

# Beyond the language explosion: What gradual word learning tells us about conceptual development

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**Keywords:** word learning, language acquisition, development, concepts, number, color, emotion, locomotion, time

## Introduction

For the past 50 years, language acquisition researchers have explored the fascinating question of “the language explosion”: how children are able to rapidly acquire hundreds to thousands of new words in a brief period of time. Focusing primarily on how basic-level nouns, such as “cup”, are quickly mapped to visible objects, researchers have proposed several constraints guiding early word learning. Their insights include the principle of *mutual exclusivity*, the *whole object bias*, the principle of *contrast*, *fast mapping*, and the notion of “comprehension before production” (e.g., Carey & Bartlett, 1978; Clark, 1988; Markman, 1994). Such work has greatly enhanced the field’s understanding of how rapid early word learning can be achieved.

Much less is known about how children acquire words that do not refer to objects, how children’s word meanings may differ from those of adults, and the inferential processes that take children from their initial mappings to adult-like meanings. In striking contrast to the notion of rapid word learning, we here explore the claim that in some cases, despite early production, children require additional months or even years to achieve adult-like comprehension (e.g., Ameel et al., 2008; Saji et al., 2011; Tillman & Barner, 2015; Wagner, Dobkins, & Barner, 2013; Widen & Russell, 2008; Wynn, 1990). This symposium brings together researchers studying five conceptual domains in which children’s word meanings evolve gradually — color, number, emotion, locomotion, and time — to explore the inferential processes children use to overcome their early assumptions and acquire adult meanings. In each case, we discuss how linguistic and perceptual cues come together to aid the construction of an abstract, domain-specific lexical category, how that category grows and gains internal structure, and how this structure in turn constrains and refines the meanings of individual words within it.

**Imai** discusses children’s acquisition of *color words*, like “red”, which are initially mapped quickly and coarsely to perceptual referents, but whose meanings must then be gradually refined to language-specific boundaries. In a similar vein, **Widen** considers how children’s use of *emotion labels*, like “sadness”, narrows as children acquire new words, like “embarrassment”. **Chu** argues that children initially have inexact meanings for *number words*, like “four”, long before they acquire their exact meanings and learn how counting works. **Malt** examines children’s early meanings for *locomotion words*, like “running” and “jumping”, and finds that although children overextend their early meanings, they rely on cues from the biomechanics of gait to help restrict the set of meanings they consider. **Tillman** explores how children learn time words, like “hour,” which lack visible referents, increasing children’s reliance on linguistic structure to constrain early meanings *prior* to mapping the words to experiences. Finally, **Shatz**, who has examined abstract word learning processes in several of these domains (e.g., Shatz et al., 1996; 2010), will serve as our moderator and discussant.

## How young children construct the lexicon as a connected system: The case of color names

(**Imai** with N. Saji, M. Asano, Y. Ujihara, K. Yasufuku, M. Ebe & M. Ohba)

To acquire adult-like word meanings, children need to construct a system in which the clusters of words in each semantic domain are mutually related, while the boundaries among these words are delineated. This is particularly true for the color lexicon. To investigate the full developmental trajectory through which children construct the color lexicon, we conducted two studies. Study 1 examined how children who knew few color words became able to map eight basic color names (red, blue, yellow, green, purple, pink, brown, orange) to their typical referents, by testing children every month, starting at 24-months of age and ending when the child was able to map all eight words correctly. In Study 2, three-, 4-, and 5-year-olds and adults were tested on their naming of 93 samples of both chromatic

and achromatic colors. The two studies together showed that children go through a process of continuous reorganization to construct the connected system of color words, but the nature of the reorganization is very different for the initial and later stages of development. In the initial stages, children build up the frame of the system quickly with coarse word-referent mappings; they then refine the system by modifying the boundaries of each word through a slow learning process.

### **Early inexact meanings of number words**

(Chu with K. Wagner and D. Barner)

Children acquire exact meanings for number words in a series of distinct stages. First, they learn the exact meaning for *one*, then *two*, and then *three*. Sometime after learning *three* or *four*, children learn to apply the counting procedure to their entire count list. Although the stages of acquisition of number word meanings are ubiquitous and well documented, the foundation of these meanings remains highly contested. Here we ask whether or not children assign preliminary meanings to number words prior to learning their exact meanings, by examining their responses on the Give-a-Number task to numbers for which they do not yet have exact meanings. While several research groups have approached this question before, we argue that because these data do not usually conform to a normal distribution, typical methods of analysis likely underestimate their knowledge. Using non-parametric analyses, we show that children acquire non-exact meanings for small number words like *one*, *two*, *three*, *four* and possibly for higher numbers well before they acquire the exact meanings.

### **The gradual development of children's understanding of emotion labels (Widen)**

Toddlers use a variety of emotion labels in spontaneous conversation and children's emotion vocabulary increases with age. But do children understand these labels in the same way adults do – as fairly discrete categories? Across several studies in which children (2-18 years) labeled facial expressions and emotion stories, children's use of emotion labels suggests that their initial understanding of emotions words such as *happy*, *sad*, and *angry* is initially broad and valence based and narrows only gradually with age. The breadth of children's use of emotion labels reflects the nature of their underlying emotion concepts. In addition, later-emerging emotion concepts are initially incorporated in the early, broad concepts (e.g., embarrassment is a part of sadness). Thus, even though children use emotion labels from an early age, their understanding of these labels is initially different from adults' and only gradually do they acquire the adult taxonomy of emotions.

### **Do children use biomechanical structure to constrain hypotheses about locomotion word meaning? (Malt with E. Ameal, A. White, and G. Storms)**

Children refine word meanings and patterns of word use into middle childhood and beyond, even for common words appearing in early vocabulary. To address where children past toddlerhood diverge and where they correspond to

adults in word use and why, we examined naming of instances of locomotion (walking, running, hopping, etc.) by children aged four to nine. Their performance was compared to that of adults. We evaluated whether the children are sensitive to discontinuities in the biomechanical properties of these actions that constrain adult word use. We also evaluated whether they apply this constraint by age four or only later in childhood. Results of two studies revealed that the children from four onward exploit biomechanical discontinuities to constrain their choice of label for actions. They do so despite having fewer words than adults to cover the domain, resulting in overextension of some terms relative to adults. Perceived domain structure plays a role in explaining later lexical development.

### **Conceptual structure and the semantics of time words (Tillman with D. Barner)**

How do children learn to label a dimension of experience that cannot be directly perceived? Children produce duration words, like "minute" and "hour," as young as age 2. However, evidence suggests that they may take up to an additional *five years* to acquire adult-like meanings for such words. Here, I will discuss what children think these words mean during the long delay between initial production and mature comprehension, and the linguistic cues they use to build these meanings. Particular attention will be paid to children's acquisition of word ordering within a common semantic domain (e.g., *second* < *minute* < *hour*). While in many cases, mapping a new word to a perceptual experience is the first step in the acquisition process, in the case of time, I will argue that it is the one of the last.

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