# Talking about Distributivity: How Cognitive Factors Influence Children's Language

Plural sets of entities are represented as groups or collections of individuals: a sentence out of context (e.g., "The girls are carrying a ladder") receives a distributive reading if the predicate refers to the atomic members or a collective reading if it refers to the whole plurality. Previous accounts suggest that the distributive representation includes an additional semantic operator (e.g., 1). Comprehension experiments show that adults interpret an ambiguous sentence as collective, hinting at easier processing costs (2). However, children accept the distributive reading more often than adults (e.g., 3), casting doubts on its presumed greater difficulty. The current study investigates these interpretations in a novel way, by comparing the same group of preschoolers in both comprehension and production. In the idea that language could be a mirror of the mind (4), we study how children describe distributive and collective scenes to explore whether the two structures differ in complexity. Furthermore, we investigate whether cognitive factors, such as the ability to take the other's perspective, may influence children's performance in the linguistic tasks.

We tested 23 Italian monolingual children (10 females; age in months $M$=68.81, range=64–76). In the first session, they participated in a production task: they saw 24 (18 experimental) trials displaying two images of transitive actions and described them. Based on the within-participants Contrast Type factor, the conditions were *mixed* (distributive vs. collective image), *distributive* (two distributive) and *collective* (two collective; Figure 1). Participants provided two descriptions, one per image, and we coded each trial as marked if at least one contained a collective or distributive marker (e.g., *insieme*, "together", or *ciascuno*, "each"). In the second session, children performed the Dimensional Change Card Sort (5), testing the executive function of shifting, and the Perspective Taking task (adapted from 6), testing the ability to switch quickly from their perspective to another one. Children saw a character in a room and judged a sentence describing how many dots they or the character saw on the walls; the two perspectives might differ (inconsistent trials, seeFigure 2). Lastly, children performed the Raven matrices as a measure of nonverbal reasoning and a linguistic comprehension task: they had to choose between a collective and a distributive image while listening to sentences ambiguous or marked for distributivity or collectivity.

In the production task, a mixed effects logistic regression on Marking, with Contrast Type as the fixed effect and the participant as the random intercept, revealed that the mixed condition had more marked descriptions than both the collective (p<.001) and the distributive one (p<.01). Children showed a very low tendency to produce linguistic marking ($M$=8.3%): they expressed more markers in the mixed condition ($M$=17%), followed by the collective ($M$=6%) and the distributive one ($M$=2%) (Figure 3). In the comprehension task, they were capable of correctly understanding the collective (accuracy $M$=93%) and distributive ($M$=86%) sentences; in the ambiguous condition, they showed a higher preference for the collective images ($M$=93%). From a cognitive point of view, the percentage of linguistic marking in the production task did not significantly correlate with the shifting or the perspective-taking score; still, it correlated positively with the Raven matrices ($r$=0.4, p<.05). Instead, by looking at the comprehension task, a correlation ($r$=-0.4, p<.05) between the egocentric bias in the perspective taking and the interpretation of the ambiguity emerged.

Children were generally not fully sensitive to the necessity for expressing markers disambiguating the two readings. Nevertheless, as expected, they produced more markers when the contrast was explicit. Children at this age are likely too young to produce these markers, even though they clearly understand them. In the comprehension task, they preferred the collective interpretation of an ambiguous sentence; this is in contrast with previous studies, but ours presented both ambiguous sentences and distributive or collective sentences in trials randomly ordered: children might have benefited from the contrast and reached a tendency similar to the adults', who consider the collective reading as the default one. Finally, we found that some cognitive factors may play a role in comprehending these linguistic structures: children who were more ahead in cognitive devel-

opment produced more linguistic markers overall. Furthermore, the more the participants were anchored to an egocentric bias, the more they chose the collective image; the more they took the other's perspective, the more they chose the distributive image. Hence, the capacity to shift quickly from different perspectives may influence linguistic processing, and good perspective-taking abilities may reverse the preferred interpretation. However, this ability should be fully developed in adults, but still, they prefer the collective reading. We will have more reliable conclusions once we finish the current data collection on older children (7 years of age) and adults.



