

## Cumulative readings of *every* with leaks\*

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**Abstract** *every* surprisingly gives rise to cumulative readings (Schein 1993; Kratzer 2000). The distribution of these readings is governed by scope-related asymmetries (Champollion 2010; Haslinger & Schmitt 2018). In this work, I notice a third property of these readings: cumulative readings of *every* receive weaker “leaky” truth-conditions under negation, previously thought to be unattested (Bayer 2013). Exploiting this third property, I build an event semantics to deliver these “leaky readings” by default. Within this semantics, it becomes possible to account for cumulative readings of *every* and their properties, keeping to standard assumption about the denotation for *every*. I also show how the same analysis predict the scope-related asymmetries and their less studied interaction with overt movement.

**Keywords:** cumulativity, every, distributivity, plural, event semantics, exhaustivity

### 1 Section

*every* is known to give rise to cumulative reading in object position (cf. (1a)), similar to the readings that are obtained for definite plurals (Schein 1993; Kratzer 2000) (cf. (1b)).

- (1) a. The three cooks opened every oyster
- b. The three cooks opened the four oysters.

The truth-conditions of that cumulative reading are usually paraphrased<sup>1</sup> as follows (Beck & Sauerland 2000):

- (2) **Truth-conditions:**  
*Every cook opened an oyster.*  
*Every oyster was opened by a cook*

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\* This work greatly improved from critical comments and observations by Frank Staniszewski, Roger Schwarzschild, Filipe Kobayashi, Martin Hackl, Patrick Elliott, Itai Bassi, Moshe Bar-Lev. It also received valuable feedback from participants at a local MIT reading group and from the audience at SALT50. Mistakes are my own.

<sup>1</sup> This paraphrase is only valid in a distributive context where opening an oyster is a one-person job.

The cumulative reading is unexpected ; standard assumptions (Barwise & Cooper 1981; Heim & Kratzer 1998), with *every NP* as a quantifier (type  $(et)t$ ) are only able to derive doubly-distributive truth-conditions described in (3), These truth-conditions are attested but marginal.

- (3)  $\llbracket \text{every oyster } \lambda x. \text{ the cooks opened } x \rrbracket$  is true  
 iff  $\forall x \in \text{oyster}, \text{opened}(x)(\iota \text{cooks})$   
 $\approx$  *every cook opened every oyster* (doubly distributive)

In addition to this puzzle, the cumulative reading only seems available when *every* occupies the object position, as remarked by Kratzer (2000).

- (4) a. Every cook opened the four oysters. (\*cumulative,  $\checkmark$  doubly-distributive)  
 b. The four cooks opened every oyster. ( $\checkmark$  cumulative,  $\checkmark$  doubly-distributive)

Explaining how the reading is derived compositionally and accounting for these subject/object asymmetries are the main empirical challenges raised by this construction.

In this paper, I will solve both these puzzles taking a hint from what Bayer (2013) calls the *leaky* reading. Bayer (2013) observes that his own attempts<sup>2</sup> at generating the cumulative readings results in weaker truth-conditions than are attested: compared to the observed (2), his leaky truth-conditions, described in (5), do not require all the cooks to have participated in the opening endeavor.

- (5) **Bayer’s (2013) leaky truth-conditions:**  
 Every oyster was opened by a cook

The main observation of this work is that the leaky truth-conditions are in fact attested in negative environments. Furthermore, we will see suggestions from NPI licensing that the leaky truth-conditions may even be underlying in positive sentences, where they are not attested. This will be our main clue for an analysis. Because the leaky truth-conditions are attested, I will design my semantics with the goal of capturing them. We will see that within a semantics with “*leaks*”, the cumulative reading can be obtained while maintaining a completely classical denotation for *every*. The resulting framework will prove entirely adequate as far as negative sentences are concerned. For positive sentences, I will propose a mandatory strengthening mechanism derived from EXH, which effectively maps the leaky truth-conditions to the attested cumulative truth-conditions.

This system will predict the asymmetries in the availability of the cumulative readings are asymmetries in c-command (following Champollion (2010), *pace*

<sup>2</sup> The “*problem*” of leaky readings (which I argue isn’t one) also appears in one of the rejected accounts considered by Kratzer (2000).

Kratzer (2000)) and that movement, overt or covert, does not create new cumulative readings. I will show new empirical evidence supporting both of these conclusions.

## 2 The leaky readings

**In negative contexts.** From the meaning of its positive counterpart (given in (6)), one would expect the negative sentence in (7) to have the reading in (7c), obtained by simply taking the complementary set of the truth-conditions in (6b). However, speakers consistently attribute to that sentence the stronger truth-conditions in (7b). In other words, they judge a scenario where only half of the cooks contributed to open all of the oysters to falsify (7). These truth-conditions are exactly the complementary set of the truth-conditions of Bayer's leaky reading.

- (6) The cooks opened every oyster.
- a. **Attested non-leaky truth-conditions:**  
*Every cook opened an oyster.*  
*Every oyster was opened by a cook*
  - b. **Unattested leaky truth-conditions:**  
*Every oyster was opened by a cook*
- (7) The cooks didn't open every oyster<sup>3</sup>.
- a. **Attested leaky truth-conditions:** *not every oyster was opened by a cook*
  - b. **Expected non-leaky truth-conditions:** at least one of the following is true
    - $\alpha$ ) *not every oyster was opened by a cook.*
    - $\beta$ ) *not every cook opened an oyster.*

Two conclusions can be drawn from this data point. First, that the leaky truth-conditions - inadequate to capture the meaning of (6) - turn out to be the correct and only truth-conditions to assign the cumulative clause in (7), when this clause is under the scope of negation. This provides the first piece of evidence that the *leaky* reading is attested, and must be derived by the theory (in negative clauses, at least).

