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Linguistic and non-linguistic cues to acquiring the strong distributivity of *each*

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Abstract. The universal quantifier *each* is more strongly distributive than its counterparts *every* and *all*. It forces predicates to apply to individuals, it more often supports pair-list readings, it's unfriendly to genericity, and, in psycholinguistic tasks, it encourages encoding and remembering individual properties. But what information leads learners to acquire this aspect of *each*'s meaning? We explore the hypothesis that, because of its meaning, parents are more likely to use *each* in situations that independently promote representing the domain of quantification as a series of individuals (as opposed to a group). In line with this, we find that in child-directed speech, parents often use *each* to quantify over small numbers of physically present things. The same cannot be said of *every* and *all*. Because such situations are independently known to trigger object-files – the mind's system for representing individuals – we argue that these cases are ideal for acquiring the individualistic aspect of *each*.

Keywords. language acquisition; corpus investigation; quantification; psychosemantics; distributivity; universal quantifiers

1. Introduction. Acquiring the meaning of *each* is notoriously protracted. Even 5- and 6-year-olds seem insensitive to some of the subtleties of its meaning (see Syrett 2019 for a helpful review). Perhaps this is in part explained by the fact that in acquiring the meaning of *each*, learners need to figure out at least three things. First, they need to hone in on its semantic category: that it's a quantity term and not, for example, a name for a property. Some work suggests that learners can use syntactic bootstrapping to this end (Syrett et al. 2012; Wellwood et al. 2016). In particular, noticing that *each* is a determiner (based on its syntactic distribution) and not, say, an adjective gives children reason for thinking its meaning is about quantity.

Second, learners need to figure out its quantificational content. That is, they need to figure out that *each* is a universal quantifier (like *every* or *all*) and not an existential quantifier (like *some*) or a proportional quantifier (like *most*). There is a good deal of work suggesting that certain details of pragmatic context can help learners solve this so-called "subset problem" (e.g., Piantadosi et al. 2008; Rasin & Aravind 2021).

But even assuming learners have a way to sort out these first two issues, there's another aspect of *each*'s meaning to consider: how exactly to represent that quantificational content. While *each* has universal content – like *every* and *all* – there are numerous reasons for thinking that *each* expresses that universality, in some sense, in a more strongly distributive way (see Section 2). This paper is concerned with how learners figure out that aspect of *each*'s meaning. What in their input could lead them to make a distinction between, for example, *each* and the less distributive *every*?

Put another way, a child hearing "each" and "every" needs to pair those pronunciations with meanings. If we suppose learners have (perhaps innately) one concept of universal quan-

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tification that's strongly distributive/individualistic and another concept of universal quantification that's less individualistic, this amounts to a mapping problem. How do learners figure out that they should pair the pronunciation "each" with the strongly distributive concept and not the other universal concept?

Here, we build off the proposal that the meaning of *each* – unlike that of *every* or *all* – serves as an instruction to the cognitive system for representing independent individuals (Knowlton et al. 2021b; Knowlton 2021). This idea is elaborated on in Section 2.1. In line with this psychosemantic proposal, we introduce and pursue the hypothesis that there are simple cues to representing the things quantified over by *each* as independent individuals in natural parent-child interactions (Section 3). In the corpus study reported in Section 4, we provide initial support for the plausibility of this acquisition proposal. Namely, we find that parents often use *each* when the domain of quantification consists of small numbers of physically present objects. The same cannot be said of *every* and *all*. This suggests that parents often use *each* in situational contexts that are independently known to promote representation of individuals in adults and children (e.g., Wood & Spelke 2005), which we argue are ideal situations for mapping *each* to the strongly distributive universal concept.

That said, the acquisition question raised above persists whether or not the proposal about the meaning of *each* that we adopt is right. Learners need to acquire knowledge of how *each* differs from the other universals, however this difference is represented. We think the acquisition proposal on offer meshes well with the psychosemantic proposal that links *each* and *every* to different cognitive systems. But in Section 5, we return to the issue of whether and how our acquisition proposal could be brought into alignment with other views on the difference between *each* and *every* (in particular, those of Beghelli & Stowell 1997 and Tunstall 1998).

2. *Each* is more distributive than *every/all*. Both *each* and *every* are often talked about as being "distributive universals" (e.g., Vendler 1962; Gil 1995; Beghelli & Stowell 1997; Tunstall 1998; Winter 2002; Champollion 2020). Generally, this refers to the observation that both quantifiers are somewhat resistant to combination with collective predicates like *gathered in the hall* or *surrounded the teacher*, as in (1).

(1) a. ?Each student {gathered in the hall/surrounded the teacher}.
    b. ?Every student {gathered in the hall/surrounded the teacher}.

