Reply to Roger Schwarzschild on event semantics*

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Abstract

I reply to various aspects of Roger Schwarzschild's note *Distributivity, negation and quantification in event semantics: Recent work by L. Champollion.*

1 Introduction

In a recent note, Roger Schwarzschild (RS) discusses various aspects of three recent papers of mine on event semantics and the interaction between them (Schwarzschild, 2014). The first paper is about covert distributivity operators previously postulated by RS and others (Champollion, 2014a), and the second paper, about distance-distributive items such as *each* and German *jeweils* (Champollion, 2014b). RS refers to the two papers as *Covert* and *Overt*. These two papers are tightly integrated both with each other and with the system in my dissertation, Champollion (2010b), which I will refer to as *Parts* and which provides the backdrop against which they are developed. All of these have in common that

*In addition to being honored by his very insightful notes and the time he spent studying my work, I am very grateful to Roger Schwarzschild for another reason. I was not sure if studying the integration between the systems described here would be of interest to anyone but me. In several conversations over the last months as well as in his note, Roger convinced me that I was wrong and kept encouraging me to think about the questions discussed here. Given the content of this note, the title *Reply to [Roger Schwarzschild's note on [the integration of [the interaction of [compositional semantics and event semantics]] with [the combination of [covert and overt] distributivity in algebraic event semantics]]]* suggested itself to me at first, but I resisted the temptation in the end.

they represent verbal denotations as sets of events, as is the current standard in Neo-Davidsonian implementations of formal semantics (e.g. Carlson, 1984).

The third paper, some of whose core ideas go back to Champollion (2010c), deals with the interaction of event semantics with the semantics of scope, negation, and coordination (Champollion, 2014c). Its main technical innovation is the representation of verbal denotations as generalized existential quantifiers over events, in contrast to the current standard. RS refers to this paper as *Interaction*.

At the time of writing, all these three papers are unpublished manuscripts. RS' remarks refer to features of these manuscripts that may not carry over to the published versions (in part because the remarks themselves may prompt me to make some changes), so for reference, here are the dates of the manuscripts his discussion is based on: *Covert* and *Overt* June 9th 2014; *Interaction* June 15, 2014. All these are available at `http://ling.auf.net/lingbuzz`.

These two lines of work rely on systems that represent verbal denotations in incompatible ways. Although I worked on them concurrently, I did not attempt to integrate them, not because I expected any principled difficulty in doing so but because the empirical and conceptual arguments that the systems underwrite do not require such an integration. However, since there is empirical and conceptual overlap, the question arises about what happens when you put these systems together. As RS puts it: "Ultimately we'd like to believe that the insights captured in *Overt* and *Covert* are preserved when phenomena like those studied in *Interaction* are brought in."

The main purpose of RS's thorough and insightful note is to study whether this integration is possible and what its properties and challenges are. In this reply, I offer some comments on some of the points the note brings up. RS's note contains a presentation of the main features of the systems in the three papers, so to avoid redundancy, I will presuppose familiarity with them and with the note itself.

This note is organized as follows. Section 2 shows that sum distributivity as used in *Covert* and *Overt* is a notational variant of a certain kind of distributivity that uses universal quantifiers and existential quantification over covers. Section 3 considers whether the treatment of *each* in *Overt* is compatible with the event semantic framework in *Interaction*. Section 4 attempts to clarify the relation between the accounts of *for*-adverbials in *Interaction* and *Covert* and answers some questions raised by RS. Section 5 amends the treatment of adnominal *each* in *Overt*, accepts that its scope includes the verb, and considers the consequences for the syntactic structure of ditransitives and prepositional datives.

2 Sum distributivity: What's essential about it?

This section shows that sum distributivity as used in *Covert* and *Overt* is a notational variant of a certain kind of distributivity that uses universal quantifiers and existential quantification over covers.

As RS notes, the distributivity operators in *Covert* and *Overt* do not use universal quantifiers rely on the star operator from Link (1983). RS refers to this feature as *sum distributivity*. For example, the D and Part operators are defined in *Covert* as follows. (As a reminder, these operators are indexed with a theta role θ, and in the second case, also with a cover variable C.)