Second, that we have here one of the rare cases in which the semantic properties cumulative sentences with *every* and ordinary cumulative sentences come apart<sup>4</sup>. Like cumulative sentences with *every*, negated ordinary cumulative sentences also receive unexpectedly strong truth-conditions given their positive counterpart

<sup>3</sup> None of the judgments reported here change if we ensure that negation takes high scope with a construction like *I doubt that ...* or *It's not true that ...*

<sup>4</sup> Another difference can be seen with collective readings. While "*the Sumerians erected a wall around the cities*" can mean that one wall was built to encircle all cities at once, "*the Sumerians erected a wall around every city*" must describe many wall buildings.

(this is referred to as a homogeneity effect, cf Bar-Lev 2018; Kriz 2015). But the truth-conditions of ordinary negative cumulative sentences are different from the truth-conditions we obtain by negating the *leaky* truth-conditions. Adapting Bayer’s (2013) terminology, we could refer to what is negated in ordinary cumulative sentence as the *extra-leaky* truth-conditions.

- (8) a. The cooks didn’t open every oyster.  
 $\approx$  “*not every oyster was opened by a cook*”  
 b. The cooks didn’t open the oysters.  
 $\approx$  “*not [ some cooks opened some oysters ]*”  
 extra-leaky truth-conditions

**NPIs.** Next, I present some data which show the benefits of assuming that the leaky truth-conditions are present, at some level of composition, even in positive contexts. These suggestive data however do not constitute an argument that the leaky truth-conditions *have to* be present at any level.

First, notice that NPIs are licensed in the restrictor of *every*, even when *every* participates in a cumulative reading:

- (9) The three inspectors interrogated every person who had any connection to the suspect.

We can ask ourselves the following question: given the non-leaky truth-conditions assumed to be adequate in positive contexts for cumulative sentences with *every*, does the sentence form a downward entailing environment for the NPI to be licensed in? Let’s consider two predicates which stand in an entailment relation to one another (e.g. strong-connection  $\Rightarrow$  connection) and check the order of entailments at the level of the sentence, *under the assumption that the sentence has the observed non-leaky truth-conditions*.

- (10) strong connection  $\Rightarrow$  connection  
 a. The three inspectors interrogated every person that had a connection to the suspect.  
 b. The three inspectors interrogated every person that had a strong connection to the suspect.

The two propositions whose strength is to be compared are given below in (11). Because it is not possible to conclude the red part of (11b) from (11a), the sentence does not provide a downward entailing environment for the NPI to be licensed.

- (11) Non-leaky cumulative truth-conditions

a. **Non-leaky TCs of (10a)**

Every inspector interrogated someone with connection to the suspect.

Every one with some connection to the suspect was interrogated by an inspector.

b. **Non-leaky TCs of (10b)**

Every inspector interrogated someone with a strong connection to the suspect.

Every one with a strong connection to the suspect was interrogated by one of the inspectors.

c. (11a)  $\not\Rightarrow$  (11b)

Now, assume, contrary to fact, that the sentence in fact receives the *leaky* truth-conditions. Then the correct downward inference can be derived:

## (12) Leaky cumulative truth-conditions

a. **Leaky TCs of (11a)**

Every one with some connection to the suspect was interrogated by an inspector.

b. **Leaky TCs of (11b)**

Every one with a strong connection to the suspect was interrogated by one of the inspectors.

c. (12a)  $\Rightarrow$  (12b)

But the leaky truth-conditions are of course not the truth-conditions of the sentence. However, if the leaky truth-conditions were underlying, that is to say if there were some node in the structure of (9) which denoted the leaky truth-conditions (or a meaning akin to it), we would have a straightforward explanation for why the NPI is licensed in cumulative sentences. This does not show that the only way to explain the licensing of the NPI in (9) is by assuming the underlying nature of the leaky truth-conditions. However, accounting for the observation in (9) is in fact challenging to alternative approaches to cumulative readings of *every*, which do not have an underlying leaky reading<sup>5</sup>. Thus, This makes the underlying nature of the leaky truth-conditions plausible.

<sup>5</sup> In Kratzer's (2000) theory, to give just one representative example, "*open every oyster*" is a predicate true of plural events which contain an opening event for every oyster. That predicate does not stand in any entailment relation with "*open every big oyster*", since no (plural) events in the extension of the latter predicate belongs to the extension of the former predicate.

### 3 Proposal

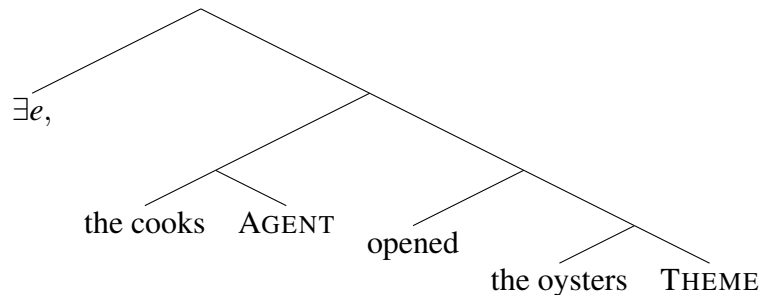
Having motivated the assumption that the *leaky* truth-conditions are the underlying reading of cumulative sentences with *every*, I will now present a semantics which generates the leaky truth-conditions *by default*. This semantics will predict overly weak meanings for positive sentences. However, it will account for the possibility of cumulative readings with *every*, assuming only the most ordinary semantics for *every*. In the last subsection, I will provide a strengthening mechanism that bridges between the leaky truth-conditions and the ordinary truth-conditions in positive sentences.