But at least since Vendler (1962), it has been noted that *each* is, in some sense, even more individualistic. For example, many of the authors cited above note that (1-b) is at least slightly better than (1-a). And as Landman (2003) notes, *every* but not *each* can combine with verbs like *combine* in (2). Likewise, *every NP* can be used to refer to a whole group, whereas *each NP* cannot, as in (3).

(2) a. #In this class I try to combine each theory of plurality.
    b. In this class I try to combine every theory of plurality.

(3) a. #The press is each person who writes about the news.
    b. The press is every person who writes about the news.

Another sense in which *each* highlights individuals to a greater extent than *every* is that the former supports pair-list readings even in contexts where the latter doesn't (Beghelli 1997; Surányi 2003; Szabolcsi 2010). To take one example, the question in (4-a) can be answered with the pair-list (one-by-one) response in (4-b). But the same response is seemingly not available for the *every*-variant in (5). A response more like (5-c) is preferred.

(4) a. Which book did you loan to each student?
    b. *Frankenstein* to Fred, *Persuasion* to Paula, and *Dune* to Dani.

(5) a. Which book did you loan to every student?
    b. #*Frankenstein* to Fred, *Persuasion* to Paula, and *Dune* to Dani.
    c. There's no one book that I loaned to every student.

Pair-list readings also arise more easily with *each* in cases like (6).

(6) a. Determine whether each number in this list is even: 2, 4, 5.
    $\approx$ *for each number, determine whether it is even*
    b. Determine whether every number in this list is even: 2, 4, 5.
    $\approx$ *determine whether the following is true: every number in this list is even*

Yet another way to see the strong distributivity of *each* is to consider its unfriendliness to generic interpretations. Beghelli & Stowell (1997) discuss examples like (7), which they attribute to Gil (1992). In (7), *each* seems ill-suited to stating a universal generalization over all of the world's languages whereas *every* is compatible with this sort of generic thought.

(7) After devoting the last three decades to a study of lexical semantics, George made a startling discovery:
    a. #Each language has over twenty color words.
    b. Every language has over twenty color words.

In the same vein, (8-a) calls to mind a situation where someone recently mixed a few drinks and wants help getting them ready to serve, whereas (8-b) sounds more like part of a recipe.

(8) a. Each martini needs an olive.
    b. Every martini needs an olive.

Lastly, we can see the strong distributivity of *each* reflected in sentence verification tasks. Vendler (1962) predicted this in his early investigations into universal quantifiers, saying: "*Each* ... directs one's attention to the individuals as they appear, in some succession or other, one by one". Building on that intuition, Knowlton et al. (2021b) show that when participants are asked to evaluate sentences like (9) with respect to images of shapes, they encode and recall group properties – like the number of circles – better in the *every* condition than the *each* condition.

(9) a. Each circle is green.
    b. Every circle is green.

Likewise, Knowlton (2021) reports that participants recall individual properties – like the hue of a particular circle – better if given the *each*-variant to evaluate. In both series of experiments, the only difference between conditions was the quantifier. Describing the scene with (9-a) versus (9-b) doesn't change the answer participants give ("true" or "false") but it does modulate how they represent the domain of quantification (as a collection whose cardinality can be estimated or as a series of independent individuals with associated properties).

2.1. EXPLANATIONS OF *each*'S STRONG DISTRIBUTIVITY. There are various sorts of explanations that have been given for the linguistic and psycholinguistic facts reviewed above. It is not our aim to try to definitively decide between them. As noted in Section 1, the acquisition question at issue here is, in some sense, orthogonal to the exact details of what learners end up acquiring. To be sure, we think the acquisition proposal pursued below meshes best with one particular proposal about what gets learned. But one could also imagine ways in which other proposals might be compatible with our learning story. With this in mind, we briefly turn to summarizing some ideas for explaining this distributivity difference between *each* and *every*.

One way of capturing differences between *each* and *every* is Beghelli & Stowell (1997)'s cartographic approach. They propose that *each* comes with a strong DIST feature, which triggers movement to the specifier of a functional projection, DistP, housing the distributivity operator. Associating with this operator gives *each* its strongly distributive meaning. In contrast, *every* has a weak DIST feature, and only optionally moves to the specifier of DistP. Given the relative position of DistP and the generic operator, GEN, Beghelli & Stowell also capture *each*'s resistance to generic interpretations. In particular, GEN is lower than DistP, and since *each* must move to DistP, it always out-scopes GEN. Assuming only material within the scope of GEN can receive a generic interpretation, *each* avoids such an interpretation. Beghelli (1997) extends this approach to pair-list questions. That said, Surányi (2003) and Szabolcsi (2010) argue that a purely scope-based approach is unable to explain cases like (6) and Brendel (2019) raises further empirical complications.[1]

