Articulated Cumulativity

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Abstract

In this work, I use cumulative readings of *every* (Schein, 1993) as a tool to investigate cumulative readings in general. Based on a new observation about the homogeneity properties of cumulative readings of *every*, I argue that cumulative readings are not primitive but always arise from the interaction of multiple operators, each operator contributing one exhaustive participation inference. I identify these operators with the thematic role heads. The fixed position of these heads provides an account of the asymmetries in the availabilities of cumulative readings of *every* (Champollion, 2010, 2016b; Haslinger and Schmitt, 2018; Kratzer, 2000). The resulting theory compares favorably to previous accounts of cumulative readings of *every.* In addition, it provides a way to rid the compositional system of cumulativity operators (Beck and Sauerland, 2000).

Introduction

When two plurals arguments appear in a clause as in (1a), they can receive a *cumulative* reading where the cooks all took part in the opening (S_{exh}) and the oysters all took part as well (O_{exh}), without specifying exactly who performed the action to what.

(1) a. The cooks opened the oysters.

  b. **Truth-conditions**[1]**:**
  every cook opened an oyster   (S_{exh})
  every oyster was opened by a cook   (O_{exh})

The truth-conditions of the negation of (1a), given in (2a), require that neither the cooks nor the oysters participated in the action described by the verb. These truth-conditions are noticeably stronger than the truth-conditions expected from the logical negation of (1b) expressed by (2c).

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[1] This paraphrase of the truth-conditions is inadequate for actions that can be performed collectively. See section 5.2 for discussion

(2) a. The cooks didn't open the oysters.

　　b. **Truth-conditions:**
　　　it's not the case that one of the cooks opened one of oysters

　　c. **Unattested truth-conditions:** ($\neg S_{\text{exh}} \vee \neg O_{\text{exh}}$)
　　　either not every cook opened an oyster
　　　or not every oyster was opened by a cook

I will refer to this difference between the truth-conditions of (1a) and its negation (2a) as a *homogeneity effect* (following Löbner (1987)).

Unexpectedly, a singular distributive quantifier like *every* can also give rise to the same cumulative readings (Kratzer, 2000; Schein, 1993), observed in (1a). This reading is subject to intriguing restrictions: for instance, it disappears when *every* heads the subject argument.

(3) a. The cooks opened every oyster.　　✓(1b)

　　b. Every cook opened the oysters.　　*(1b)

The possibility and limited availability of cumulative readings with *every* is a serious puzzle ; it is not straightforward to see how one would account for it under a canonical treatment of *every*.

Interestingly, the cumulative readings obtained in (1a) and (3) are not entirely similar, despite *prima facie* appearances. They differ in what readings they give rise to under negation:

(4) a. The cooks didn't open every oyster.

　　b. **Truth-conditions:**
　　　it's not the case that every one of the oysters was opened by a cook ($\neg O_{\text{exh}}$)

This paper has two related goals. The first goal is to propose a structured view of cumulativity. Specifically, I will propose that the two inferences S_{exh} and O_{exh} that form the basis of the cumulative reading do not enter the composition as one. Each of them is contributed by a different operator in the structure. The argument will draw from a comparison between the strong reading of (2a) and the weak reading of (4a): the presence of *every* only seem to remove the part of the homogeneity effect associated with normal cumulative sentences associated with the inference O_{exh}. This suggests that the homogeneity effect has two components: one associated with S_{exh}, one associated with O_{exh}. The presence of *every* only affects one of these components. I will spell out these intuitions formally, using event semantics. In this system, the operators that give rise to S_{exh} and O_{exh} will be identified with the thematic role heads AGENT and THEME respectively.

The second goal of this paper is to provide a full account of cumulative readings of *every*. I will import an event denotation for *every* from Kratzer (2000) to the articulated system of cumulativity defended here. Since cumulativity is tied to rigid locations - thematic role heads - in the articulated system, we will be able to account for the asymmetries observed in cumulative readings with better empirical

predictions than previous accounts. Second, having split S_{exh} from O_{exh}, we will be able to account formally why negative cumulative readings of *every* are weaker than ordinary negative readings and why *every* acts as a homogeneity remover.

The roadmap is as follows: section 1 details the main data points about cumulative readings of *every* given above. Then, in section 2, I develop the articulated theory of cumulative readings, which accounts for ordinary cumulative readings. Section 3 applies the framework to cumulative readings of *every*. I compare the resulting theory to previous approached in section 4. Finally, I propose some predictions and extensions of the basic proposal in section 5 before concluding.

1 Data

This section outlines and details three main facts about cumulative readings of *every*. The first fact is, trivially, that these readings are possible. They receive similar truth-conditions to ordinary cumulative sentences. Second, this reading is not available in every configuration ; I will provide additional support for a generalization by Champollion (2010) on the availability of these readings. Third, the negative cumulative reading of *every* differs from the negative cumulative reading of ordinary sentences.

I will use these 3 facts to guide the analysis: the commonalities between ordinary cumulative readings and cumulative readings of *every* suggest we give these readings a common source. The asymmetries and homogeneous properties, which are peculiar to *every*, on the other hand, tells us how this common source interacts with the particular semantics of *every*.

1.1 Fact I: possibility of cumulative readings.

Trivially, our first main fact is that cumulative readings, as in (5), are possible.

(5)   The three cooks opened every oyster.

The cumulative readings of *every* in particular cannot be reduced to a putative group construal of *every*, where it denotes the plurality of elements in its restrictor. Group construals are indeed attested for some speakers of English[2] (represented by %), for some collective predicates.

(6)   a.% Every revolutionary met at the *Café Musain*.

      b.% I stapled every sheet of paper together

These construals are specific to *every* however. Interestingly, Thomas and Sudo (2016) have shown that cumulative readings extend to another singular distributive quantifier, i.e. *each*.

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[2]My small sample of speakers suggests that this feature is prevalent in British English.

(7) Two farmers sold each sheep to one customer. (Thomas and Sudo, 2016)

However, none of the speakers that accept group construals of *every* accept similar construals for *each*. I conclude that cumulative readings require an independent explanation from group construals.

(8) a.%Each revolutionary met at the *Café Musain*.

b.%I stapled each sheet of paper together.

1.2 Fact II: hierarchical asymmetries.

The second fact to be explained are the asymmetries in the availability of the cumulative readings of *every*. The cumulative readings, which are natural when *every* occupies the object position, are absent when it is in a subject position.

(9) a. The cooks opened every oyster. (✓cumulative)

b. Every cook opened the oysters. (*cumulative)

The correct description of the asymmetry is controversial. Before we proceed further, we need to clear up what the empirical generalization is. On the one hand, Kratzer (2000), who noticed the asymmetry, used this fact[3] to argue for a distinguished status of the thematic role THEME. We could state her generalization as follows: a cumulative reading is only available when the coargument of *every* does not bear the thematic role THEME.

However, as pointed out in Champollion (2010); Zweig (2008), the asymmetry is not simply a AGENT/THEME asymmetry. He points out the passive version only has the odd distributive reading where oysters can reseal themselves after opening. If all it takes for a cumulative reading to appear was for *every* to be a THEME, the sentence in (10) would be predicted felicitous under the cumulative reading:

(10) Every oyster was opened by the cooks

His own generalization is one of c-command: *every* needs to be c-commanded by the plural it enters a cumulative relationship with.

Champollion's criticism of Kratzer's claim is suggestive but one could maintain that Kratzer's claim that only AGENT can give rise to the cumulative reading[4] is basi-

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[3]There are other arguments for her proposal. Thus, dismissing her claim about cumulative reading of *every* does not threaten the original proposal.

[4]XXXXXXX suggests this criticism does not extend to an alternative formulation of Kratzer's generalization: The cumulative reading is only available when *every* is c-commanded by a DP bearing a "*separable*" thematic role, i.e. incorporated in the verb via a thematic role head and not by direct functional application. I don't know which of these two formulations Kratzer (2000) meant. However, note that if the latter interpretation is correct, then her generalization is only distinguished from Champollion (2010)'s generalization in cases when *every* is c-commanded by a plural argument bearing a non-separable thematic role. But arguments bearing non-separable thematic roles also happens to be the lowest, because they are semantic arguments of the verb and must combine with it to form an event predicate. If both generalizations make the same prediction in the cases that are testable, we should provisionally opt for the simpler one, Champollion's which only needs to make reference to c-command.

cally correct but passives, for unknown reasons, disrupts the cumulative construals. To render Champollion's generalizations truly impermeable to this repair, let us look at a wider range of environments. In particular, I propose to turn to double-object constructions which have well-defined rigid scope relations[5]. I construct an example for each position that the plural and *every* could appear in[6]. The third argument slot is filled with a singular. There are six such combinations:

(11)   AGENT/THEME

    a. The twelve challenges taught Hercules every cardinal virtue. (cumulative)

    b. Every challenge taught Hercules the four cardinal virtues.   (#cumulative)

(12)   AGENT/GOAL

    a. The ten servers sent every customer an e-mail.   (cumulative)

    b. Every server sent the ten customers an e-mail.   (#cumulative)

(13)   GOAL/THEME

    a. Anya gave the ten charities in Boxborough every penny she had earned.
    (cumulative)

    b. Anya gave every charity in Boxborough the fifteen checks she had earned.
    (#cumulative)

I summarize the results of these investigations in the following table:

		DP "*every*"		
		AGENT	GOAL	THEME
Plural DP	AGENT		✓	✓
	GOAL	#		✓
	THEME	#	#	

This table does not reveal a distinguished status of the theme: the cumulative reading is unavailable even when the coargument of every is not a THEME, but a GOAL. Champollion's generalization about the availability of cumulative readings seem vindicated: whenever the argument position of the plural expression is higher than the argument position of the DP headed by *every* in the c-command hierarchy in (14), a cumulative reading is available.

(14)   **Hierarchy of cumulative readings:** AGENT ≫ GOAL ≫ THEME

Because of these data points, I take Champollion's generalization to be correct. This generalization is the second fact that a theory of cumulative readings of *every* must explain.

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[5]For a discussion of asymmetries in ditransitives with the Italian quantifier *ogni*, see Flor (2017)

[6]A definite read non-maximally in the scope of *every* may yield a reading that is similar to the cumulative reading. To avoid this confound, I used definites with numerals. These definites typically do not tolerate exceptions.

1.3 Fact III: possibility of weak readings.

The final fact has to do with the homogeneity properties of the sentence as already mentioned in the introduction. Cumulative sentences with *every* have a truth-value gap: in a positive environment, the cumulative reading seems to entail that all the investors bought at least one share, as attested by the strange elaboration in (15a).