#### 3.1 Towards “leaky” readings

I will work within a fully decompositional Neo-Davidsonian semantics (Krifka 1989, 1992; Lasersohn 1998; Kratzer 2007). Based on previous literature, I assume that event form a plural domain, with  $\oplus$  as join and  $\prec$  as its order.  $\prec$  is not identified with mereological parthood<sup>6</sup>. Meta-language predicates such as “*be the agent of*”, “*be an event of opening*” are assumed to be cumulative.

To each thematic relation in the meta-language, there corresponds a covert object language operator (e.g. AGENT for “*be the agent of*”). These operators allow us to semantically combine the verb with its syntactic arguments. An event closure operator is assumed to stand at the top of the clause. These assumptions amount to the following LF for ordinary cumulative sentence:

(13)



The heart of my account is the semantics of the thematic role heads and the verb. In traditional Neo-Davidsonian semantics (Krifka 1989; Landman 2012), given in (14a), AGENT asserts that its argument  $x$  is the agent of the event argument  $e$  (cf (14a)). Instead, I propose to amend the semantics of thematic role-head to include an event extension:  $x$  is now asserted to be the agent of  $p$ -subevent of  $e$  (denotation in

<sup>6</sup> In other words, I do not take an event of chewing to be part of an event of eating (in the sense of  $\prec$ ). But I take an event of eating  $e_1$  to be part of a plurality composed of one eating and one chewing  $e_1 \oplus c$

	Traditional	This work
[[AGENT]]	$e$ <div style="border: 1px solid black; border-radius: 10px; padding: 5px; display: inline-block;">           agents = the cooks  <math>p(e)</math> </div>	$e$ <div style="border: 1px solid black; border-radius: 10px; padding: 5px; display: inline-block;"> <math>e'</math> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; display: inline-block;">           agents(<math>e'</math>) = <math>x</math>  <math>p(e')</math> </div> </div>
[[eat]]	$e$ <div style="border: 1px solid black; border-radius: 10px; padding: 5px; display: inline-block;"> <math>e</math> are openings         </div>	$e$ <div style="border: 1px solid black; border-radius: 10px; padding: 5px; display: inline-block;"> <math>e'</math> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; display: inline-block;"> <math>e'</math> are openings         </div> </div>

**Figure 1** Comparison between the standard denotation and the denotations with leaks with Venn diagrams.

(14b)). The same use of event extensions in the denotation of *every* is what gave rise to leaky readings in Bayer 2013. The same modification is proposed for all thematic role heads.

(14) a. **Traditional denotation:**

$$[[\text{AGENT}]](x_e)(p_{vt}) = \lambda e_v. p(e') \wedge x \text{ is the agent of } e'$$

b. **This work:**

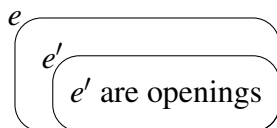
$$[[\text{AGENT}]](x_e)(p_{vt}) = \lambda e_v. \exists e' \prec e, p(e') \wedge x \text{ is the agent of } e'$$

Similarly, while traditional Neo-Davidsonian semantics takes the verb *eat* to denote a predicate true of events of eating, I assume that the verb denotes a predicate true of events *which contains events of eating*.

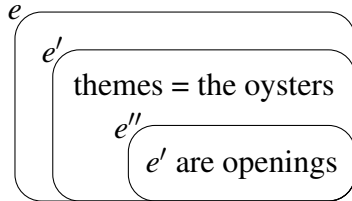
Schematically, we can represent these denotations by the Venn diagrams in fig. 1. Each box represents an event. Properties of the event are indicated inside the box, immediately below its top edge. Because these box diagrams are easier to grasp, I will frequently use them, in addition to  $\lambda$ -expressions.

**Ordinary cumulative sentences.** With these assumptions in place, we are ready to compose the LF in (13). The derivation is given below with both  $\lambda$ -expressions and box representations.

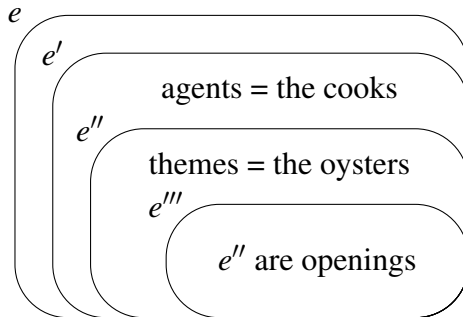
(15) a.  $[[\text{open}]] = \lambda e. \exists e' \prec e, e$  are events of opening



- b.  $\llbracket \text{open} [\text{the 4 oysters THEME}] \rrbracket$   
 $= \lambda e. \exists e' \prec e, \iota \text{oysters are the themes of } e' \wedge \exists e'' \prec e', e'' \text{ is an opening}$



- c.  $\llbracket [\text{the 3 cooks AGENT}] \text{open} [\text{the 4 oysters THEME}] \rrbracket$   
 $= \lambda e. \exists e' \prec e, \iota \text{cooks are the agents of } e' \wedge \exists e'' \prec e' \iota \text{oysters are the themes of } e'' \wedge \exists e''' \prec e'', e''' \text{ is an opening}$



We can see the effect of introducing event extensions in the denotations: when combining, each thematic role brings along another extension to the event argument. The final predicate of events is true of events with the structure in (16d): events which contain events done by the cooks, which contain events done to the oysters, which contain openings.

In terms of truth-conditions, this means that the sentence will be true just in case the world of evaluation contains an event of that sort. To sort out what this means concretely, let’s observe some implications of the sentence. Because it is asserted that some openings are part of events done by the cooks and events done to the oysters, this must mean that sentence can only be true if some cooks opened some oysters. The sentence also implies that all the cooks did something, but apart from opening of some of the oysters, it is not specified what they did exactly. Given that one is always *doing something*, the implication that all the cooks did something is so weak that one may consider it tautologous. Similarly, there is an implication that something was done to all the oysters by at least some of the cooks. More controversially, I propose that this is also a tautologous implication. Namely, I make the following ontological assumption about events:

- (16) **Event richness:** for any thematic roles  $\theta_1, \dots, \theta_n$ , and any entities  $x_1, \dots, x_n$ , there is an event where the  $x_i$ ’s bear the thematic role  $\theta_i$



This assumption can be paraphrased as saying that for any set of entities, there is always some events in which these entities are related. In other words, if a sentence implies that an event relates some entities without specifying what type of event this event is, this implication is tautologous.