In contrast to a purely syntactic approach, other theorists have considered placing strong distributivity into the lexical specification of *each* (e.g., Szabolcsi 2010; LaTerza 2014; Champollion 2017). On one such view, Tunstall (1998) proposes that *each* and *every* impose different conditions on events they describe. In particular, *each* imposes the very strict condition of full event differentiation: Each object in the denotation of the determiner's internal argument has to be part of a separate event, at some level. For example, *Kermit lifted each box* is true if and only if Kermit lifted each box independently of the others (i.e., one at a time). Less stringently, *every* imposes a condition of partial differentiation: There has to be some object in the denotation of the determiner's internal argument that is part of a separate event from some other object in that denotation. So *Kermit lifted every box* is true if and only if Kermit lifted all the boxes, but not all at once (i.e., there were at least two separate lifting events). In contrast, *all* imposes no such condition (meaning *Kermit lifted all boxes* can be true even if he lifted them all at once). Brasoveanu & Dotlačil (2015) offer some experimental support for Tunstall's differentiation condition: When resultatives are present to enforce event differentiation, reading times decrease for sentences with *each* but not for sentences with *every*.

On another view that places the difference within the lexical specifications, Knowlton et al. (2021b) and Knowlton (2021) propose that *each* and *every* have formally different concepts of universal quantification as their meanings. In particular, *each* has a restricted first-

[1] It is also not clear how a purely syntactic view would capture the result that sentences with *each* encourage treating the internal argument as a series of independent individuals whereas those with *every* encourage grouping the satisfiers of the internal argument. The distributivity operator with which *each* associates is responsible for ensuring that the predicate it combines with applies to individuals. But the psycholinguistic results come from testing participants on sentences with distributive predicates (e.g., *be green*). These predicates likewise enforce application to individuals (*every circle is green* if and only if *each individual circle is green*). So if associating with the distributivity operator is responsible for the results, why would combining with a distributive predicate not have the same effect?

order meaning whereas *every* has a restricted second-order meaning.[2] On this view, a sentence like *each frog is green* is represented in a way that implicates only individuals (e.g., *frog*$_1$ *is green & frog*$_2$ *is green & ...*) whereas *every frog is green* is represented in a way that calls for grouping the satisfiers of the internal argument (e.g., *the frogs are such that they are all green*). Because they treat the internal argument differently, these proposed representations serve as instructions to distinct cognitive systems: the system for representing object-files (Kahneman & Treisman 1984; Kahneman et al. 1992; Carey 2009) and the system for representing ensembles (Ariely 2001; Whitney & Yamanashi Leib 2018). This distinction is schematized in Figure 1.

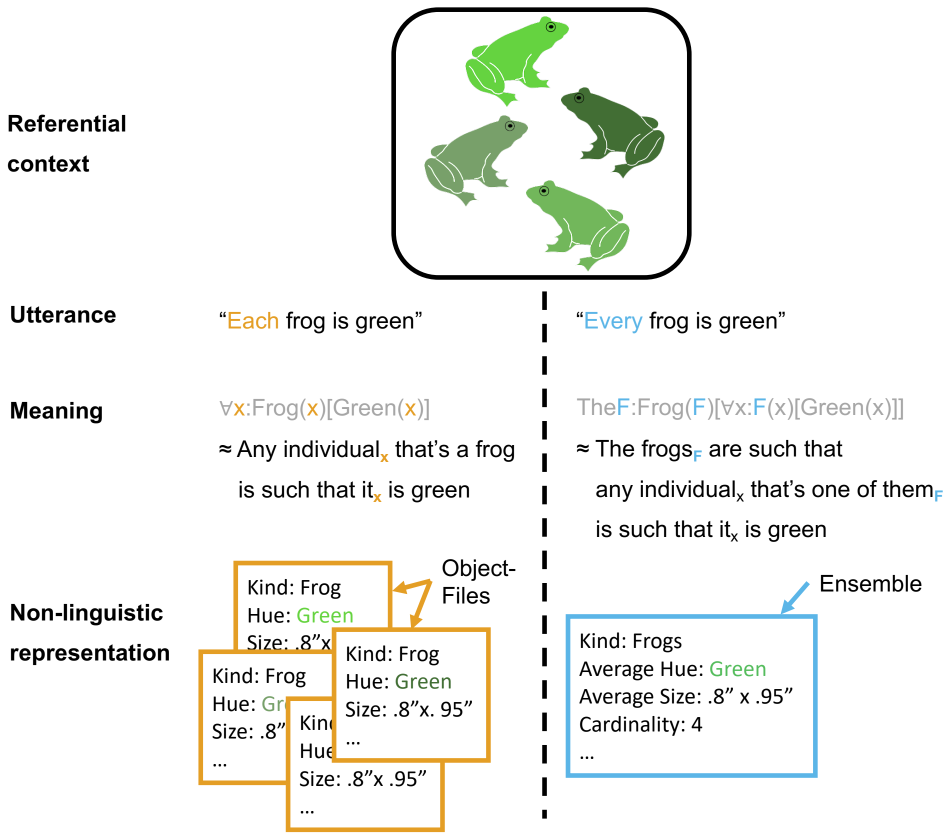

Figure 1. Proposed meanings and related non-linguistic representations.

