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Animals, foods, and household items—oh my! Evidence of 24-30-month-old children's increasing flexibility in word learning from naturalistic data

At 18 months of age, children frequently generalize (and overgeneralize) novel objects' labels by shape (Landau et al., 1988). However, data from laboratory studies using ostensive word-learning paradigms indicate that, by three years of age, children generalize the labels of novel objects depending on the objects' perceptual characteristics and taxonomy (Lavin & Hall, 2001; Jones et al., 1991). The current study sought to document this shift in children's word-learning strategies using naturalistic data. We tracked children's vocabularies over a six-month period of time (between 24-30 months of age) and classified their known words according to perceptual organization of the object categories to which they refer (e.g., shape-based, material-based). Children's vocabulary sizes and rates of growth varied in meaningful ways between types of object categories and between the superordinate categories (e.g., animals, toys) to which the object categories belong. Findings carry implications for two popular accounts of vocabulary acquisition.

Key words: categorization, word learning, vocabulary acquisition

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The current study explored how children's word-learning strategies become more numerous and diverse over time. In the earliest stages of vocabulary acquisition, children's approach to word learning can be quite rigid. At approximately 18 months of age, they frequently generalize labels for novel objects by shape rather than other perceptual features that are equally plausible as referents—a tendency called the *shape bias* (Jones et al., 1991; Landau et al., 1988; Imai & Gentner, 1997; Smith et al., 2002). The shape bias serves as an effective word-learning strategy—at least initially. Many of the words young children hear, and are therefore tasked with learning, refer to basic-level categories of objects that are organized by shape—that is, categories for which shape is common among most or all members (e.g., “ball,” “book;” Sandhofer et al., 2000). However, not all object categories are organized by shape (Bloom, 1973; Bowerman, 1978; Carey, 1978; Gelman, 1988; Imai & Gentner, 1997; Samuelson et al., 2008; Samuelson & Smith, 1999; Soja et al., 1991; Subrahmanyam et al., 1999). In fact, the perceptual organization of basic-level object categories appears to vary systematically according to the superordinate category to which they belong. For example, the superordinate category of animals appears to encompass numerous basic-level object categories organized by shape and/or texture (Booth & Waxman, 2002a; Booth & Waxman, 2002b; Booth et al., 2005; Jones & Smith, 1998; Jones et al., 1991; Shutts, Markson et al., 2009) whereas the superordinate category of foods appears to encompass numerous basic-level object categories organized by material/texture (Lavin & Hall, 2001; Macario, 1991; Santos et al., 2002). Generalizing labels for members of these superordinate categories by shape—or only by shape—is a less effective word-learning strategy.

By 36 months of age, children have numerous labels for members of many different superordinate categories in their productive vocabularies (Fenson et al., 2007). How do they come to learn these words? They appear to develop multiple-category specific word-learning strategies: They generalize the labels of novel objects from different superordinate categories by different perceptual features (Booth & Waxman, 2002a; Imai et al., 1994; Jones & Smith, 1998; Jones et al., 1991; Keil, 1994; Lavin & Hall, 2001; Macario, 1991; Samuelson et al., 2008; Santos et al., 2002). The evolution of children's word-learning strategies has been documented using ostensive word-learning paradigms conducted in laboratory settings (e.g., Jones & Smith, 1998; Jones et al., 1991). Typically, these studies compare younger and older children's generalization of labels for experimenter-created novel objects. In contrast, we explored the content of children's vocabularies developing over a six-month period of time. In other words, whereas previous research has focused on the beginning and the end of a given period, we focused on the course children take. The words that children know and learn can speak to the word-learning strategies they currently utilize; They can also predict which word-learning strategies they will soon develop (Gershkoff-Stowe & Smith, 2004; Samuelson & Smith, 1999). Thus, our analyses

had the ability to shed new light on the evolution of children's word-learning strategies as well as to supplement the findings of existing research.

The Evolution of Children's Word-Learning Strategies

Many studies have documented two-year-old children's tendency to generalize novel objects' labels by shape (Clark, 1973; Graham & Poulin-Dubois, 1999; Hupp, 2015; Imai et al., 1994; Jones et al., 1991; Landau et al., 1988; Samuelson & Horst, 2007; Smith et al., 1992; but cf. Diesendruck & Bloom, 2003; Diesendruck et al., 2003; Booth et al., 2005; Kemler Nelson et al., 2000; Soja et al., 1991). For example, Landau et al. (1988) provided a classic demonstration of the shape bias. In a word-generalization task, the authors asked two- and three-year-old children and adults if the labels of novel objects (e.g., "dax") also referred to shape-match, size-match, or texture-match test objects. The researchers found that all participants generalized the objects' labels by shape more frequently than by size or texture; however, this preference for shape increased in strength and generality between two and three years of age, and more markedly between early childhood and adulthood.