With this assumption, the sentence becomes equivalent to the first implication we discussed, namely that some cooks opened some oysters. These truth-conditions are so drastically different from what we observe (see (17)) that one wonders why we put so much effort in deriving them.

(17) **Observed truth-conditions:**

*Every cook opened some oysters*

*Every oyster was opened by some of the cooks*

(18) **Predicted truth-conditions:** *some cooks opened some oysters*

However, observe that these truth-conditions are in fact entirely adequate, as far as negative sentences are concerned. They are what I referred to earlier as the “*extra-leaky*” truth-conditions.

(19) a. The cooks didn’t open the oysters.

b. **Predicted truth-conditions::**

*no cook opened any oysters.*

≈ negation of the “*extra-leaky*” truth-conditions

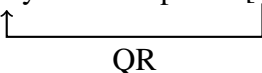
In the next section, we will see another reason to adopt this seemingly inadequate semantics: it gives us a simple handle on cumulative readings of *every*.

### 3.2 Cumulative readings of *every*

The sentence to be accounted for is (20):

(20) The cooks opened every oyster.

Assuming the standard denotation of *every* in (22a), let us try to have an LF where *every* scopes above the VP, as in (21). Because the VP is a node of type *vt*, the standard rules for interpreting QR (Heim & Kratzer 1998) will result in type mismatch. However, since *vt* is a *t*-ending type, we can shift “*every oyster*” so that it may combine with the VP nevertheless<sup>7</sup>, as (21b) shows.

(21) [The cooks AGENT ] every oyster  $\lambda x$ . opened [x THEME ]  


QR

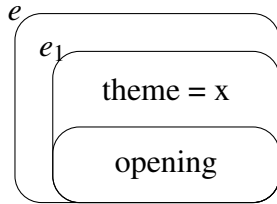
<sup>7</sup> We could also resolve the type mismatch by vacuous operator movements, or by shifting the predicate that *every* combines with. I don’t see any empirical or aesthetic reasons to choose between these options.

Cumulative readings of “every” with leaks

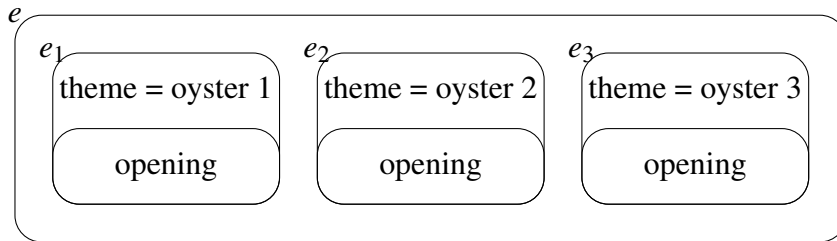
- (22) a.  $\llbracket \text{every NP} \rrbracket = \lambda p_{et}. \forall x, x \in \llbracket \text{NP} \rrbracket \rightarrow p(x)$   
 b.  $\llbracket \uparrow \text{every NP} \rrbracket = \lambda p_{eat}. \lambda y_a. \forall x, x \in \llbracket \text{NP} \rrbracket \rightarrow p(y)(e)$  (for any type  $a$ )

With this shift, the whole sentence can now compose without type clashes:

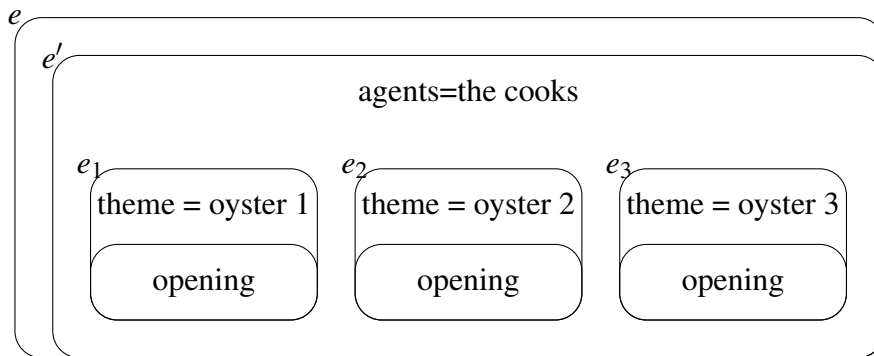
- (23) a.  $\llbracket \text{VP} \rrbracket = \lambda e. \exists e' \prec e, \text{THEME}(e') = x \wedge \exists e'' \prec e', \text{opened}(e'')$



- b.  $\llbracket \text{every oyster } \lambda x. \text{VP} \rrbracket = \lambda e. \forall x \in \text{oyster}, \exists e' \prec e, \text{THEME}(e') = x \wedge \exists e'' \prec e', \text{opened}(e'')$



- c.  $\llbracket (21) \rrbracket = \lambda e. \exists e' \prec e, \text{AGENT}(e') = \iota \text{cooks} \wedge \forall x \in \text{oyster}, \exists e'' \prec e', \text{THEME}(e'') = x \wedge \exists e''' \prec e'', \text{opened}(e''')$



**d. Predicted truth-conditions:**

*Every oyster was opened by a cook.*

The resulting truth-conditions imply that for every oyster, there be at least one event of opening that oysters done by some of the cooks. Assuming *Event Richness*, this entailment is in fact an equivalence. In other words, the sentence is true whenever every oysters was opened by some of the cooks.

