Cumulative readings of *each*

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While cumulative readings of *every* have garnered some attention in the literature (Schein 1993, Kratzer 2000, Champollion 2009, 2010), cumulative readings of *each* have not been discussed much, if any. In fact, *each* is often assumed to only have distributive readings. We present experimental results showing that *each* in fact does have cumulative readings, although their availability is constrained. We argue that the constraints on cumulative readings of *each* can be made sense of under Tunstall's (1998) DIFFERENTIATION CONDITION, an independent constraint on the use of *each*.

Differentiation Condition: *Each* is known to prefer wide distributive scope. For instance, (1a) with *each* prefers the inverse scope reading, unlike (1b) with *every*, which readily allows the surface scope reading. Tunstall (1998) proposes that this scope preference is due to the Differentiation Condition, which we restate as (2).

(1) a. A helper dyed each shirt. b. A helper dyed every shirt.

(2) **Differentiation Condition (DC)**: A sentence containing *each NP* can only be true of event structures where each individual in the restrictor of *each NP* is associated with a subevent that can be differentiated from the other subevents in some way. The preferred way to differentiate the subevents is to have a one-to-one correspondence with the bearers of a thematic-role distinct from that of *each NP*.

As a consequence, the surface scope reading of (1a) is dispreferred; under this reading all the subevents involve the same agent. Under the inverse scope reading, the subevents can have different agents, and the DC can be satisfied. Thus, the inverse scope is preferred. *Every* is not subject to the DC. A nice thing about Tunstall's account is that it explains the fact that the preference for wide scope disappears in sentences like (3): Unlike in (1), the subevents of (3) can be differentiated by the resultative states (see Brasoveanu & Dotlačil 2015 for experimental support).

(3) A helper dyed each shirt blue.

Assuming that the DC is an independent constraint on the use of *each*, we claim that *each* does have cumulative readings, but they are only observed if the DC can be satisfied. We present results from two experiments in support of this claim.

Experiment 1: Given the DC, a cumulative reading with *each* with a different QP should be possible, only when *each* takes distributive scope over yet another clause-mate QP. To see this concretely, consider (4) under the reading where *each sheep* takes distributive scope over *one customer*. Under this reading, the DC can be satisfied, if each sheep is associated with a subevent with a different customer. If *each* has a cumulative reading at all, it should surface here, i.e. each famer sold at least one sheep, and each sheep was sold by at least one farmer.

(4) Two farmers sold each sheep to one customer. (5) Two farmers sold each sheep.

Contrast (4) with (5) without an additional QP. Here, the only way to satisfy the DC is to have an inverse distributive scope, so that each sheep is associated with two farmers. Then, the cumulative reading should be absent.

Experiment 1 looked at the acceptability ratings of these two types of sentences under the cumulative reading between the subject and object QPs. The ratings are given on a 4-point scale. We included versions of the sentences with *every* and a (bare) numeral. Numerals are known to have cumulative readings; thus providing a baseline. *Every* is known to sometimes give rise to cumulative readings, but is expected to be oblivious to the DC.

Each target sentence contained one of three determiners (EACH, EVERY, NUM(ERAL)) and a verb with one of two valencies (TRANSITIVE, DITRANSITIVE), and was paired with a picture describing a situation where only the cumulative reading is true. E.g. for (4), the picture contained a farmer who sold two sheep to different customers and another farmer who sold three sheep to different customers,

as illustrated in (7), while for (5) a picture without the customers was presented, as illustrated in (8). There were 6 sentence-picture pairs, and each subject saw only one version of each, and each condition only once. They were presented with 12 fillers.