These two concepts of universal quantification could be thought of as two different "modes of presentation" of universality. The first-order concept behind *each* – which avoids quantifying into uppercase variable positions – eschews any notion of grouping the frogs. But the second-order concept behind *every* calls for restricting the domain to the things that satisfy the internal argument. The way the mind delivers individual representations is with object-files, and the way it delivers group representations is with ensembles. In that sense, these different concepts are closely tied to different non-linguistic cognitive systems.

[2] The proposed meanings are restricted in the sense that the first argument serves to restrict the domain of quantification. So, *each frog is green* has a meaning like "$\forall x : Frog(x)[Green(x)]$" (≈ *each thing such that it is a frog is such that it is green*) as opposed to the unrestricted "$\forall x[Frog(x) \rightarrow Green(x)]$" (≈ *each thing is such that if it is a frog it is green*). Knowlton et al. (2021c) offer some initial support for thinking quantifier meanings in general are restricted in this sense. But at issue here is the difference between *each* and *every*.

It is worth being clear that although object-files and ensembles are most often discussed in the visual modality, this proposal is not meant to be restricted to the visual domain. Object-file and ensemble representations are more general. They can be formed in response to auditorily-presented tones and they can be inferred (e.g., Jordan et al. 2010; Hyde 2011; Gallivan et al. 2011). Indeed, we expect the representation created in response to hearing *every unicorn has a horn* to involve an ensemble despite there being no direct perceptual access to unicorns.

But importantly, this proposal does not predict that people will always represent object-files upon encountering a sentence with *each* or ensembles upon encountering a sentence with *every*. The idea is that the meaning representation carries some weight in determining which non-linguistic cognitive system will be deployed, but undoubtedly other considerations play a role (Lidz et al. 2011). The meaning, on this view, can be seen as a cognitive recipe for assembling a thought, but this far from guarantees that the recipe will be followed (Pietroski 2018; Knowlton et al. 2021a).

As noted, we think the acquisition proposal presented below pairs well with idea that there is a psychosemantic difference between *each* and *every* along the lines in Figure 1. For ease of exposition, the rest of this paper will assume this view about what gets acquired. In Section 5, we return to the question of whether alternative ideas about what gets acquired might be compatible with the proposed acquisition story.

3. Acquisition proposal: Object-files as a route of semantic access. Supposing what learners need to do is pair the pronunciation "each" with a first-order universal concept instead of a second-order one, the question is how children solve this mapping problem. What in their input could lead them to favor one concept over the other? We propose that relatively low-level properties of the domain of quantification set up ideal situations for learning.

In particular, as the corpus study presented in Section 4 confirms, parents use *each* to quantify over domains that are physically present in small numbers. These are two properties that are known independently to promote representation of object-files. Physical presence matters because spatial information is privileged over other kinds of information, like color or size (e.g., Xu & Carey 1996). Small number matters because there is a working memory limit (of 3) on the number of object-files that can be simultaneously represented (e.g., Feigenson & Carey 2005). Wood & Spelke (2005) offer a striking demonstration of the importance of this working memory limit. They showed that in otherwise identical experimental setups, 6-month-old infants successfully distinguished 8 versus 4 actions but failed to distinguish 4 versus 2 actions. That is, when the context of presentation involved large numbers, infants spontaneously recruited their ensemble processing system (which has no such working memory constraint). But when shown 2 or 4 actions, infants attempted to represent them as individual object-files (or, "event-files", in this case), and failed due to the working memory load.

So, the fact that the things being quantified over with *each* are present in small numbers causes children to represent them as object-files. Representing the domain of quantification as object-files in turn provides reason to favor the first-order concept, as this concept serves as an instruction to create object-files.

To consider a concrete case, imagine a parent sees a small number of frogs and wants to point them out to their child. Parents might want to individuate those frogs for any reason (e.g., if there is a high degree of spatial separation between them or if they are particularly heterogeneous). Given that small numbers of objects also independently trigger object-files, the frogs in this scenario are likely to be represented as object-files. And given the proposed meanings, parents would thus be more inclined to describe such a situation with *each frog is green*. Now imagine a learner who knows the meanings of *frog* and *green* but not *each*. They are wondering which concept of universal quantification *each* picks out. But suppose that based on the context – the frogs are physically present and there are only four of them – the learner is also treating the relevant frogs as object-files. This provides strong evidence for favoring the first-order universal concept, which itself promotes treating the domain as object-files. The situation independently highlights individuals, so it would make sense that the parents' utterance offers an instruction for building a thought that does the same.