(1) **Definition: Event-based D operator**
$[\![\mathrm{D}_\theta]\!] \stackrel{\text{def}}{=} \lambda V_{\langle vt\rangle}\lambda e[e \in {}^*\lambda e'(V(e') \ \wedge \ \mathrm{Atom}(\theta(e')))]$

(2) **Definition: Event-based Part operator**
$[\![\mathrm{Part}_{\theta,\mathrm{C}}]\!] \stackrel{\text{def}}{=} \lambda P_{\langle vt\rangle}\lambda e[e \in {}^*\lambda e'(P(e') \ \wedge \ C(\theta(e')))]$

In *Overt*, these operators are at the basis of the denotations of adverbial, adnominal and determiner *each*.

The sum-distributive formulation of these operators goes back to the sum-distributive formulation of stratified reference in Chapter 4 of Champollion (2010b).

In this section I show that the use of the star operator is not essential. Sum distributivity can be reformulated using combinations of universal quantifiers and existentially bound covers. See Vaillette (2001) for a clear technical discussion of the relevant issues.

Here is an application of Vaillette's insights. See also Champollion (2010b), Section 5.4.2, for relevant details. We start by defining covers in the mereological sense as follows:

(3) **Definition: Cover (mereological)**
$\mathrm{Cov}(C, x) \stackrel{\text{def}}{=} x = \bigoplus C$
(C is a cover of a mereological object x if and only if C is a set whose sum is x.)

There is a close connection between the concept of cover and starred predicates, as shown by the following.

(4) **Theorem, Champollion (2010b), Section 5.4.2:**
$\forall x[x \in {}^*\lambda y[C(y)] \ \Leftrightarrow \ \exists C' \subseteq C[\mathrm{Cov}(C', x)]]$

Given this connection, we can reformulate (1) in terms of universal quantifiers as follows:

(5) **Alternative Definition: Event-based D operator**
$[\![\mathrm{D}_\theta]\!] \stackrel{\text{def}}{=} \lambda V_{\langle vt\rangle}\lambda e[\exists C.\mathrm{Cov}(C,e) \wedge \forall e'.C(e') \rightarrow [V(e') \ \wedge \ \mathrm{Atom}(\theta(e'))]]$

Apart from the fact that I have translated covers into mereology, the notion of cover used here is technically the same as the one in Gillon (1987), who used existentially bound covers in order to account for nonatomic distributivity. But it is used here for a different purpose, namely to reformulate the *atomic* distributivity operator in a way that does not make use of the star operator and that makes the connection to universally quantified distributivity apparent.

One way of looking at the existentially bound cover variable in (5) is that it supplies what is necessary to prevent leakage (see Section 5 of *Covert*). To get an intuition, consider this. A partition of S is a division of S as a jointly exhaustive, mutually exclusive set of "cells". A cover is similar to a partition but drops the "mutually exclusive" part of the condition and keeps only the "jointly exhaustive" part. So the effct of using covers in (5) is to add this "jointly exhaustive" condition to universal quantification. This becomes necessary because we are not directly universally quantifying over atomic individuals but about subevents. Even though each of these subevents is related to an atomic individual, the subevents need not be atomic themselves. Therefore it is not possible to universally quantify over them or else we would end up quantifying over too many of them.

Following Schwarzschild (1996), I have assumed in *Covert* that existential quantification over covers is too strong for the purpose of modeling (phrasal) nonatomic distributivity and that context should be taken to supply the cover for a given instance of nonatomic distributivity. This is reflected in my Part operator in (2), in that the "cover variable" C is left free. But given what we have said above we can still reformulate (2) in the same way as we have reformulated (1). We just have to keep in mind that there are two different uses of covers here, with different purposes and properties. The result is as follows.

(6) **Alternative Definition: Event-based Part operator**
$[\![\mathrm{Part}_{\theta,\mathrm{C}}]\!] \stackrel{\text{def}}{=} \lambda V_{\langle vt\rangle}\lambda e[\exists C'.\mathrm{Cov}(C',e) \wedge \forall e'.C'(e') \rightarrow [V(e') \ \wedge \ \mathrm{C}(\theta(e'))]]$

One might wonder why the "cover variable" C is not explicitly required to be a cover of e, unlike C'. As a result of how C is used in this formula, there will always be a subset of C that will be a cover of e, so it is not necessary to specify anything special about C. Thus coverhood does not need to be seen as a privileged

notion. C can be an arbitrary contextually salient predicate. On this point see Champollion (2010b), Section 5.4.2.

