Title

Slow Mapping in Lexical Development

Authors

Brooks, Patricia

Kempe, Vera

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Slow Mapping In Lexical Development

Fast mapping (also called quick incidental learning) has received considerable attention as a word learning phenomenon. Fast mapping is defined as inferring a correct or near-correct word meaning from one or a few exposures to the word. It is considered noteworthy because inferring word meanings is theoretically a difficult, under-constrained inductive task (see below). Carey and Bartlett (1978) first reported that young children mapped a new color word onto a novel color after hearing it just twice. Since then dozens of studies have documented fast mapping in children aged 2 years and older, in a handful of languages, and in populations of children with developmental disabilities or risk factors. Most studies have examined fast mapping of object nouns, but a few have tested verbs and adjectives.

How hard is the problem of induction? Several philosophers (Ludwig Wittgenstein, Nelson Goodman, Willard van Orman Quine) pointed out that a symbol could have infinite possible meanings, so learners might never converge upon a shared meaning. This makes fast mapping seems implausible, so some psychologists have assumed that it must reflect some robust *a priori* word learning capacity. Other researchers, however, have noted that many non-specific cognitive phenotypes (e.g., perceptual salience, generalization, forgetting, active attention) strongly constrain what people talk about, or assume others are talking about. Thus, the actual difficulty of word learning is unknown, but is certainly not as intractable as sometimes portrayed by philosophers. Also, this difficulty is often greatly reduced in experimental studies, so fast mapping, when it occurs, might not be such a profound inductive feat. In fact, the historic Carey and Bartlett study did not actually show especially fast word learning: children guessed the intended referent equally well whether or not a novel word was used, presumably by choosing the more distinctive referent.

Rate of Word Learning

It is often assumed that the speed of children's word learning is reflected in their overall rates of vocabulary growth. Although estimates vary somewhat, the most convincing study, by Jeremy Anglin, suggests that children from 1st through 3rd grades gain facility over about 4,500 words/year. Often such statistics are translated into units of average words learned per day, presumably for the purpose of convincing the audience of children's astounding word-learning ability. Yet the practice is misleading: there is no study of how many words, on average, children learn *per* day. The closest data come from studies of L2 learners' acquisition of words within a single study session from a text passage. Those studies often show that a small proportion of novel words (< 10%) are induced and remembered in a single episode. Thus, word learning by older children appears laborious and often unsuccessful. More generally, however, vocabulary growth statistics tell us nothing about the rate of learning any single word. Cross-sectional studies might reveal that vocabulary grows by 1000-2000 words/year, but it is possible that most or all of the words were learned slowly, in parallel, over many repetitions. Vocabulary growth statistics are uninformative about either the rate of learning any single word, or about how much input preceded learning.

If data on vocabulary growth trends are in fact tangential to, or even misleading about, questions of word learning rate, other data might prove more informative. Specifically, starting with the parsimonious assumption that word learning proceeds much like other kinds of learning, a host of studies of animal and human learning suggest that the rate of learning all sorts of associations (including, perhaps, between words and referents) shows a predictable distribution, which approximates a normal curve. That is, a few items will be learned very fast, a few items will be learned very slowly, and most items will be learned over an intermediate number of exposures or repetitions. The question then becomes: does children's word learning deviate from this expected distribution? Do children learn relatively many words from very few exposures, yielding a skewed distribution of learning times? Unfortunately there is no direct evidence for the question, because few studies have tracked growth curves for word meanings over successive presentations. However, a recent study by Deák and Toney tested preschoolers' comprehension after each of four unambiguous presentations of novel words for objects. Children's accuracy after one or two exposures was modest (~45% correct; chance = 25%), rising to ~60% after three or four exposures. This suggests that fast-mapping is not unusual, nor is it inevitable. But how common is it, in general? Is it robust enough to disconfirm the prediction that word learning follows normally distributed learning rates?

The Prevalence Of Fast Mapping

Subsequent studies show a great deal of variability in children's word learning over a small number of exposures. In a handful of studies of older infants and toddlers, fast mapping appears variable and fragile. One study attempted to teach infants a single noun and verb. After more than 20 repetitions, learning was evident in fewer than one-third of 9-11 month olds, half of 12-14 month olds, and three-fourths of 15-17 month olds. Using very different methods (preferential looking), another study showed that 15 month olds looked at a named object slightly more than another object, after hearing the first object named three times. Results such as these suggest that 1-year-old infants can form perceptual biases to associate a visual stimulus with a distinctive word pattern after a few pairings, but across contexts the necessary number of pairings seems to differ widely. Also, in these studies it is unclear whether infants or toddlers learn anything beyond a weak, low level visual-auditory association.