In the laboratory, the shape bias has been observed in ostensive word-learning paradigms (Booth et al., 2005; Diesendruck & Bloom, 2003; Imai et al., 1994; Jones et al., 1991; Samuelson & Horst, 2007; Smith et al., 1992), as well as in children's spontaneous labeling of objects (Samuelson & Smith, 2005). It is also manifested within the content of children's vocabularies (Gershkoff-Stowe & Smith, 2004; Samuelson & Smith, 1999). Samuelson and Smith (1999) classified a subset of words from the MacArthur-Bates Communicative Developmental Inventory (MCDI), a normative measure of 15- to 30-month-old children's vocabularies (Fenson et al., 2007). To do so, they asked adult participants to rate the words in the corpus according to the perceptual similarity of their referents. For example, for the word "book," participants were asked to think of all books and to determine if they are similar in shape, material, and color (or some combination thereof). A category of objects was classified as being organized by shape, material, and/or color if a sufficient number of participants were in agreement regarding the feature or features common among members. By tallying the frequency of each type of classification, they found that more words in the corpus refer to shape-based object categories than to object categories based on material or color. Next, they used the classifications to code the content of 17- to 32-month-old children's vocabularies (as measured by the MCDI). They also measured the strength of children's shape bias in an ostensive word-learning paradigm. They found that children's attention to shape increased as a product of their shape vocabulary sizes (i.e., the number of words they knew referring to shape-based object categories).

Similarly, Gershkoff-Stowe and Smith (2004) classified the first 100 nouns learned by children between the ages of 17 and 21 months. Children's vocabularies

were measured via parental daily diary every three weeks, starting before children knew more than 25 nouns and concluding when they knew between 75 and 100 nouns. Children also participated in an ostensive word-learning paradigm at each measurement interval. The authors found that, regardless of children's noun vocabulary sizes, their vocabulary growth for count nouns was faster than their vocabulary growth for other noun types (e.g., mass nouns). Count nouns refer to solid, discrete, and thus, "countable" objects (e.g., "book") and the vast majority of them refer to shape-based object categories (Gershkoff-Stowe & Smith, 2004; Samuelson & Smith, 1999). In contrast, mass nouns refer to nonsolid, continuous entities (e.g., "butter," "cereal"). Fewer mass nouns refer to shape-based object categories. They also found that the strength of children's shape bias increased as a product of their count noun vocabulary size. Indeed, it was only after children had acquired sizable shape vocabularies that they began exhibiting a pronounced shape bias. The authors argued that exposure to the regularities of shape among referents of early-learned words had "tuned" children's attention to shape in label-learning contexts, resulting in the behavior associated with the shape bias.

Taken together, the results of these studies suggest that most of children's earliest learned words refer to shape-based object categories and that their shape vocabulary size predicts the strength of their shape biases. More broadly, they suggest that the content of children's vocabularies is closely tied to their behavior in ostensive word-learning contexts. The words they have learned are both a measure of—and a factor influencing—the way they approach learning new words.

In many instances, generalizing novel objects' labels by shape is an effective word-learning strategy (Smith, 2000)—especially in the early stages of vocabulary acquisition, when parents frequently label members of shape-based categories when speaking to their children (Sandhofer et al., 2000). In support of this idea is the finding that increased attention to shape in label-learning contexts predicts a period of rapid vocabulary growth (Gershkoff-Stowe & Smith, 2004; Smith et al., 2002). However, shape is not the only feature that organizes categories of objects (Bloom, 1973; Bowerman, 1978). Although categories of solid, manmade objects (i.e., artifacts) tend to be organized by shape, categories of deformable objects tend to be organized by material or other perceptual features (Carey, 1978; Gelman, 1988; Imai & Gentner, 1997; Samuelson et al., 2008; Samuelson & Smith, 1999; Soja et al., 1991; Subrahmanyam et al., 1999). There appears to be even greater variability of perceptual organization between superordinate categories—that is, the broad, higher-level categories (e.g., animals, foods, vehicles, etc.) that encompass specific, basic-level object categories (e.g., cats, apples, bicycles, etc.). Some research (e.g., Booth & Waxman, 2002a; Booth & Waxman, 2002b; Booth et al., 2005; Jones & Smith, 1998; Jones et al., 1991; Shutts, Markson et al., 2009) suggests that the superordinate category of animals is organized by shape and/or texture. Other research (e.g., Lavin & Hall, 2001; Macario, 1991; Santos et al., 2002) suggests that the superordinate category of foods is organized by color and material. Finally, the superordinate category of

vehicles appears to be organized not by perceptual features alone, but by the functions those features afford category members (Mandler, 1992; Rakison & Poulin-Dubois, 2001, 2002).