In other words, the idea is that linguistically, *each* encourages treating the domain of quantification as individuals, which are represented with the object-file system. Perceptually, small numbers of physically present objects (or actions) trigger object-file representations. So by quantifying over small, physically present domains, parents create an ideal circumstance for acquiring *each*. Note that this proposal implicates a richer notion of perception than is often appreciated in the word-learning literature: Perception doesn't merely provide access to object-concepts, but to certain construals of them (a series of object-files versus an ensemble).

Given this proposal, one might wonder why *each* seemingly takes learners so long to acquire. As noted above, various studies suggest that children are insensitive to *each*'s strong distributivity until they are surprisingly old (e.g., Brooks & Braine 1996; Syrett & Musolino 2013; Achimova et al. 2017). At the same time, pre-verbal infants can represent object-files (for helpful reviews, see Feigenson et al. 2004; Spelke & Kinzler 2007). And we suspect the concept of universal quantification that gets paired with *each* is likewise available from a young age.[3] But if both the concept and the route of semantic access are in place early on in development, why does it seemingly take learners so long to acquire the meaning of *each*?

We think there are two factors at play. First, as already mentioned, learners will not be in a place to choose between the relevant concepts until they realize that *each* is a quantifier and moreover one with universal content. As this likely involves syntactic bootstrapping and pragmatic reasoning, learners need to have first acquired enough syntactic and lexical knowledge.

Second, mapping problems are hard. Up to this point, we have remained agnostic about particular learning mechanisms. But we think the protracted acquisition timeline tells against the operative mechanism being global cross-situational learning models that take into account multiple hypotheses. Instead, we think mapping problems like this one are solved by making and trying to verify a proposal in the moment (Trueswell et al. 2020). To do so learners require just the right coordination of word and world; cases in which the utterance and relevant scene are temporally coordinated and in which the scene supports the right construal. Such "referential gems" are rare (Gleitman & Trueswell 2020). Indeed, learners likely need to encounter a few of these gems before they get lucky enough to propose the correct hypothesis and be in a position to confirm it.

4. Results of a corpus investigation. To provide some initial support for the proposal outlined above, we analyzed videos of naturalistic parent-child interactions from the Language Development Project corpus (Goldin-Meadow et al. 2014). Utterances that contained a universal quan-

[3] Cesana-Arlotti et al. (2020) offer some initial evidence that a strongly distributive universal concept is present in 10-month-olds. An alternative possibility is that conceptual change is at play (Carey 2009). But to our knowledge, no one has proposed a conceptual change account of quantification.

tifier spoken by parents to their (14-58 month-old) children were isolated. Out of 223,390 utterances in the portion of the corpus considered, 223 contained *each*, 139 contained *every*, and 2,915 contained *all* (out of which we randomly sampled 217 to analyze). Each utterance and corresponding video was coded with respect to the distinctions in (10).

(10) a. What is being quantified over linguistically? (e.g., individuals, times, events)
b. Is the domain of quantification physically present around the time of utterance?
c. How many things are being quantified over?

Sample utterances from one parent-child pair are given in Figure 2. For the *each* example (*you want one bite of each piece, huh?*), individuals are being quantified over (pieces of banana) and those individuals are co-present around the time of utterance. In the *every* case (*every time you color you get better*), times are being quantified over (times that the child colors), and as such, the domain is not physically present. At best, only one time of coloring is physically present (though, in this case, the coloring happened well before the time of utterance). In the *all* case (*all the yellow ones are in a row*), quantification is again over individuals (yellow cars), and the domain is physically present, though in a larger quantity than in the *each* case.

"You want one bite of each piece, huh?" "Every time you color you get better" "All the yellow ones are in a row"

Figure 2. Example parent-child interactions from the Language Development Project corpus.

These examples are representative of how parents generally use universal quantifiers in their speech to children. Parents are more likely to quantify over individuals (versus e.g., times or locations) with *each* than with *every* ($\chi^2 = 169.8, p < .001$) or *all* ($\chi^2 = 24.8, p < .001$), replicating previous work (Knowlton & Lidz 2021). This already suggests that the domain of quantification is more likely to be physically present in small numbers when universal quantification is indicated with *each*. But we cannot know for sure from transcripts alone.