So there is nothing essential about the use of algebraic closure (i.e. the star operator) in my "sum-distributive" formulation of distributivity. What *is* essential is the avoidance of leakage, as I have argued in *Covert*, Section 5. The rest is a choice between notations. By this I don't mean to suggest that different notations aren't useful. I agree with the following observation by Vaillette (2001):

> Despite the equivalence between the closure and cover approaches, their different formulations make them lend themselves differently to certain extensions. For instance, it has proved heuristically fruitful to begin with covers but then consider various stronger notions, such as "pseudo-partitions"; this path is followed in Verkuyl (1994) and van der Does and Verkuyl (1996). Another line of thinking introduced in Schwarzschild (1991) replaces quantification over covers with pragmatic determination. This allows some of the distinctions the summative approach erases to be reintroduced, but in a parsimonious and context-dependent way that is consistent with a treatment of sentences with [plural noun phrases] as semantically unambiguous.

3 Is sum distributivity compatible with *Interaction*?

This section considers whether the treatment of *each* in *Overt* is compatible with the event semantic framework in *Interaction*. We will not come to a definitive conclusion.

RS considers the question of how to implement ideas from *Overt* about adnominal and adverbial *each* in the context of the Interaction system. *Overt* gives entries for *each* in terms of the D operator in (1). In particular, since the D operator is an adverbial modifier, it corresponds closely to adverbial *each*. So if we figure out how to integrate adverbial *each* into *Interaction*, the result also carries over to the D operator. RS looks at one particular way of doing so, which leads to a problem involving the loss of an egg, and cautiously concludes that "there is no way to implement a sum-distributive analysis of adverbial *each* in the *Interaction* system". He then goes on to propose a non-sum-distributive *Interaction* compatible entry for adverbial *each*.

Here I would like to make another attempt at translating the D operator in (1), a modifier of event predicates, into a modifier of event quantifiers, in a way that is suitable for the *Interaction* system and that stays as close as possible to the original sum-distributive formulation. We will see that this will necessitate some changes in the *Interaction* treatment of quantifiers and leads to an incompatibility with respect to the *Interaction* treatment of negation. Therefore the tentative conclusion will be that the systems in the two papers are not fully compatible with each other, at least not in any way that is obvious to me.

In *Interaction*, verbal denotations denote properties of sets of events (type $\langle vt, t\rangle$). Take a verb phrase such as *ate one egg*, which is true of any set that contains an event in which an egg is eaten. In *Covert*, this verb phrase denotes a property of events (type vt), the property which is true of any event in which an egg is eaten. The D operator in *Covert* expects such event properties. This suggests that we should type-shift an event quantifier into an event property. A natural way to do this is the BE operator (Partee, 1987), of which an event-semantic version is given here. RS discusses a similar type shift on page 23 of his note.

(7) $[\![\text{BE}]\!] = \lambda V_{\langle vt,t\rangle}\lambda e'.V(\lambda e.e = e')$

The guiding idea of *Interaction* is that event quantifiers should be introduced as low as possible, and the paper only looks at cases that involve only one event variable. In such cases, there is plenty of reason to assume that the event variable is bound within the verb. But Schein (1993) has convincingly argued that distributivity in event semantics requires the introduction of a separate event variable. Schein's argument underlies both the implementation of the event-based D operator by Lasersohn (1998) that I discuss in Section 5 of *Overt*, and my own implementation as well. For example, (1) involves two event variables, e and e'. The former corresponds to the "sum event" and the latter ranges over the parts of this sum event. In *Overt*, I have (conservatively) assumed that the sum event variable is bound at sentence level. As we go to *Interaction*, I will follow the guiding idea of that paper and assume that just like the parts-of-the-sum-event variable, the sum event variable also is bound as low as possible, in this case within the D operator or the adverbial modifier *each*. So what we are looking for is a way to lift such modifiers in such a way that they introduce and existentially bind their own sum event variable. Here is a general way to do this:

(8) $[\![\text{modifier-lift}]\!] = \lambda m_{\langle vt,vt\rangle}\lambda V_{\langle vt,t\rangle}\lambda f_{vt}.\exists e[f(e) \wedge m(\text{BE}(V))(e)]$

Given this lift, we can define an *Interaction*-compatible version of the D operator

as follows:

