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Linguistic cues are privileged over non-linguistic cues in young children's categorization☆

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ABSTRACT

Language affects the way that humans build categories. When two objects share a verbal label, children and adults are encouraged to group them together. In the present study, we offer a stringent test of the potency of labels by comparing them to non-linguistic cues that have been matched in terms of critical properties. In Experiment 1, Four-year-old children were given two categorization tasks with novel natural kinds and artifacts. In both tasks, we compared the effectiveness of novel Labels like *zeg* and equally discriminable, intentionally introduced patterned Frames. In Experiment 2, we included pretest trials before each of the tasks to ensure children's awareness of the cues. We observed a pervasive advantage of Labels over Frames in both experiments. Our results offer some of the strongest evidence to date for the conclusion that young children prioritize labels over superficially equipotent non-linguistic cues when drawing category boundaries.

It is well known that language affects the way that humans build categories. At just a few months of age, the presence of verbal labels helps infants to form a category of objects where they otherwise would not, despite the fact that very little linguistic ability is present at this stage of development (Fulkerson & Waxman, 2007; Balaban & Waxman, 1997; Ferry, Hespos, & Waxman, 2010; Graham, Kilbreath, & Welder, 2004; Waxman & Markow, 1995). More sophisticated language users – preschool-aged children – continue to benefit from the presence of verbal labels: young children are likely to extend a novel property from one exemplar to another with a shared label in an induction task (Gelman & Markman, 1986, 1987; Davidson & Gelman, 1990; Gelman & Coley, 1990; Childers & Tomasello, 2003; Sloutsky & Fisher, 2004; Sloutsky, Kloos, & Fisher, 2007; Gelman & Davidson, 2013) and believe on the basis of a shared label that two objects belong together (Diesendruck & Peretz, 2013; Johanson & Papafragou, 2016; Sloutsky, Lo, & Fisher, 2001). Labels seem to facilitate categorization more so than other cues beginning at just a few months of life. In one study, three-month-old infants formed a category of dinosaurs when the exemplars were presented with labels, but not when they were presented with tones (Ferry et al., 2010). Similar results have been found with six- to twelve-month-old infants (Fulkerson & Waxman, 2007), even though younger infants are less selective (Ferry et al., 2010).

Although the strongest evidence for the unique role of language in categorization comes from these comparisons of labels with other, non-linguistic cues, such comparisons are unavailable for older children. This presents an important gap in our knowledge about how children use language to guide category formation because there are ongoing debates concerning the precise mechanisms underlying preschoolers' use of labels in category formation (Davidson & Gelman, 1990; Gopnik & Sobel, 2000; Sloutsky et al., 2001; Booth & Waxman, 2002; Sloutsky et al., 2007; Sloutsky & Fisher, 2004). Proponents of *Conceptual* accounts argue that even young children treat linguistic labels as conceptual category markers (e.g., Gelman & Markman, 1986; Diesendruck & Peretz, 2013; Gelman

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& Davidson, 2013). On these accounts, young children understand, for instance, that count nouns can be used to refer to objects, and objects that share a label also share underlying unobservable properties (i.e., belong to the same category). According to *Attentional/Perceptual* accounts, linguistic labels are external cues that serve to draw children's attention to relevant details of the stimuli, highlighting similarities and differences among them (e.g., Jones, Smith, & Landau, 1991; Sloutsky et al., 2001; Smith, 2005; Sloutsky et al., 2007). Such accounts argue that children do not treat verbal labels as signals of underlying conceptual category structure, but take language to enhance attention to relevant object features. These two accounts make different predictions about how linguistic labels should fare compared to other cues. Conceptual accounts predict an advantage of labels over non-linguistic cues, while Attentional/Perceptual accounts predict that non-linguistic cues will function just as well as linguistic labels as cues for categorization as long as such non-linguistic cues are perceptually equivalent to the labels.

