

## Child lexical acquisition without direct observation: Evidence from pupillometry

Alex Cairncross (aac61@cam.ac.uk)<sup>1</sup>, Chrysoula Vassiliu<sup>1</sup>, Chenyi Zhang<sup>1</sup>, Mirjana Bozic<sup>2</sup>,  
Ianthi Tsimpli<sup>1</sup>

<sup>1</sup>Theoretical & Applied Linguistics, University of Cambridge, <sup>2</sup>Psychology, University of Cambridge

**Background:** Early word learning heavily relies on direct observation guided by biases (e.g., mutual exclusivity, whole-object, shape). Yet language is flexible; speakers can recombine known elements to express novel meanings. A striking example is conversion, the change in syntactic category without overt morphology (e.g., *mop<sub>NV</sub>*). This is a highly productive process in English [2] and observational work suggests that it is early acquired with children producing converted forms absent from the input (e.g., *Don't broom my mess* [1]) from around age 2. Although these *ad hoc* productions may reflect a strategy to fill communicative gaps, more recent interpretive evidence suggests children may actually expect cross-categorical polysemy. After learning a novel verb (e.g., *to dax*), 4- and 5-year-olds preferentially interpret unrelated novel nouns (e.g., *a kiki*) as referring to something other than the instrument used for daxing [3]. This follows from the mutual exclusivity bias if children have already assigned a label to that tool. In turn, this suggests children can exploit regular polysemy to obviate the need for observational learning and instead 'learn from within.' However, the finding in [3] has not been widely replicated and relies on a demanding behavioural task that is not suitable for younger or multilingual children. The present study therefore tests children's expectations using a more passive method, pupillometry, in a way that does not rely on mutual exclusivity.

**Methods:** Participants were 39 English-speaking children (3 excluded; mean age: 5;6, range: 4;0–6;10) with no known language-related disorders. In each trial (N = 90), children viewed a video of an unusual tool being used while hearing a narration that described the action with three instances of a novel verb (*will dax, is daxing, daxed*). A fixation cross (500 ms) centred attention before an image of a tool appeared. After 2000 ms, an audio named the object (e.g., *This is a (dax/kiki).*). Manipulating image–audio pairings yielded three conditions: distractor (novel tool novel label), baseline (same tool same label), and experimental (novel tool same label). Trials were grouped into 4-minute story blocks with rest in between. Pupil data (head-stabilised) was recorded for 1500 ms after the onset of the critical noun and baselined (subtractive) to the preceding 250 ms.

**Prediction:** If children expect cross-categorical polysemy for instrument Ns/Vs, the experimental condition should lead to greater processing effort, eliciting greater dilation than the baseline one.

**Results:** Average time courses for the three conditions are presented in Figure 1. Cleaned data (excluding distractor items) was subjected to a GAMM. This revealed that the experimental condition elicited meaningfully greater pupil dilation than the baseline condition between around 120ms and 1060ms after the onset of the critical noun (Figure 2).

**Discussion:** The present study provides convergent evidence that young children expect polysemous cross-categorical pairs to be phonologically related. Combined with the results in [3], this indicates that children do not always require direct observation for lexical acquisition. Rather, they can generalise over known items to expand their lexicons from within. Should this generalise to other types of regular polysemy (e.g., locatum or location N-V pairs), this could present a powerful tool to speed lexical acquisition. This also raises a new question for future research: given the preponderance of nouns in early lexical acquisition, can children generalise in the other direction; upon learning a new instrument noun, can/do children infer its verbal counterpart?

## References

- [1] Eve V. Clark. The young word maker: a case study of innovation in the child's lexicon. In Elizabeth Warner and Lila R. Gleitman, editors, *Language Acquisition: The State of the Art*, pages 390–425. Cambridge University Press, 1982.
- [2] Eve V. Clark and Herbert H. Clark. When nouns surface as verbs. *Language*, 55(4):767–811, 1979. doi: 10.2307/412745.
- [3] Mahesh Srinivasan, Sara Al-Mughairy, Ruthe Foushee, and David Barner. Learning language from within: Children use semantic generalizations to infer word meanings. *Cognition*, 159: 11–24, 2017. doi: 10.1016/j.cognition.2016.10.019.