(9) **Definition: Event-based D operator, lifted**
$[\![\text{D-lift}_\theta]\!] \stackrel{\text{def}}{=} [\![\text{modifier-lift}]\!]([\![\text{D}_\theta]\!])$
$= \lambda V_{\langle vt,t\rangle}\lambda f_{vt}.\exists e[f(e) \wedge [\![\text{D}_\theta]\!](\text{BE}(V))(e)]$
$= \lambda V_{\langle vt,t\rangle}\lambda f_{vt}.\exists e[f(e) \wedge e \in {}^*\lambda e'(\text{Atom}(\theta(e')) \ \wedge \ \text{BE}(V)(e'))]$
$= \lambda V_{\langle vt,t\rangle}\lambda f_{vt}.\exists e[f(e) \wedge e \in {}^*\lambda e'(\text{Atom}(\theta(e')) \ \wedge \ V(\lambda e.e = e'))]$

This entry correctly derives the fact that *each* distributes over quantifiers in its syntactic scope, as shown by the following derivation:

(10) $[\![\text{eat an egg}]\!] = \lambda f\exists x\exists e.[f(e) \wedge \text{eat}(e) \wedge \text{egg}(x) \wedge \text{th}(e) = x]$

(11) $[\![\text{each}_{ag}]\!]([\![\text{eat an egg}]\!])$
$= \lambda f_{vt}.\exists e[f(e) \wedge e \in {}^*\lambda e'(\text{Atom}(\text{ag}(e')) \ \wedge \ \exists x\exists e''.[e'' = e' \wedge \text{eat}(e'') \wedge \text{egg}(x) \wedge \text{th}(e'') = x])]$
$= \lambda f_{vt}\exists e.[f(e) \wedge e \in {}^*\lambda e'(\text{Atom}(\text{ag}(e')) \ \wedge \ \text{eat}(e') \wedge \exists x.\text{egg}(x) \wedge \text{th}(e') = x)]$

(12) $[\![\text{Jack and Jill}]\!] = \lambda V\lambda f.V(\lambda e[\text{ag}(e) = \text{jack} \oplus \text{jill} \wedge f(e)])$

(13) $[\![\text{Jack and Jill}]\!]([\![\text{each}_{ag} \text{ eat an egg}]\!])$
$= \lambda f.\exists e[\text{ag}(e) = \text{jack} \oplus \text{jill} \wedge f(e) \wedge e \in {}^*\lambda e'(\text{Atom}(\text{ag}(e')) \ \wedge \ \text{eat}(e') \wedge \exists x.\text{egg}(x) \wedge \text{th}(e') = x)]$

(14) $[\![\text{closure}]\!]([\![\text{Jack and Jill each}_{ag} \text{ ate an egg}]\!])$
$= \exists e[\text{ag}(e) = \text{jack} \oplus \text{jill} \wedge e \in {}^*\lambda e'(\text{Atom}(\text{ag}(e')) \ \wedge \ \text{eat}(e') \wedge \exists x.\text{egg}(x) \wedge \text{th}(e') = x)]$

One problem with this entry is that it does not gracefully interact with strong quantifiers in the way they are defined in *Interaction*, which is based on classical GQ theory, e.g. Barwise and Cooper (1981):

(15) $[\![\text{see every zebra}]\!] = \lambda f\forall x.\text{zebra}(x) \rightarrow \exists e[f(e) \wedge \text{see}(e) \wedge \text{th}(e) = x]$

(16) $[\![\text{each}_{ag}]\!]([\![\text{see every zebra}]\!])$
$= \lambda f_{vt}.\exists e[f(e) \wedge e \in {}^*\lambda e'(\text{Atom}(\theta(e')) \ \wedge \ \text{see}(e') \wedge \forall x.\text{zebra}(x) \rightarrow [\text{th}(e') = x])]$

To avoid this problem, following the treatment of determiner *each* in *Overt*, we can rewrite the strong quantifiers themselves using sum distributivity. I have previously explored this option in Champollion (2010a) and in Sui and Champollion (2010).

(17) $[\![\text{see every zebra}_{\textit{sum-dist}}]\!] = \lambda f \exists e[f(e) \wedge \text{th}(e) = \bigoplus \text{zebra} \wedge e \in [\![\text{D}_{th}]\!](\lambda e'.\text{see}(e'))]$
$= \lambda f \exists e[f(e) \wedge \text{th}(e) = \bigoplus \text{zebra} \ \wedge \ e \in {}^*(\lambda e'.\text{see}(e') \wedge \text{Atom}(\text{th}(e')))]$

(18) $[\![\text{see most zebras}_{\textit{sum-dist}}]\!] = \lambda f \exists e[f(e) \wedge \exists x.{}^*\text{zebra}(x) \wedge \text{th}(e) = x \wedge 2 \cdot |x| > |\text{zebra}| \ \wedge \ e \in {}^*(\lambda e'.\text{see}(e') \wedge \text{Atom}(\text{th}(e')))]$