Over time, children begin generalizing novel objects' labels by shape more judiciously (Booth & Waxman, 2002a; Imai et al., 1994; Jones & Smith, 2002; Jones & Smith, 1998; Jones et al., 1991; Keil, 1994; Lavin & Hall, 2001; Macario, 1991; Samuelson et al., 2007; Santos et al., 2002, but cf. Shutts, Condry et al., 2009). Jones et al. (1991) demonstrated developmental differences in two- and three-year-old children's attention to shape when generalizing the labels of animate and inanimate objects. The researchers labeled novel objects for participants and asked them whether or not the labels also referred to test objects that matched the target object in shape, texture, or both shape and texture. In some instances, the objects had eyes as a cue to animacy. In the others instances, the objects had no eyes, and thus, no cues to animacy. They found that two-year-old children generalized the objects' labels by shape whether or not animacy was cued. In contrast, three-year-old children generalized the objects' labels by shape and texture when animacy was cued but by shape only when animacy was not cued.

Lavin and Hall (2001) demonstrated differences in three-year-old children's attention to shape when generalizing the labels of toys and foods. The authors manipulated children's understanding of labeled novel objects' superordinate categories by saying that they liked to either "play with" them or "eat" them. In some instances, the objects were solid (e.g., made of wax); in other instances, the objects were nonsolid (e.g., made of Vaseline). The researchers then asked children to choose another referent of the label from a set of two test objects: one that matched the target object in material, but not in shape, and one that matched the target object in shape, but not color, texture, or smell. They found that children generalized the labels of toys more frequently by shape than they did the labels of foods. Furthermore, although children generalized the labels of solid objects by shape more frequently than they did the labels of nonsolid objects, this pattern was less pronounced for the labels of foods. According to the researchers, this suggests that children's understanding of the novel objects' superordinate category counteracted the influence of solidity on children's label generalization.

Taken together, the findings of Lavin and Hall (2001) and Jones et al. (1991) suggest that, between two and three years of age, children become sensitive to differences in the perceptual organization of superordinate categories and adapt their word-learning strategies accordingly.

Current Study and Objectives

The evolution of children's word-learning strategies has been well documented in the laboratory, but less so outside of it. This is true even though analyses of the content of children's vocabularies have provided unique insight into the development of children's word-learning strategies and testable predictions for

experimental studies (Gershkoff-Stowe & Smith, 2004; Samuelson & Smith, 1999; Smith et al., 2002). Do the words that children know and learn reflect the waning of the shape bias just as they reflect its onset? Do they reflect the development of any other word-learning strategies? What more can we learn from close analyses of children's vocabularies at this later stage of vocabulary acquisition? These are the questions we sought to answer.

We know that children typically produce labels for members of many different superordinate categories by 30 months of age (Fenson et al., 2007). In the current study, we tracked how children add these words to their vocabularies. Our primary objective was twofold: (a) to compare children's vocabulary sizes and growth between seven superordinate categories; and (b) to explore the types of words children learned within and across these categories. To this end, we measured eight children's vocabularies within the seven categories at three- to four-week intervals over the course of six months, beginning when they were 24 months of age and ending when they were 30 months of age. We made our comparisons according to age rather than overall vocabulary size to be consistent with existing research suggesting that children's word-learning becomes more flexible between two and three years of age (e.g., Jones et al., 1991; Lavin & Hall, 2001). However, we did explore differences according to overall vocabulary size in our analyses.

It has been proposed that the shape bias is specific to certain experimental paradigms, appearing only when certain objects and linguistic cues are used (Bloom, 2000; Diesendruck & Bloom, 2003). However, analyses of the content of children's vocabularies (e.g., Gershkoff-Stowe & Smith, 2004; Samuelson & Smith, 1999) have indicated that the phenomenon is also exhibited in naturalistic settings—and even identified possible factors driving its development. These studies have contributed uniquely to our understanding of the shape bias; the current study had the potential to do the same for our understanding of other word-learning strategies.

