset is the first bit of drinking. The onset is not preserved, and (10a) is not felicitous.

In (10b) we can use *every twelve minutes* to define a new event type:

drink ₁	drink ₂	drink ₃	drink ₄	drink ₅	drink ₆
12 min	12 min	12 min	12 min	12 min	12 min

The basic situation is exactly as we saw for *knock*. We assume that the semantics of (10b) involves the same iteration operation as iterative *knock*. This operation operates on *sequences* of events in the event type α . Semantically, *every twelve minutes* constraints not the events in α , but the sequences that the iteration operation operates on: it constrains the lengths of the pauses in the sequences.

The operation forms an event type of incrementally homogenous processes of drinking a glass of orange juice at twelve minutes intervals. While the events in event type α are accomplishment events with onsets not in α , the notion of onset gets redefined for the iteration event type: the onset relative to the iteration event type is the stage consisting of the first drinking event, the following 12 minute pause, and the second drinking event. This is the first stage that is non-trivially itself of the iterative event type.

The proper analysis of these examples requires a modification of the algorithm for building iterative processed sketched in the previous section: we do not assume that the accomplishment events in α are quasi-punctual, hence they need to be added themselves to the iteration process *in stages*. We will not go into the technical details of that.

While the events in α are accomplishment events that cannot be felicitously modified by aspectual *for*-phrases, the iterative event type is homogenous and consists of incrementally homogenous events. This means that (10b) is felicitous on the iterative interpretation.

4.3. The case of accomplishments/achievements with bare arguments.

We have analyzed the case of accomplishment/achievement predicates with bare plural arguments – like the examples in (11) – extensively in Landman and Rothstein 2010.

- (11) a. Fred ate *mangos* for an hour.
 b. *Guests* arrived at the hotel for six hours.

We take the fact that the relevant predicates are felicitous with bare plural arguments, but not with non-bare count arguments as evidence that it is something specific about the semantics of predicates with *bare* arguments that makes these cases felicitous, and not a distinction like *cumulativity/quantization* which induces a distinction *within* the class of predicates with non-bare count arguments. We discuss (11a) here.

We follow Carlson 1977 in assuming that bare nouns have interpretations on which they denote kinds, and we assume that the interpretation on which (11a) is felicitous involves the kind k_{MANGO} .

We assume that the verb *eat* is systematically ambiguous between an interpretation as an event type with an individual theme EAT and different sorts of =event types with a kind theme EAT_{GN} and EAT_{EK} .

-The individual-relating event type EAT is the set of events whose theme is an individual object, like a mango. Events in this event type express relations of the agent ingesting the theme.

-The gnomic event type EAT_{GN} is a set of generic events whose theme is a kind, like the kind k_{MANGO} . These events express gnomic-eating-relations between their agent and the kind-theme, which are generic relations with a modal semantics. A gnomic eating event has an indirect relation to individual eating events, for instance:

- Sufficiently many individual mangos get consumed by the agent over a sufficiently long period of time (inductive reading).
- The agent has a disposition towards ingesting instances of the kind Mango.
- Mangos often stand on the agent's menu.

-The agent has once eaten a mango to prove that he is not afraid of mangos.
 -The episodic-kind-event type EAT_{EK} is also a set of events whose theme is a kind, but the events in this event type express *episodic* relations between the agent and the kind theme. An episodic-kind eat-event has a unique indirect relation to individual eating events, namely: episodic-kind eating event e is *witnessed* by individual eating events within the running time of e . We formulate this as a witness postulate:

Witness postulate:

If $e \in EAT_{EK}$ and $Th(e)=k_{MANGO}$ and $\tau(e,w)$ is defined, then there is an event of ingestion $e' \in EAT$ with the same agent as e , which has as theme an individual mango (or a piece of mango) and $\tau(e',w) \subseteq \tau(e,w)$.

Unlike Carlson 1977, we are not reducing the episodic kind event type semantically to the individual event type through an instantiation relation introduced by the semantics: the witnesses are accessed by entailment through the above witness postulate.

An episodic-kind-event of eating mangos, is an event in the event type α :

$$\alpha = \lambda e.EAT_{EK}(e) \wedge Th(e) k_{MANGO}$$

The set of episodic-kind-events with the kind Mango as theme.