To analyze the videos of parent-child interactions, we extracted a range of time starting 10 seconds before and ending 30 seconds after each utterance. As seen in Figure 3, parents are overwhelmingly more likely to use *each* (and to a lesser extent, *all*) to quantify over things that are physically present, whereas they are more likely to use *every* to quantify over things that are not. The things quantified over in parents' speech are more likely to be present given *each* than given *every* ($\chi^2 = 133.87, p < .001$) or *all* ($\chi^2 = 5.37, p < .05$).

As noted above, this is related to the finding that parents more often than not use *every* to quantify over times. In these cases the entire domain will likely not be present. Even if a parent says *every time we go to the store you cry* while in a store, they obviously intend the utterance to generalize over more than one store-going. But though it undoubtedly plays a role,

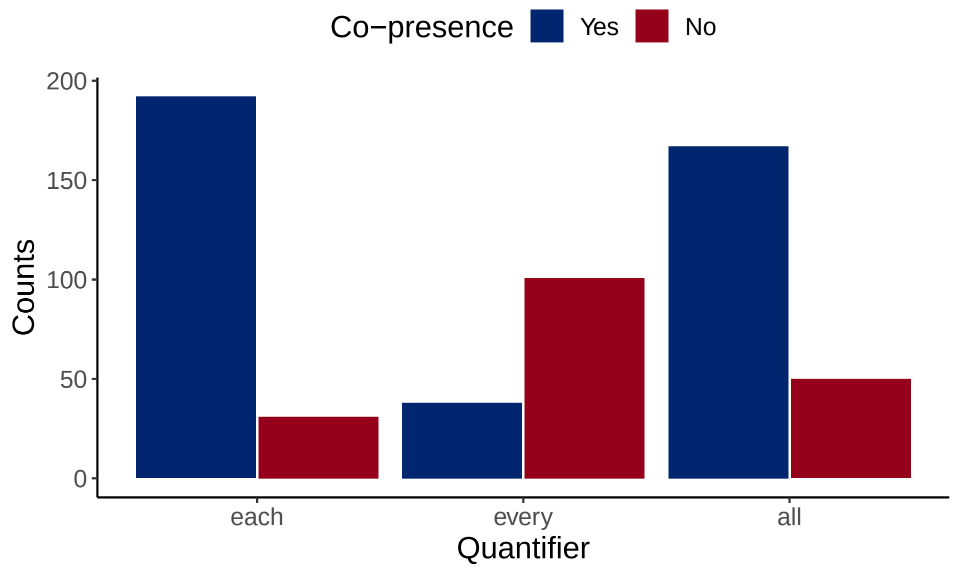

Figure 3. Is the domain of quantification co-present with (or around) the utterance?

the difference between *each* and *every* does not seem to be entirely driven by the fact that *every* is most often used to quantify over times. As seen in Figure 4, if times are removed from consideration, the things being quantified over are still more likely to be physically present if universal quantification is indicated by *each* than by *every* ($\chi^2 = 7.3, p < .01$).

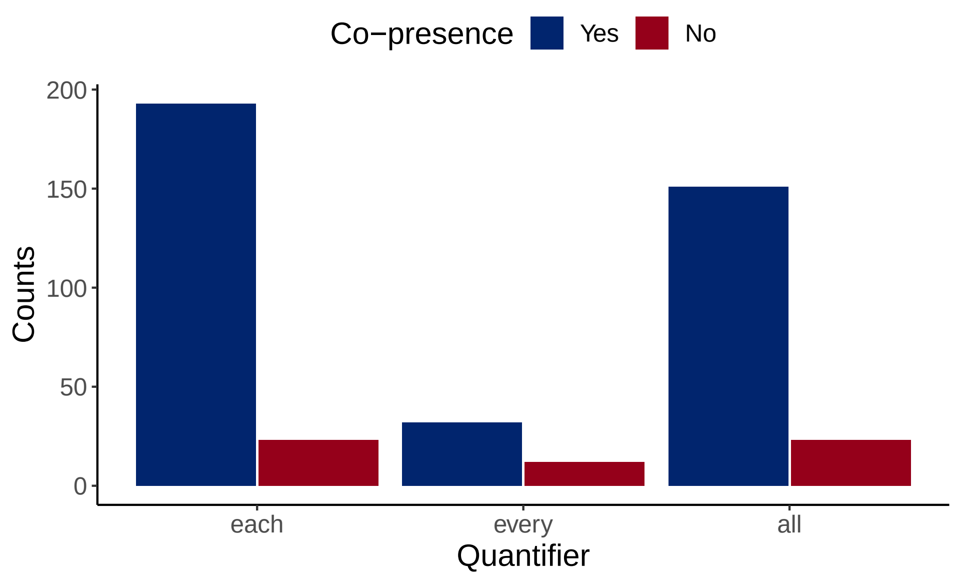

Figure 4. Is the domain of quantification co-present with (or around) the utterance excluding all cases of quantification over times (e.g., *every time you color, you get better*)?