(15) a. These ten investors bought every one of our shares…

    b. …# nine of them didn't buy any share.

    c. **Truth-conditions:**
    Every investor bought a share.
    Every share was bought by one of the investors.

In negative environments however, this inference disappears. In other words, it is not possible to deny (15a) by pointing out that an investor didn't contribute to the buying:

(16) a. I doubt that these ten investors bought every one of our shares…

    b. …# indeed, that investor didn't buy any share.

    c. …✓ indeed, that share was bought by an investor from a different group.

    d. **Truth-conditions:**
    not [*every share was bought by one of the investors.*]

Let me rephrase in terms that will be useful later on. While (15a) carries both the inference S_{exh} that all the investors did some buying of shares and the inference O_{exh} that all shares were bought by the investors (= $S_{\text{exh}} \wedge O_{\text{exh}}$), its negation seems paraphrasable as the negation of O_{exh} only.

    Homogeneity in the presence of definite plurals is not a surprising fact in and of itself. What is surprising is that the truth-value gap differs from the one observed in "*normal*" cumulative sentences. In normal cumulative sentences, both inferences S_{exh} and O_{exh} disappear under negation. Denying (17) does not amount to denying either exhaustive participation S_{exh} of the subject or exhaustive participation of the object O_{exh}. It amounts to denying that any participation occurred (which I will note $\neg \exists\exists$)

(17) I doubt that these ten investors bought our shares

    a. …# indeed, that investor didn't buy any share.

    b. …# indeed, that share was bought my cousin

    c. **Truth-conditions:**
    not [*one of the shares was bought by one of the investors.*]

So, despite having similar truth-conditions to ordinary cumulative sentences, cumulative sentences with *every* are not entirely parallel to them. This third fact sheds light on the compositional underpinnings of cumulativity: whatever underlies these readings must be able to give rise to both the truth-conditions of (16b) and (17c)

1.4 Summary

We've discussed three main facts: the possibility of cumulative readings, the asymmetries in their availability and the difference in truth-conditions with the normal reading. I repeat below the observed generalizations:

Fact I: *every* gives rise to cumulative readings

Fact II: The cumulative reading is available whenever the plural argument c-commands *every*

		DP "*every*"		
		AGENT	GOAL	THEME
Plural DP	AGENT		✓	✓
	GOAL	#		✓
	THEME	#	#	

Fact III: With *every*, the inference O_{exh} persists under negation

	positive	negative
the cooks ... every oyster	$S_{\text{exh}}\, O_{\text{exh}}$	$\neg\, O_{\text{exh}}$
the cooks ... the oysters	$S_{\text{exh}}\, O_{\text{exh}}$	$\neg\exists\exists$

2 Articulated cumulativity in event semantics

General overview of the account   One of the main highlights of the data tour conducted in the previous section is the curious difference between the truth-conditions of ordinary negative cumulative sentences and negative cumulative sentences with *every*.

The effects of the minimal replacement of a definite plural by *every* is to maintain O_{exh} under negation, so that the observed reading negates exhaustive participation of the object. In other words, *every* has a *homogeneity-removing effect*. However, this homogeneity-removing effect only affects O_{exh}. The inference S_{exh} is not maintained under negation, i.e. the reading obtained is $\neg O_{\text{exh}}$ not $\neg\,(O_{\text{exh}} \wedge S_{\text{exh}})$. The fact that the homogeneity removing effect is localized suggests that the inference itself is localized: there must be some part in the structure which delivers the inference O_{exh}, without delivering the inference S_{exh}, and *every*'s homogeneity removing effect applies to it.

If this is so, then cumulative readings have some structure. The cumulative truth-conditions $S_{\text{exh}} \wedge O_{\text{exh}}$, which we observe, arise compositionally from these two separate pieces. This is what I call *articulated cumulativity*. Which two elements of the structure encode S_{exh} and O_{exh} respectively? These must be elements tightly connected to the position of the subject and the object. I make the assumption that

these elements are the thematic role heads. Note that this assumption will commit us to a Neo-Davidsonian event semantics. Making this assumption has promising consequences: if cumulativity is tied to unmovable elements like thematic role heads whose order in the tree is rigidly determined by syntax, we expect to find the hierarchical effects in the availability of cumulative reading. This is what we observed in fact II.

In this system then, S_{exh} and O_{exh} are two independent semantic contributions and each gives rise to homogeneity effects. To understand their combined contribution, in light of homogeneity, requires some discussion of *homogeneity projection*: how two independent homogeneity effects compose. For concreteness, I adopt Križ (2016)'s treatment of homogeneity and the rules of projection of Strong Kleene logic, which have received support from Križ and Chemla (2015). Alternatives are possible but these rules deliver the right readings without amendments.

The last piece of the account is to explain why *every* has the homogeneity-removing effect that it does and how it gives rise to cumulative readings. The first remark is that in cumulative sentences, *every* must be able to take local scope within the event predicate. This is only possible if *every* incorporates an event argument in its semantics. I will review previous arguments that this move, which may seem drastic, is nonetheless empirically motivated. These considerations will lead us to adopt a denotation *à la Kratzer*. The main difference between her proposal and the current one concerns the assumption about thematic role separability, which are necessary to capture the properties of homogeneity. With these ingredients in hand, the homogeneity-removing effect of *every* directly follows from its atomic distributive quantification.

This, in a nutshell, is the account. I will now elaborate on each component. I will start off by developing a traditional Neo-Davidsonian system (section 2.1). I will then incorporate homogeneity in the thematic role heads, to account for the homogeneous properties of ordinary cumulative sentences (section 2.2). I will end by introducing the projection rules I assume and applying them to an ordinary cumulative sentences (section 2.3).

This system will be applied to the case of cumulative readings of *every* in the next section - section 3.

2.1   Event semantics

For the reasons outlined in the section above, I aim for a Neo-Davidsonian logical form. This means both ontological and semantic assumptions. I detail each of these below.

Ontological assumptions   I assume that events form a plural domain, whose join operator is written $\oplus$. Each event is connected to some regular individuals via thematic roles: agent, theme, goal. Following Champollion (2016a); Krifka (1989), I make two ontological assumptions about thematic roles. First, a thematic role associates only one individual to an event (*thematic role uniqueness*). Second, thematic roles are cumulative: if x is the agent of e and y is the agent of e', then $x \oplus y$ is the agent of $e \oplus e'$.

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Note that this form of ontological cumulativity does not prejudge whether thematic role heads, which belong to the object language, will denote cumulative relations. To emphasize the difference between object language and meta-language, I will always use plain English to describe thematic relations, like "*x is the agent of e*", and use small caps AGENT to write the thematic role heads of the object language.

Semantic assumptions. In line with fully decompositional Neo-Davidsonian assumptions, I assume the verb denotes an event predicate. Its DP arguments combine with the predicate through the thematic role heads AGENT, THEME, GOAL, etc. This thematic role heads are of type $e(vt)vt$, they combine with nominals first and event predicate second. Finally, the event predicate is existentially closed at matrix level. These assumptions amount to the following LF for simple cumulative sentences:

(18)
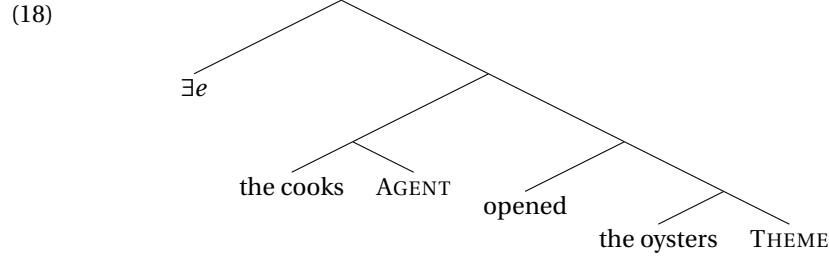
The critical part of the analysis is to give the proper denotation to thematic role heads. Standardly, one assumes that the denotation of AGENT and other thematic roles incorporates the meta-language relation "*be the agent of*" directly:

(19) a. $[\![\text{AGENT}]\!] (p) = \lambda x. \lambda e.\ x$ is the agent of e and $p(e)$

    b. $[\![\text{THEME}]\!] (p) = \lambda x. \lambda e.\ x$ is the theme of e and $p(e)$

If this is so, the truth conditions of (18) come out as follows:

(20) $[\![(18)]\!]$ is true iff there exists e such that   the cooks are the agents of e
                                                                    the oysters are the theme of e
                                                                    e is an opening

By the ontological assumptions, and assuming that openings are done individually[7], this must mean that for each cook was the agent of some event of opening of an oyster and each oyster was the theme of an opening event by the cooks. In other words, the standard account derives exhaustive participation of the cooks and the oysters (S_{exh} and O_{exh}) right away.

The standard account does not give a handle on homogeneity effects however. It predicts that (21a), the negation of (18) given by the LF in (21b) will simply have the truth-conditions of $\neg(S_{\text{exh}} \wedge O_{\text{exh}})$

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[7]I defer discussion of collective action to section 5.2

(21) a. The cooks didn't open the oysters.

     b. not ∃e, [the cooks AGENT] opened [the oysters THEME]

For this reason, we cannot adopt the denotations for AGENT and THEME proposed in (19) above but we need incorporate homogeneity into them. The next section details an account of homogeneity by Križ (2016), which I will then use to properly define thematic roles.

2.2 Trivalence

The homogeneity effect creates a truth-value gap between (22a) and its negation (22b): in case half of the ravens croaked, neither (22a) or (22b) may felicitously be used. Križ (2016) proposes to treat homogeneity exactly as such: a gap in the truth-conditions of the sentence. That is to say: in some circumstances, the sentence may fail to yield a truth-value. Thus, the meaning of a sentence must specify three exclusive cases: the truth-conditions, the falsity-conditions and the undefinedness conditions.

(22) a. The ravens croaked.
        $\approx$ *all ravens croaked*

     b. The ravens didn't croak.
        $\approx$ *no raven croaked*

     c. **Kriz's denotation**

$$[\![\text{the ravens croaked}]\!] = \begin{cases} \text{true} & \text{if all ravens croaked} \\ \text{false} & \text{if no ravens croaked} \\ \text{undefined} & \text{otherwise} \end{cases}$$

Križ (2016) argues that this truth-value gap is a *sui generis* phenomenon which cannot be assimilated to other "*gappy*" phenomena, like presuppositions or scalar implicatures. The present account, however, does not need to take a stance on the nature of the truth-value gap. In particular, I take Križ (2016)'s account to be a place-holder for any theory of homogeneity. I see trivalence as one way to describe the observed truth-value gap in the sentence. My main interest is where these truth-value gaps are generated -whatever they are, however they may be generated- and how they combine to yield the cumulative readings we observe.

