The scope of *for*-adverbials: A reply to Deo and Piñango (2011)*

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1 Introduction

- Deo and Piñango (2011 at SALT, D&P for short) present an ambitious theory of *for*-adverbials that claims to account not only for their aspectual sensitivity but also for a number of other phenomena: their puzzling scopal behavior and their ability to trigger iterative and partitive reinterpretations, along with certain psycho-/neurolinguistic effects.
- I will show that their account suffers from technical shortcomings. To overcome them, I will use a combination of previous accounts (Dowty, 1979; Krifka, 1998; van Geenhoven, 2004; Kennedy, 2010; Champollion, 2010a,b).
- There is a lot of common ground between D&P and myself, in particular we have a common view on the data and the relevant generalizations.
- The changes to D&P proposed here are expected to be backwards compatible with the analysis of generic/habitual sentences in Deo (2009) from which D&P is technically derived.

2 Facts that a theory of *for*-adverbials needs to account for

2.1 Aspectual sensitivity

- *For*-adverbials are commonly considered the most reliable diagnostic of the distinction between atelic and telic predicates (Vendler, 1957; Verkuyl, 1989):

(1) a. John ran / drove towards the store / drank wine for an hour. *atelic*
    b. ?John ran a mile / drove to the store / drank 1l of wine for an hour. *telic*

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2.2 Availability and cost of iterative interpretations

- *For*-adverbials sometimes do combine successfully with telic predicates. This may lead to iterative interpretations (van Geenhoven, 2004, 2005).

(2) a. Mary biked to the store for two months.
    b. The girl dove into the pool for an hour.

- *For*-adverbials also trigger iterative interpetations when they combine with atelic punctual predicates (i.e. semelfactives, Smith (1997)):

(3) a. The horse jumped for an hour.

- As reviewed by Deo and Piñango (2011), iterative interpretations engender cost by various psycho-/neurolinguistic measures:
  - increased centro-parietal activity (Downey, 2006);
  - increased reading times and brain activity (Brennan and Pylkkänen, 2008);
  - longer reaction time in cross-modal lexical decision (Piñango et al., 1999, 2006);
  - comprehension difficulties in Wernicke's Aphasics (Piñango and Zurif, 2001).

2.3 Availability of partitive interpretations

- When there is not enough time for an iterative interpretation to make sense, *for*-adverbials can trigger a partitive interpretation instead:

(4) a. Mary read a book for an hour.
    b. Mary baked a cake for an hour.

- The availability of a partitive interpretation can be blocked by an explicit endpoint description (Smollett, 2005):

(5) a. Mary polished the countertop for 15 minutes.
    b. *Mary polished the countertop **smooth** for 15 minutes.
    c. *Mary polished the countertop **to a shine** for 15 minutes.

2.4 Scope generalization: Indefinites take wide scope

- Suppose that *for*-adverbials are universal quantifiers over moments (*for an hour* = *at each moment of an hour*). Then indefinites stubbornly take scope over them (Kratzer, 2007):

(6) a. John pushed a cart for an hour. $\exists > \forall$; $*\forall > \exists$
    b. I dialed a wrong phone number for five minutes. $\exists > \forall$; $*\forall > \exists$
    c. She bounced a ball for 20 minutes. $\exists > \forall$; $*\forall > \exists$
    d. He kicked a wall for a couple of hours. $\exists > \forall$; $*\forall > \exists$
    e. She opened and closed a drawer for half an hour. $\exists > \forall$; $*\forall > \exists$

f. I petted a rabbit for two hours. $\exists > \forall$; $*\forall > \exists$

- This even holds in German, despite its preference for surface scope (Kratzer, 2007):

(7) a. Ich hab' fünf Minuten lang eine falsche Telefonnummer gewählt.
I have five minutes long a wrong telephone.number dialed.
b. Ich hab' eine falsche Telefonnummer fünf Minuten lang gewählt.
I have a wrong telephone.number five minutes long dialed.

- And it even holds when pragmatics would favor a narrow-scope reading:

(8) ??John found a flea on his dog for a month. (Zucchi and White, 2001)

(9) a. ??John noticed a discrepancy/two discrepancies for a week. D&P (2011)
b. ??John discovered a new proof/two new proofs for a week. D&P (2011)

- Same effect for other indefinites such as numerals:

(10) John saw thirty zebras for three hours. $30 > \forall$; $*\forall > 30$

2.5 Exceptions to the wide-scope generalization

2.5.1 Bare plurals and mass nouns

- Bare plurals and mass nouns do not have to take distributive wide scope over *for*-adverbials (Carlson, 1977; Verkuyl, 1972; Dowty, 1979)

(11) a. John found fleas on his dog for a month.
b. John discovered crabgrass in his yard for six weeks.