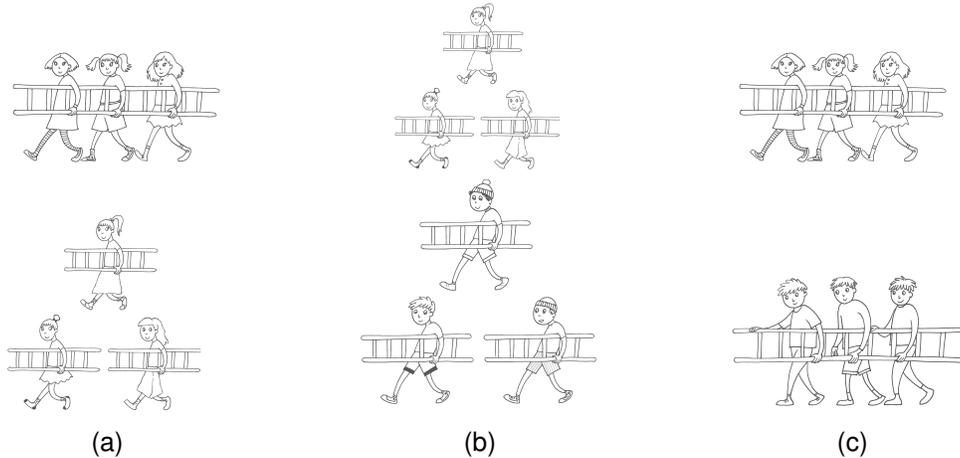|        (a)        |        (b)        |        (c)        |

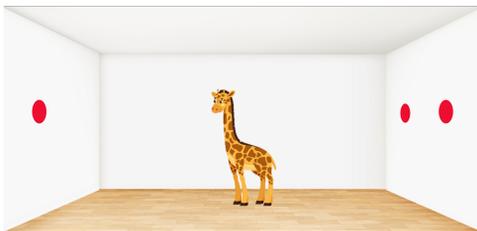Figure 1: Example conditions (in vertical): a) mixed, b) distributive, c) collective.
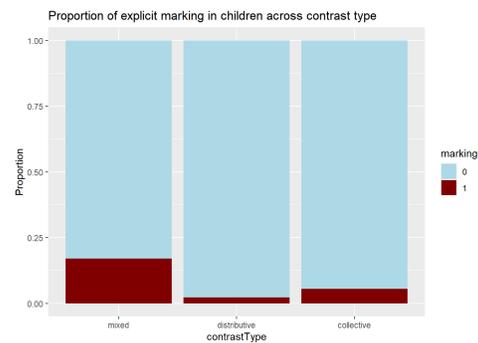


Figure 2: Example trial in the PT task.



Figure 3: Proportion of linguistic marking.

# References

[1] L. Champollion, "Covert distributivity in algebraic event semantics," *Semantics and Pragmatics*, vol. 9, pp. 15–1, 2016.

[2] L. Frazier, J. M. Pacht, and K. Rayner, "Taking on semantic commitments, ii: collective versus distributive readings," *Cognition*, vol. 70, pp. 87–104, 1999.

[3] K. Syrett and J. Musolino, "Collectivity, distributivity, and the interpretation of plural numerical expressions in child and adult language," *Language acquisition*, vol. 20, 10 2013.

[4] M. T. Guasti, A. Alexiadou, and U. Sauerland, "Undercompression errors as evidence for conceptual primitives," *Frontiers in Psychology*, vol. 14, 2023.

[5] P. Zelazo, "The dimensional change card sort (dccs): A method of assessing executive function in children," *Nature protocols*, vol. 1, pp. 297–301, 02 2006.

[6] L. M. Sacheli, E. Arcangeli, D. Carioti, S. Butterfill, and M. Berlingeri, "Taking apart what brings us together: The role of action prediction, perspective-taking, and theory of mind in joint action," *Quarterly Journal of Experimental Psychology*, vol. 75, no. 7, pp. 1228–1243, 2022. PMID: 34609238.