Concepts of universal quantification ("each" and "all") may support infant and adult understanding of collective and distributive actions.

Nicolò Cesana-Arlotti §, Tyler Knowlton #, Jeffrey Lidz #, Paul Pietroski ‡ & Justin Halberda §

§ Department of Psychological and Brain Sciences, Johns Hopkins University, Baltimore, MD # Department of Linguistics, University of Maryland, College Park, MD ‡ Department of Philosophy, Rutgers University, New Brunswick, NJ

nicolocesanaarlotti@gmail.com

James S. McDonnell Foundation

Background

The English universal quantifiers “All”, “Every”, and “Each” can be used to describe scenes in which agents engage in actions exhaustively (i.e. everyone is doing it). But, while “Each" can only be used with distributive predicates(i), “All" can also be used with collective predicates (iii) (Dowty, 1987). A recent study in adults provided evidence that “Each" and “All” may express different forms of quantification, one based on individuals, the other on groups of them (Knowlton et al., submitted). In the present study, we tested adults' and infants' ability to distinguish visually presented exhaustive collective (All) and exhaustive individual actions (Each).

i. Each wolf was chasing a sheep alone.

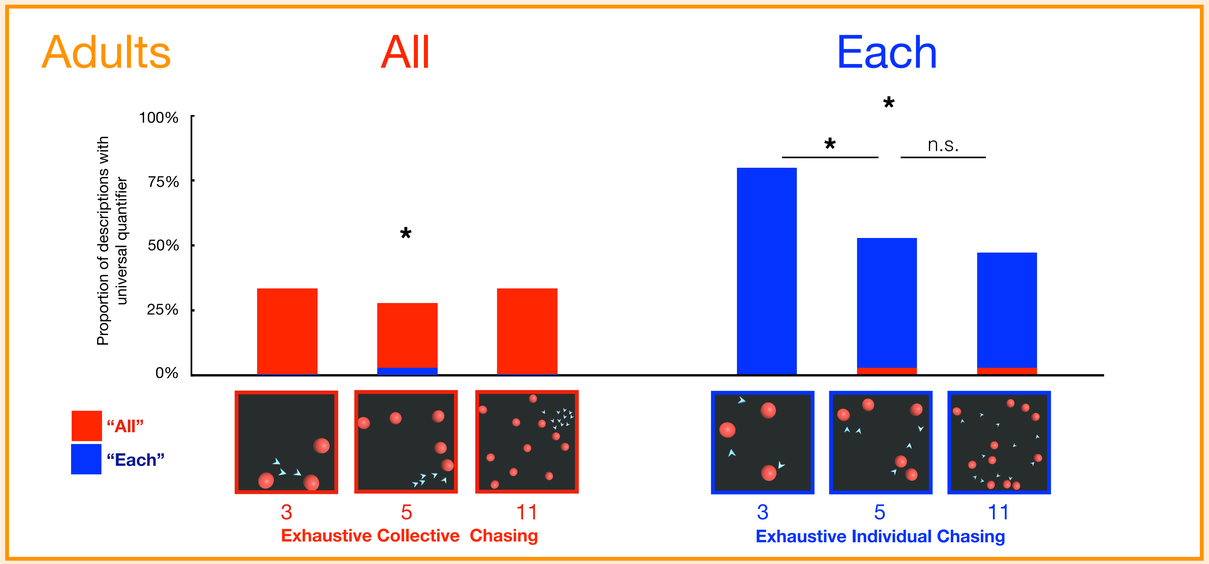
ii. *Each wolf was chasing a sheep together.

iii. All the wolfs were chasing a sheep together.

- (i) = **for any individual wolf** it is the case that it is chasing alone a sheep
- (iii) = **every member of the group of wolfs** chased sheep together with the others.

Result: adults spontaneously use distinct universal quantifiers for collective and individual events.

- Adults used “all” to describe exhaustive collective actions and “each” to describe exhaustive individual actions.
- The rate of production of “each" was higher for actions involving 3 chasers (within the capacity of working memory) suggesting that “each" expresses quantification over discrete individual agents (i.e., each chevron was chasing a different ball).
- The rate of production of “all" was not affected by the number of chasers, suggesting that "all" expresses quantification over the members of a group of agents (i.e., all the chevrons were chasing the same ball).