My main contention, motivated by the data on cumulative readings of *every*, is that each thematic role head gives rise to its own gap. In positive sentences, AGENT gives rise to the exhaustive participation inference S_{exh} (e.g. *all of the cooks participated in the event*). In the scope of negation, it should should assert total lack of participation. Within Kriz's trivalent semantics and the Neo-Davidsonian set-up from the previous section, we can express this contention as in (23). The AGENT head is true of x and p if x is the whole agent of a p-event, and false if no element of x participated in a p-event:

(23) $[\![\text{AGENT}]\!](p) = \lambda x.\lambda e.$ $\begin{matrix} \text{true} & \text{iff } x \text{ is the agent of } e \text{ and } p(e) \\ \text{false} & \text{iff no } y < x \text{ is the agent of } e \text{ or } \neg p(e) \end{matrix}$

This denotation of course generalizes to all thematic roles:

(24) $[\![\text{THEME}]\!](p) = \lambda x.\lambda e.$ $\begin{matrix} \text{true} & \text{iff } x \text{ is the theme of } e \text{ and } p(e) \\ \text{false} & \text{iff no } y < x \text{ is the theme of } e \text{ or } \neg p(e) \end{matrix}$

To see the effect of this assumption about the denotation of AGENT and THEME on the whole sentence, we need to understand how the truth-value gap of the sentence may depend on the truth-value gap of its parts.

2.3 The Strong Kleene recipe

How do potentially undefined semantic values from sub-constituents determine values of super-constituents? For instance, what are the truth/falsity-conditions of (25a), given the true and false extension of the predicate in (25b)? (These examples are for demonstration only ; I suppress talk of events for the time being.)

(25) a. Some golf player signed the postcards.

   b. $[\![\text{signed the postcards}]\!] = \lambda x. \begin{cases} \text{true} & \text{if } x \text{ signed all the postcards} \\ \text{false} & \text{if } x \text{ signed none of the postcards} \\ \text{undefined} & \text{otherwise} \end{cases}$

We could in principle let each lexical items decide for itself how to deal with undefinedness. The denotation in (26) has this feature: it specifies its output to be undefined if its scope is undefined for some values of its restrictor and is not false of any of them.

(26) $[\![\text{some golf-player}]\!] = \lambda p_{et}. \begin{cases} \text{undefined} & \text{if } \forall x, \ x \text{ is a golf player} \rightarrow p(x) = \text{undefined} \\ \text{true} & \text{if } \exists x, \ x \text{ is a golf player} \wedge p(x) = \text{true} \\ \text{false} & \text{otherwise} \end{cases}$

However, we would have a much more explanatory theory[8] if there were a general item-independent recipe for determining, given a denotation adequate for completely bivalent arguments like (27), how this denotation scales up to trivalent arguments. In other words, we would like a general procedure for turning (27) into (26).

(27) $[\![\text{some golf-player}]\!] = \lambda p_{et}.\exists x, x \text{ is a golf player} \wedge p(x)$

Such a general recipe would mean that we could define lambda-terms in our denotations assuming that the variables they bind are perfectly bivalent and let the recipe

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[8]Note that epistemologically, the problem of *homogeneity projection* is entirely parallel to the problem of *presupposition projection*. Exactly the same reasons that I used above to motivate having a recipe for homogeneity projection are used to motivate the rules of presupposition projection.

handle the other cases. The only cases of undefinedness one would need to specify in the lexical entry of a word would be the cases of undefinedness that arise from the word itself. In the sections to come, once we have reviewed Strong Kleene projection rules, my lexical entries will have that feature: they will only make reference to undefinedness if that undefinedness comes from the word itself. Before that, we need to outline the Strong Kleene recipe that I assume.

Homogeneity and strong Kleene projection. Križ and Chemla (2015), studying the behaviour of homogeneity in non-monotonic environment, find that the Strong Kleene[9] recipe for projection (extended to first-order logic quantifier) is adequate for homogeneity projection.

The recipe is best explained by considering any instance of undefinedness in an element as an instance of uncertainty about the truth-value of that element (George, 2008). For instance, $A \wedge B$, where A is false and B is undefined would correspond to the conjunction of a false statement and a statement whose truth-value is not known. Note that in this case, the truth-value of the whole $A \wedge B$ can be determined without knowing for certain the truth-value of B. It is false, because A is false. Now, consider the case $A \vee B$ where A is false and B undefined. No conclusion can be drawn about the truth-value $A \vee B$. It may turn out either true or false, pending on the unknown truth value of B. In our parlance therefore, this means the truth-value of $A \vee B$ is undefined.

This is in essence the recipe. If the truth-value of a whole may be determined no matter what the undefined values in its parts turn out to be, then that truth-value is the truth-value of the whole. If, on the other hand, a whole may be true or false depending on the undefined values in its parts, then that whole has an undefined truth-value.

We can apply this recipe to classical logical operators, $\vee$, $\wedge$ and $\neg$. For conjunction for instance, the meaning of the whole may only be positively determined if both conjuncts are known to be true, in which case the conjunction is true, or if at least one of them is known to be false, in which case it is false. I leave the reader to apply similar reasoning to the other operators. The overall results are given below:

(28) a. $A \wedge B$ is true if both A and B are true
           $A \wedge B$ is false if either A or B is false
           $A \wedge B$ is undefined otherwise

      b. $A \vee B$ is true if either A or B is true
           $A \vee B$ is false if both A and B are false
           $A \vee B$ is undefined otherwise

      c. $\neg A$ is true if A is false
           $\neg A$ is false if A is true
           $\neg A$ is undefined otherwise

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[9]More precisely, they consider the Strong Kleene logic to be a trivalent logic for propositional logical ; they give another name to a first-order extension of this type of trivalent logic. Here, I lump the propositional and first-order logic under the heading "*Strong Kleene*" following Fox (2013), given that they can be described in similar ways.

The recipe can similarly be applied to first-order quantifiers. We can positively know that a universal statement "$\forall x, A(x)$" will be true just in case $A(x)$ is true for all x. If some of the $A(x)$ happened to be undefined, i.e. their truth-value were not known, and the rest of them were true, we could not conclude anything regarding the truth of "$\forall x, A(x)$". If finally, at least one of the $A(x)$ is false, then it is certain that "$\forall x, A(x)$" is false, whether or not we know what truth-value other A gets for other x. (29) synthesizes the result of applying this reasoning to other first-order quantifiers:

(29) a. $\forall x, A(x)$ is true if for all x, $A(x)$ is true
          $\forall x, A(x)$ is false if $A(x)$ is undefined for some x
          $\forall x, A(x)$ is undefined otherwise

      b. $\exists x, A(x)$ is true if there exists an x such that $A(x)$ is true
          $\exists x, A(x)$ is false if for all x, $A(x)$ is false
          $\exists x, A(x)$ is undefined otherwise

This is not evident at first sight but the Strong Kleene recipe is compositional (George, 2008). To determine the truth-value of $[\alpha\ [\beta\ \gamma]]$, we may start off by computing the denotation/truth-value of $[\beta\ \gamma]$, and substitute a certain δ with similar meaning for the complex expression and apply the Strong Kleene reasoning to $[\alpha\ \delta]$. The result will be the same as if we had reasoned about the meaning of $[\alpha\ [\beta\ \gamma]]$ directly.

Alternative presentation.   Even if compositional, the Strong Kleene recipe is cumbersome to deal with in actual computations. Here, I present a notational trick which will ease the process. So far, I have presented the meaning of elements in terms of their truth- and falsity-conditions (e.g. (30a)). Instead, we could write meanings by specifying their truth-conditions and their non-falsity conditions, as in (30b). The two presentations are equivalent ; each can be recovered from the other.

(30) a. $[\![\text{the ravens croaked}]\!] = \begin{cases} \text{true} & \text{iff all ravens croaked} \\ \text{false} & \text{iff no ravens croaked} \\ \text{undefined} & \text{otherwise} \end{cases}$

      b. $[\![\text{the ravens croaked}]\!] = \begin{cases} \text{true} & \text{iff all ravens croaked} \\ \text{not false} & \text{iff some ravens croaked} \end{cases}$

In the sequel, I will refer to the truth-conditions as the *strong meaning* of an element and to the non-falsity-conditions as its *weak meaning*. Now observe what happens if we rephrase our conclusions about projection out of standard logical operators in terms of the new presentation:

(31) a. $A \wedge B$ is true iff both A and B are true
          $A \wedge B$ is not false iff both A and B are not false

      b. $A \vee B$ is true iff either A or B is true
          $A \vee B$ is not false iff either A or B is not false

c. $\neg A$ is true iff A is not not false (i.e. it is false)
$\neg A$ is not false iff A is not true

d. $\forall x, A(x)$ is true iff for all x, $A(x)$ is true
$\forall x, A(x)$ is not false iff for all x, $A(x)$ is not false

e. $\exists x, A(x)$ is true iff there exists an x such that $A(x)$ is true
$\exists x, A(x)$ is not false iff there exists an x such that $A(x)$ is not false

To the exception of the one downward-entailing operator in (31c), the projection rules all follow one general principle: the strong and weak meanings of the whole are simply the application of the logical operator to the respective strong and weak meanings of its parts. It is *as if*[10] the weak and strong reading formed two independent dimensions of meaning. This makes for an easy statement of complex projection rules, e.g. (32).

(32) $\forall x, A(x) \vee B(x)$ is true iff for all x, $A(x)$ is true or $B(x)$ is true
$\forall x, A(x) \vee B(x)$ is not false iff for all x, $A(x)$ is not false or $B(x)$ is not false

By comparison, in the old presentation, the two clauses that specify the meaning would involve completely different logical operators.

(33) $\forall x, A(x) \vee B(x)$ is true iff for all x, $A(x)$ is true or $B(x)$ is true
$\forall x, A(x) \vee B(x)$ is false iff there exists x, $A(x)$ is false and $B(x)$ is false

This generalization about projection holds true of all operators upward-entailing in their arguments. By chance, all of the operators we will consider, with the exception of negation, are of this sort.

For instance, we can reformulate our trivalent denotation for thematic roles in the new presentation as in (34). In its strong meaning, the thematic role head AGENT, for instance, asserts that its complement is the exhaustive agent. In its weak meaning, it simply states that some part of its complement is.