(19) $[\![\text{each}_{ag}]\!]([\![\text{see every zebra}]\!])$
$= \lambda f_{vt}.\exists e[f(e) \wedge e \in {}^*\lambda e'(\text{Atom}(\text{ag}(e')) \ \wedge \ \text{th}(e') = \bigoplus \text{zebra} \ \wedge \ e' \in {}^*(\lambda e''.\text{see}(e'') \wedge \text{Atom}(\text{th}(e''))))]$

(20) $[\![\text{each}_{ag}]\!]([\![\text{see most zebras}]\!])$
$= \lambda f_{vt}.\exists e[f(e) \wedge e \in {}^*\lambda e'(\text{Atom}(\text{ag}(e')) \ \wedge \ \exists x.{}^*\text{zebra}(x) \wedge \text{th}(e') = x \wedge 2 \cdot |x| > |\text{zebra}| \ \wedge \ e' \in {}^*(\lambda e''.\text{see}(e'') \wedge \text{Atom}(\text{th}(e''))))]$

This gives the correct results. We have exploited the fact that while *Interaction* remains neutral with respect to the existence of sum events and sum individuals, *Overt* and *Covert* presuppose them, and so we can rely on their existence without additional theoretical cost. The question of whether it is possible to maintain the *Overt/Covert* view on distributivity as well as the classical entries of generalized quantifiers as in Barwise and Cooper (1981) and *Interaction*, however, is still open.

The case of negation poses more severe problems for the entry I have suggested above. The point of *Interaction* with respect to negation is that one does not need to resort to a mereology-based account. However, if one does import such an account by adopting the *Overt* entry for *each*, the classical negation suggested there does not mesh well with the entry for *each* proposed here:

(21) $[\![\text{not}]\!] = \lambda V \lambda f \neg V(\lambda e[f(e)])$

(22) $[\![\text{not}]\!]([\![\text{eat an egg}]\!]) =$
$\lambda f \neg \exists x \exists e[f(e) \wedge \text{eat}(e) \wedge \text{egg}(x) \wedge \text{th}(e) = x]$

(23) $[\![\text{each}_{ag}]\!]([\![\text{not eat an egg}]\!])$
$= \lambda f \exists e[f(e) \wedge e \in {}^*\lambda e'(\text{Atom}(\text{ag}(e')) \ \wedge \ \neg \exists x \exists e.[e = e' \wedge \text{eat}(e) \wedge \text{egg}(x) \wedge \text{th}(e) = x])]$
$= \lambda f \exists e[f(e) \wedge e \in {}^*\lambda e'(\text{Atom}(\text{ag}(e')) \wedge \neg[\text{eat}(e') \wedge \exists x.\text{egg}(x) \wedge \text{th}(e') = x])]$

(24) $[\![\text{closure}]\!]([\![\text{Jack and Jill}]\!]([\![\text{each not eat an egg}]\!]))$
$\exists e[\text{ag}(e) = \text{jack} \oplus \text{jill} \wedge e \in {}^*\lambda e'(\text{Atom}(\text{ag}(e')) \wedge \neg[\text{eat}(e') \wedge \exists x.\text{egg}(x) \wedge \text{th}(e') = x])]$

This problem could perhaps be avoided by moving to a sum-based entry in the way suggested by Krifka (1992), one that makes reference to maximal sums of

events. This is of course precisely the kind of entry that is critically discussed in *Interaction*. To be sure, *Interaction* does not claim that there is anything wrong with this entry per se, only that event semantics does not make it necessary to adopt it. One way to put it is that *Interaction* shows that adopting event semantics does not require adopting a sum-based entry for negation. But it may be that if we adopt a sum-based entry for adverbial *each*, this commits us to a sum-based entry for negation. On the other hand, it may be that that what I have said above does not exhaust the ways in which the *Covert* treatment of adverbial *each* can be made to carry over. I will leave this question open for now.