(12) a. Tourists discovered that quaint little village for years.
b. Water leaked through John's ceiling for six months.

2.5.2 Salient granularity

- Narrow scope possible when a salient level of granularity can be inferred from context or from world knowledge (Moltmann, 1991; Champollion, 2010b)

(13) *Context:* discussing the daily intake of patients
The patient took two pills for a month and then went back to one pill.

(14) We built a huge snowman in our front yard for several years. (D&P)

- This inference takes time: reading time increases at the *for*-adverbial in (15a) compared with (15b) in self-paced reading tests (Todorova et al., 2000)

(15) a. Even though Howard sent a large check to his daughter for many years, she refused to accept his money.
b. Even though Howard sent large checks to his daughter for many years, she refused to accept his money.

Summary The following facts about *for*-adverbials need to be explained:

1. They are not readily compatible with telic predicates
2. They trigger iterative interpretations
3. These iterative interpretations engender processing costs
4. They trigger partitive interpretations on some accomplishments
5. The wide scope generalization: Indefinites take wide scope over *for*-adverbials
6. Exceptions to the wide scope generalization:
   (a) bare plurals and mass nouns
   (b) salience and world knowledge effects

3 Background: Telicity and atelicity as higher-order properties

- I use lowercase $i, j, \ldots$ for moments (intervals of infinitesimal length) and capital $I, J, \ldots$ for intervals in general. I write $\sqsubseteq$ for "is a subinterval of" (a reflexive relation) and $\sqsubset$ for "is a proper subinterval of" (an irreflexive relation).
- I write $\textsc{At}(P, I)$ to generalize over event and interval predicates:

(16) $$\textsc{At}(P, I) = \begin{cases} P(I) & \text{if P is an interval predicate} \\ \exists e[P(e) \wedge I = \tau(e)] & \text{if P is an event predicate} \end{cases}$$

- As an idealization, atelicity and telicity correspond to two higher-order properties:
- An atelic predicate has the **subinterval property**: whenever it holds at an interval I, it holds at every subinterval of I. (Attributed to Bennett and Partee, 1972)

(17) John ran from 3 to 5pm. $\Rightarrow$ John ran from 3 to 4pm. *atelic*

Definition: Subinterval(P) $\stackrel{\text{def}}{=} \forall I\ [\textsc{At}(P, I) \rightarrow \forall J[J \sqsubset I \rightarrow \textsc{At}(P, J)]]$

- A telic predicate is **temporally quantized**: Whenever it holds at an interval, it does not hold at any one of its subintervals. (Based on Krifka, 1986)

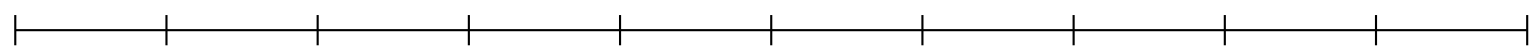
(18) John ran a mile from 3 to 5pm. $\not\Rightarrow$ John ran a mile from 3 to 4pm. *telic*

Definition: Temporally-quantized(P) $\stackrel{\text{def}}{=} \forall I\ [\textsc{At}(P, I) \rightarrow \forall J[J \sqsubset I \rightarrow \neg\textsc{At}(P, J)]]$

4 Deo and Piñango (2011)

- D&P argue for an analysis of *for*-adverbials which is based on regular partitions.

(19) **Definition.** A *regular partition* of an interval I, written $\mathscr{R}_I$, is a set of disjoint intervals of equal length whose concatenation equals I.



- They write $\mathscr{R}_I^c$ for a contextually determined regular partition of I and $\mathscr{R}_I^{inf}$ for a regular partition of I whose intervals have infinitesimal value (i.e. are moments).
- They write Coin(P,I) to generalize over intervals and events – note that unlike At, it allows overlap if P is an event predicate:

(20) $$\text{Coin(P,I)} = \begin{cases} P(I) & \text{if P is an interval predicate} \\ \exists e[P(e) \wedge I \circ \tau(e)] & \text{if P is an event predicate} \end{cases}$$

- D&P's translation of a *for*-adverbial:

(21) $[\![\text{for an hour}]\!]_{D\&P}$
$= \lambda P \lambda I[\text{hours}(I) = 1 \wedge \forall J[J \in \mathscr{R}_I^c \rightarrow \text{Coin}(P, J)]]$

- In D&P's system, predicates to which *for*-adverbials apply are always event predicates, except when they already contain another aspectual modifier. Since the latter case doesn't occur in any of their examples, we can rewrite Coin for presentation purposes.