Figure 1 summarizes the results from 78 native speakers of US English recruited on Amazon Mechanical Turk. They indicate that in the Transitive condition, (5), cumulative readings are less accessible with *every* than with numerals, and even less with *each*. In contrast, in the Ditransitive condition, (4), cumulative readings with *each* become more acceptable, in fact as acceptable as with numerals, while *every* and numerals are not affected

Figure 1

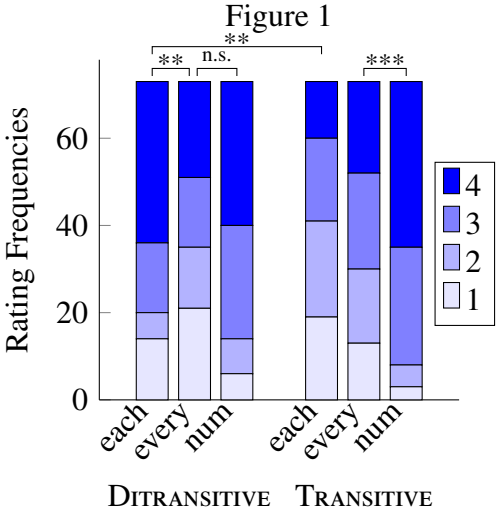
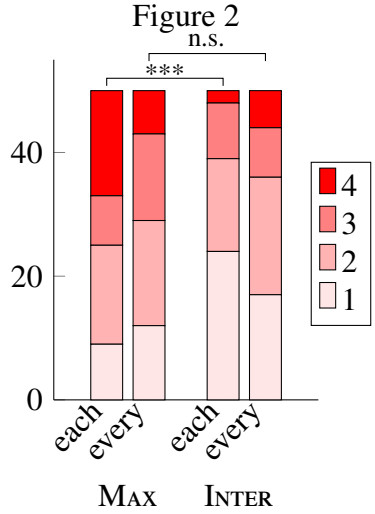


Figure 2



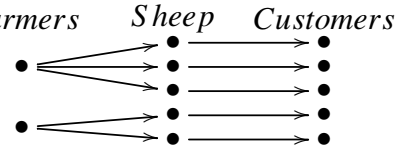
by this manipulation. The interaction effect is statistically significant ($p<0.0001$). This supports our claim that *each* does have cumulative readings, but their distribution is constrained by the DC.

Experiment 2: A prediction of the present analysis is that cumulative readings of transitive sentences with *each* should improve in situations where each subevent of selling a sheep has a different agent. We tested this prediction with another set of 60 native speakers of US English on Mechanical Turk. The task was as in Experiment 1, with a 2×2 design crossing quantifier choice (*each* vs *every*) and situation type (Max(imal) vs Inter(mediate)). In the Max condition, pictures depicted a situation where the agents (e.g. farmers) and the individuals in the restrictor of the object QP (e.g. sheep) were in one-to-one correspondence, as illustrated in (9). In the Inter condition, this mapping was one-to-many. The verb was always transitive as in (6). The results summarized in Figure 2 confirm our prediction that cumulative readings of *each* are more readily available in the Max condition and that cumulative readings for *every* are not affected by the manipulation.

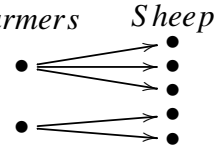
(6) Five farmers sold each sheep.

Theoretical implications: Schein (1998) and Kratzer (2000) derive cumulative readings from two assumptions: (i) that (agent) arguments are syntactically separated from verbs in a Neo-Davidsonian event semantics and (ii) that the propositional scope of all distributive quantifiers is prefixed by an existential quantifier over subevents. Since (i) is independent of quantifier choice and (ii) applies to both *each* and *every*, Kratzer and Schein predict that, everything else being equal, cumulative readings with *each* should be attested, although they do not discuss them. Our results show that this prediction is borne out and therefore support these analyses. They also show that these analyses would over-generate cumulative interpretations without the adoption of a principle that constrains the scope-taking options of *each*, like the DC. Finally, both Tunstall in her study of distributivity and Schein and Kratzer in their studies of cumulativity reached the conclusion that a proper analysis of quantification in English requires the adoption of a (Neo)-Davidsonian event semantics. Our results show that the argument from distributivity and the argument from cumulativity are not independent but instead strengthen each other.

(7)



(8)



(9)