This result is satisfying for our system in two ways. First, these truth-conditions are exactly the *leaky* truth-conditions. As a result, we correctly predict the meaning of negated cumulative sentences with *every*, cf (24a). Second, these “*leaky*” truth-conditions are correctly predicted to differ from the *extra-leaky* truth-conditions observed in negative ordinary cumulative sentences. As a corollary, the system accounts for the observed difference between the two types of sentences under negation (cf (24)).

- (24) a. The cooks didn’t open every oyster.  
 $\rightsquigarrow$  *not [every oyster was opened by a cook]*
- b. The cooks didn’t open the oysters.  
 $\rightsquigarrow$  *not [some cooks opened some oysters]*

Note that the account of this section only introduces one new assumption: the type-shifter. In other words, the core of this account is the semantics with *leaks* of thematic roles, rather the relatively innocuous assumptions it makes about *every*.

### 3.3 EXH

However, this account remains in need of an explanation for positive sentences. Some strengthening must occur in positive sentences, which turns the leaky truth-conditions into the attested truth-conditions. To develop an intuition about what this operation will look like, let us compare the denotation of a verb in the present framework to one ordinarily assumed in Neo-Davidsonian fragment:

- (25) a. **“Leaky” denotation:**  
 $\llbracket \text{opened} \rrbracket = \lambda e. \exists e' \prec e, e' \text{ are events of opening}$
- b. **Traditional Neo-Davidsonian denotation:**  
 $\llbracket \text{opened} \rrbracket = \lambda e. e \text{ are events of opening}$

Informally, the denotation in (25a) can be paraphrased as “*e contains some openings*” and the denotation in (25b) can be paraphrased as “*e only contains openings*”. To put it differently, the denotation of (25b) derives from an exhaustive interpretation of (25a) in the context of the question “*What does the event e contain?*”.

Formally, we may want to model this exhaustive interpretation of (25a), in terms of an exhaustivity operator EXH (Fox 2007), which is designed for that purpose. This operator would strengthen (25a) against the set of alternatives formed by the question “*what does the event e contain?*”.

- (26) EXH ( $\lambda e. \exists e' \prec e, e' \text{ are events of opening, alts}$ )  
 where  $\text{alts} = \{\lambda e. e' \prec e \mid e'\}$

There is an additional reason to use EXH. EXH is argued to be inactive under negation and negation is precisely the environment where we need to see the un-strengthened meanings, i.e. the leaky truth-conditions, appear. There is a problem though: given the meaning of EXH given in Fox 2007, its application in (26) is vacuous. In fact, EXH only gives the “*intuitive*” results, i.e. the result suggested by the meta-language paraphrase, in cases of the form in (27) (which our current cases belong to) when the restrictor set of the indefinite has a constant extension across world and its scope’s extension doesn’t.

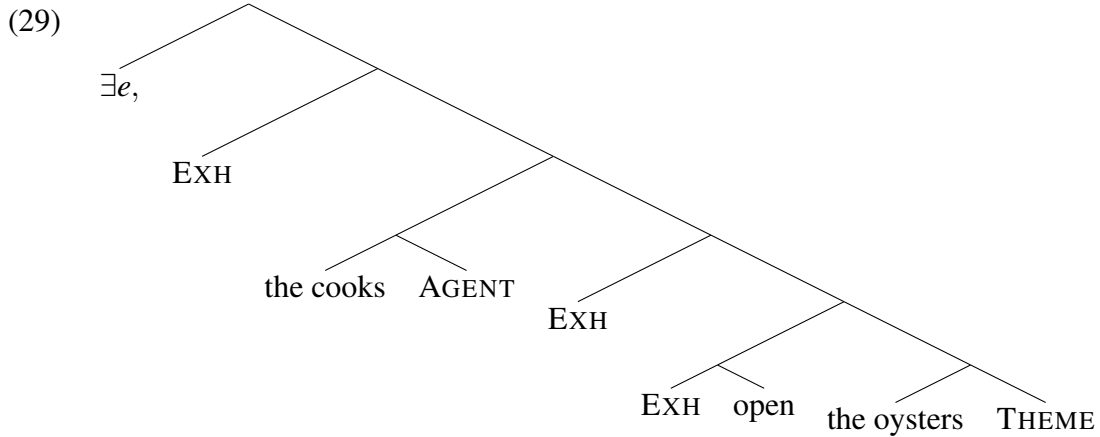
- (27) a. EXH ( $\exists x \in A, B(x), \{B(y) \mid y \in D_e\}$ )  
 b. *\_ Who ate sushi? \_ Some UNO diplomats*  
 read as: *only some UNO diplomats ate sushi.*

For reasons of space, I refer the interested reader to this [online complement](#) to the present work, detailing the exact problem and some avenues for resolution. It is important to note that because this problem affects sentences unrelated to our work (cf (27b)), it is not a flaw in our account but in theories of exhaustification.

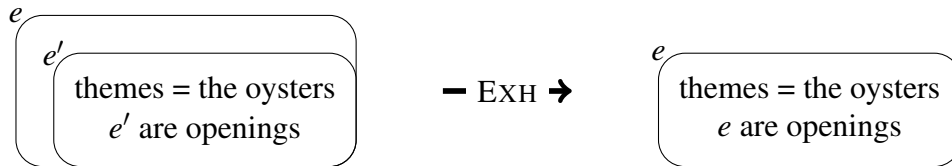
Given the orthogonality of this issue, I will run computation using the stipulative computation principle in (28), which matches the intuitions from the meta-language paraphrases. In future research, I hope that this principle can be grounded in theories of exhaustification.