We focused on the superordinate categories of animals, body parts, clothing, foods, small household items, toys, and vehicles based on their apparent diversity in perceptual organization. However, our secondary objective was to verify the perceptual similarity among members of the categories rather than relying on assumptions about them. Using the ratings of adult participants, we classified the words in our vocabulary measure as labels for shape-based, material-based, color-based, or ambiguously organized object categories. These classifications then informed our other comparisons, providing insight into the perceptual cues that children are exposed to/attending to when learning labels for members of each superordinate category, and more generally, how the superordinate categories might be organized. For example, if “ant,” “bear,” and “cat” are classified as referring to categories of objects that are based on shape and/or texture, then we might extrapolate that the superordinate category of animals is organized by shape and texture.

Our current understanding of the perceptual organization of various

superordinate categories comes from a body of research with diverse methodologies (Jones et al., 1991; Lavin & Hall, 2001; Macario, 1991; Santos et al., 2002; cf. Booth & Waxman, 2002a; Booth & Waxman, 2002b; Booth et al., 2007). Some studies have used ratings of adult participants as a basis for classifying superordinate categories (Colunga & Smith, 2000; Gershkoff-Stowe & Smith, 2004; Jones et al., 1991; Samuelson & Smith, 1999; Jones & Smith, 2002). Other studies have used children's label generalization behavior as a basis for classifying superordinate categories. For example, if children generalize labels for items deemed as toys by shape, then the superordinate category of toys is classified as being organized by shape. For this reason, comparing between studies is complicated. Therefore, our findings regarding adults' ratings of words were, on their own, relevant to previous and future research.

Method

Participants

Adults

Twelve adult participants (all female; $M_{\text{age}} = 23;25$ years; $SD = 6.47$) provided ratings of the perceptual similarity of items indicated by the subset of words from the MCDI. Participants were undergraduate students at a large public university the greater Los Angeles area. All were majors in departments that are overwhelmingly female. Therefore, the entire sample was female by chance. They were recruited via word-of-mouth and compensated with course credit or a small gift (e.g., a gift card). Participants were included if English was their native language and they currently used English at least 80% of the time. On average, they spoke English 95% of the time ($SD = 7.07$; range = 85%-100%) and all indicated "7" when asked to rate their English fluency on a scale from 1 to 7 (i.e., they were able to read, write, and speak English at an advanced level).

Children

We used archival data consisting of measurements of eight children's vocabularies, collected eight times at three- to four-week intervals over the course of six months. There were five female and three male children in our sample. On average, children were 24;41 months of age ($SD = 0.68$) at Time 1 and 29;58 months of age ($SD = 0.31$) at Time 8; they knew an average of 324.88 words in total ($SD = 174.35$, range = 3-519) at Time 1, and an average of 524.75 words in total ($SD = 122.58$, range = 290-673) at Time 8. This developmental window made it likely that we were observing children at the point when their word-learning strategies were diversifying. Vocabulary measurements were made using the MCDI (Fenson et al., 2007), which the children's primary caregivers had filled out in a developmental psychology laboratory at a large

public university in the Midwestern US. The children were from English-monolingual households and were recruited through a birth record database and local newspaper advertisements.

Materials and Procedure

Word Corpora

The MCDI contains over 700 words and phrases that 50% of children learn between the ages of 15 and 30 months. Of those 700, approximately 375 are nouns (i.e., labels for objects, people, etc.) The MCDI was developed from numerous studies involving parental reports as well as laboratory measures of children's vocabularies (Fenson et al., 2007). The MCDI is widely used, and it is considered to be a reasonable proxy for the words and phrases that children typically learn in the early stages of vocabulary acquisition (Samuelson & Smith, 1999). We created a corpus of 247 to-be-rated words by drawing from the seven sections of the MCDI corresponding to the superordinate categories of interest: "animal names" ($n = 42$), "body parts" ($n = 28$), "clothing" ($n = 28$), "food and drink" ($n = 67$), "small household items" ($n = 53$), "toys" ($n = 15$), and "vehicles" ($n = 14$). We chose these superordinate categories because of their apparent diversity in perceptual organization and in the function they serve in young children's lives. We also chose them because their labels (i.e., the words from the sections of MCDI) had been classified by previous research using the same methodology (e.g., Samuelson & Smith, 1999). This allowed us to determine if we had successfully replicated their findings as well as the extent to which our findings expanded upon them.

