Toddlers rapidly infer multiple polysemous meanings in familiar and unfamiliar languages

Sammy Floyd, Mariesa Cay, Adele E. Goldberg & Casey Lew-Williams (Princeton University)
sfloyd@princeton.edu

Word learning is generally studied as a process of mapping each word form to its referent [1,2]. However, studies have largely overlooked a pervasive feature of language: that a majority of words are **polysemous** (40-80% in English) in that they have multiple related meanings for the same form, e.g., baseball *cap,* pen *cap,* bottle *cap* [3,4]. Critically, languages differ in how they extend labels: *cap* can to refer to a bottle cap or a hat but not to a lid, while the Spanish word *tapa* can apply to a bottle cap or a lid, but not a hat. The present study is the first to investigate how young English-speaking children contend with the meanings of polysemous words. In an English-meaning condition, toddlers were tested on their ability to recognize multiple English meanings for *cap* (e.g. a baseball cap and a bottle cap) and other polysemous words. Further, a Spanish-meaning condition prompted them with the same English label (e.g., *cap),* but evaluated their ability to recognize meanings from Spanish (and unfamiliar language) that are *not* related in English (e.g., a lid). By comparing the two conditions, the present study is also the first to tease apart the role of learned conventions (English-meaning condition) vs. conceptual generalization or inference (Spanish-meaning condition) in learning polysemy.

Thirty-two English-speaking 24-36 month olds (*M*= 31 months, SD= 2.7 months*)* participated in an eye-tracking experiment; they were prompted with simple English sentences, “Look! Look at the **cap**!”, with two images on screen. We measured children’s proportion of looking to target vs. distractor from 300-2000ms following noun onset (*cap*), following previous research on children’s word recognition [5] (see Figure 1). Other target words included *sheet, balloon, horn, glasses,* and *collar* (see Figure 2); trials were constructed such that a higher-frequency meaning of one word was presented alongside the higher-frequency meaning of a different word [6]. In the English-meaning trials, we found that children looked significantly above chance to the target meanings (β=0.13, *t*=7.13, *p*=1.52e-09) (see Figure 3). Interestingly, we found no difference in performance between higher and lower frequency meanings (β=0.01*,* t =0.167*, p*=0.87), suggesting that toddlers were able to identify both the common *and* less common meanings of words.

In the Spanish-meaning trials, we again prompted the monolingual English-speaking children with English words, but presented them with a distractor and a related meaning that is only conventional in Spanish (e.g., an image of a lid upon hearing *cap)*. We selected pairs of items to ensure that they were equally similar to one another as in the corresponding pairs of English meanings. We found that toddlers again performed significantly above chance in this condition (β=0.08412, *t*=3.07, *p*=0.003), suggesting they can quickly infer additional related meanings that they have not previously witnessed in their language. At the same time, average performance on Spanish-meaning trials fell significantly below English-meaning trials during 600-1000ms following noun onset (β=0.12104, *t*=2.74, *p*=0.008). Consistent with the prediction that children are familiar with multiple meanings that they have previously heard, participants were faster to switch to the correct meaning following noun onset on English- over Spanish-meaning trials (β=141.15, *t*=2.050, *p*=0.0453). This provides evidence that language specific input does, to some degree, confer an advantage, and that performance on the English trials was not entirely attributable to inference.

We find that monolingual English-speaking toddlers successfully identify multiple conventional meanings of target words in English. Furthermore, we find that children willingly extend words to unfamiliar but related meanings for those words: toddlers successfully inferred Spanish-only meanings for English words in real time, suggesting that the ability to extend a label to multiple, polysemous forms is a rapid and early-emerging process. Further work will investigate the role of individual-level input in learning multiple meanings, as well as activation of multiple, multi-language representations in bilingualism.

Figure 1: example *cap* trials

Word label	**High-frequency meaning**	**Low-frequency meaning**	**Spanish meaning**
cap	bottle cap	baseball cap	*(tapa)* container lid
sheet	bedsheet	sheet of paper	*(hoja)* leaf
glasses	eyeglasses	drinking glasses	*(gafas)* goggles
collar	dog collar	shirt collar	*(collar)* necklace
horn	animal horn	musical horn	*(cuerno)* croissant
balloon	party balloon	hot air balloon	*(globo)* globe

Figure 2: table of items

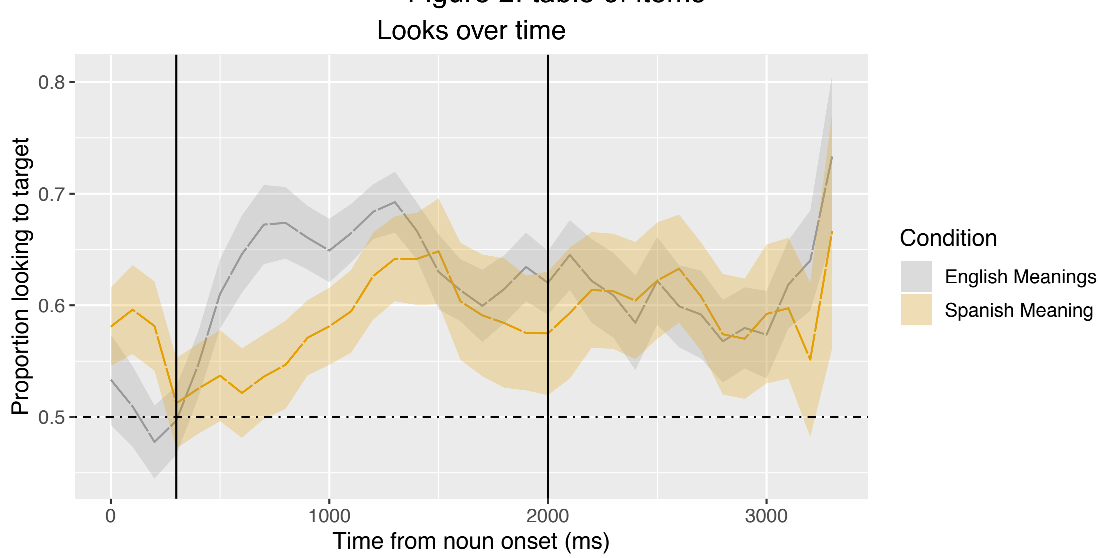

Figure 3: Proportion looking to target following noun onset (shown at 0ms) in toddlers (n=32) ages 24-36 months in English-meaning and Spanish-meaning conditions. The vertical lines indicate 300 and 2,000ms following noun onset (Fernald, 2008).

[1] **Quine**, W. V. O. (1960). *Word and object*. Cambridge, MA: MIT Press. [2] **Trueswell**, JC *et al* (2013). Propose but verify: Fast mapping meets cross-situational word learning. *Cognitive Psychology*. [3] **Fellbaum**, C. (1998). *WordNet*. John Wiley & Sons, Inc. [4] **Rodd**, J, *et al* (2002). Making Sense of Semantic Ambiguity: Semantic Competition in Lexical Access. *Journal of Memory and Language.* [5] **Fernald**, A *et al* (2008). Looking while listening: Using eye movements to monitor spoken language comprehension by infants and young children. [6] **MacWhinney**, B. (2000). The CHILDES project: Tools for analyzing talk.