- (28) For any event predicate  $p$ ,  
 $\text{EXH}(p, \{\lambda e. e' \prec e \mid e'\}) = * \text{MIN}(p)$   
 where  $\text{MIN}(p) = \lambda e. p(e) \wedge \neg \exists e' \prec e, p(e')$  and  $*$  is ?’s star, as defined in e.g. Link 1987

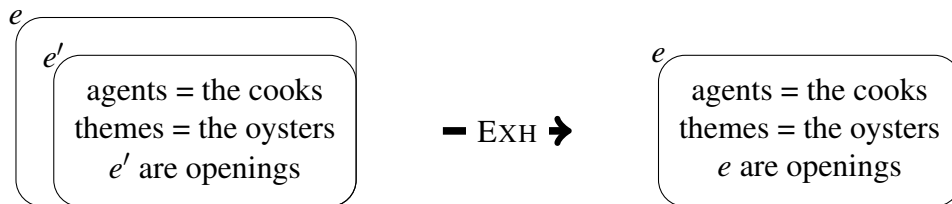
**Applying the strengthening recipe.** EXH can be seen as providing a bridge between the denotations with leaks that I assume and the traditional denotation provided in Neo-Davidsonian semantics. To recover strong truth-conditions in positive sentences then, we can associate to every thematic role head and verb in the clause a corresponding EXH which counter-acts the effect of the leak. The EXH are assumed to sit at  $vt$  type nodes, as per the set of alternatives posited. The computation is run below with box diagrams to facilitate legibility.



- (30) a.  $\llbracket \text{EXH opened} \rrbracket$   
 $= \lambda e. e$  are events of opening  
 $\llbracket \text{EXH [THEME the oysters] EXH opened} \rrbracket$   
 $= \text{EXH} (\lambda e. \exists e' \prec e, e'$  are events of opening  $\wedge \text{THEME}(e') = \iota\text{oysters})$   
 $= \lambda e. e$  are events of opening  $\wedge \text{THEME}(e) = \iota\text{oysters}$   
 $(\approx \lambda e. e$  **only** contains an opening of the oysters)



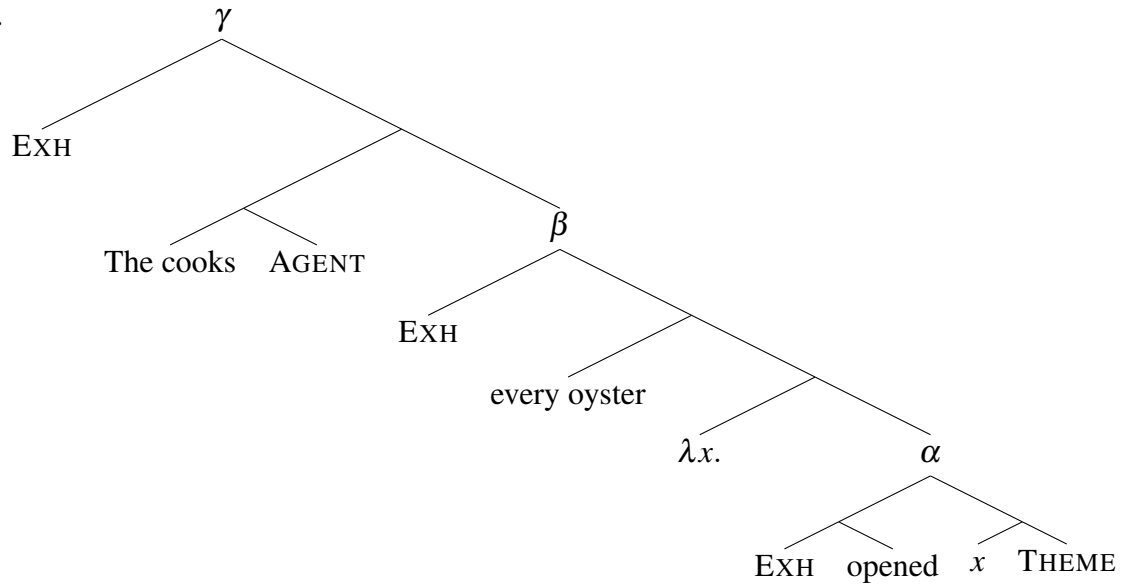
- b.  $\llbracket \text{EXH [AGENT the cooks] EXH [THEME the oysters] EXH opened} \rrbracket$   
 $= \text{EXH} (\lambda e. \exists e' \prec e, e'$  are events of opening  $\wedge \text{THEME}(e') = \iota\text{oysters} \wedge \text{AGENT}(e) = \iota\text{cooks})$   
 $= \lambda e. e$  are events of opening  $\wedge \text{THEME}(e) = \iota\text{oysters} \wedge \text{AGENT}(e) = \iota\text{cooks}$   
 $(\approx \lambda e. e$  **only** contains an opening of the oysters by the cooks)



The resulting meaning is the same as in standard Neo-Davidsonian semantics and is just as adequate for positive ordinary cumulative sentences. More importantly, the same procedure also derives the correct strong meaning for cumulative sentences with *every*:

Cumulative readings of “every” with leaks

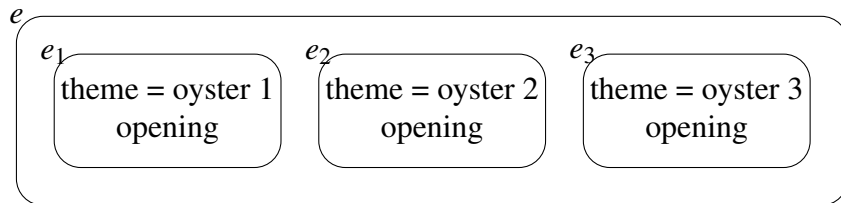
(31) a.