By the witness postulate, each event e in α with $\tau(e,w)$ defined has to be witnessed by an individual eating event within its running time $\tau(e,w)$. Let i be the interval from the beginning of $\tau(e,w)$ to the end of the running time of the *first* witness event for e . It is unproblematic to assume that there is an event $e' \in \alpha$, with $e' \sim e$ and $\tau(e',w)=i$. Since it is unproblematic, we make exactly that assumption. This event e' is itself witnessed by the first witness of e , and we set $e' = O(e,EAT_{EK})$.

The first bit of eating witnesses the onset of an episodic-kind event of *mango eating*. We can assume that this first bit is good enough to extend the process incrementally through cross-temporally identical stages: it is unproblematic to assume that α contains cross-temporally inertia events incrementally extending e' : these events are themselves episodic-kind events of *mango eating*, and they are witnessed by the very same witness as e , which is, after all, within their running time.

At some point *you* get impatient, and, say to the agent: it's been a long time since you ate any mango, if you want me to continue to call this *mango eating*, you got to eat some more. At this point the agent quickly eat two more pieces of mango, which adds two more witnesses, and, looking segmentally, some spread of witnesses, because the previous witnesses keep counting (that is the point of incrementality). This keeps you happy, with three witnesses accumulated, you unproblematically assume that there is an event e'' in α , cross-temporally identical to the onset, at the running time which runs from the beginning of the onset to the end of the last witness, and this event e'' is witnessed by the three events of individual eating.

With this, we postulate:

Homogeneity postulate:

Episodic-kind-event types are homogenous, they consist of incrementally homogenous episodic kind events.

In essence, what happens is that we have an *incremental* sequence of witnessing events and intervals containing them, and we lay an incrementally homogenous *process* of episodic kind-events over that witnessing-event-interval sequence. Thus, a sequence of witnessing accomplishment events (each an eating of a chunk of mango) is turned into an activity, a k_{MANGO} -eating process.

With this assumption, the definedness condition of the aspectual *for*-phrase in (11a) is satisfied for the episodic kind interpretation of the predicate in (11a). Hence, on that interpretation (11a) is felicitous.

We propose exactly the same analysis for the achievement in (11b):

(11) b. *Guests arrived at the hotel for six hours.*

(11b) involves the episodic-kind event type $\lambda e. \text{ARRIVE}_{\text{EK}}(e) \wedge \text{Th}(e)=k_{\text{GUEST}}$. As in (11a), this event type is an homogenous activity event type.

On this analysis, we account naturally for the fact that the arrival events required for the truth of (11b) may be spread over the six hour interval, and in fact cover by themselves *very little* of that interval. On our account, the spread – how many guests are required to arrive when – is part of the cross-temporal identity conditions of the arrival process: how often guests are required to arrive during the night depends on how many instances *you*, the speech participant, need, in order to think of the guest-arrivals as part of *one* coherent process.

Secondly, while *arrive* is an achievement predicate, and doesn't by itself allow the progressive or allows it via contextual shifting, $\text{ARRIVE}_{\text{EK}}$ is an *activity* event type, and, like all activities, allows the progressive unproblematically. Not just that, but like other activities, there is very little detectable meaning difference between the sentence with the progressive and the sentence without:

(11) b. *Guests arrived at the hotel for six hours.*

c. *Guests were arriving at the hotel for six hours.*

5. Conclusion.

We propose that aspectual *for*-phrases semantically modify homogeneous predicates. Homogeneity means that the predicate is appropriately spread over subintervals. For stative predicates we follow the standard assumption that homogeneity means that the predicate is spread over all subintervals. For eventive predicates we assume, following Landman 2008, that the spread requirement is incremental: the event type is preserved incrementally between the onset of the events and the events themselves.

We showed that the analysis is not only adequate (it correctly predicts that stative and activity predicates can be felicitously modified by aspectual *for*-phrases, unlike basic accomplishment and achievement predicates), it successfully – and we think insightfully – deals with intricate examples, like the examples in (5) above.

We discussed several operations that form complex states or complex activities, allowing for felicitous modification by aspectual *for*-phrases. In particular, we showed in

detail how operations of iteration (including the witnessing of kinds in episodic kind interpretations) form incrementally homogeneous activities. We showed that the analysis finds important support in the interaction between achievement predicates and the progressive (the examples in (11)).

Notions like the subinterval property and the cumulative-quantized distinction are temporally static, in that they do not take the arrow of time into account. Such notions are appropriate for stative predicates. In these papers we have made a case for the fruitfulness of interpreting homogeneity of eventive predicates as *incremental homogeneity*, a notion that is temporally dynamic in that it does take the arrow of time into account.

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