## Figures and Tables

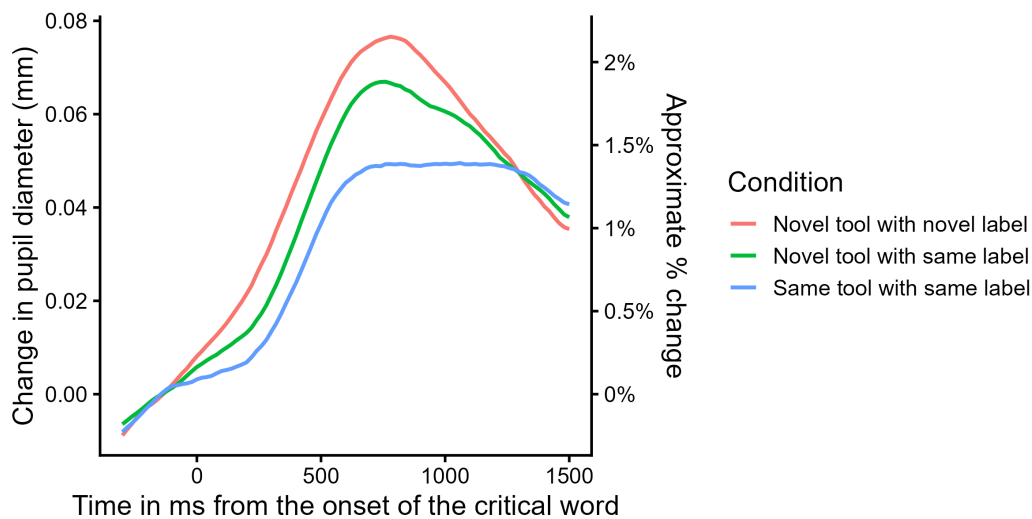


Figure 1: Average time course for the three conditions. Approximate % change is calculated from the average baseline (3.56 mm).

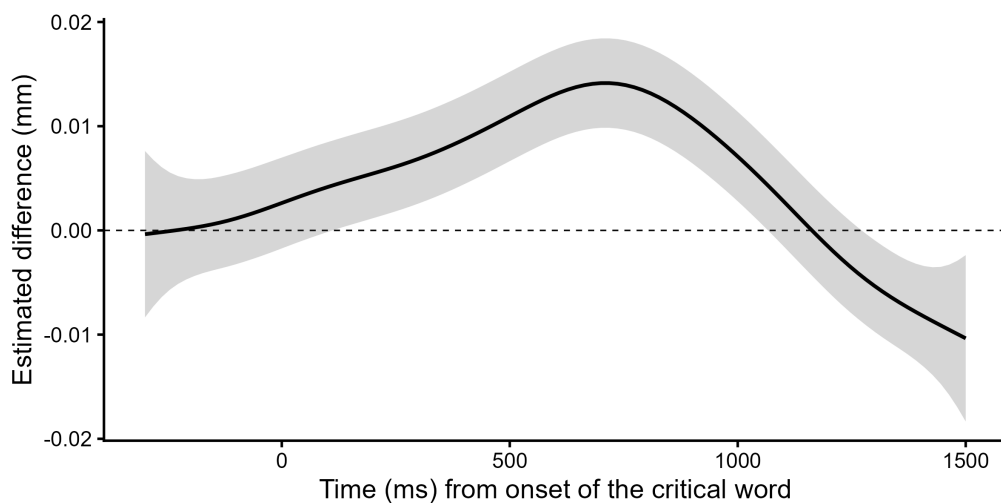


Figure 2: Difference plot for the experimental condition (novel tool with same label) against the baseline one (same tool with same label) with 95% confidence interval.