Having established this difference in likelihood of the domain being physically present, we turn to the size of the domain of quantification. Of particular importance for the acquisition story sketched above is whether the domain is within young children's working memory limit of three, as this is the limit of object-files that children can simultaneously represent (Feigenson & Carey 2005). As seen in Figure 5, the domain of quantification is more likely to be within children's working memory limit given *each* than given *every* ($\chi^2 = 16.25, p < .001$) or *all* ($\chi^2 = 80.97, p < .001$). (This result was unchanged if we used adults' average working memory limit of four as the cutoff instead of children's working memory limit of three.)

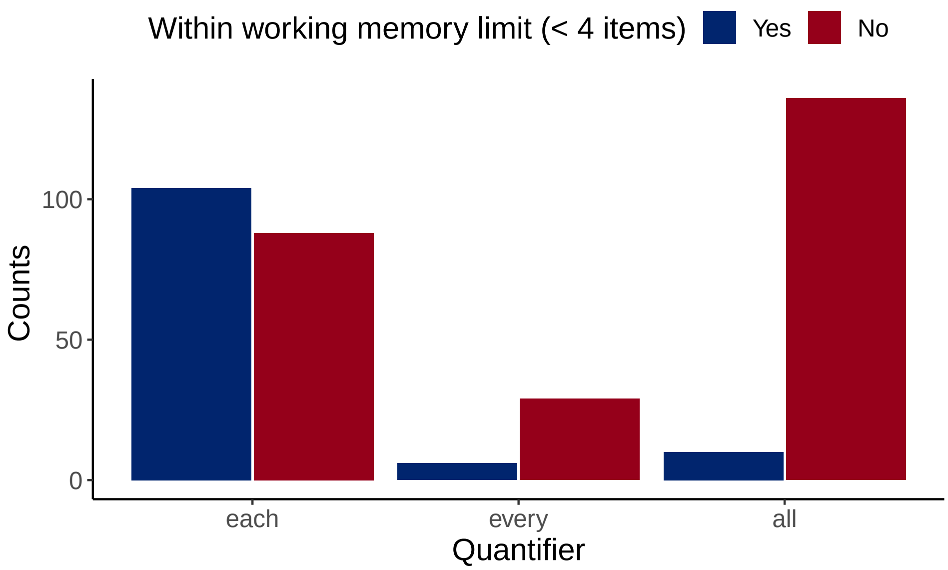

Figure 5. Is the domain of quantification within children's working memory limit of 3 items?

The resulting empirical picture is clear. In speech to children, parents often use *each* and *all* to quantify over physically present individuals. In contrast, they use *every* to quantify over times or individuals that are not co-present with the utterance. But while *each* and *all* pattern together with respect to the domain being physically present more often than not, they come apart with respect to the number of things they get used to quantify over. Parents use *each* when quantifying over small domains, but use *all* to quantify over domains that are larger than children's working memory capacity.

5. Conclusion. The corpus investigation reported above reveals that parents often use *each* to quantify over small numbers of physically present things. This differentiates it from its universal counterparts *every* and *all* in a principled way. Namely, these sorts of contexts independently trigger object-file representations (presumably, this is what leads parents to choose to use *each* instead of *every* in these situations). From an acquisition perspective, we think this finding is important, because it sheds light on the evidence learners might use to differentiate a strongly distributive universal like *each* from a similar but less distributive universal like *every*.

The idea is that contexts in which *each* is used independently trigger representations of object-files. This creates an ideal situation for acquisition. If learners have reason to represent the domain of quantification as object-files, then they'll have reason to pick the universal concept that also triggers object-file representations (the one that serves as the meaning of *each*) as opposed to a less individualistic concept (the one that serves as the meaning of *every*).

But what of the other universals? If representing the domain of quantification as a series of object-files is the main route of acquiring *each*, we might expect representing the domain as an ensemble to be the main route of acquiring its less distributive counterparts. *Every* presents a particular challenge. On our view about its meaning (see Figure 1), parents who use *every* to indicate universal quantification often mentally represent the domain in exactly this way (as an ensemble). But the above results suggest that learners often hear *every* in contexts where the domain of quantification is not physically present. As a consequence, perceptual cues to representing the domain in the relevant way are not present for *every* as they are for *each*. Absent the ability to read their parents' minds, what about *every*'s use would encourage learners to group the things being quantified over into an ensemble representation?