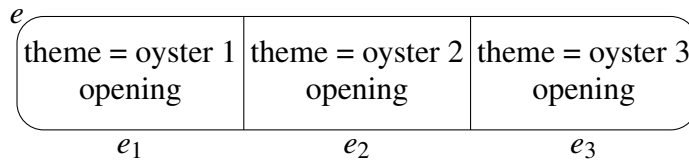
b.  $\llbracket \text{EXH every oyster } \lambda x. \text{ EXH [opened] [THEME } x] \rrbracket$

$= \lambda e. \forall x \in \text{oyster}, \exists e' \prec e, e' \text{ are openings } \wedge x \text{ is the theme of } e'$

$\forall e', (\neg \exists x \in \text{oyster}, e' \text{ is an atomic opening } \wedge x \text{ is the theme of } e') \rightarrow e' \not\prec e$



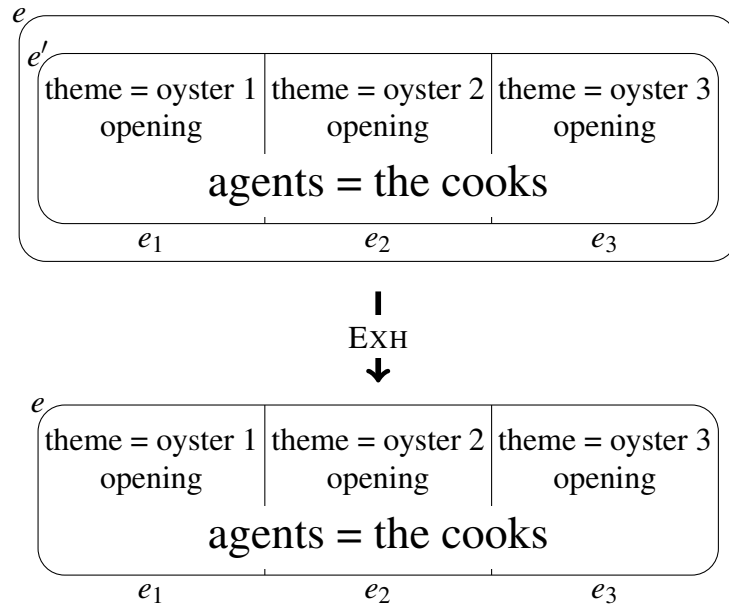
↓  
EXH  
↓



c.  $\llbracket \text{EXH [AGENT the cooks] EXH every oyster } \lambda x. \text{ EXH [opened] [THEME } x] \rrbracket$

$= \lambda e. \text{AGENT}(e) = \iota \text{cooks} \wedge \forall x \in \text{oyster}, \exists e' \prec e, e' \text{ are openings } \wedge x \text{ is the theme of } e'$

$\forall e', (\neg \exists x \in \text{oyster}, e' \text{ are openings } \wedge x \text{ is the theme of } e) \rightarrow e' \not\prec e$



As one can see from the box diagrams, this meaning now correctly implies that all the cooks contributed to the opening of the oysters. It is the attested non-leaky reading.

#### 4 c-command requirement and the effect of A/A' movement

This section explores how the current system deals with cumulative asymmetries mentioned in the introduction.

##### 4.1 The generalization about cumulative asymmetries

Recall that the cumulative reading is not available if *every* occupies the subject position:

- (32) a. Every cook opened the four oysters.  
b. The cooks opened every oyster.

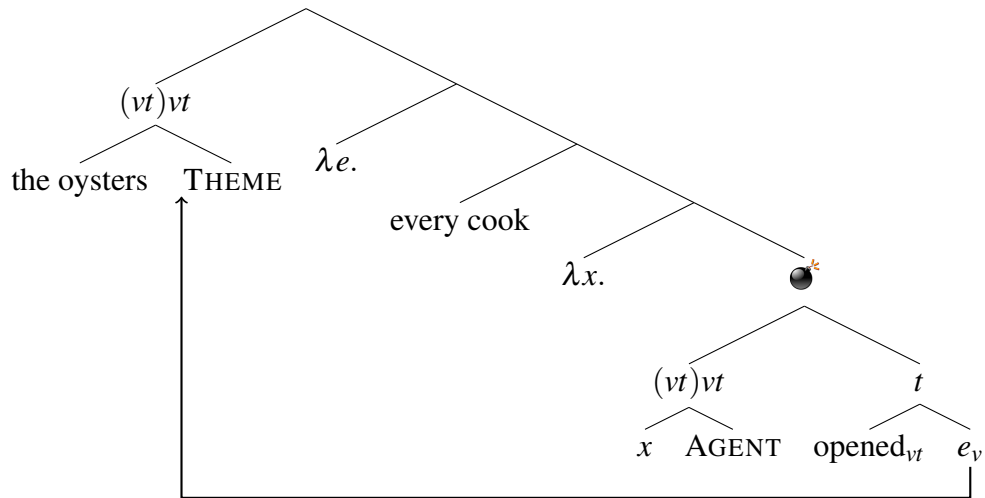
The system seems to correctly derive this:

- (33) a. EXH every cook  $\lambda x$ . [AGENT  $x$ ] EXH opened [THEME the oysters]  
b.  $\llbracket$ EXH opened [THEME the oysters] $\rrbracket = \lambda e$ . opened( $e$ )  $\wedge$  THEME( $e$ ) =  $\iota$  oysters  
c.  $\llbracket$ (33a) $\rrbracket = \lambda e$ .  $\forall x \in \text{cook}$ ,  $\exists e' \prec e$ , opened( $e$ )  $\wedge$  THEME( $e$ ) =  $\iota$  oysters  $\wedge$  AGENT( $e$ ) =  $x$

The event denotation of (33b) is non-empty iff every cook opened every oyster. This is the attested doubly-distributive reading of (32a). This result seems to be achieved because the plural falls within the scope of *every*