(22) $[\![\text{for an hour}]\!]_{D\&P}$
$= \lambda P \lambda I[\text{hours}(I) = 1 \wedge \forall J[J \in \mathscr{R}_I^c \rightarrow \exists e[P(e) \wedge J \circ \tau(e)]]]$

- D&P assume that to generate continuous (i.e. non-iterative) readings of *for*-adverbials, the partition cell length is set to infinitesimal. This amounts to universal quantification over moments. We can rewrite $\circ$ as $\sqsubseteq$ since we are dealing with moments (any moment that overlaps with an interval is contained in it).

(23) $[\![\text{for an hour}]\!]_{D\&P}^{continuous}$
$= \lambda P \lambda I[\text{hours}(I) = 1 \wedge \forall i[i \in \mathscr{R}_I^{inf} \rightarrow \exists e[P(e) \wedge i \circ \tau(e)]]$
$= \lambda P \lambda I[\text{hours}(I) = 1 \wedge \forall i[i \sqsubset I \rightarrow \exists e[P(e) \wedge i \sqsubseteq \tau(e)]]$

- Example:

(24) $[\![\text{John walk for an hour}]\!]_{D\&P}^{continuous}$
$= \lambda I[\text{hours}(I) = 1 \wedge \forall i[i \sqsubset I \rightarrow \exists e[\text{john-walk}(e) \wedge i \sqsubseteq \tau(e)]]$
(True of any one-hour timespan of which every moment is temporally contained in an event of John walking.)

- D&P assume that iterative readings arise when the interval is partitioned into subintervals which are relatively small-sized compared with the interval of the *for*-adverbial, but still larger than moments:

- Accomplishments:

(25) $[\![\text{Mary bike to the store for a month}]\!]^{iterative}_{D\&P}$
$= \lambda I[\text{months}(I) = 1 \wedge \forall J[J \in \mathscr{R}^c_I \to \exists e[[\![\text{Mary bike to the store}]\!](e) \wedge J \circ \tau(e)]]]$
(True of any one-month timespan if each cell of its contextually given regular partition overlaps with an event of Mary biking to the store.)

- Semelfactives:

(26) $[\![\text{The horse jump for an hour}]\!]^{iterative}_{D\&P}$
$= \lambda I[\text{months}(I) = 1 \wedge \forall J[J \in \mathscr{R}^c_I \to \exists e[[\![\text{The horse jump}]\!](e) \wedge J \circ \tau(e)]]]$
(True of any one-hour timespan if each cell of its contextually given regular partition overlaps with an event of the horse jumping.)

- The value of the variable c that determines the size of the subintervals is anaphoric on the context, following ideas in Moltmann (1991) and Champollion (2010b).

- D&P attribute the higher processing costs for iterative interpretations to the process of retrieving a value for c from the context.

- They assume that this process is not necessary when c can be set to an infinitesimal value (this means no processing costs for continuous readings).

5 Problems of D&P's account

5.1 Aspectual sensitivity is deliberately not modeled

- By design, D&P do *not* model the aspectual sensitivity of *for*-adverbials.

- **Fact.** Let P be a temporally quantized event predicate that holds at some interval I of at least one hour length. Then $[\![P \text{ for an hour}]\!]^{continuous}_{D\&P}$ holds of some $I' \sqsubseteq I$.

- **Proof.** The idea is that when we apply the *for*-adverbial to a subinterval I' of I, it does not check whether P holds at that subinterval. All it does it make sure that each moment of I' is contained in an interval at which P holds. By assumption, I is such an interval.

(27)
$$\begin{array}{ll}
\text{hours}(I) \geq 1 \wedge \text{AT}(P, I) & \text{(by assumption)} \\
\Leftrightarrow \text{hours}(I) \geq 1 \;\wedge\; \exists e[P(e) \wedge I = \tau(e)] & \text{(by definition of AT)} \\
\Leftrightarrow \exists I'[I' \sqsubseteq I \wedge \text{hours}(I') = 1 \;\wedge\; \exists e[P(e) \wedge I' \sqsubseteq \tau(e)]] & (\textit{hours} \text{ is monotonic}) \\
\Leftrightarrow \exists I'[I' \sqsubseteq I \wedge \text{hours}(I') = 1 \;\wedge \forall i[i \sqsubset I' \to \exists e[P(e) \wedge i \sqsubseteq \tau(e)]]] & \text{(transitivity of } \sqsubseteq) \\
\Leftrightarrow \exists I'[I' \sqsubseteq I \wedge [\![P \text{ for an hour}]\!]^{continuous}_{D\&P}(I') & \text{(see (23))}
\end{array}$$

- In D&P's view, "telic predicates are perfectly acceptable with for-adverbs" since they can give rise to iterative and partitive interpretations. They explicitly reject the idea that telic predicates must be coerced into atelic predicates before combining with a *for*-adverbial.
- D&P expect that telic predicates are ruled out by pragmatic considerations. But they do not describe these pragmatic considerations for the continuous case.

