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What's in a link: Associative and taxonomic priming effects in the infant lexicon

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ABSTRACT

Infants develop a lexical-semantic system of associatively and semantically related words by the end of the second year of life. However, the precise nature of the lexical relationships that underpin the structure-building process remains under-determined. We compare two types of lexical-semantic relationship, associative and taxonomic, using a lexical-priming adaption of the intermodal preferential looking task with 21- and 24-month-olds. Prime-target word pairs were either associatively or taxonomically related or unrelated. A further control condition evaluated the facility of a prime word, in the absence of a target word, to promote target preferences. Twenty-four-month-olds, but not 21-month-old infants, exhibited a priming effect in both associative and taxonomic conditions, pointing to the formation of a lexical-semantic network driven by both associative and taxonomic relatedness late in the second year. The pattern of priming in 24-month-olds indicates the operation of inhibitory processes: unrelated primes interfere with target recognition whereas related primes do not. We argue that taxonomic and associative relationships between words are integral to the emergence of a structured lexicon and discuss the importance of inhibitory mechanisms in shaping early lexical-semantic memory.

1. Introduction

A proper understanding of how children acquire the meaning of words involves not only an appreciation of the concepts to which words refer but also how these concepts relate to each other. If children's early lexicons are best characterised as independent listings of words and their associated concepts, then an important part of any theory of lexical development will involve an explanation of how children make a qualitative shift to the network-like organisation that characterises the adult's lexical-semantic system. If, on the other hand, children's early lexicons are already organised in a network-like fashion, then a theory of how new words are added to the system and a set of principles that specify the structure of the system is required.

Many studies of early lexical development have successfully identified the range of words that young children can understand and say (Barrett, Harris, & Chasin, 1991; Dale & Fenson, 1993; Golinkoff, Mervis, & Hirsch-Pasek, 1994; Reznick & Goldfield, 1992), specified the constraints that they use to identify the referents of words (Markman, 1990, 1994) and established the conditions under which they learn novel words (Booth, Waxman, & Huang, 2005; Pruden, Hirsh-Pasek, Golinkoff, & Hennon, 2006; Smith & Yu, 2008). Some researchers have argued that early word meanings are initially represented independently of each other (Anglin, 1970; Arias-Trejo & Plunkett, 2009; McNeill, 1970). For example, infants may be insensitive to the similarity in meaning of the words 'cat' and 'dog', even though both words may be initially used and understood correctly.

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Studies of older children have attempted to identify *when* words are integrated into a coherent semantic system. Anglin (1970) suggested that this process does not start until relatively late in development, at around 6–8 years. However, Mansfield (1977) tested children with a "false recognition" technique in which they were asked if a probe word had occurred in an immediately preceding sentence. She found that even 5-year-olds were more likely to make false recognition errors for semantically related than unrelated probe words. Mansfield concluded that 5-year-olds (the youngest children she tested) "have well-organized conceptual systems based on shared meaning components" (p. 57), indicating that lexical memory is semantically structured for these children.

Bowerman (1978) conducted a detailed analysis of spontaneous speech errors produced by her two daughters. As early as 2–4 years of age, the children occasionally substituted an intended word with one that was semantically related to it, even though the intended and substituted words had been used correctly for a substantial period. Bowerman (1978) concluded that "children's errors, like those of adults, can be interpreted as resulting from an incorrect choice among semantically related words that compete for selection in a particular speech context" (p. 979). Bowerman noted that these semantic substitutions were taken primarily from the category of verbs.

Based on evidence from free- and cued-recall tasks with pre-schoolers, Nelson and colleagues (Lucariello & Nelson, 1985; Nelson, 1985) have argued that intra-word relationships are initially formed on the basis of the event structures to which the words refer. For example, *eggs* and *cereal* might be related in the 3–4 year-old's lexical memory because they commonly occur at breakfast time. Nelson argues that this overlapping *function* predominates over more abstract, taxonomic relationships, such as *toast* and *ice-cream*, in structuring lexical memory during early childhood. In a similar vein, Petrey (1977) offers a re-analysis of Entwisle's (1966) study of childhood word associations and concludes that an episodic (thematic) to semantic shift in the system of lexical storage occurs between childhood and adulthood.