A related issue that bears on the debate about whether children treat labels as conceptual or perceptual/attentional cues is that existing comparisons of the potency of linguistic and non-linguistic cues for categorization have not typically equated the two types of cue for discriminability. Labels may exert a greater effect on categorization simply because two labels might be perceived as being more distinct from one another than, for instance, two tones; as a result, labels might more clearly signal a contrast between members and non-members of a particular category. Similarly, linguistic and non-linguistic cues have not typically been equated for intentionality. Verbal labels, unlike non-linguistic cues, are typically communicated by the experimenter and hence are bound to appear more intentional, and therefore more relevant for the task, than other cues. In support of the role of intentionality, infants have been found to ignore labels produced by a non-human source such as a baby monitor (Campbell & Namy, 2003; Fulkerson & Haaf, 2003) and make use of non-linguistic cues when they appear to be part of a conversation (Ferguson & Waxman, 2016). In a further recent demonstration with older learners, novel labels ('It's a zeg!') were found to be as potent as linguistically communicated facts ('It drinks milk!') in shaping four-year-old children's categorization of novel animals and plants (Johanson & Papafragou, 2016; cf. also Diesendruck & Peretz, 2013).

In sum, it is an open question whether young children prioritize linguistic labels when forming novel categories compared to perceptually comparable, intentional non-linguistic cues. The present study fills this gap in the literature by comparing the effectiveness of linguistic cues (novel verbal Labels like *zeg*) and non-linguistic cues (patterned, geometric Frames that surround each to-be-categorized object) in four-year-olds' categorization decisions. Unlike past work, we took steps to equate linguistic and non-linguistic cues for discriminability to guard against low-level differences in responses to stimuli. Additionally, we took steps to equate the two types of cues for intentionality: the experimenter drew children's attention to the Labels and Frames in a similar manner, such that both types of cues were presented as intentional. Of interest is whether language would still hold a special status in categorization (in line with Conceptual but not Perceptual/Attentional accounts). If so, children should make greater use of Labels than Frames in a categorization task despite these steps.

In a further departure from prior studies that have typically focused on a single class of stimuli (e.g., novel animals), we explore the role of Labels and Frames across two categorization tasks: one with novel man-made artifacts (mostly tools) and one with unfamiliar exemplars of natural kinds (mostly animals and plants). By replicating the task across two domains, we can determine whether the effects of labels and other cues generalize to any type of stimuli, or whether labels might hold a special status for a limited class of stimuli. For example, some theorists expect a difference in children's cue use across domains because of beliefs children might reasonably hold about category structure. Specifically, some hypothesize that the influence of labels should be greatest for artifact categories but more restricted for natural kinds (e.g., Rhodes & Gelman, 2009) because natural kinds like plants and animals are believed to have "essences," undefinable but biological internal properties that define strict category boundaries (e.g., Atran, 1990; Gelman, 2013). Man-made artifacts, on the other hand, are typically categorized according to creator intent, function, and other social information and might thus be more susceptible to influences from labels or other intentional cues (Bloom, 1996; Margolis & Laurence, 2007). Some support for this position comes from a recent study in which five-year-olds used labels more actively to categorize novel artifacts than novel animals (Diesendruck & Peretz, 2013). Nevertheless, because the labels were not compared to other cues, it is not clear whether this effect was selectively due to the presence of labels or whether similar results might have been obtained with different (e.g., non-linguistic) cues.

In line with previous developmental research, we use a strong test of the efficacy of linguistic and non-linguistic cues by manipulating whether perceptual similarity in the stimuli was consistent, inconsistent or uninformative (ambiguous) with respect to the groupings indicated by these cues. Previous research has found complex interactions between perceptual similarity and the facilitative effects of labels. A label may encourage children to group perceptually dissimilar objects together (Gelman & Markman, 1986, 1987) or draw category boundaries for perceptually ambiguous objects (Johanson & Papafragou, 2016), although the influence of labels may not completely override perceptual similarity (Sloutsky et al., 2001, 2007; Sloutsky & Fisher, 2004; Gelman & Davidson, 2013). For present purposes, children should be more likely to group two objects together as perceptual similarity between the objects increases regardless of the cue (Label, Frame) that the objects might share. However, if language is privileged in children's categorization decisions, Labels (but not Frames) should exert an influence beyond perceptual similarity alone.

1. Experiment 1

Experiment 1 investigated children's spontaneous use of linguistic and non-linguistic cues in forming novel artifact and natural kind categories.

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