5.2 Partitive interpretations are not constrained correctly

- By making the infinitesimal partition length available at no cost, D&P predict partitive-like interpretations for all accomplishments:

(28) $[\![\text{Mary polish the countertop for 15 minutes}]\!]^{continuous}_{D\&P}$
$= \lambda I[\text{minutes}(I) = 15 \wedge \forall i[i \sqsubset I \rightarrow \exists e[[\![\text{Mary polish the countertop}]\!](e) \wedge i \sqsubseteq \tau(e)]]$
(True of any fifteen-minute timespan of which every moment is temporally contained in an event of Mary polishing the countertop.)

- However, this process is not constrained, so nothing stops it from applying to accomplishments with explicit endpoint descriptions like resultatives:

(29) $[\![\text{Mary polish the countertop smooth for 15 minutes}]\!]^{continuous}_{D\&P}$
$= \lambda I[\text{minutes}(I) = 15 \wedge \forall i[i \sqsubset I \rightarrow \exists e[[\![\text{Mary polish the c. smooth}]\!](e) \wedge i \sqsubseteq \tau(e)]]$
(True of any fifteen-minute timespan of which every moment is temporally contained in an event of Mary polishing the countertop smooth.)

5.3 Indefinites are not predicted to take wide scope

- Indefinites which are interpreted in situ end up taking scope under the universal:

(30) $[\![\text{John push a cart for an hour}]\!]^{continuous}_{D\&P}$
$= \lambda I[\text{hours}(I) = 1 \wedge \forall i[i \sqsubset I \rightarrow \exists e[[\![\text{John push a cart}]\!](e) \wedge i \sqsubseteq \tau(e)]]$
$= \lambda I[\text{hours}(I) = 1 \wedge \forall i[i \sqsubset I \rightarrow \exists e \exists x[\text{cart}(x) \wedge \text{push}(e, \text{john}, x) \wedge i \sqsubseteq \tau(e)]]$
(True of any one-hour timespan of which every moment is temporally contained in an event of John pushing a potentially different cart.)

- Imagine that John pushed a certain cart from 3pm to 3:30pm and then another cart from 3:30pm to 4pm. Then *John pushed a cart for one hour* is wrongly predicted to be true of the interval from 3 to 4pm.
- The account does not enforce narrow scope in iterative readings either:

(31) ??John found a flea on his dog for a month. (Zucchi and White, 2001)

(32) $[\![\text{John find a flea for a month}]\!]^{iterative}_{D\&P}$
$= \lambda I[\text{months}(I) = 1 \wedge \forall J[J \in \mathscr{R}^c_I \rightarrow \exists e[[\![\text{John find a flea}]\!](e) \wedge J \circ \tau(e)]]]$
$= \lambda I[\text{months}(I) = 1 \wedge \forall J[J \in \mathscr{R}^c_I \rightarrow \exists e \exists x[\text{flea}(x) \wedge \text{find}(e, \text{john}, x) \wedge J \circ \tau(e)]]]$

- Assume a contextually given regular partition into days. Then the above formula is true of any one-month timespan if each of its days overlaps with an event of John finding a potentially different flea.

5.4 Exceptions to the wide-scope-generalization

5.4.1 Contrast between indefinites and bare plurals is not predicted

- D&P cannot rule out (31) above by making the contextual partition into days unaccessible, since this would also rule out the following:

(33) John found fleas on his dog for a month. (Zucchi and White, 2001)

(34) $[\![\text{John find fleas for a month}]\!]^{iterative}_{D\&P}$
$= \lambda I[\text{months}(I) = 1 \wedge \forall J[J \in \mathscr{R}^c_I \rightarrow \exists e[[\![\text{John find fleas}]\!](e) \wedge J \circ \tau(e)]]]$
$= \lambda I[\text{months}(I) = 1 \wedge \forall J[J \in \mathscr{R}^c_I \rightarrow \exists e \exists X[\text{fleas}(X) \wedge \text{find}(e, \text{john}, X) \wedge J \circ \tau(e)]]]$