RS suggests the following entry as a non-sum-distributive way to import the *Overt* account of adverbial *each* into *Interaction*:

(25) $[\![\text{each-RS}_{ag}]\!] = \lambda V \lambda z \lambda f. \forall y [y \leq z \wedge |y| = 1 \rightarrow V(\lambda e.\text{ag}(e) = y \wedge f(e)])$

This account does not run into the same problem with strong quantifiers as mine above:

(26) $[\![\text{each-RS}_{ag}]\!]([\![\text{see every zebra}]\!]) = \lambda z \lambda f. \forall y [y \leq z \wedge |y| = 1 \rightarrow [\forall x.\text{zebra}(x) \rightarrow \exists e[\text{ag}(e) = y \wedge f(e) \wedge \text{see}(e) \wedge \text{th}(e) = x]]$

And it can be reformulated as a sum-distributive account, if one wants to:

(27) $[\![\text{each-RS-alt}_{ag}]\!] = \lambda V \lambda z \lambda f. z \in {}^*(\lambda y. |y| = 1 \rightarrow V(\lambda e.\text{ag}(e) = y \wedge f(e)]))$

Although I would welcome the conclusion that a sum-distributive entry for adverbial *each* is compatible with the *Interaction* framework, I do see two problems with RS' entry (and since the reformulation in terms of sum distributivity is just a notational variant, they have not gone away in the process). One is that the relationship between adverbial *each* and the next argument is required to be local. We don't want this for the D operator, as explained in *Covert* Section 5 based on observations due to Kratzer (1996). So the treatment won't carry over. Similar arguments could perhaps also be made in the case of adverbial *each* in connection with modals and auxiliaries that intervene between it and the next argument (e.g. the subject), but one would need to see if these are necessarily present at LF. The second problem is that the universal quantifier takes scope over $f(e)$ and therefore over everything that is added to the derivation after the next argument. This will cause problems in connection with various things, such as nondistributive adverbial modifiers like *Surprisingly*, as also explained in *Covert* Section 5. The underlying insight here goes back to Schein (1993): distributivity needs to make available for further modification a variable that corresponds to

the sum event.

4 *For*-adverbials

This section attempts to clarify the relation between the accounts of *for*-adverbials in *Covert* and *Interaction* and answers some questions raised by RS. Both papers propose accounts of *for*-adverbials and RS spends some time comparing them. I should say that I view the account in *Interaction* mainly as a stand-in for a serious analysis, which in my view requires the kind of mereological setting that I avoided in *Interaction*. A serious analysis is developed and justified at length in Champollion (2010b) and it is adopted in the *Covert* paper (in the current version only in simplified form). As for the analysis in *Interaction*, following standard practice (see Champollion (2010b), Section 5.3.1) it is based on Dowty (1979) and given only for the purpose of concreteness, in connection with a discussion that focuses on negation. It is adequate for the purpose at hand even though it ignores many problems, such as the minimal-parts problem, as Dowty himself was already aware. (It does, however, include a treatment of tense that is not present in Champollion (2010b), where tense is ignored. Studying the interaction of tense and adverbial modifiers is something I only started doing in the process of putting together Champollion (2010c), the precursor of *Interaction*, and the relevant parts were written after Champollion (2010b) was completed. But since RS does not focus on tense I will ignore this part.)

RS points out, correctly, that the analysis of *for*-adverbials given in *Covert* when applied to a sentence like **John found a flea on his dog for a month* entail that there was a one-month-long event (possibly a sum event) in which only a single flea was found. This is against world knowledge and it is how the oddness of that sentence is derived, following previous authors such as Zucchi and White (2001). One important thing to point out is that also Dowty's analysis of the *for*-adverbial as a quantifier over subintervals, as I adopted it in *Interaction*, predicts the same result. This is because the subinterval relation in question is reflexive – any interval is a subinterval of itself – and so Dowty's analysis entails that there was a one-month-long event in which only a single flea was found. In *Interaction*, we are neutral on the existence of sum events, and so the oddness of the sentence will be derived either from the lack of existence of sum events or else in the same way as in *Covert*. (The lack of commitment about sum events will only get us so far. If we get more serious about *for*-adverbials and want to analyze sentences like *John found fleas on his dog for a month*, we will not be able to import the

Covert analysis into *Interaction* without committing to sum events after all.)

RS correctly notes that I assume that *fleas* literally means *one or more fleas*. Specifically, I follow Spector (2007) and Zweig (2009) in assuming that the *more than one* component of a plural noun is an implicature. I meant *one or more fleas* as no more than a quick paraphrase of the truth conditions that *fleas* is assigned under these theories, i.e. $\lambda x.{}^{*}\text{flea}(x)$. RS asks why there is a difference between the following sentences:

(28) a. John found fleas on his dog for a month.
b. ??John found one or more fleas on his dog for a month.