(34) a. $[\![\text{AGENT}]\!](p)$ $= \lambda x. \lambda e. \begin{cases} \text{true} & \text{iff } x \text{ is the agent of } e \text{ and } p(e) \\ \text{false} & \text{iff no } y \prec x \text{ is the agent of } e \text{ or } \neg p(e) \end{cases}$

$= \lambda x. \lambda e. \begin{cases} \text{true} & \text{iff } x \text{ is the agent of } e \text{ and } p(e) \\ \neq \text{false} & \text{iff some } y \prec x \text{ is the agent of } e \text{ and } p(e) \end{cases}$

b. $[\![\text{THEME}]\!](p)$ $= \lambda x. \lambda e. \begin{cases} \text{true} & \text{iff } x \text{ is the theme of } e \text{ and } p(e) \\ \text{false} & \text{iff no } y \prec x \text{ is the theme of } e \text{ or } \neg p(e) \end{cases}$

$= \lambda x. \lambda e. \begin{cases} \text{true} & \text{iff } x \text{ is the theme of } e \text{ and } p(e) \\ \neq \text{false} & \text{iff some } y \prec x \text{ is the theme of } e \text{ and } p(e) \end{cases}$

Note that I write $p(e)$ instead of $p(e) = $ true. This is a corollary of the fact that we have a recipe for homogeneity projection. I can assume that p is bivalent (i.e. true

---

[10]The two dimensions of meaning are not completely independent. The strong meaning, by nature, must always entail the weak meaning
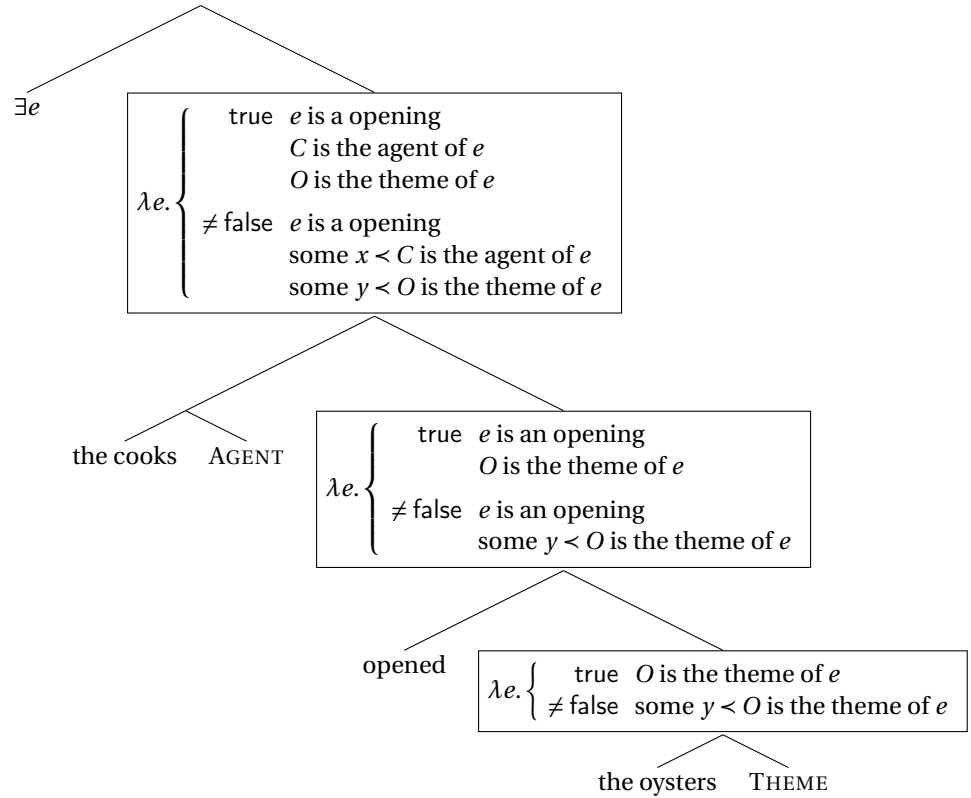
or false); the Strong Kleene recipe will handle all cases where p is trivalent and where the notation $p(e)$ may be ambiguous. Similarly, the "*and*" which appear in the meta-language statement of the predicate can be taken to be a run-of-the-mill bivalent "*and*".

2.4   Event semantics and trivalence

With the trivalent denotation for thematic roles and the Strong Kleene recipe for homogeneity projection described in the previous section, we are ready to compose the meaning of the simple sentence in (35a). The computation is made simpler in the new presentation: since the thematic role heads are upward-entailing in their arguments, applying their meaning to the meaning of their argument amounts to applying their strong meaning to the strong meaning of their argument and their weak meaning to the meaning of the argument. The composition is given below:

(35)   a.   The cooks opened the oysters

   b.

$\exists e$

$$\lambda e. \begin{cases} \text{true} & e \text{ is a opening} \\ & C \text{ is the agent of } e \\ & O \text{ is the theme of } e \\ \neq \text{false} & e \text{ is a opening} \\ & \text{some } x \prec C \text{ is the agent of } e \\ & \text{some } y \prec O \text{ is the theme of } e \end{cases}$$

the cooks   AGENT

$$\lambda e. \begin{cases} \text{true} & e \text{ is an opening} \\ & O \text{ is the theme of } e \\ \neq \text{false} & e \text{ is an opening} \\ & \text{some } y \prec O \text{ is the theme of } e \end{cases}$$

opened

$$\lambda e. \begin{cases} \text{true} & O \text{ is the theme of } e \\ \neq \text{false} & \text{some } y \prec O \text{ is the theme of } e \end{cases}$$

the oysters   THEME

   c. $[\![(35)]\!] = \text{true}$ iff $\exists e$, e is a writing
   C is the theme of e
   O is the agent of e

15

d.　$[\![(35)]\!] \neq$ false　iff $\exists e$,　e is a writing
　　　　　　　　　　　some $x < C$ is the theme of e
　　　　　　　　　　　some $y < O$ is the agent of e

The strong truth-conditions in (36c) are the same ones that we obtained in (20) before we introduced homogeneity. Just as before, they yield a reading that requires exhaustive participation of the subject and the object ($S_{\text{exh}} \wedge O_{\text{exh}}$), in conjunction with our ontological assumptions.

　　The weak truth-conditions are new. They should capture our intuitions about the truth-conditions of the negation of (35a) given in (36). To be more precise, the negation of the weak truth-conditions should amount to the cases where (35a) has a defined truth-value and is false. In other words, these should be the cases where (36a) is true. This is exactly what we find: the negation of the weak truth-conditions means that there is no event of opening involving some of the cooks as agents and some of the oysters as themes. To put it simply, no cook opened any oyster. These are indeed the intuitive truth-conditions of (36a):

(36)　a.　The cooks didn't open the oysters

　　　b.　**Intuitive truth-conditions:**
　　　　　not [some of the cooks opened some of the oysters]

2.5　Summary

In this section, I developed a black-box theory of homogeneity in cumulative sentences. I made two main assumptions: that the truth-value gaps observed in homogeneity project according to the Strong Kleene projection rules and that there are several loci of homogeneity, one per thematic role: homogeneity in cumulative sentences is articulated. No commitment to the nature of the truth-value gap were made.

　　The next section reaps the pay-off of these assumptions. We will start developing a theory of cumulative readings of *every* and see how the articulated system gives a handle on the difference between ordinary cumulative sentences and the cumulative sentences with *every*.

3　Cumulative readings of *every*

3.1　Event denotation for *every*

To capture cumulative readings, it will be necessary that the meaning of *every* makes reference to events. This step represents a strong departure from standard Montagovian assumptions but it isn't totally unmotivated. An argument for making this step comes from Schein (1993) (originally from Taylor (1985)). He observes that when modifiers to the event predicate (underlined in (37)) appear with *every*, they modify an ensemble event composed of elements from the scope of *every*. In (37a), *unharmoniously* describes an event containing note-striking for each student.

(37) a. <u>Unharmoniously,</u> every student struck a note on the piano. Schein (1993)

b. She ate every cookie <u>in less than two minutes</u>.

c. Every ship departed, <u>one in the wake of the other</u>.

The simplest way[11] to contend with these observations is to wire *every* to deliver the ensemble event that these adjuncts modify. This implies that the semantics for *every* makes reference to events.

One denotation apt to this task in the one in Kratzer (2000) (see also Champollion (2016b)), which I will present below with cosmetic adjustments. It may seem strange but along with the Neo-Davidsonian system for homogeneity that I developed in the previous section, we will end up validating Champollion's hierarchical generalization about the cumulative readings of *every*.

To simplify the presentation, I adopt some notation: if p and p' are two predicates of events, let us call $p + p'$, the set of events[12] that are the sum of a p_1 event and a p_2 event.

(38) a. $p + p' = \{e \oplus e' \mid e \in p, e' \in p'\}$

b.
$$\{e_1, e_2, e_3\}$$
$$+$$
$$\{e'_1, e'_2\}$$
$$=$$
$$\{e_1 \oplus e'_1, e_2 \oplus e'_1, e_3 \oplus e'_1, e_1 \oplus e'_2, e_2 \oplus e'_2, e_3 \oplus e'_2,\}$$

This notation can be generalized to sums of arbitrarily many predicates and I use the symbol Σ to represent such a sum.

With this notation in place, the effect of *every* is simply to add together the event predicates that corresponds to each element in the restrictor of *every*. As the example in (38b) shows, this denotation for *every* creates an ensemble event, just as desired.

(39) a. $[\![\text{every NP}]\!] = \lambda p_{evt}. \sum_{x \in [\![\text{NP}]\!]} p(x)$

b. $[\![\text{every ship departed}]\!] = [\![\text{ship 1 departed}]\!] + [\![\text{ship 2 departed}]\!] + \dots$
$= \lambda e. \, e = e_1 \oplus e_2 \oplus \dots$

where e_1 is a departure of ship 1,
e_2 is a departure of ship 2, etc.

---

[11]An intriguing alternative would be to treat the ensemble event as a discourse anaphor to the event existential introduced in the scope of *every*. Indeed, it seems that *ensemble events* shares a lot of properties with discourse referents introduced in the scope of *every* (Schein, 1993).

[12]Here, I identify predicates of events and sets of events.

3.2 Accounting for the desiderata

We are now ready to discuss concrete predictions. First off, we will compose a cumulative sentence with *every* and check that it differs from ordinary cumulative sentences in exactly the way that we observed in section 1.3.