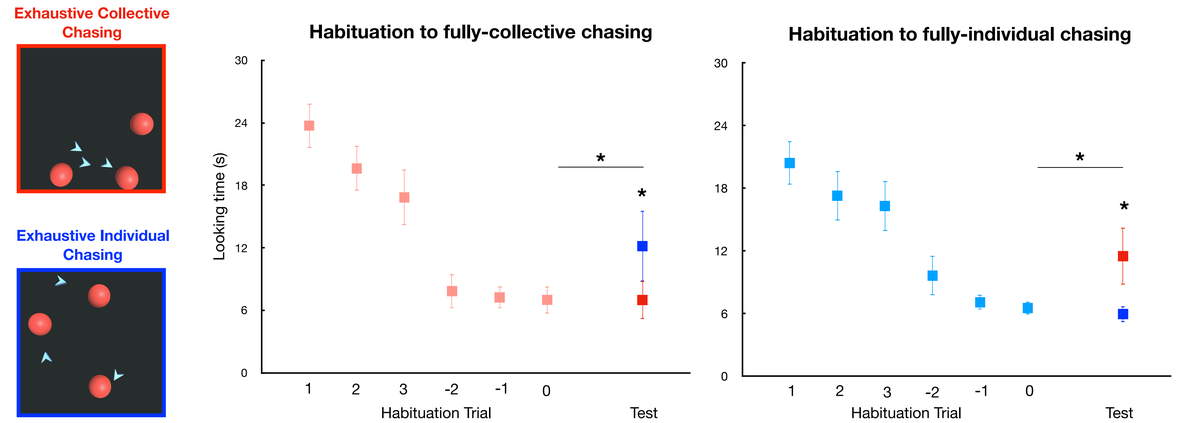


Methods:

- Each of the participants (N = 36, M_{age} = 19.03 years) was presented with six animated movies of chasing events that varied in composition (collective vs individual) and in number (3 vs 5 vs 11) of the chasers.
- After each movie (20 s), the participants were asked to describe it: *“In a full sentence, describe what was happening in the movie you just saw. Please, refer to the objects as “balls” and “chevrons”.”*
- At no time during the experiment participants were hinted to use quantifiers to describe the movies.

Results: nine-month-old infants may distinguish collective and individual exhaustive actions.

- Infants who were habituated to exhaustive collective actions dis-habituated to exhaustive individual actions, and vice versa, with 3 chasers. These results shows that infants successfully internalized distinct representations of the two scenes.
- Just like adults, infants might have relied on quantification over individual events (i.e., each chevron was chasing a different ball) in one case and on quantification over the members of a group in the other (i.e., all the chevrons were chasing the same ball). However, nailing this will require ongoing work in our Future directions.



Methods:

- In a between subjects visual habituation procedure, in infants (N = 36, M_{age} = 9.27 months) were presented with several animated movies displaying continuous chasing events involving three chevrons and three balls.
- Each infant was habituated to either collective or distributed exhaustive actions and was tested with either the same type of action or the other one (4 groups, 8 participants each).

Future directions

What is the content of infants’ representation of the two types of movies?

If, similarly to adults, infants represent the two types of chasing events via two distinct forms of quantification (over discrete individuals vs. over members of a group),then they will be able to internalize an exhaustive action with five agents when it is collective but not when it is individual. In contrast, if infants internalize the dispersion of the chevrons or the relative entropy of the scene, then they might succeed regardless of the number of chasers. We are currently running an experiment to address this question.

References

Dowty, David R. 1987. “Collective predicates, distributive predicates, and ‘all’.” Proceedings of the 1986 Eastern States Conference on Linguistics (ESCOL). edited by Fred Marshall et al., 97-116. Columbus: Ohio State University.

Knowlton, T., Pietroski, P., Halberda, J., Lidz, L. (subitted), "The Mental Representation of Universal Quantifiers".