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Preschool-age children and adults flexibly shift their preferences for auditory versus visual modalities but do not exhibit auditory dominance

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ABSTRACT

The goal of this study was to evaluate the claim that young children display preferences for auditory stimuli over visual stimuli. This study was motivated by concerns that the visual stimuli employed in prior studies were considerably more complex and less distinctive than the competing auditory stimuli, resulting in an illusory preference for auditory cues. Across three experiments, preschool-age children and adults were trained to use paired audio–visual cues to predict the location of a target. At test, the cues were switched so that auditory cues indicated one location and visual cues indicated the opposite location. In contrast to prior studies, preschool-age children did not exhibit auditory dominance. Instead, children and adults flexibly shifted their preferences as a function of the degree of contrast within each modality, with high contrast leading to greater use.

Introduction

Understanding and explaining children's induction and categorization behaviors are important goals for developmental psychologists. Two broad approaches—one focusing on associative and similarity-based processes and the other focusing on children's theories—are at the center of an ongoing debate (e.g., Gelman & Waxman, 2009; Sloutsky, 2009). Similarity-based and associative learning approaches suggest that basic cognitive and perceptual processes, such as the ability to detect statistical regularities (Rakison, 2004) and judge perceptual similarity (Sloutsky & Napolitano, 2003), are sufficient to guide children's categorization and induction. In contrast, theory-based approaches argue

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that children also make use of domain-specific knowledge, ontologies, causal relations, and nonobvious properties (Carey, 2009; Gelman, 2003; Gopnik & Sobel, 2000; Wellman & Gelman, 1998).

One key point of contention concerns the role of category labels. Hearing the same label for two items increases the likelihood that children (and adults) will generalize information from one item to the other (Balaban & Waxman, 1997; Gelman & Coley, 1990; Gelman & Markman, 1986, 1987; Sloutsky & Fisher, 2004; Xu, Cote, & Baker, 2005). Yet there are at least two possible explanations for this result. One possibility is that conceptual similarity guides the effect. On this view, the label conveys information regarding category membership, and items from the same category are assumed to share many important features. Evidence in support of this interpretation is that the same effect holds when synonyms are used (Gelman & Markman, 1986, Study 2) or when conceptual similarity is detectable by subtle featural cues (Gelman & Markman, 1987, picture-only condition). Furthermore, when children hear nonlinguistic sounds (e.g., tones, emotional expressions) rather than linguistic labels, children do not make use of them to guide their categorization (Balaban & Waxman, 1997; Fulkerson & Waxman, 2007; Xu, 2002; Xu et al., 2005).

In contrast, an alternative possibility is that the labeling effect is due to perceptual similarity (Sloutsky & Fisher, 2004; Sloutsky, Fisher, & Lo, 2001; Sloutsky & Lo, 1999). In one prominent similarity-based model, the SINC (similarity, induction, naming, and categorization) model, labels are perceived as perceptual features of objects, and items with the same label are judged to be more similar to one another than are items that are unlabeled or that receive different labels. Moreover, the model stipulates that young children find auditory cues to be more salient than visual cues (Napolitano & Sloutsky, 2004; Robinson & Sloutsky, 2004; Sloutsky & Napolitano, 2003). Thus, labels affect children's inferences because they are auditory cues and, therefore, have greater perceptual salience.

The current article does not examine the SINC model in general but rather examines the foundational claim that auditory cues are more salient than visual cues for young children. In prior research testing the auditory dominance theory, young children were presented with stimuli with both auditory and visual components, and the relative salience of the two cues was tested (Napolitano & Sloutsky, 2004; Robinson & Sloutsky, 2004; Sloutsky & Napolitano, 2003). Specifically, a modified switch design was employed (e.g., see Werker, Cohen, Lloyd, Casasola, & Stager, 1998) that trained participants to use cross-modal cues to complete a task. Visual and auditory stimuli were paired (e.g., a visual display including a circle, a pentagon, and a triangle might be paired with a burst of white noise), and each pair reliably indicated that a target stimulus would appear at a certain location (e.g., one target appeared on the right side of the computer screen and another target appeared on the left side of the screen). At test, conflicting cues were presented so that one modality indicated that the target was in one location and the other modality indicated that the target was in the other location. Participants did not receive feedback, so they could only rely on a preferred modality to predict the target's location. In two sets of studies, 4-year-olds displayed an auditory preference, whereas adults showed a visual preference (Robinson & Sloutsky, 2004; Sloutsky & Napolitano, 2003). Napolitano and Sloutsky (2004) expanded on these results by exploring the mechanisms that might underlie auditory dominance in children, concluding that children exhibit "a default auditory dominance" (p. 1869) when stimuli are unfamiliar but that the pattern can reverse when the visual stimuli are familiar.

Before concluding that children overall are biased to attend to auditory cues, however, it is important to demonstrate that the stimuli provide a fair test by including cues that are as evenly balanced between the two modalities as possible. One can readily imagine tests in which the two modalities are not evenly balanced. For example, if one were to compare an "easy" auditory distinction (e.g., a pleasant bell tone vs. a loud undulating siren) with a "hard" visual distinction (e.g., two different paintings of water lilies by Monet), it might not be surprising to find that people show an auditory preference. In contrast, if one were to compare a "hard" auditory distinction (e.g., two musical tones played on a synthesizer < 0.5 decibels apart in volume) with an "easy" visual distinction (e.g., a small black dot vs. a large red star), people might then show a visual preference. In other words, intuition suggests that some comparisons may be more balanced than others.

Pretesting in prior experiments demonstrated that the stimulus sets used were individually discriminable (i.e., listeners could tell the difference between the two stimuli within a given modality), but this does not mean that the contrasts between stimuli within a given modality were of the same magnitude between stimuli across modalities. For example, both a small contrast in visual stimuli and