Since *every* is a scope-taker, there are several LFs to consider. Let me focus on the LF that delivers the correct reading, given in (40):

(40)
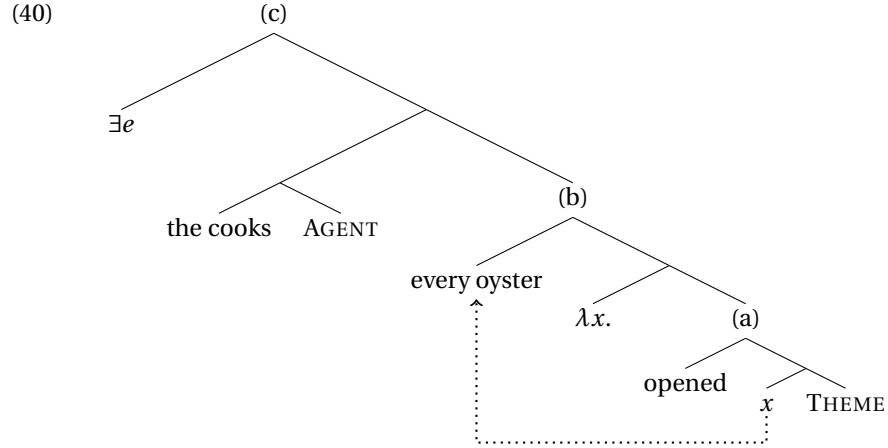
There are three relevant stages of composition that are worth discussing. The most important stage is stage (a), when the variable x is incorporated in the main verb event predicate by the homogeneous THEME heads. (41a) gives the result that is delivered by applying the denotation of THEME blindly.

(41) a. $[\![(a)]\!] = \lambda e. \begin{cases} \text{true} & e \text{ is a writing and } x \text{ is the theme of } e \\ \neq \text{false} & e \text{ is a writing and some } x' \prec x \text{ is the theme of e} \end{cases}$

b. $[\![(a)]\!] = \lambda e.\ e$ is a writing and x is the theme of e

The crucial observation is that since x is a singularity[13], there is no difference between x being the theme of the event and some part of x being the theme of the event. In other words, the strong and the weak truth-conditions are the same and we can rewrite (42a) as (42b). This means that *every*, by virtue of quantifying over singularities, negates the effect of homogeneity in the thematic role heads. The expectation is that the inference O_{exh} should persist in the weak truth-conditions of the sentence.

At stage (b), *every* forms the ensemble event which combines an opening of each oyster (cf (42a)). By the ontological assumptions, this is just an event of opening the oysters (cf (42b)). As you can note, the meaning we obtain at this stage corresponds to the strong meaning obtained for the corresponding VP in (35b) ; there is no longer any trace of homogeneity from the object position.

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[13]To be more fatihful to how the composition actually unfolds, the predicate abstracted over by $\lambda x.$ is formed for both singular and plural arguments but will only be evaluated on singular arguments. So we need only worry about the case when x is a singular.

(42) a. $[\![(b)]\!] = \sum_{x \text{ is an oyster}} \lambda e.\ e$ is an opening and x is the theme of e

b. $[\![(b)]\!] = \lambda e.\ e$ is an opening and O is the theme of e
where O is the plurality of oysters

Finally, we incorporate the cooks in event predicate through AGENT and existentially close the event predicate.

(43) a. $[\![(43)]\!] =$ true   iff $\exists e,$ e is a writing
O is the theme of e
C is the agent of e
where C is the plurality of cooks

b. $[\![(43)]\!] \neq$ false   iff $\exists e,$ e is a writing
O is the theme of e
some $y < C$ is the agent of e

Are these truth/falsity-conditions adequate? The strong truth-conditions do not differ from (35b). This is as desired: normal cumulative sentences and a cumulative sentences with *every* do not differ in positive contexts.

The difference lies in the weak truth-conditions. The weak truth-conditions in (43b) assert that there was an opening event with all the oysters as theme and part of the cooks as agents. In other words, the inference O_{exh} that every oyster was opened by some of the cooks. The negation of that $\neg O_{\text{exh}}$ - i.e. not every oyster was opened by a cook (or at all) - should correspond to the truth-conditions of (44a). As discussed in section 1.3, this is the desired result:

(44) a. The cooks didn't open every oyster.

b. **Intuitive truth-conditions:**
not [every oyster was opened by some of the cooks] $(=\neg O_{\text{exh}})$

This computation shows that *every*'s event denotation, along with the articulated system for cumulativity, achieves two of our desiderata. We now have an account of how cumulative reading for *every* are possible and how the difference between cumulative readings of *every* and ordinary cumulative readings comes about.

In the next section, we will show that this account also derives the hierarchical effects that we observed, our last desideratum, without further addition. The account follows similar lines to the one offered in Champollion (2016b), but see section 4.2 for a critical comparison.

3.3 Asymmetries and hierarchical effects

To start off, let us consider an alternative LF for the sentence (45a), where *every* obtains wider scope than the subject.

(45) a. The cooks opened every oyster.

  b. ∃*e* every oyster λx. [the cooks AGENT] opened [x THEME]

This LF has a meaning: it requires that for every oyster, there is an event where all the cooks open it. This reading is a distributive reading, not a cumulative reading. It is marginally possible in (46a) and improves with proper contextual cues:

(46) The fans in this audience have read every one of your books.

This would seem to show that every time *every* out-scopes a plural it will only generate a distributive reading. This situation is precisely that which obtains when *every* lies in subject position. As a result, the LF in (47b) is bound to deliver a distributive reading. We correctly predict an asymmetry between subject and object *every* in the availability of the cumulative reading.

(47) a. Every cook opened the oysters.

  b. ∃*e* every cook λx. [x AGENT] opened [the oysters THEME]

If the scope of *every* is the issue, is it possible that the cumulative reading may be obtained by scoping "*the oysters*" above *every* as in (48)?

(48) ∃*e* the oysters λy. every cook λx. [x AGENT] opened [y THEME]

However, this scope assignment is idle because scoping a type *e* element is vacuous. Another possibility would be to add a covert distributivity operator to *the oysters* in order to make its scope meaningful (see section 3.4 for further discussion of the covert distributivity operator), as in (49).

(49) ∃*e* the oysters **Dist** λy. every cook λx. [x AGENT] opened [y THEME]

Here again, it is unclear what this is meant to achieve, as it would only render the reading of *the oysters* distributive, keeping it away from a cumulative relation where the oysters may have been opened by different cooks.

In order to generate the missing reading, one would need a covert operator of the form given in (50), similar to the operator ** proposed in Beck and Sauerland (2000), which relates sub-groups of a plural individual to sub-events of an event *e*. With this operator in hand, the LF in (50b) can relate the oysters to sub-events of opening by a sub-part of the cooks, generating the missing reading.

(50) a. $[\![**]\!] (p_{evt}) = \lambda x. \lambda e.$ $\forall x' < x, \exists e' < e, p(x')(e')$
$\forall e' < e, \exists x' < x, p(x')(e')$

  b. ∃*e* the oysters ** λy. every cook λx. [x AGENT] opened [y THEME]

20

So, in order to explain the asymmetry, we must assume that such an operator does not exist. This is not problematic as there isn't any data point so far arguing that it should. However, this operator is similar to the ** operator proposed in Beck and Sauerland (2000) (except for the type $(evt)evt$ for (50a), $(eet)eet$ for them), I will review the evidence for the ** operator in the next section. Specifically, I will show that it is dispensable within the current system, provided the independent need for covert distributivity.

The generalization that emerges from this discussion is that *a cumulative reading with* every *is only available when it is c-commanded by the thematic role head of the plural argument it tries to enter a cumulative reading with.* In the system we have set up, thematic role heads are the true key to entering cumulative relations.

In the double object constructions we studied in section 1.2, this means that all of the sentences in (51) where *every*'s plural co-argument is higher than it may receive a cumulative reading but none of the sentences in (52) with the reverse configuration will.

(51) **Cumulative readings possible**

    a. Hera's twelve challenges taught every cardinal virtue to Hercules.

    b. The ten servers sent every customer an e-mail.

    c. Anya gave the ten charities in Boxborough every bill she won on the show.

(52) **Only distributive readings**

    a. Every one of Hera's challenges taught the four cardinal virtues to Hercules.

    b. Every server sent the ten customers an e-mail.

    c. Anya donated every charity in Boxborough the fifteen checks she won on the show.

3.4 Reducing ** operators to distributivity operators

Beck and Sauerland (2000) present cases of cumulativity at a distance (e.g. (53)). Their goal is to argue that that not all cumulative readings arise through lexical entailments[14]. Instead, they propose that cumulative readings derive, in some cases, by application of a ** operator, which enforces cumulative readings with both S_{exh} and O_{exh} inferences.

(53)   a. The two lawyers have pronounced the two proposals to be against the law.

    b. **Beck and Sauerland (2000)'s LF:**
       [the two lawyers] [the two proposals] $\lambda x.\ \lambda y.\ x$ have pronounced y to be against the law

---

[14]In their prose, they target more specifically Winter (2001)'s less simple-minded functional account.

This account challenges the current one on a number of counts. First, in the theory proposed, plural arguments enter in a cumulative relationship with other pluralities by first entering a cumulative relationship with an event predicate, through the thematic role head. This seems to entail that only co-arguments of the same event predicate can enter a cumulative relationship. But (53a) shows that this is not correct. Second, we have seen that an event version of the ** operator challenges the explanation of the asymmetries in cumulative reading of *every*. Finally, Beck and Sauerland (2000) is at odds with the articulated view of cumulative readings since they wire one operator to deliver both the S_{exh} and O_{exh} inferences.

Is there is a way to contend with Beck and Sauerland (2000)'s main claim that cross-clausal cumulation is possible, without involving a ** operator? I argue that it is possible. All that one needs is a distributivity operator - call it **Dist**[15] - that turns a plural DP into a distributive quantifier. The important fact to remember is that distributive quantifiers, in the current analysis, create ensemble events at the place where they take scope. This includes the ones created by **Dist**. Assuming **Dist**, consider the following LF where the embedded DP *the two proposals* and **Dist** takes scope in the matrix clause:

(54)
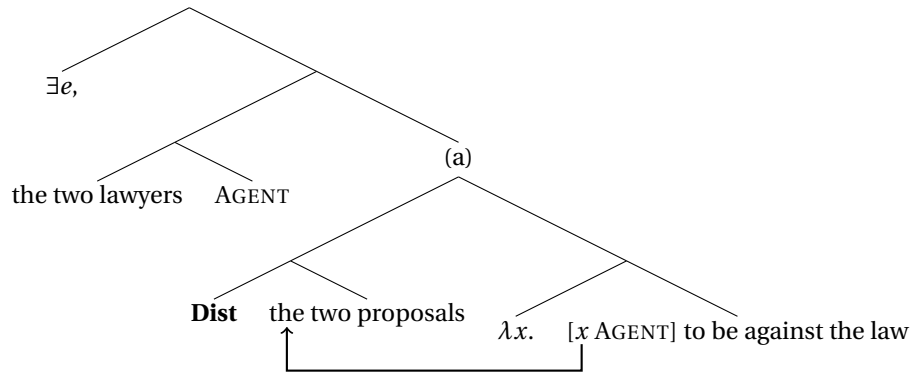
Let's first look at this LF informally: given our assumption about distributive quantifiers and ensemble events, the constituent (a) will denote a predicate true of an ensemble event containing for each proposal, an event of pronouncing that proposal to be illegal. The subject can then enter a cumulative relationship with that plural event through the thematic role head AGENT. In other words, the cumulative relation is made possible by the mediation of the ensemble event created by scoping[16].