**Can scope create the missing reading?** If scope is the obstacle to cumulative readings, maybe scoping the plural argument would result in creating the missing cumulative readings. Scoping the plural argument (type  $e$ ) on its own will be semantically vacuous. The only way to make (32a) and (32b) truly parallel to one another and thus hope to derive the cumulative reading for (32a) would be to scope the plural argument along with its thematic role. However, trying to create this structure via QR results in type mismatches as (34) illustrates

(34)



The conclusion of this discussion is that under the current system, the cumulative reading is categorically unreachable when *every* c-commands the plural argument’s thematic role head. While this conclusion is drawn for covert scoping operations, it extends to any scoping operation, including overt ones. In the sequel, I verify this prediction on three test cases: English *wh*-movement, Russian scrambling and English passives

## 4.2 Verifying predictions

**wh-movement.** Sauerland (2001) shows that new ordinary cumulative readings can be created by *wh*-movement. However, an object *wh* moved above a subject *every* does not get a cumulative reading as the contrast between (35a) and (35b)

- (35) a. Which 25 oysters did every cook open?  
 ⇝ incompatible with 1 oyster per cook



- b. Which 25 oysters did the cooks open?  
 ~→ compatible with 1 oyster per cook

**Russian scrambling.** Russian scrambling has scopal effects (Ionin 2001; Stoops & Ionin 2013; Antonyuk 2006)<sup>8</sup> and thus can be semantically contentful.

I find that the distributive quantifier *kazhdyj* is like English as far as non-scrambled sentences are concerned, cf (36): it can have cumulative readings but only when *kazhdyj* is in object position<sup>9</sup>. Scrambling a plural object above subject *kazhdyj* does not create the missing cumulative reading, as expected under my account (cf (37a)).

- (36) **Baselines:** in non-scrambled sentences, English and Russian pattern the same wrt availability of cumulative readings with distributive quantifier
- a. **Background knowledge:** *opening an oyster is a one-person-job. An opened oyster may not be closed again*
- b. Kazhdyj povar                      otrkyl      ustricy  
 every    cook.NOM.M.SG open.**Perf** oyster.PL.ACC  
 “Every cook opened the oysters” (#background)
- c. Povara                      otrkyli      kazhduju ustricu  
 cook.NOM.PL open.**Perf** every    oyster.SG.F.ACC  
 “The cooks opened every oyster” (✓ background)
- (37) **Scrambled sentences**<sup>10,11</sup>: no new reading is generated by scrambling the arguments.
- a. Ustricy                      kazhdyj povar                      otrkyl  
 oyster.PL.ACC every    cook.NOM.M.SG open.**Perf**  
 “Every cook opened the oysters” (#background)
- b. Kazhduju ustricu                      povara                      otrkyli  
 every    oyster.SG.F.ACC cook.NOM.PL open.**Perf**  
 “The cooks opened every oyster” (✓ background)

<sup>8</sup> Judgments in the cited literature vary as to whether Russian scrambling necessarily gives rise to scopal effects (i.e. whether scrambled sentences are scopally ambiguous).

<sup>9</sup> It is somewhat surprising that the plural bare noun cannot receive an indefinite interpretation (e.g. *some oysters*) in those examples, in which case infelicity would not ensue. This is presumably due to the use of perfective (Krifka 1992). Judgments collected on one speaker seem to be the same, when I force definite interpretation with a demonstrative.

<sup>10</sup> One speaker preferred OVS word order for scrambled sentences. The judgments they gave were the same as the judgment of the two other speakers on the corresponding OSV sentences.

<sup>11</sup> Scrambling has information structure effects which the translation of these examples does not reflect.

**English passives.** English passives is another case where a plural object can be moved above subject *every*. There are conflicting reports in the literature as to whether this movement can give rise to a cumulative reading. Conforming to my predictions, [Kratzer \(2000\)](#) reports that this is not possible (cf (38a)), which matches what I found in my own elicitations. [Bayer \(2013\)](#), on the other hand, discusses the intriguing example in (38c), which seem to counter-exemplify my generalization

(38) 
$$\begin{array}{ccccccc} & S_{\text{every}} & V & O_{\text{plural}} & (\# \text{cumulative}) & & \\ O_{\text{plural}} & \text{by } S_{\text{every}} & V & t & (? \text{cumulative}) & & \\ & \uparrow & & \downarrow & & & \end{array}$$

(39) *every* bears AGENT role

- a. Three mistakes were caught by every copy-editor. (# cumulative, [Kratzer 2000](#))
- b. The ten oysters were opened by every cook. (#, collected K.C.)
- c. *Gone with the Wind* was written by every screenwriter in Hollywood (✓, [Bayer 2013](#))

However, as [Bayer \(2013\)](#) himself notes, (39) is of a different kind than the cumulative readings investigated so far: it involves a mereologically complex object, rather than a linguistic plurality. Perhaps, this feature explains the difference in judgments. Independently, my account makes no prediction regarding this type of cumulativity.

## Conclusion

This work argues for the utility of counting leaky readings as an integral part of the semantics of cumulativity. Building a semantics with *leaks* achieves not only greater empirical adequacy in negative sentences, both ordinary and with *every*, but also allows us to maintain a relatively minimal and standard semantics for *every* in cumulative sentences that include it.

This is an initial step. The semantics with “*leaks*” that I presented here can be seen as an account of homogeneity in cumulative sentences. As such, its empirical domain overlaps with studies of homogeneity phenomena in plural semantics ([Bar-Lev 2018](#); [Kriz 2015](#)). Future research will determine how much the semantics with “*leaks*” can extend to phenomena discussed in this line of work or, from a different angle, whether the semantic frameworks designed in these works can provide an account of cumulative sentences with *every*, parallel to the one proposed here.

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Cumulative readings of “every” with leaks

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