Children's use of comparison and function in novel object categorization ☆

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A B S T R A C T

Although young children often rely on salient perceptual cues, such as shape, when categorizing novel objects, children eventually shift towards deeper relational reasoning about category membership. This study investigates what information young children use to classify novel instances of familiar categories. Specifically, we investigated two sources of information that have the potential to facilitate the classification of novel exemplars: (1) comparison of familiar category instances, and (2) attention to function information that might direct children's attention to functionally relevant perceptual features. Across two experiments, we found that comparing two perceptually similar category members—particularly when function information was also highlighted—led children to discover non-obvious relational features that supported their categorization of novel category instances. Together, these findings demonstrate that comparison may aid in novel object categorization by heightening the salience of less obvious, yet functionally relevant, relational structures that support conceptual reasoning.

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Introduction

The ability to form categories rapidly is a fundamental attribute of human cognition that involves remarkable flexibility and requires surprisingly few exemplars. Take, for example, a Dalmatian. We readily categorize a Dalmatian as a *dog*, along with German Shepherds, Chihuahuas, and Poodles despite their obvious differences in size, shape, and color. However, with just as much ease, we exclude cows from the category *dog* even though cows and Dalmatians each have four legs, a tail, and similar black spots and are both considered *animals*. This apparent insufficiency of perceptual similarity as a diagnostic basis for category membership raises a series of important questions about conceptual development: How do children form object categories and, critically, how do they learn to revise these categories to incorporate new information and accommodate novel instances? This is an especially challenging endeavor in cases in which novel instances do not perceptually resemble familiar category members. For example, when children encounter a bean bag chair for the first time, what cues do they use to classify it as something to sit on despite its irregular, non-canonical shape?

It is clear that young children often rely on surface-level perceptual features, such as shape, as a basis for categorization early in development (Baldwin, 1989; Landau, Smith, & Jones, 1988; Smith, Jones, Landau, Gershkoff-Stowe, & Samuelson, 2002). However, it is unclear *how* children recruit perceptual information in the service of category formation, particularly in cases where shape is not diagnostic of category membership and therefore not a useful heuristic. It may be that children initially rely heavily on features such as shape as a basis for categorizing by virtue of their salience and then iteratively refine the perceptual bases for their categorization based on information gleaned through experience about how perceptual features correspond to and support object functions. Alternatively, children may recognize early on that perceptual features are often correlated with object function and goal-based actions (Kelemen, Seston, & Saint Georges, 2012; McCarrell & Callanan, 1995; Ware & Booth, 2010). If this is the case, then perceptual features may serve as a sound basis for categorizing by virtue of their relation to an object's function. For example, children may learn that a horizontal surface that provides structural support for sitting is more informative when identifying whether an object is a chair than its overall shape.

The goal of this investigation was to explore how children incorporate unknown objects into their developing conceptual systems. Specifically, we investigated how children incorporate new category instances (e.g., a bean bag chair) into their existing object categories (e.g., chairs). We consider two mechanisms by which children may use perceptual information to identify taxonomically relevant properties to form rich conceptual categories that extend beyond object shape. First, children may utilize comparison across category exemplars to identify functional affordances and structural relations that support category membership. Another possibility is that children may independently detect and base their categorization on perceptually relevant features that afford function. Both of these mechanisms have evidence in the literature to support them.

Comparison

Comparing two or more category instances facilitates children's ability to detect and utilize taxonomically relevant yet perceptually subtle object properties. Gentner and Namy (1999; Namy & Gentner, 2002) demonstrated that four-year-olds who are given opportunities to compare perceptually similar, familiar category members reliably generalize categories based on conceptually relevant features that go beyond overall shape. For instance, comparing two similarly-shaped, familiar objects (e.g., a bicycle and a tricycle) led four-year-olds to inhibit attention to a shape match (e.g. a pair of glasses) as a basis for categorization and instead extend category membership to familiar objects that share relational properties such as function or role (e.g., a skateboard). However, when children saw only one exemplar (e.g., a bicycle), they extended category membership predominantly to the shape match. Comparison has also been shown to facilitate the discovery of non-obvious perceptual commonalities (e.g., texture) among geometric objects (Graham, Namy, Gentner, & Meagher, 2010), of key perceptual parts (e.g., wings) that are necessary for performing specific functions (e.g., flying;