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Development of category-based reasoning in 4- to 7-year-old children: The influence of label co-occurrence and kinship knowledge

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ABSTRACT

Category-based reasoning is central to mature cognition; however, the developmental course of this ability remains contested. One strong indicator of category-based reasoning is the propensity to make inferences based on semantically similar labels. Recent evidence indicates that in preschool-age children the effects of semantically similar labels are limited to a small subset of labels that co-occur in child-directed speech, suggesting that performance with these labels may reflect lexical priming rather than category-based reasoning. However, most co-occurring labels used in prior research refer to offspring–parent relationships (e.g., *puppy–dog*). Thus, it is possible that children in previous research performed induction by relying on kinship rather than co-occurrence information. To address this possibility, the current studies examined the role of kinship knowledge and label co-occurrence in induction in 4- to 7-year-old children and adults. The results point to a gradual age-related increase in the ability to spontaneously rely on kinship knowledge when making inferences.

Introduction

Category-based reasoning is central to mature cognition and underlies much of our learning and functioning in the world (e.g., Heit & Rubinstein, 1994; Osherson, Smith, Wilkie, Lopez, & Shafir, 1990; Sloman, 1993; Yamauchi & Markman, 2000). For example, on learning that English Setters have 39 pairs of chromosomes, we may conclude (without explicitly being told) that Dalmatians also have

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39 pairs of chromosomes because English Setters and Dalmatians are the same kind of animal (i.e., both are a kind of dog). However, the developmental course of this fundamental ability remains contested.

A considerable body of prior research suggests that young children, including infants, are capable of spontaneous category-based reasoning and that category labels promote this type of reasoning (Gelman, 1988; Gelman & Coley, 1990; Gelman & Markman, 1986; Jaswal, 2004; Jaswal & Markman, 2007; Welder & Graham, 2001). The strongest evidence in support of this possibility comes from a study demonstrating that preschool-age children make inferences based not only on identical category labels but also on semantically similar labels (henceforth referred to as *synonyms* for brevity) (Gelman & Markman, 1986). In that study, children were presented with a triad of objects and provided with respective category labels. For example, children could be presented with a rabbit (target item), a squirrel (Test Item 1) that was designed to look similar to the target, and another rabbit (Test Item 2) that was designed to look dissimilar from the target. Children were told about the properties of each test item (e.g., the rabbit eats grass and the squirrel eats bugs). Children were then asked to generalize one of these properties to the target item. Importantly, similarity in category membership was conveyed either by identical labels (e.g., *rabbit–rabbit*) or by synonymous labels (e.g., *bunny–rabbit*). The results indicated that the rate of category-based inferences was above chance in both conditions (i.e., 67% with identical labels and 63% with synonymous labels), suggesting that children use category labels to guide their inductive inferences.

However, recent findings (Fisher, 2010; Fisher, Matlen, & Godwin, 2011) suggest that preschoolers' ability to make inferences using synonyms is limited to a small set of words that not only share meaning but also co-occur in child-directed speech. For example, Fisher et al. (2011) revisited the question of whether young children engage in category-based reasoning with synonymous labels by analyzing children's responses separately for co-occurring synonyms (e.g., *puppy–dog, kitty–cat*) and non-co-occurring synonyms (e.g., *crocodile–alligator, mouse–rat*). Consistent with the possibility that children's performance in earlier studies stemmed from label co-occurrence rather than semantic similarity, the results of that study indicated that most 4-year-olds performed at above chance in making category-based inferences with co-occurring synonyms, but these same children did not systematically select category choices when presented with non-co-occurring synonyms.

Fisher et al. (2011) hypothesized that these effects stemmed from lexical priming. Specifically, prior research suggests that co-occurrence plays an important role in the formation of lexical associations (Brown & Berko, 1960; McKoon & Ratcliff, 1992; Spence & Owens, 1990). Strong lexical associations between co-occurring labels may facilitate inductive generalization via priming. For example, when children are asked whether a "bunny" shares a property with a "rabbit" or a "squirrel," they may select the category match (i.e., "bunny") due to lexical priming rather than category-based reasoning. Based on current evidence, the co-occurrence hypothesis offers a plausible explanation for the observed pattern of results.

However, there is an alternative explanation consistent with the notion that young children are capable of engaging in category-based reasoning with semantically similar labels. Prior studies have identified only a few semantically similar labels that not only are familiar to preschool-age children but also co-occur in child-directed speech in the English language according to the CHILDES database (MacWhinney, 2000). Incidentally, these words can be construed as referring to offspring–parent relationships (e.g., *puppy–dog, kitty–cat, bunny–rabbit*).[1] Therefore, it is possible that children's induction with these labels is driven by the knowledge of kinship information rather than label co-occurrence. In other words, children may spontaneously engage in category-based reasoning when they are

[1] Although *kitty* and *bunny* are not labels exclusively used for baby animals, these labels are often used to refer to the young of these species. For instance, the Merriam–Webster dictionary defines bunny as a "rabbit; especially young rabbit" and kitty as a "cat; especially kitten." Common use of these words seems consistent with the dictionary definitions; a Google picture search using the term "bunny" yielded 74 animal images of which 62% depicted young rabbits, and a search using the term "kitty" yielded 79 animal images of which 49% depicted kittens. Conversely, a Google picture search using the term "rabbit" yielded 151 animal images of which 80% depicted mature rabbits, and a search using the term "cat" yielded 214 animal images of which 74% depicted mature cats. Therefore, it is reasonable that children may interpret bunny and kitty as words that refer to the young of the species.