Studies of older children also reveal highly variable fast-mapping outcomes. For example, in one study 4½ year-olds correctly identified referents of five novel words with ~33% accuracy, after 13 presentations. Other studies show better performance (~60-80% accuracy) after 2-4 presentations of a novel word. Thus, fast mapping clearly occurs, but its likelihood seems to depend greatly upon the details of the methods used, as elaborated below.

Across these variable results, is it possible to infer whether fast mapping of words is more commonly than expected, in a normal distribution of learning rates? A handful of studies directly compared children's fast-mapping of words to other kinds of information: facts, gestures, pictograms, etc. No study reported faster learning of words. One study found *slower* learning of words than facts or pictograms, by 3- to 5-year-olds. Thus, fast-mapping is not more likely for words.

What Is Mapped, And How Well?

Fast-mapping must be specified in terms of the kinds of measures used: 'learning' is a complex, multivariate construct, but in most studies, 'learning' has been estimated using an insensitive, minimally informative measure: children are shown two or more objects, including the learned referent. The other referent(s) is usually a distinctly different novel object, or perhaps a familiar object. In some studies, children could answer correctly by picking whatever object the experimenter recently pointed out or talked about. Children need not choose an object based on any specific features, or subtle distinction, or specific association with a word or phonological pattern. An exacerbating problem is that in many studies children chose between only two or three objects. Choosing the right object by chance is quite likely. Moreover, because the objects and word(s) are so distinctive, children could choose correctly if they learned only the weakest association between *any* distinctive feature of the referent and any feature of the name. In short, most fast-mapping studies use extraordinary loose criteria for 'learning.' In several studies, however, children were taught several words for several referents, and then had to pick out which referent was paired with each word. This is a better design, especially if additional experimental controls are used. However, such studies tend to report less robust fast-mapping.

Very few studies have tested whether children retain functional knowledge of fast-mapped words. Even if children can pick out the referent immediately after learning the word, if that association is not retained, it is unclear how important fast-mapping is for language learning. Two studies reported that 3- to 5-year-old children were above chance in recognizing fast-mapped objects after a delay of one to four weeks. However, another study reported that 24-month-olds forgot novel words after several minutes. Thus, fast mapped representations might be quite fragile, especially in toddlers.

Another criterion for functional knowledge is the ability to use a word productively. The few fast-mapping studies that tested children's production report very low performance, even for distinctive, easy to pronounce words. In sum, fast-mapped words seem to be fragile and of limited utility.

Some criteria for functionality remain virtually untested in studies of fast-mapping. There is almost no evidence that children generalize fast-mapped words across word forms (e.g., inflected forms), different referents, or different contexts (e.g., a different speakers or locations). Critically, there is no evidence of fast mapping in naturalistic settings. In several studies adults have taught infants or preschoolers words using controlled protocols but within relatively natural contexts (e.g., homes). These studies showed relatively slow learning. One study, for example, used a play-like interaction to teach children four novel words and the relations among them. Four- and 5-year-olds learned few words, even after 20+ exposures and multiple reminders of the defining referent features. Also, the children made many errors about the semantic relationships between words, suggesting that they often learned incorrect associations even when there was sufficient information to learn the correct relations. Children aged 6-7 years did considerably better (~75% accuracy), showing that the task was not intractable. The results suggest that in more naturally rich and complex learning contexts, young children learn words more slowly than is suggested by the results of experimental studies using maximally simplified, stripped-down teaching and testing paradigms, and low-threshold criteria for 'learning.'

Who's Fast?

Educators, researchers, and lay-people often imply that preschool-aged children are precocious language learners, acquiring new words "like sponges." Astonishingly, there are virtually no comparisons of word learning speed of preschool children and older children or adults. However, the aforementioned study shows that 6/7-year-olds are faster and more accurate word-learners than 4/5-year-olds. Also, an adult control group in Deák and Toney's study greatly outperformed 3- to 5-year-olds in learning and remembering four novel words. Thus, what little evidence there is suggests that preschool children are slower word learners than older children and adults.

Summary

In optimal conditions children as young as 2 years occasionally fast-map novel words. However, even under optimal conditions fast mapping is far from inevitable. There are several studies showing that in slightly more challenging or ambiguous tasks, children learn most words much more slowly, with many errors and imperfect representations of meaning.

Gedeon O. Deák
Department of Cognitive Science
University of California, San Diego
gdeak@ucsd.edu

See Also: Associative processes in language development, Fast mapping in lexical development, Lexical Development, Semantic development, Symbol formation, Vocabulary growth, Word learning strategies

Further Readings

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