Knowlton & Lidz (2021) suggest that it is pragmatic reasoning, not perceptual triggering, that encourages learners to represent ensembles in situations when parents use *every*. The proposal is as follows. Parents often use *every* to express claims that project beyond the local domain. That is, an utterance like *every time we go to the store, you cry* expresses a sort of "generic" speaker meaning. Object-files do not support projecting beyond the local domain, but ensembles do. So if learners are aware of parents' intended speaker meaning when saying "every" (i.e., that they are making a claim that projects beyond the local domain), then learners would have reason to pair it with the universal concept that also supports projecting beyond the local domain. That is, they would have reason to reach for the second-order universal concept that serves as a call to represent an ensemble. On this proposal, ensembles play as large of a role in the acquisition of *every* as we think object-files play in the acquisition of *each*.

In sum, how the domain of quantification is represented – as a series of object-files or as an ensemble – might be a route of semantic access for both *each* and *every*. But what triggers learners to represent the domain in different ways differs. In the case of *every*, details about parents' intended speaker meaning lead to the formation of ensemble representations; in the case of *each*, perceptual properties of the scene naturally invite representing object-files.[4]

This is not to say that utterances with *every* never trigger representing the domain of quantification as a series of independent object-files. Parents might well say something like (11-a), which seems to individuate the peas more strongly than an utterance like (11-b).

(11) a. You have to eat every single one of your peas if you want dessert!
b. You have to eat all your peas if you want dessert!

In principle, these sorts of cases might encourage representing the peas as object-files, which could lead to confusion between *each* and *every*.

In practice though, we suspect cases of *every* used to individuate will not lead learners too far astray. For one thing, in such a case, the domain of quantification would likely be large: (11-a) seems more natural than something like (12).

(12) You have to eat every single one of your pizza slices if you want dessert!

So if situations like (11-a) occur, they would make *every* look more like *all* than like *each* (i.e., the domain of quantification would be physically present in large quantity). But given that *all* is an order of magnitude more frequent than other universals, we suspect learners already know its meaning by the time they are concerned with differentiating *each* and *every*. Perhaps more importantly, instances of *every* used to individuate seem to be rare. In our sample, there were only three instances of parents saying *every one* (and no cases of *every single*

[4] We do not yet have a proposal about the route of semantic access for *all*, though we suspect it will be informative to consider approaches that view *all* not as a genuine quantifier, but as an intensifier (e.g., Baker 1995; Brisson 1998).

one). All three were cases in which the domain was physically present, though in two cases, the cardinality of the domain was larger than 3, supporting the (11-a) versus (12) intuition.

As noted above, this acquisition proposal fits well with the particular psychosemantic proposal schematized in Figure 1. But we might wonder whether the acquisition proposal could be made to be consistent with other approaches. On Beghelli & Stowell (1997)'s approach, for example, *each* and *every* have the same meanings, but learners need to decide whether or not to append a strong distributivity feature onto one of the lexical items. Given a bias to avoid synonymy, learners might endeavor to find some difference between *each* and *every*. Since *each* is often used when object-files are being represented, they may reason that it should be associated with the distributivity operator, which we might suspect also triggers representations of object-files. If learners already know where the distributivity operator resides in the syntactic tree, then parents' frequent use of *each* – but not *every* – in cases that promote representations of individuals could be seen as evidence that *each* scopes higher than *every*. And if Beghelli & Stowell's explanation of *every*'s compatibility with generic thoughts is on the right track – if *every* scopes below GEN whereas *each* scopes above it – then learning the high position of *each* could also be taken as evidence that it cannot give rise to generic readings.

Alternatively, perhaps the acquisition proposal could also be made to be consistent with other approaches that situate the difference between *each* and *every* in their lexical specifications. On Tunstall (1998)'s view, for example, what needs to be learned is essentially that *each* enforces a one-to-one correspondence between individuals in the domain of quantification and events. Object-files can be thought of as supporting one-to-one correspondence in the sense that the system itself doesn't support any sort of generalization beyond individuals. If object-file$_1$ has the property *is green* and object-file$_2$ has the property *is green*, from the point of view of the object-file system at least, there is no sense in which the property applies to a group. That said, if object-file$_1$ has the property *was lifted by Kermit* and object-file$_2$ has the property *was lifted by Kermit*, there is also no guarantee that both liftings happened separately. So it is not obviously clear how object-files relate to the event differentiation condition to be associated with *each*. Moreover, it is not clear how ensembles relate to the partial event differentiation condition to be associated with *every*.

In any case, whether our acquisition proposal is compatible with various views about the target of learning, it nonetheless shows that thinking about how linguistic meanings are related to non-linguistic conceptual systems can add new tools to the acquisitionist's arsenal. In particular, we think this case study exemplifies a new sort of "learning by observation" in which rich perceptual outputs (e.g., representing the domain as object-files or as an ensemble) allow the learner to make inferences about linguistic meanings.

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