---

[15]XXXXXXX notes that we could also obtain the same result with a * operator, instead of *Dist*. This would avoid assuming that Beck and Sauerland (2000)'s sentences require a distributive reading of the embedded argument. Since an overt distributivity operator (*every*) was already introduced, the presentation is smoother with **Dist**, hence my presentation choice.

[16]Note that I follow Beck and Sauerland (2000) in assuming that scoping is necessary to create cumulative readings across clauses. See Schmitt (2013) for arguments against that view.

Before we spell out a semantics of **Dist** adequate for the account above, I must mention one subtlety: contrary to a distributive quantifier like *every*, the covert distributivity quantifier **Dist** gives rise to homogeneity effects. Thus, (55a) negates S_{exh} but (55b) negates any form of participation whatsoever.

(55) a. I doubt that the cars still have a motor.
⤳ *no car has a motor* (distributive, $\neg\exists$)

b. I doubt that every car still has a motor.
⤳ *no car has a motor* (distributive, $\neg S_{\text{exh}}$)

This extends to the cases discussed by Beck and Sauerland (2000):

(56) a. I doubt that the two lawyers pronounced the two proposals to be against the law.
⤳ *no lawyer pronounced any proposal to be against the law.* ($\neg\exists\exists$)

b. I doubt that the two lawyers pronounced every proposal to be against the law.
⤳ *not every proposal was pronounced to be against the law* ($\neg$ embedded S_{exh})

Our definition will have to be trivalent to capture this form of homogeneity[17]. This is done in (57a)

(57) a. $[\![\text{Dist}]\!](x)(p)(e)$ is true $\qquad$ iff $\sum_{y<X} p(y)$ is true of e

$[\![\text{Dist}]\!](x)(p)(e)$ is true or undefined $\qquad$ iff for some $X' < X$, $\sum_{y<X'} p(y)$ is true of e

b. $\exists e$, [the two lawyers AGENT] [**Dist** the two proposals] λx. have pronounced [x AGENT] to be against the law

Here are key steps in the composition:

(58) $[\![[\text{\textbf{Dist}} \text{ the two proposals}] \lambda x. \text{ have pronounced } [x \text{ AGENT }] \text{ to be against the law}]\!] =$
$= \lambda e. \begin{cases} \text{true} & e \in \sum_{p<p_1\oplus p_2} \lambda e'. e' \text{ is a pronouncing of } p \text{ being against the law} \\ \neq \text{false} & \exists p' < p_1 \oplus p_2, e \in \sum_{p<p'} \lambda e'. e' \text{ is a pronouncing of } p \text{ being against the law} \end{cases}$

To simplify notation, let's call P_1 the predicate of events of pronouncing p_1 to be against the law, and P_2 the predicate of events of pronouncing p_2 to be against the law.

(59) $[\![[\text{\textbf{Dist}} \text{ the two proposals}] \lambda x. \text{ have pronounced } [x \text{ AGENT }] \text{ to be against the law}]\!] =$
$= \lambda e. \begin{cases} \text{true} & e \in P_1 + P_2 \\ \neq \text{false} & e \in P_1 \text{ or } e \in P_2 \text{ or } e \in P_1 + P_2 \end{cases}$

---

[17]The definition of covert distributivity in (57a) reemploys some of the same elements that were involved in the definition of the thematic role heads. This suggests that we could factor out the common trivalent component from the denotations of thematic role heads and covert distributivity. In that regard, cf (Bar-Lev, 2018, appendix A)

The final truth/falsity conditions of the sentence are as in (60). They are adequate: in a positive sentence, they correctly assert the cumulative relation that each of the lawyers pronounced one of the proposal to be against the law and that each proposal was pronounced against the law by at least one lawyer. In a negative sentence, they assert that no lawyer pronounced any proposal to be against the law.

(60) $[\![(c)]\!]$ = true   iff $\exists e$ e is $P_1 + P_2$ and the agents of e are the two lawyers
         $[\![(c)]\!]$ ≠ false   iff $\exists e$ e is P_1, P_2 or $P_1 + P_2$
                             and the agents of e are a subset of the two lawyers.

The upshot of this discussion is that the articulated view of cumulativity presented here is compatible with Beck and Sauerland (2000)'s data. Furthermore, the account can preserve the same type of syntax that was used in a ** account. If this is correct, then it suggests that ** operators are dispensable. This alleviates the worries raised in section 3.3.

3.5   Summary

In this section, I have developed a semantics for cumulative readings for *every* which account for all three facts on cumulative readings seen in section 1. The analysis of cumulative readings of *every* relies on the trivalent Neo-Davidsonian semantics developed in section 2. The only addition to this system is an event-conscious denotation for *every* adapted from Kratzer (2000). In this system, cumulativity is created by the thematic role heads only. Their fixed position in the tree explains why we see asymmetries in cumulative readings. Furthermore, the particular denotation for *every* interacts with the homogeneity located in the head so as to remove the homogeneity associated with a particular head.

In the next section, I discuss the advantages of this account over previous proposals.

4   Comparisons

In this section, I review three proposals on cumulative readings of *every*: Champollion (2010), Haslinger and Schmitt (2018) and Champollion (2016b). A point that will recur in this discussion is that in these accounts, cumulative readings of *every* arise in mostly the same way normal cumulative readings do. Consequently, any attempt to incorporate homogeneity into the analysis will result in incorrectly predicting that cumulative readings of *every* have the same falsity-conditions as normal cumulative sentences.

4.1   Without events

4.1.1   Champollion (2010)

Champollion (2010)'s proposal for cumulative readings of *every* is radically simple. In his view, *every child* denotes the plurality of children. However, its trace must be

interpreted as a singular, for syntactic reasons. The only way out of these conflicting requirements is for some distributivity operator to intervene between "*every child*" and its trace. This accounts for *every*'s distributive properties. Being a plural, *every child* can enter cumulative relations with other elements using Beck and Sauerland (2000)'s ** operator.

(61) a. The simple case

Every person
$= p_1 \oplus \ldots \oplus p_n$ *

λ_i

$t_{i\,[+sg]}$ arrived on time
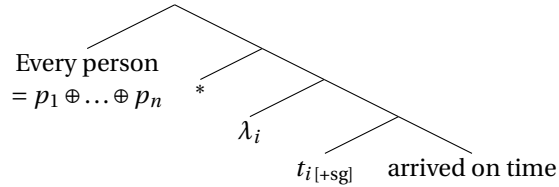
b. The cumulative case:

The copy-editors

every mistake

**

λ_1

λ_2 t_2 caught $t_{1\,[+sg]}$
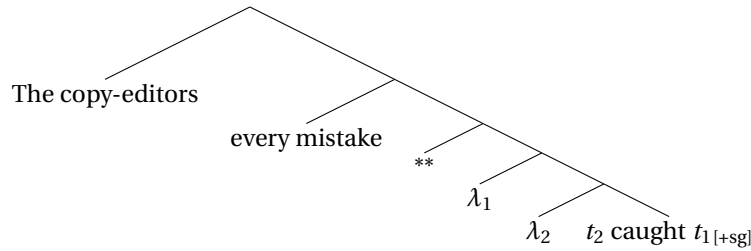
The elegant simplicity of the theory is appealing. However, it does not explain all the facts from section 1. This account finds no difference between the LF of (62a) and (62b) and thus predict that they should pattern the same in negative environments. But they don't, as we noticed in section 1.3:

(62) a. The copy-editors caught every mistake.

b. The copy-editors caught the mistakes

(63) a. I doubt the copy-editors caught every mistakes
↤⤳ I think that some mistake wasn't caught by any of the editors.

b. I doubt that the copy-editors caught the mistakes
↤⤳ I think that no mistake was caught by any of the editors.

There are also some glitches. In this system, two *every*'s can get a cumulative reading, through the LF in (65), contrary to fact.

(64) a. Every copy-editor caught every mistake.

b. **Predicted:** every editor caught a mistake *and* every mistake was caught by an editor.

c. **Actual:** every copy-editor caught every mistake

25

(65)

```
              _____
             /                   \
   every copy-editor              \
                     _____
                    /                   \
             every mistake               \
                           **             \
                              _____
                             /           \
                            λ₁            \
                                 _____
                                /                   \
                               λ₂    t₂[+sg] caught t₁[+sg]
```
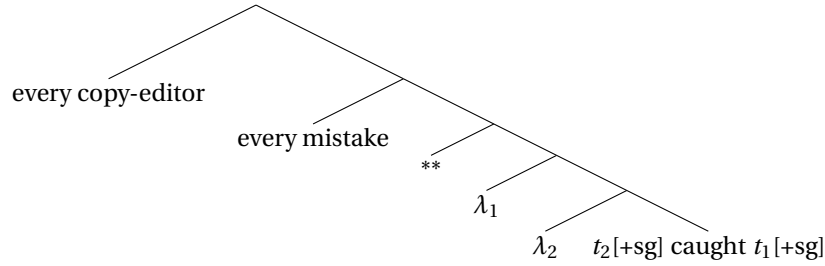
4.1.2 Haslinger and Schmitt (2018)

Haslinger and Schmitt (2018) proposes an event-free analysis of cumulative readings of *every*. Their analysis is embedded in the framework of cross-categorial pluralities of Schmitt (2013). In this framework[18], any type has a corresponding plural type: there are plural predicates, plural propositions, etc. The denotation of *every* that they propose forms a plurality of predicates from each quantificational case. For instance, *patted every cat* will denote the plurality in (66).