- Assuming the same partition as in (31) above, this is true of any one-month timespan if each of its days overlaps with an event of John finding fleas.
- D&P's account cannot capture the contrast between (31) and (33) because it is not sensitive to the algebraic properties of the verb phrase, i.e. to the distinction between *a flea* and *fleas.*

5.4.2 Salience and world knowledge effects are unexplained

- For the same reason, D&P cannot explain the finding by Todorova et al. (2000) that singular indefinites take longer reading time than bare plurals:

(35) a. Even though Howard sent <u>a large check</u> to his daughter for many years, she refused to accept his money. *(longer reading time)*
b. Even though Howard sent <u>large checks</u> to his daughter for many years, she refused to accept his money. *(shorter reading time)*

- Also for this reason, D&P cannot explain contrasts between pairs with singular indefinites where one is better than the other, and corresponding pairs with bare plurals where both are OK:

(36) a. ?John found a flea on his dog for a month.
b. We built a huge snowman in our front yard for several years.

- D&P cannot account for the contrast between (36a) and (36b) by stipulating that the former cannot access a contextually given partition, because this would also predict a contrast between (37a) and (37b).

(37) a. John found fleas on his dog for a month.
b. We built huge snowmen in our front yard for several years.

Section summary D&P do not model all the facts about *for*-adverbials as intended:

1.	They are not readily compatible with telic predicates	**not modeled** (by design)
2.	They trigger iterative interpretations	modeled
3.	These iterative interpretations engender processing costs	modeled
4.	They trigger partitive interpretations on some accomplishments	**not modeled**
5.	Indefinites take wide scope over *for*-adverbials	**not modeled**
6.	Exceptions to the wide scope generalization:	
	(a) bare plurals and mass nouns	**not modeled**
	(b) salient granularity and world knowledge	**not modeled**

6 Fixing D&P's account

- The following is based on insights in Kratzer (2007) and in Champollion (2010b).
- Rather than introducing the accounts in these references from scratch I will show how to fix D&P's account to get something equivalent.
- Let's start with their translation of a *for*-adverbial:

(38) $[\![\text{for an hour}]\!]_{D\&P}$
$= \lambda P \lambda I[\text{hours}(I) = 1 \wedge \forall J[J \in \mathscr{R}_I^c \rightarrow \textsc{Coin}(P, J)]]$

- Reminder: For event predicates, Coin allows temporal overlap, At doesn't.

(39) $\textsc{Coin}(\text{P,I}) = \begin{cases} P(I) \\ \exists e[P(e) \wedge I \circ \tau(e)] \end{cases}$ $\quad \textsc{At}(\text{P,I}) = \begin{cases} P(I) & \text{(intervals)} \\ \exists e[P(e) \wedge I = \tau(e)] & \text{(events)} \end{cases}$

6.1 Reintroducing sensitivity to the telic/atelic distinction

- We'll start by replacing Coin by At.

(40) $[\![\text{for an hour}]\!]_{step1}$
$= \lambda P \lambda I[\text{hours}(I) = 1 \wedge \forall J[J \in \mathscr{R}_I^c \rightarrow \underline{\textsc{At}(P, J)}]]$

- Then we add a conjunct that says that the predicate applies at the whole hour:

(41) $[\![\text{for an hour}]\!]_{step2}$
$= \lambda P \lambda I[\underline{\textsc{At}(P, I)} \wedge \text{hours}(I) = 1 \wedge \forall J[J \in \mathscr{R}_I^c \rightarrow \textsc{At}(P, J)]]$

- Note: This is just the classical account found e.g. in Krifka (1986, 1998).

- **Fact.** As long as $\mathscr{R}_I^c$ has at least two cells, this entry will prevent *for*-adverbials from truthfully combining with any temporally quantized predicate.

- **Proof.** Let P be a temporally quantized predicate. Suppose that $[\![P \text{ for an hour}]\!]_{step2}$ holds of some interval I. Then P holds at I and at every J such that $J \in \mathscr{R}_I^c$. Fix J. By definition of $\mathscr{R}_I^c$, J is a subinterval of I. Since $\mathscr{R}_I^c$ has at least two cells and since they are disjoint, J must be a proper subinterval of I. Since P is temporally quantized, it cannot hold both at J and at I. Contradiction.

6.2 Iterative interpretations

- In step 2 we have required that P hold at the whole hour.

- At first sight, this means we can no longer account for iterative readings of semelfactives: How can a single jump last an entire hour?