This difference is indeed not explained either on the *Covert* or on the *Interaction* account. In order to explain it, a theory of *one or more* is needed on which its meaning differs from $\lambda x.{}^{*}\text{flea}(x)$. The problem is not specific to the view of the plural I adopt. If *fleas* literally meant *two or more fleas*, then one would have to explain the contrast between (28a) and the following sentence.

(29) ??John found two or more fleas on his dog for a month.

See for example Krifka (1998, Section 3.8) and especially Zucchi and White (2001) for relevant discussion of how to deal with such cases. As far as I can tell, the problem affects all current accounts of *for*-adverbials. It remains to be seen if their account extends to examples like this (also discussed by RS):

(30) John found less than three fleas on his dog for a month.

A final note: RS wonders about the universal quantifier over events in the atelicity presupposition of the *for*-adverbial (page 25), and gives a convincing argument that it is too strong. Like RS, I too have wondered about this universal quantifier. I think I have taken it from Krifka (1989) and similar algebraic treatments of *for*-adverbials, where it is introduced indirectly (and perhaps inadvertently) as a matter of relying on higher-order properties of predicates, as I do in Champollion (2010b) and in *Covert*. But RS is probably right in that it is too strong. I come to a similar conclusion in Champollion (2010b), Section 6.4.1, where I suggest that context restricts the domain of the universal quantifier, but I did not go as far as to altogether drop it, as RS suggests. But it is the natural next step to take. It would make *for*-adverbials rather similar to distributivity operators, but ones that rely on an existentially quantified cover in the style of Gillon (1987), not on a anaphorically given one in the style of Schwarzschild (1996) (otherwise the account in *Overt*, where the process of anaphorically retrieving a cover is supposed to lead to a

cost; on this point see Champollion (2013)). I considered that step at some point when I was writing Champollion (2010b), but I didn't implement it. To be honest, I don't remember now if it was for principled reasons or just for practical ones. I was developing a unified theory of *for*-adverbials, pseudopartitives, *each* and *all*, and any such change would have had to be propagated throughout the lexical entries of all these items. It would be worth trying out if this can be done without harm.

5 The scope of adnominal *each*

This section amends the treatment of adnominal *each* in *Overt*, accepts that its scope includes the verb, and considers the consequences for the syntactic structure of ditransitives and prepositional datives.

In a section titled *Side remarks event-based distributivity operators*, RS points out some consequences of my entry for adnominal *each* in connection with the background assumptions on mereology. Following observations by Dotlačil (2012) and LaTerza (2014), I have opted to give adnominal *each* semantic scope only over its host argument (the noun phrase that contains it), but not over the verbal predicate.

For example, *Overt* predicts that a sentence like (31) will be true whenever there is a building event whose agents is the artists and which consists of book-themed events with atomic agents.

(31) #The artists built one book each.

He gives a scenario in which these truth conditions are arguably true:

> A playful group of artists get together and decide to build a wall of books on the sidewalk. The first one places a book on the sidewalk, the second one places another book next to it, and so on, with each artist putting one book down next to or on top of other books until a wall is built.

The intuitive reason that (31) is odd is that it entails the following sentence:

(32) Each artist built one book.

This sentence is not true in the scenario given, and in fact it can be ruled out on principled grounds to the extent that books are not the kinds of things that can be built.

RS discusses differences in the ontological assumptions we make. I assume that entities in the denotation of singular nouns are always atomic in the mereological sense, which RS doesn't see as a desirable option. In fact one could drop that assumption for most purposes in *Covert* and *Overt*, as long as one still recognizes that there is a class of entities (intuitively, singular individuals) which have a distinguished status and distinctive properties: when choosing nouns to talk about them, one uses singular nouns; when counting, one assigns them the number one; when distributing using *each*, it is only over them that one can distribute. In that case, in order for "atomic" distributivity to work, one would need to give a new meaning to the predicate *Atom* so that instead of picking out mereological atoms, it picks out these distinguished entities without respect for their mereological properties. Another possibility would be to drop even that distinguished status and to make use of the notion of "natural units" in Krifka (1998). Depending on the details of the implementation, one might then face the difficulty of accessing the same set of distinguished individuals at different places in the sentence.

Irrespectively of these considerations, there is a problem with the entry for adnominal *each* in (the current manuscript version of) *Overt*, in that it does not explain the entailment from (31) to (32). It only predicts that (31) entails that each artist did something to one book, and that all these events add up to a building event. This is too weak.