(66) $\llbracket$patted every cat$\rrbracket$ = patted cat$_1 \oplus \ldots \oplus$ patted cat$_n$ (=plural predicate)

The second ingredient is to hard-code the meaning of ** in the compositional rules ; they propose a rule of *cumulative functional application*[19]. This allows plural arguments higher in the syntactic tree to enter cumulative relations with the plurality of predicates created below by *every*. So (67a) and (67b) will combine to yield (67c):

(67) a. $\llbracket$caught every mistake$\rrbracket$ = caught mistake 1 $\oplus$ caught mistake 2

   b. $\llbracket$the copy-editors$\rrbracket$ = copy-editor 1 $\oplus$ copy-editor 2

   c. $\llbracket$the copy-editors caught every mistake$\rrbracket$
       = the copy-editor 1 caught mistake 1 $\oplus$ the copy-editor 2 caught mistake 1
       $\vee$the copy-editor 1 caught mistake 2 $\oplus$ the copy-editor 2 caught mistake 2
                                           (by *cumulative functional application*)

This correctly captures the cumulative reading. In addition, it gives a handle on the subject-object asymmetries: everything below *every* is interpreted in its scope, thus distributively. Only plural arguments higher in the tree can combine cumulatively with the plural predicate formed by *every*.
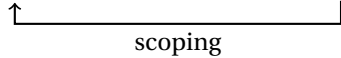
   Both this analysis and my analysis consider that *every* creates a plurality as some level of composition: in my analysis, it is an ensemble event; in Haslinger and Schmitt (2018), a plural predicate. One interest of Haslinger and Schmitt (2018) is to get rid of the middle man in cumulative relations, the event structure[20]. However, the account of the asymmetry is under-specified in one respect and I can't assess whether

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[18]The system is in fact richer than my presentation here can do justice to. For full technical details, cf the original paper.

[19]My name, not theirs.

[20]It is not clear that this is the right move entirely, since we need to account for ensemble event reading regardless of cumulative readings of *every*.

it is successful. If the availability of cumulative readings of *every* is a matter of scope, what prevents a syntactically lower plural, as in (68), to scope outside of *every*, evading the distributive interpretation[21]? The structure obtained by this scoping parallels that of the sentence that does get a cumulative reading.

(68)   the dogs λ_1 every woman patted t_1

scoping

To know whether this a problem, one would need to know how the λ-abstraction rule, which is used for scoping, functions in the system. This rule is not given in the fragment. The authors (p.c.) note that to specify such a rule would imply tackling the problem of abstraction in alternative semantics, a well-known problem (Shan, 2004). Thus, we cannot say, as of now, whether this account will be able to capture the asymmetries in cumulative readings. Note that the predictions of the present account are clearer on that front: scoping the plural DP does not deliver the cumulative reading as seen in section 3.3.

There is a more transparent point of comparison. As with Champollion (2010), (69a) and (69b) are composed the same way. Both involve a lower plurality entering a cumulative relation with a higher plurality via cumulative function application. The only difference is that in (69a), the lower plurality is a plurality of entities; in (69b), it is a plurality of predicates. Both (69a) and (69b) use cumulative functional application to compose.

To take into account homogeneity, adjustments to the cumulative composition rule need to be made. But whatever changes are made to the cumulative functional application rule will affect both (69a) and (69b) in identical ways. This means that there is no way to express the difference in behavior between the negative versions of these sentences (70a) and (70b).

(69)   a.   The women patted the dogs.

   b.   The women patted every dog.

(70)   a.   I doubt that the women patted the dogs.

   b.   I doubt that the women patted every dog.

4.2   Within event semantics: Champollion (2016b)

Champollion (2016b) proposes an event denotation for *every* which, just like ours and Kratzer (2000), creates ensemble events that higher operators can combine with. Because he is interested in building unification between different cases of distributivity, his denotation for *every* (given in (71)) is more involved: not only is the event predicate an argument of *every* but the thematic role head is as well.

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[21]With the cumulative composition rule, scoping pluralities of type *e* is not necessarily vacuous, since scoped elements can enter cumulative relations at their landing site.

(71) $[\![\text{every NP}]\!] = \lambda\theta_{evt}.\lambda P_{vt}.\lambda e.\,\theta(e) = \bigoplus[\![\text{NP}]\!] \wedge e \in^* [\lambda e'.\,P(e') \wedge \theta(e') \text{ is an atom}]$

Let us see this denotation at work on some of our examples. In (72) for instance, *every* forms an ensemble event. In each event, only one of the cooks participated as an agent. It is then re-asserted that this ensemble event contains all the cooks as its agent.

(72) a. Every cook opened the oysters

    b. $[\![\text{Every cook opened the oysters}]\!]$
      $= \lambda e.\,[\![\text{AGENT}]\!](e) = \bigoplus[\![\text{cook}]\!] \wedge e \in^* [\lambda e'.\,\text{open}(e') \wedge [\![\text{AGENT}]\!](e') \text{ is an atom}$
      $\wedge \text{THEME}(e) = \iota\text{oysters}]$

Just as with our account, *every* can take a local scope within the VP, as in (73). When it scopes at this level, *every* creates an ensemble event containing, for every oyster, an event of opening that oyster. Because *open* is distributive on its object, this is the same as the denotation of the predicate "*opened the oysters*". Therefore, both will give rise to cumulative readings as expected

(73) a. The cooks opened every oyster.

    b. $[\![\text{opened every oyster}]\!]$
      $= \lambda e.\,[\![\text{THEME}]\!](e) = \bigoplus[\![\text{oyster}]\!] \wedge e \in^* [\lambda e'.\,\text{open}(e') \wedge [\![\text{THEME}]\!](e') \text{ is an atom}]$
      $= \lambda e.\,[\![\text{THEME}]\!](e) = \bigoplus[\![\text{oyster}]\!] \wedge \text{open}(e)$
      $= [\![\text{opened the oysters}]\!]$

Similarly to the discussion of section 3.3, Champollion observes that his denotation will only give rise to cumulative reading if the DP that *every* enters a cumulative relation with does not fall within the scope of *every*. In other words, if *every* only scopes over the verb, as it does in (73b), a cumulative reading of *every* with the agent will be possible but not in (72b), where it scopes over the whole clause.

    As we saw with Haslinger and Schmitt (2018), the analysis of the asymmetries must also explain why covert scope-shifting operations are not able to generate the missing reading. Champollion (2016b) does not discuss how inverse-scope might be achieved in his system. Given the denotation of *every*, we can nevertheless see that the constituent "*every NP*" is a meaningful scope-taker[22]. However, the readings it generates by scoping are not inverse-scope readings (glossing over composition details):

(74) a. I gave a flower to every poet.

    b. $[\![\exists e\,[\text{I AGENT}]\,[\text{every poet}]\,\lambda x.\,\text{gave}\,[\text{a flower THEME}]\text{ to }[x\text{ GOAL}]]\!]$
      $= \exists e, \exists x \in \text{flower},\ \text{give}(e) \wedge x \text{ is the theme of } e \wedge \text{ the poets are the goal of } e$
      $\wedge e \in^* [\lambda e'.e \text{ is a giving of a flower to one individual only}]$
      $\approx$ *I gave the same flower to every poet*

---

[22]Its type is $(evt)(vt)vt$. In other words, it leaves traces of type e and scopes at nodes of type vt and creates a $(vt)vt$ denotation. "θ *every NP*" can also be viewed as a scope-taker, but there is no node where it can meaningfully attach.

An explanation of inverse-scope is lacking[23]. Because of this, it is unclear, as of now, how much of the asymmetries can actually be captured in this system.

The second point of comparison are homogeneity effects. Champollion (2016b) does not discuss them but since his denotation is close the one advocated by the present work, one may nevertheless hope that our explanation of the interaction between *every* and these effects would carry over to his system. The simplest way of bridging the two accounts would be to adopt the trivalent denotation of thematic roles from section 2.2 while maintaining Champollion (2016b)'s denotation for *every*.

Problematically, Champollion's denotation for *every* does not have the desired homogeneity-removing effect on thematic roles that our denotation does. As a result, the difference between ordinary cumulative sentences and cumulative sentences with *every* cannot be explained. To see this, observe that in Champollion's denotation, repeated below in (75), the semantic contribution of the thematic role is duplicated (marked in red). One part of the contribution is to assert that the ensemble event should only be composed of events where the relevant thematic role is atomic (the second one). As seen in section 2.2, the requirement of atomicity on our trivalent thematic role will cancel the homogeneity associated with θ. The first contribution modifies the ensemble event itself and asserts that the elements in the denotation of NP should stand in relation θ to the event. Because $\bigoplus P$ is a plural, that part of the meaning has a truth-value gap. In fact, that part of the meaning of *every* is the same meaning as obtained by combining a DP like "*the oysters*" with the thematic role head. As a result, the same type of homogeneity that "*opened the oysters*" give rise to will arise in the case of "*opened every oyster*".

(75) $[\![\text{every NP}]\!] = \lambda\theta_{evt}.\lambda P_{vt}.\lambda e. \,\textcolor{red}{\theta(e) = \bigoplus [\![\text{NP}]\!]} \wedge e \in {}^*[\lambda e'. \, P(e') \wedge \textcolor{red}{\theta(e') \text{ is an atom}}]$

Thus, the account, while similar in spirit to ours, does not give a full account of the two facts that we have been considering.

5   Extensions

This section explores more intricate predictions of the analysis and suggests possible avenues to improve it.

5.1   The elusive subject-inexhaustive readings

The analysis presented so far assumes that each of the thematic role heads contributes its own exhaustive inference: AGENT contributes S_{exh}, THEME contributes O_{exh}, etc. When *every* is introduced, it removes the homogeneity associated with the thematic role it bears, namely the homogeneity associated to O_{exh}. Thus, negating a cumulative sentence with *every* yields the reading $\neg O_{\text{exh}}$.

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[23]In fact, given the dependence of this entry on thematic roles, it may prove hard for this analysis to contend to the bi-event cases "*the two lawyers pronounced every motion to be against the law*", seen in section 3.4. If *every* scopes in the matrix clause where presumably, access to the lower event and its thematic roles is lost, then it is hard to see what the value of the argument θ should be.

We may wonder whether it is possible to find a sentence where the homogeneity associated with the inference S_{exh} is suppressed. Negating that sentence would amount to negating that all the subjects participated in the action described by the subject. The type of sentence we are looking for would have the following shape:

(76) a. I doubt that *D* cooks opened the oysters

    b. **Truth-conditions:**
       not [every cook opened an oyster] $(= \neg S_{\text{exh}})$

Placing *every* in subject position will only yield a distributive reading, as we have seen ; it is not the right test case. The right test case would involve a homogeneity remover which does not impose distributivity to its scope. That homogeneity remover placed in the subject position would allow S_{exh} to survive negative environments. Križ (2016) gives *all* as an example of homogeneity remover. For instance, (77a) does not exhibit homogeneity effects:

(77) a. I opened all the oysters.

    b. I didn't open all the oysters.
       ⇜ *not [I opened all the oysters]*

However, that item carries some form of distributivity, just like *every*. In particular, in subject position, (Minor, 2017, sec. 1.4.1) claims that *all* disallows cumulative reading (cf (78)). If this is so, then we cannot use *all* as our test case either[24].