The view that episodic and functional factors constitute the core principles for the organisation of early lexical memory has not gone unchallenged. Blewitt and Toppino (1991) report a cued-recall task with 3- to 7-year olds and find no evidence of a shift from a schematic/functional/episodic to a taxonomic/semantic organisation of lexical memory over the age-range studied, and conclude that their "findings are consistent with the view that lexical memory is both schematically and taxonomically organized from early childhood" (p. 296). Waxman and Namy (1997) used a match-to-sample task in which 2-, 3- and 4-year olds were asked to choose between thematic (episodic) and taxonomic (semantic) alternatives. For example, after the experimenter picked up a carrot and labelled it, children were asked to choose between a rabbit (thematic choice) and a tomato (thematic choice). Waxman and Namy (1997) found no pervasive evidence for thematic over taxonomic choices even in the 2 year olds. Although their study did not investigate intra-word relations in young children's lexical memory (only the target object was labelled), their findings suggest that taxonomic relations have the potential to underpin the structure of lexical memory in young children.

Theoretical analyses of the structure of typical 30-month old vocabularies (Hills, Maouene, Maouene, Sheya, & Smith, 2009a, 2009b; Hills, Maouene, Riordan, & Smith, 2010) derived from CDI data (Fenson et al., 1994) and adult feature norms (McRae, Cree, Seidenberg, & McNorgan, 2005) show that these vocabularies possess the *small-world* and *scale-free* properties characteristic of adult semantic networks (Steyvers & Tenenbaum, 2005), and predict a *preferential acquisition* of new words on the basis of functional and perceptual feature overlap, frequency and phonological neighbourhoods in the learning environment. Hills et al. (2009b) argue that young children's lexical-conceptual networks have a clustering structure, based on perceptual and functional feature overlap, which resemble those found in adult taxonomic groupings. In a follow-up study, also analysing vocabulary development based on parental reports, Hills et al. (2010) argue for toddler's preferential acquisition of words based on adult associative norms. These theoretical analyses suggest that *both* semantic and associative relationships between words can mediate priming effects in the toddler lexical-semantic system. Evidence that such priming effects exist would provide support for the view that toddlers can exploit both associative and semantic relationships between lexical concepts when structuring their long-term semantic memories.

In adults and older children, the structure of the lexical-semantic system has primarily been investigated using lexical-decision or naming tasks. Pioneering work by Meyer and Schvaneveldt (1971) found that adults in a lexical decision task identified a target word (e.g., 'nurse') faster when related to a previously presented prime word (e.g., *doctor*) as compared with an unrelated word, suggesting that *doctor* and *nurse* are related in the adult lexicon. Subsequent studies with adults have found more reliable priming effects for words that are both semantically and associatively related (e.g., *dog–cat*) than for words that are only semantically (e.g., *dog–cow*) or associatively related (e.g., *dog–bone*), the so-called 'priming boost' (McRae & Boisvert, 1998; Moss, Ostrin, Tyler, & Marslen-Wilson, 1995; Perea & Rosa, 2002). These findings demonstrate that semantic and associative relatedness are factors that underpin the organisation of adult semantic memory.

In order to identify some of the structuring principles of semantic memory, considerable research effort has been expended to test whether priming effects for adults derive from purely associative effects or purely semantic effects (Alario, Segui, & Ferrand, 2000; Ferrand & New, 2003; Hodgson, 1991; McRae & Boisvert, 1998; Perea & Rosa, 2002; Thompson-Schill, Kurtz, & Gabrieli, 1998). Existing findings indicate that both types of effects are present: priming effects of semantic relations in the absence of normative association have been detected (Ferrand & New, 2003; Fischler, 1977; McRae & Boisvert, 1998; Thompson-Schill et al., 1998); priming for associated words in the absence of semantic relations have also been found (Ferrand & New, 2003; Hodgson, 1991; Williams, 1996). Different meta-analyses have also attested to the variability in these results. For example, Hutchison (2003) suggested that automatic priming is due to both associative strength and semantic feature