When I wrote *Overt* I assumed that such cases could be handled by meaning postulates. For example, the particular entailment from (31) to (32) follows if one assumes that *build* is distributive on its agent position, i.e. that every building event either has an atomic agent or is the sum of such atomic-agent building events, as expressed by the following meaning postulate:

(33) $\forall e[\text{build}(e) \rightarrow e \in [\![D_{ag}]\!](\lambda e'.\text{build}(e'))]$

The problem with this assumption is that at an intuitively level, *build* is very clearly not distributive on its agent position, since *The girls built a raft* has a collective reading. One could follow the arguments in Landman (1996, 2000) regarding thematic collectivity (see "Ten men and women got married today" (2014) for relevant discussion) and take the position that only groups in Landman's sense – a certain kind of "impure" atoms –, not sums, can be the agents of collective readings. One then needs to reformulate *each* so that it involves reference specifically to "pure" atoms – see Champollion (2010b, Chapter 9) for details. So in *The girls built a raft*, on the collective reading it is the group of the girls and not the sum of the girls that act together to build a raft.

However, for the rest of this note I would like to explore another possible response, which is that after all, adnominal *each* does obligatorily take scope over both its host argument and the verb, contra Dotlačil (2012), LaTerza (2014), and the current version of *Overt*. As *Overt* shows, adnominal *each* does not obligatorily take scope over any other arguments than its host. This is shown by examples of double object constructions tested via Amazon Mechanical Turk, and discussed in *Overt*, where the two noun phrases that are not hosting *each* stand in a cumulative relation to one another.

(34) a. 100 million voters gave two candidates one vote each.
b. 20 boys gave 10 girls one kiss each.

This leads me to the conclusion that double-object constructions like these have the following syntactic structures at LF, since in them the word *each* can be given scope over just the verb and its host, as indicated:

(35) a. 100 million voters two candidates [give one vote each]
b. 20 boys 10 girls [give one kiss each]

This is compatible with the right-branching syntax proposed by Marantz (1993) (see also Bruening (2010)), and as discussed in *Overt*, it is compatible with the framework I adopt. It is perhaps also compatible with the proposal in Harley (2002) depending on how the semantics of CAUSE and HAVE is spelled out:

(36) a. 100 million voters CAUSE two candidates [HAVE one vote each]
b. 20 boys CAUSE 10 girls [HAVE one kiss each]

On the other hand, prepositional datives like the following must have left-branching LFs that mirror their surface appearance:

(37) John and Bill [served four meals each] to (exactly) three judges.

This is not readily compatible with theories where prepositional datives have a right-branching structure, since in these theories *served four meals* is not a constituent and so it is not possible to give *each* scope over *served four meals* without also giving them scope over *three judges*.

(38) John and Bill [served four meals each to (exactly) three judges.]

Thus we are led to interesting conclusions about the syntax of ditransitives and prepositional datives. The former are right-branching and the latter are left-

branching. In the latter case, this goes against received textbook wisdom, such as Adger (2003, Section 4.4.2), who gives the following contrast as evidence against a left-branching constituent structure of prepositional datives:

(39) a. Benjamin said he would give the cloak to Lee and [give the cloak to Lee] he did.
b. *Benjamin said he would give the cloak to Lee and [give the cloak] he did to Lee.

Benjamin Bruening (p.c.) notes that this contrast could also be interpreted as showing that obligatory arguments do not like to strand, and informs me that he always gets a significant minority in syntax classes who accept sentences like (39b). He thinks such examples get better for most speakers when the PP is optional:

(40) a. He said he would donate his car to a charity, and donate his car he did to the Make-A-Wish Foundation.
b. ...and drag the chair he did to the other side of the room.
c. ...and present the paper he did to an astounded audience of experts.

There is another type of evidence for a right-branching structure of prepositional datives, binding. See Barss and Lasnik (1986) for an overview of the relevant facts. Examples like the following have generally been taken to suggest that ditransitives have a right-branching structure:

(41) a. I denied each worker$_i$ his$_i$ paycheck.
b. *I denied its$_i$ owner every paycheck$_i$

These arguments rely on the assumption that it is c-command (rather than, say, linear precedence or something like it) that determines binding. But recent work has suggested that binding cannot be used as an indicator of c-command relationships. See Barker (2012) and Bruening (2014) for arguments from semantics and syntax respectively supporting that conclusion.

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