(42) $[\![\text{The horse jump for an hour}]\!]_{step2}$
$= \lambda I[\exists e[\text{jump}(e, \text{the horse}) \wedge I = \tau(e) \wedge \text{hours}(I) = 1 \wedge$
$\forall J[J \in \mathscr{R}_I^c \rightarrow \exists e'[\text{jump}(e', \text{the horse}) \wedge J = \tau(e')]]]]$

- One possible solution (Kratzer, 2007; Champollion, 2010b) exploits a notion familiar from algebraic semantics (Krifka, 1986, 1998): event predicates are closed under sum formation. *Jump* holds not only of single jumps but also of sums of jumps. Then *jump* can hold of hour-long events.

- But this does not explain why iterative interpretations engender cost.

- Another popular solution: a silent verb-level ITER operator meaning "once or repeatedly" (see e.g. van Geenhoven (2004) for a semantics that does not make use of type coercion). Here for simplicity I assume that it just has the meaning of the star operator (Link, 1983).

(43) $[\![\text{The horse [jump ITER] for an hour}]\!]_{step2}$
$= \lambda P \lambda I[\exists e[{}^*\text{jump}(e, \text{the horse}) \wedge I = \tau(e) \wedge \text{hours}(I) = 1 \wedge$
$\forall J[J \in \mathscr{R}_I^c \rightarrow \exists e'[{}^*\text{jump}(e', \text{the horse}) \wedge J = \tau(e')]]]]$

- D&P reject this approach because the processing cost of ITER shows up at the "wrong" place: about 300ms after the *for*-adverbial, which they say

> cannot be easily reconciled with an explanation involving the detection of a mismatch and its resolution via the insertion of a meaning-changing operator. That is, although the experimental findings report processing cost and delay, this does not provide clear evidence for the sort of discrete "fix" invoked in the coercion-based explanation. What the evidence actually suggests is the slow emergence of some process in the brain that remains active for some time and then gradually tapers off. (Deo and Piñango, 2011, p. 5)

- This slow emergence could be handled in a processing model where the brain simultaneously considers different parse hypotheses (one with and one without ITER) and takes about 300ms of time to resolve it.

- Another reason why D&P reject ITER: iterative readings occur with higher frequency, so ITER should become conventionalized and not lead to higher costs.

- Recall that D&P attribute the higher processing costs for iterative interpretations to the process of retrieving a value of c from the context. So c acts as a "penalty" on processing.

- They build the "penalty" into the *for*-adverbial (via $\mathscr{R}_I^c$), but we can just as well move this "penalty" into ITER. I leave open what this may look like.

6.3 Reintroducing partitive interpretations

- Recall that partitive interpretations can be blocked by an explicit endpoint description (Smollett, 2005):

(44) a. Mary polished the countertop for 15 minutes.
b. *Mary polished the countertop **smooth** for 15 minutes.
c. *Mary polished the countertop **to a shine** for 15 minutes.

- We need a theory in which *polish the countertop smooth/to a shine* is temporally quantized, but *polish the countertop* is not.

- On closer inspection, *polish the countertop* is an example of variable telicity:

(45) Mary polished the countertop for/in 15 minutes.

- So it should come out as being temporally quantized in some contexts but not in all.

- The theory of variable telicity in Kennedy (2010), 3.2, provides such an account.

6.4 Explaining the wide-scope behavior of indefinites

- Earlier, we had added a conjunct that says that the predicate applies at the whole hour:

(46) $[\![\text{for an hour}]\!]_{step2}$
$= \lambda P \lambda I[\underline{\textsc{At}(P, I)} \wedge \text{hours}(I) = 1 \wedge \forall J[J \in \mathscr{R}_I^c \rightarrow \textsc{At}(P, J)]]$

- This conjunct also accounts for the "wide scope" of indefinites (Zucchi and White, 2001; van Geenhoven, 2004; Kratzer, 2007; Champollion, 2010b).

- The conjunct will entail that there is an event whose runtime is five minutes and which satisfies the VP. For (near-)punctual predicates like *dial*, I assume that ITER ("once or repeatedly") is present at V-level (van Geenhoven, 2004).

