Interpreting collective predication

The process of collective predication is inherently vague. Whereas distributive predication commits a speaker to relatively concrete statements about the state of the world — if a plurality distributively holds some property, then each member holds that property — collective predication admits much broader construals. So when are collective interpretations appropriate, what do they communicate, and what mediates the choice between distributive and collective interpretations in the first place? Rather than focusing our efforts on the nebulous interpretations of collective action statements, highlighted by predicates like *build a raft*, we consider in detail a specific class of predicates with more concrete, (relatively) objective evaluation strategies: gradable adjectives. Predicates like *heavy* or *expensive* admit ambiguities in interpretation when used to ascribe properties to sets of objects. *The boxes are heavy* can mean either that each member of some salient set of boxes is heavy, or that taken together the set of boxes collectively counts as heavy (even if no individual member is). Not all predicates are so permissive. Since Quine (1960, p.140), researchers have assumed that some predicates lack collective interpretations: *The boxes are big* is said to communicate about individual, but not total box size. Other size and shape predicates behave similarly (e.g., *long, round*); Schwarzschild (2011) terms them "stubbornly distributive." Here we show that the probability of an interpretation depends crucially on potential variability in the property being communicated. Collective weight is a stable property of sets: Stacking boxes on top of each other or lining them up side by side, the total weight of those boxes remains the same, and corresponds to the sum of the weights of each box. The collective interpretation that eludes predicates like *big* or *wide* or *long* or *tall* depends crucially on the way a set of objects is arranged physically (e.g., stacked one on top of the other, lined up side by side, etc.). The collective size of a set will therefore change depending on the physical arrangement of the members of that set. Manipulating variability in interpretation by decreasing noise in physical arrangement makes a collective interpretation more likely: If sets of boxes regularly come stacked on top of each other, *The boxes are big* is more likely to communicate that the total size of some set of boxes is large. These facts support a general model of rational communication under which the resolution of ambiguities is sensitive to the amount of variability in possible interpretations: A more variable interpretation is potentially less informative because it requires more coordination between speakers and listeners. The interpretation is therefore less likely. **Expt. 1 (N=50):** One way to access interpretations of ostensibly ambiguous plural predications is to elicit ratings of unambiguous paraphrases, for example rating (2) and (3) as paraphrases of (1). First, we must establish that these are in fact unam-

(1) The boxes were big/heavy/tall.

(2) The boxes each were big/heavy/tall.

(3) The boxes together were big/heavy/tall.

Click on the boxes you think Cubert was referring to:
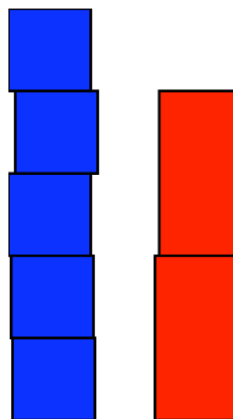

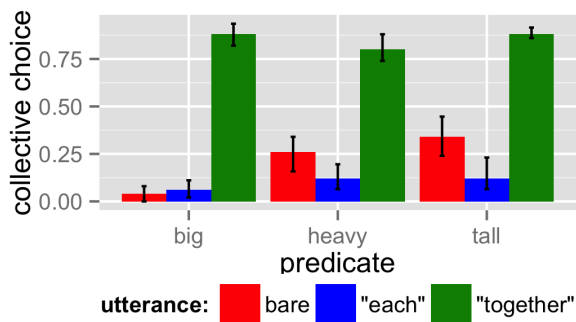
Fig. 1: Sample trial from Expt. 1.

Fig. 2: Expt. 1 collective response rate.

1

biguous paraphrases. To do so, we used a reference task. Subjects were introduced to Cubert, an alien in a factory working with boxes. They were told that after receiving a shipment of boxes, Cubert told his friend Dot about them. The task was to help Dot decide which boxes Cubert was referring to; subjects chose between a collective interpretation-satisfying referent (Fig. 1, left) and a distributive interpretation-satisfying one (Fig. 1, right). Fig. 2 presents rates of collective referent choice for each of the three predicates and their three variants. The disambiguating paraphrases behave as expected: *each* results in a distributive interpretation and *together* results in collective. We also find that the bare form of *big* patterns differently from *heavy* and *tall* – it is more distributive. This finding is expected with respect to *big* vs. *heavy*, but surprising given the behavior of *tall*: both *tall* and *big* are size and shape predicates, so what allows *tall* to more readily receive collective interpretations in our experimental context? One candidate factor is the contextual predictability of the collective property: how easy it is for speakers and listeners to arrive at the same collective property for a given set of objects. Collective weight is a stable property of sets, which stands to explain the complaisance of *heavy* toward collective interpretations. In the context of Expt. 1, collective height is also predictable: boxes always appeared stacked one on top of the other, yielding stable total set heights. Collective size, however, could vary depending on the strategy used to evaluate it (height? width? area? volume?), thus accounting for the relative lack of collective interpretations for bare *big*. In Expt. 2, we use the unambiguous *each/together* paraphrases to investigate the role of contextual predictability in plural predication. **Expt. 2 (N=80):**

If physical arrangements are less likely to change, collective predication becomes more predictable and stands a better chance of being informative. It should therefore become more likely. We manipulated predictability through a series of context scenarios. Subjects saw Cubert receive sets of boxes from a dispenser. Between subjects, the dispenser either dispensed boxes in RANDOM (Fig. 3, left) or REGULAR physical arrangements (stacked on top of each other; Fig. 3, right). Subjects observed the dispenser four times, then Cubert spoke to his friend, Dot. Subjects were asked to help Dot understand Cubert's utterance by rating distributive and collective paraphrases on a sliding scale (Fig. 4). Fig. 5 presents average paraphrase endorsement rates for the three predicates tested. For each predicate, regular contexts had higher ratings for collective paraphrases and lower ratings for distributive. *Tall* was most affected by our contextual manipulation, which directly targeted the height dimension, stacking boxes on top of each other. Our results demonstrate the central role of context in plural predication: as collective properties become more predictable, collective interpretations become more viable,

Fig. 3: Example context priming scenarios.

"The boxes were big!"

Is this what Cubert meant?

definitely not   definitely

The boxes together were big.

The boxes each were big.

Fig. 4: Example *big* trial from Expt. 2.

Fig. 5: Expt. 2 results.

regardless of the predicate involved. We formalize this choice in a Bayesian RSA model (Frank and Goodman, 2012; Lassiter and Goodman, 2013): Noisy interpretations are less useful because they require more coordination between speakers and listeners;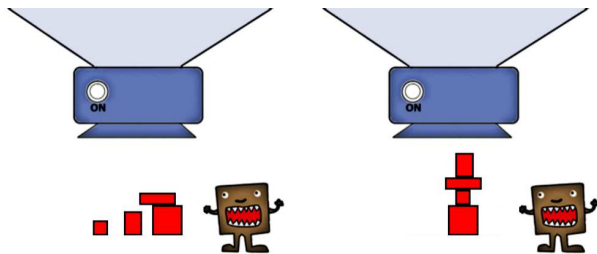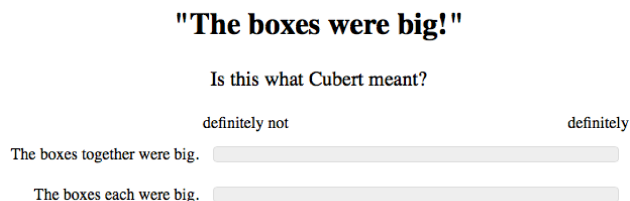 they are therefore less likely.