(78) All the cooks opened twenty oysters.
    ⇝ *twenty oysters per cook*
    ⇏ *twenty oysters overall*

I propose to look at a different homogeneity remover instead: stressed partitive numerals. As can be seen in (79a), these items exhibit a universal reading in positive sentences ; in other words, a O_{exh} inference. In negative sentences, the same O_{exh} inference is negated; the target reading is $\neg O_{\text{exh}}$. (SMALL CAPS for focus and, here, nuclear pitch accent.)

(79) *Pointing to the books on my shelf...*

    a. I read the THREE of them yesterday.

    b. I didn't read the THREE of them yesterday.

So stressed partitives do trigger homogeneity removal. Furthermore, they are not incompatible with collective interpretation:

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[24]I have found some native speakers to dispute the judgment in (78) and allow for cumulative readings. It would be interesting to go to the bottom of this disagreement but caution commands that I do not use *all* as a homogeneity remover.

(80)   a.   The THREE of them carried one piano.

        b.   **Possible interpretation:** *they carried a piano together.*

All there remains to do is to use this homogeneity remover in subject position in a
negative environment:

(81)   *Talking about the cooks…*
        I doubt that the THREE of them opened the oysters.

        a.   **Context A:** *Lily was absent today*

        b.   **Context B:** *This oyster wasn't opened*

Consultants judge context A in (81a) to confirm the speaker's doubts. Since context
A spells out a scenario where S_{exh} is false, this suggests that negating S_{exh} means
negating "*the* THREE *of them opened the oysters*". Context B, on the other hand, does
not confirm the speaker's doubts, suggesting that negating O_{exh} means negating "*the*
THREE *of them opened the oysters*".
    This data point goes in the direction of proving that the homogeneity effect as-
sociated to S_{exh} can be removed without removing the homogeneity effect associ-
ated to O_{exh}. However, the interpretation of this datapoint is not so straightforward
because of the ill-understood role of focus. A counter-interpretation of our claim
would go as follows[25]: assume that, contrary to what I hope to prove, the homo-
geneity of both S_{exh} and O_{exh} is removed by the stressed partitive numeral. In other
words, the basic meaning of (81) is paraphrasable as:

(83)   I think either not every cook opened an oyster *or* not every oyster was opened
        by a cook

This is weaker than the intended reading would predict (81b) to be a valid continua-
tion. However, note that the focus placement in (81) may evoke a set of alternatives
of the form:

(84) $\{n\text{-many of them opened the oysters} \mid n\}$

If evocation of a set of alternatives comes with an existential presupposition that one
of them must hold, then (85) must be true:

---

[25]A similar counter-interpretation could be formed for cumulative readings of *every*: *every* cancels the
homogeneity of both S_{exh} and O_{exh}, the existence presupposition evoked by narrow focus on *every* rules
out the interpretation $\neg S_{\text{exh}}$, yielding the observed inference O_{exh}. However, narrow focus on *every* is
not required to trigger *every*'s homogeneity-removing effect, contrary to stressed partitive numerals. For
instance, narrow focus on *this* is possible in (82), with the reading $\neg O_{\text{exh}}$.

(82)   I doubt that the cooks opened every oyster in THIS bag.

(85) for some n, n-many of them opened the oysters

This existence presupposition seems to entail that all oysters were opened by a cook (O_{exh}). This means that of the two disjuncts that the speaker takes to be true in (83), only the one that corresponds to $\neg S_{\text{exh}}$ can hold. In the nutshell, according to this interpretation of the data, it is not required to separate the inference S_{exh} and O_{exh} in order to generate the asymmetric reading $\neg S_{\text{exh}}$ which is observed.

This counter-interpretation has some appeal. Certainly, focus must be a component in the explanation of why stressed numerals have the homogeneity-removing effect that they do. However, the existence presupposition it rests on is cancellable in the meaning of (83). This is part of a broader point that the existence inference associated with narrow focus is not necessary, as first noted by Jackendoff (1972).

(86) I don't think that the THREE of them opened the oysters . . .
. . . in fact, I also think it possible that the cooks didn't do anything and that none of the oysters were in fact opened.

Since this counter-interpretation is not sound, the original interpretation may be correct: (81) may be a genuine case of removing the homogeneity effect associated with S_{exh}. We must nevertheless remain cautious of this data point insofar as it involves an construction left unanalyzed: the stressed partitive numerals.

5.2 Collective action

The discussion above has been carefully sidestepping the case of collective predication. I have regularly used the predicate *opened the oysters*, which is usually a one-person-task and can only be done once to oysters. Turning to predicates which allow collective participation, the strong truth-conditions derived by the system seem correct (cf (87b)). Indeed, it does not matter how many movers were involved in the carrying of each individual pianos ; so long as the carriers of all the pianos add up to the totality of movers, our ontological assumptions will guarantee the existence of the event in (87b)

(87) a. The movers carried the pianos upstairs

b. **Truth-conditions:**
There is a moving event e
The movers are the agents of e
The pianos are the themes of e

The predicted weak truth-conditions, as revealed by the negative version of the sentence, are less satisfactory:

(88) a. The movers didn't carry the pianos upstairs.

b. **Truth-conditions:**
not[there is a moving event e

some of the movers are the agents of e
some of the pianos are the themes of e]

Consider (88a) in the scenario below:

(89)   **Outside help**
       One mover and one inhabitant of the building carried some of the pianos
       upstairs together

The sentence in (88a) is not judged true in this context[26]. However, it is predicted
to come out true, simply because the only events of carrying which happened in
Outside Help did not involve a sub-part of the movers as its agents, satisfying (88b)'s
requirements.

To fix this, we may consider changing the notion of participation that appears
in the weak truth-conditions, replacing subsethood with overlap[27], as in (90a). And
indeed, the notion of overlap is sometimes used in trivalent work on homogeneity
Križ (2017).

(90)   a. $[\![\text{AGENT}]\!](x)(p)(e) = \text{true}$ iff $p(e)$ and x are the agents of e
            "*x is the agent of some p-event e*"

            $[\![\text{AGENT}]\!](x)(p)(e) \neq \text{false}$ iff $p(e)$ and some Y overlapping X is the agent of e

       b.   **Predicted truth-conditions of (88a):**
            not[there is a moving event e
            the agents of e overlapped with the movers
            the themes of e overlapped with the pianos]

But these truth-conditions come out too strong. For instance, they come out false in
the scenario (91a), because of the existence of the event e_0 described in (91b). Yet,
(88a) is true in that context.

(91)   a.   **To each their own**
            The movers carried the chairs upstairs.
            The inhabitants carried the pianos upstairs.
            No other carrying happened.

       b.   Event e_0 of carrying.
            The agents of e_0 are the movers and the inhabitants
            The themes of e_0 are the chairs and the pianos

To get a weaker reading of (91) then, we need a stronger notion of overlap. I suggest
that the correct notion of participation is "*overlap with all subparts*". Compositional
details pending, the truth-conditions which spell out these intuitions are as in (92).

---

[26]Speakers hesitate to call it false either. This is the feeling of undefinedness typical of homogeneity
cases.

[27]A plurality X overlaps Y just in case there is a part of X that is also a part of Y.

(92) **Predicted truth-conditions:**
  not[there is a moving event e
  $\forall e' < e$, the movers overlaps with the agents of e'
  $\forall e' < e$, the pianos overlaps with the themes of e']

This notion of participation is slightly weaker than subsethood but not so weak as overlap. As a result, it correctly predicts scenario **Outside Help** to not be true and **To Each Their Own** to be true. In the **Outside Help** scenario for instance, the event e_0 containing the inhabitant and the mover carrying one piano upstairs has only itself as a sub-event. The movers overlap with the agents of e_0 and, concomitantly, all sub-events of e_0. The pianos do as well. So the truth-conditions of the sentence are falsified: the sentence is not true. It is in fact undefined.

Similarly, scenario **To Each Their Own** is predicted to be true. Contrary to the simple notion of overlap, the large event e_0 described in (91b) here does not falsify the truth-conditions in (92). Indeed, this event e_0 contains an event e_1 of the inhabitants carrying the pianos. The agents of that sub-event do not overlap with the movers ; thus they do not falsify the conditions specified by the truth-conditions.

All there remains to do is to wire this notion of "*overlap with all subparts*" in the meaning of thematic role heads:

(93) a. $[\![\text{AGENT}]\!](x)(p)(e)$ is true   iff $p(e)$ and x are the agents of e
        "*x is the agent of some p-event e*"

     $[\![\text{AGENT}]\!](x)(p)(e)$ is true or undefined   iff $p(e)$ and $\forall e' < e$, X overlaps with the
        agent of e'

This notion may seem remote from the notion of subset-hood we started with. However, note that in a context where no collective actions are ever performed, so that any event can always be broken down into a sum of event whose agents and themes are singularities, the two notions coincide. Since this is precisely the kind of sentences I have been careful to use in our discussion, none of our previous results are compromised by this addendum.

Conclusion

In this paper, I pursued two related objectives. The first objective is to provide an account of cumulative readings of *every*, which can account for the asymmetries in the availability of that reading and the difference between its ordinary non-quantified counterpart. The second goal is to draw a conclusion from this analysis for cumulative readings in general. In particular, cumulative readings were argued to be articulated: the two components of meaning S_{exh} and O_{exh} at its core are specified in the AGENT and THEME thematic roles respectively. Both of these thematic role heads give rise to homogeneity inferences. In the resulting system, cumulativity always flows from thematic roles, without resorting to ** operators. This conclusion applied to both the kind of cumulativity exhibited by lexical verbs such as *open* or across clauses as in Beck and Sauerland (2000)'s examples.

While I believe that the resulting view holds promises, there remains some issues which need further research. In particular, the event denotation for *every*, crucial to derive the attested ensemble event readings, is problematic. It predicts that *every* must always take scope within an event domain, i.e. below the existential over events. However, all other quantifiers behave as though they always took scope above event closure (Champollion, 2014). If *every* is to take scope above these other elements, scope ordering paradoxes are likely to arise. This is part of a larger issue concerning the proper treatment of quantification in event semantics. This program is beyond the scope of the current paper but it may affect the results presented here.

Unrelatedly, the current account also used trivalent semantics as a theory-neutral way to represent homogeneity. However, I did make a strong commitment Strong Kleene logic as a recipe for project. This proved useful in combining the homogeneity effects associated with AGENT and THEME together. It remains to be seen which proposals regarding homogeneity can actually accommodate that assumption or, if they can't, whether they can derive the particular combination of homogeneity associated with thematic role heads in some other way.

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