(47) John dialed a wrong phone number for five minutes. (Zucchi and White, 2001)

(48) $[\![$John [ITER dial] a number for five minutes$]\!]_{step}$

$= \lambda I[\underline{\exists e[[\![\text{John [ITER dial] a number}]\!](e) \wedge I = \tau(e)]} \;\wedge\; \text{minutes}(I) = 5 \wedge$
$\forall J[J \in \mathscr{R}^c_I \rightarrow \exists e'[[\![\text{John [ITER dial] a number}]\!](e') \wedge J = \tau(e')]]]$

$= \lambda I[\underline{\exists e \exists x[\text{number}(x) \wedge {}^*\text{dial}(e, \text{john}, x) \wedge I = \tau(e)]} \wedge \text{minutes}(I) = 5 \;\wedge$
$\forall J[J \in \mathscr{R}^c_I \rightarrow \exists e' \exists y[\text{number}(y) \wedge {}^*\text{dial}(e', \text{john}, y) \wedge J = \tau(e')]]]$
(True of any five-minute timespan at which there is a number which John repeatedly dials, and which consists of short subintervals at each of which there is a number which John dials once or repeatedly)

- This "double scope" approach is not yet perfect: it still allows for the possibility that John dials a certain phone number x repeatedly (say his wife who he is trying to reach), and at the same time he dials certain other phone numbers y_1, y_2, y_3 once each (say customers).
- This can be avoided by adding the requirement that the events whose themes are y_1, y_2, y_3 sum up to the event whose theme is x, along with the background assumption that themes are cumulative (the theme of the sum of two events is the sum of their themes), pace Kratzer (2003). See Champollion (2010b) for how this can be done.
- Here I will omit this step for time reasons.

6.5 Explaining exceptions to the wide-scope behavior of indefinites

6.5.1 Bare plurals and mass nouns

- Bare plurals take semantic scope above *for*-adverbials through the same mechanism as indefinites. But their meaning contribution is the same as if they took narrow scope under a universal quantifier.
- Following van Geenhoven (2004), the ITER operator can only apply to the verb level, but not to the verb phrase.
- If themes are cumulative, $[\![$[ITER dial] numbers$]\!]$ can hold of a sum of consecutive dialing events in each of which a number is dialed once.
- We have seen bare plurals do not require a special context to be interpretable in sentence with *for*-adverbials. I conclude that the value of the partition measure in a *for*-adverbial is *not* retrieved anaphorically.
- As in Champollion (2010b), I assume instead that there is a vague predicate "*short*" which maps any time interval to a value which is very short in comparison to it (e.g. one hour is mapped to one minute, 100 years are mapped to a few months).

(49) $[\![$for an hour$]\!]_{final}$
$= \lambda P \lambda I[\underline{\textsc{At}(P, I)} \wedge \text{hours}(I) = 1 \wedge \forall J[J \in \mathscr{R}^{short(I)}_I \rightarrow \textsc{At}(P, J)]]$

- Note that we no longer rely on infinitesimal values.

(50) John dialed phone numbers for five minutes.

(51) $[\![$John [ITER dial] numbers for five minutes$]\!]_{final}$

$= \lambda I[\exists e[[\![\text{John [ITER dial] numbers}]\!](e) \wedge I = \tau(e)] \ \wedge\ \text{minutes}(I) = 5 \wedge$
$\forall J[J \in \mathscr{R}_I^{short(I)} \rightarrow \exists e'[[\![\text{John [ITER dial] numbers}]\!](e') \wedge J = \tau(e')]]]$

$= \lambda I[\exists e \exists X[{}^*\text{number}(X) \wedge {}^*\text{dial}(e, \text{john}, X) \wedge I = \tau(e)] \wedge \text{minutes}(I) = 5 \ \wedge$
$\forall J[J \in \mathscr{R}_I^{short(I)} \rightarrow \exists e' \exists Y[{}^*\text{number}(Y) \wedge {}^*\text{dial}(e', \text{john}, Y) \wedge J = \tau(e')]]]$

(True of any five-minute timespan at which there is are one or more numbers which John dials, and which consists of short subintervals at each of which there are one or more numbers which John dials once or repeatedly)

- Mass nouns are handled in the same way.

6.5.2 Salience and world knowledge effects

- Recall that singular indefinites take longer reading time than bare plurals:

(52) a. He sent a large check to his daughter for many years. *(longer reading time)*
b. He sent large checks to his daughter for many years. *(shorter reading time)*

- In (52a), *a large check* is interpreted with "narrow scope" – that is, there are many checks.
- In Champollion (2010b) I have argued that this must be subsumed under the more general phenomenon of nonatomic distributivity (Gillon, 1990).
- Normally in order to distribute an entire VP over nonatomic entities, one needs a level of granularity that is salient through context or world knowledge (Lasersohn, 1995):

(53) a. The men weigh 250 pounds. **per pair*
b. The shoes cost fifty dollars. *per pair*

(54) *Context:* discussing the daily intake of patients
The patient took two pills for a month and then went back to one pill.

- A VP whose object is a bare plural is exempt from this requirement (Link, 1997):

(55) a. Rodgers, Hammerstein and Hart wrote a musical. **pairwise*
b. Rodgers, Hammerstein, and Hart wrote musicals. *pairwise*

- Following Schwarzschild (1996) we can model the context dependency by assuming that there is a VP-level D operator that contains an anaphoric cover over contextually salient entities (pairs of shoes, temporal intervals, etc.).

(56) The shoes $\mathrm{D}_{Schwarzschild}$ cost \$50.
$\approx$ Each contextually salient set of shoes costs \$50.
$\approx$ e.g. Each pair of shoes costs \$50. *nonatomic distributive*

- We can use D&P's notion of a regular partition as an anaphoric cover. The predicate C is taken to be anaphoric on a salient partition:

(57) $[\![\mathrm{D}^{\tau}_{C}]\!] = \lambda P \lambda I \forall J[J \in \mathscr{R}^{C}_{I} \rightarrow \textsc{At}(P, J)]$

(58) $[\![\text{John } D^{\tau}_{C} \text{ [took two pills] for a month}]\!]_{final}$

$$= \lambda I[\text{months}(I) = 1 \ \wedge \ \forall J[J \in \mathscr{R}^{C}_{I} \rightarrow \exists e[[\![\text{John take two pills}]\!](e) \wedge J = \tau(e)] \wedge \forall J[J \in \mathscr{R}^{short(I)}_{I} \rightarrow \exists e'[[\![\text{John } D^{\tau}_{C} \text{ [take two pills]}]\!](e') \wedge J = \tau(e')]]]$$

- By putting the anaphoricity into the D operator rather than the *for*-adverbial, we can condition it indirectly on the algebraic properties of the VP. A VP with a bare plural object will already be temporally quantized. A VP with a singular indefinite may require the D operator to become temporally quantized.

- This is just a sketch. More details and a clean implementation within a general theory of distributivity are in Champollion (2010b).

7 Summary and Outlook

All the facts can be modeled, in part by importing earlier accounts:

1. They are not readily compatible with telic predicates **modeled** (Krifka, 1998)
2. They trigger iterative interpretations **modeled** (van Geenhoven, 2004)
3. These iterative interpretations engender processing costs **by stipulation only**
4. They trigger partitive interpretations **modeled** (Kennedy, 2010)
5. Indefinites take wide scope over them **modeled** (Kratzer, 2007; Champollion, 2010b)
6. Exceptions to the scope generalization:
   (a) bare plurals and mass nouns **modeled** (Champollion, 2010b)
   (b) salient granularity and world knowledge **modeled** (Champollion, 2010b)

7.1 Loose ends

7.1.1 Lexical cumulativity vs. ITER

- One open question concerns lexical cumulativity (the assumption that verbs are closed under sum). D&W have convinced me that one needs to introduce ITER, and this only works if we don't also have lexical cumulativity, at least not for punctual verbs. But at the same time it's clear that we need some restricted version of lexical cumulativity, in order to get cumulative inferences (Krifka, 1992).

- The processing costs of iterative interpretations are explained by positing a silent ITER operator which is equipped with a "penalty" on processing.

7.1.2 ITER and garden paths

- Another open question concerns ITER, which D&P argue against.
- Plausibility evidence for ITER is available from languages in which it is overt, e.g. West Greenlandic (van Geenhoven, 2004). But the penalty remains a stipulation.
- It seems natural to assume that postulating silent operators should result in extra processing cost since if one seems them as a kind of garden path effect – ways to fix a sentence that would otherwise not make sense.
- D&P reject this because if people encounter these situations too often, they should conventionalize ITER and should not walk down the garden path anymore.
- But perhaps not all silent operators can be conventionalized?

7.1.3 Next steps: Habituals

- D&P strive for theoretical parsimony by deriving their account of *for*-adverbials from a more general theory of imperfective and generic/habitual sentences proposed in Deo (2009) for English and Gujarati.
- Habitual sentences show analogous scopal effects to *for*-adverbials (Anna Szabolcsi, p.c.):

(59) a. Mary smokes cigarettes / *a cigarette.
b. Mary smokes cigarettes / a cigarette after dinner. (Krifka et al., 1995, 39f.)

(60) Yesterday, Mary smoked cigarettes / *a cigarette for an hour.
(60) Last month, Mary smoked a cigarette after dinner for a week.

- Similar effects both for habituals and for *for*-adverbials hold in Hindi, which is close to Gujarati (Deo, p.c.).
- I plan to account for this by propagating the changes to D&P proposed here to their theory of habituals.

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