Note that, although the corpus represented approximately one-third of all the words and phrases on the MCDI, it represented approximately two-thirds of the nouns on the MCDI. Thus, we argue that the corpus was a sufficiently representative sample of children's typical noun vocabularies to address our research questions. Also note that most of the words in the corpus referred to basic-level categories (e.g., "bee," "egg," "ball"). However, some did refer to superordinate level categories (e.g., "animal," "food," "toy"). Lastly, on the MCDI, some words are listed under multiple sections (e.g., "chicken" is listed in "animal names" and "food and drink"). These words were included twice within the corpus, but were rated only once by participants.

Surveys

Our methodology closely followed that of previous research (e.g., Colunga & Smith, 2000; Gershkoff-Stowe & Smith, 2004; Samuelson & Smith, 1999). We obtained ratings of the shape-, material-, and color-similarity of the items indicated by the words in the corpus using printed surveys and Scantron forms. Prior to completing the surveys, adult participants were instructed to think about the items indicated by the words (e.g., for the word "apple," participants would consider the perceptual features common among all apples), and to determine

the perceptual feature(s) shared among those items by marking their answer(s) on the Scantron forms. The 247 words from the corpus were listed without section headings and the answer choices (shape, material, color, or none of these) were listed under each word, lettered a-d. To ensure that the order of the words or of answer choices did not impact participant ratings, we created three different versions of the survey. Between the versions, the order of the words was randomized and the order of the answer choices was counterbalanced. However, the content of each survey was identical.

All surveys were administered in a laboratory setting. Participants completed surveys individually, although other participants were sometimes also present. They were given unlimited time to complete the surveys; most finished within 45 min. They were also given the option to take a 5 min break whenever necessary, but none made use of this opportunity.

To classify the words in the corpus, we calculated agreement among participants' ratings. A feature was considered contributing to the organization of an object category if at least 8/12 (75%) participants agreed regarding the similarity among members (binomial probability, $p < .05$). For example, eight participants agreed that "ball" referred to similarly shaped items. Therefore, we classified the "ball" object category as being shape-based. The agreement criterion was comparable to that used by other studies (e.g., Gershkoff-Stowe & Smith, 2004). To determine the perceptual organization of the superordinate categories, we calculated the frequency of object category types (e.g., shape-based, material-based) within them. For example, "ball" was counted as a shape-based object category belonging to the superordinate category of toys.

Results

We approached data analysis in three ways. We first asked what meaningful patterns might exist in the distribution of category types across and within the superordinate categories of interest. Next, we compared children's trajectories of vocabulary acquisition between the superordinate categories of interest as well as between category types. Lastly, we coded the content of individual children's vocabularies.

Classification of Corpus

Figure 1 (see also Table 1) presents the proportion of words in the corpus that were classified as referring to shape-based, material-based, color-based, or perceptually ambiguous object categories across and within the superordinate categories of interest (and the class of artifacts). Note that perceptually ambiguous object categories were those for which there was no agreement regarding similarity in any feature (including those not listed) among members. Also note that labels

Figure 1. Proportion of words in the corpus that were classified as referring to shape-based, material-based, color-based, or perceptually ambiguous object categories across and within the superordinate categories of interest and the class of artifacts.

Table 1. Proportion of labels for all possible object category types across and within the superordinate categories of interest. Examples of classified words within each object category type are also provided.								
	Animals	Body parts	Clothing	Foods	Sm. items	Toys	Vehicles	Overall
Shape	0.40	0.48	0.52	0.18	0.13	0.13	0.21	0.29
Material	0.02	0.07	0.03	0.01	0.17	0.13	0.29	0.08
Color	0.02	N/A	N/A	0.09	N/A	0.07	N/A	0.03
Shape and material	0.02	0.07	0.10	0.04	0.21	0.20	0.33	0.11
Shape and color	0.38	0.03	N/A	0.10	0.02	N/A	N/A	0.10
Color and material	N/A	N/A	N/A	N/A	N/A	0.07	N/A	0.004
Shape, color, and material	0.05	N/A	N/A	0.03	N/A	N/A	0.07	0.02

could be rated as referring to objects that were similar in multiple perceptual features (e.g., shape and material), which happened quite often. As can be seen, the majority of words in the corpus (0.56) was classified as labels for shape-based object categories. Labels for perceptually ambiguous object categories occurred second most frequently (0.34), followed by labels for material-based (0.27) and, finally, color-based object categories (0.18). This general pattern of results—in other words, the ranking of labels for category types—held true even when the agreement criterion was made more or less stringent. Importantly, these presented values (determined using a 75% agreement criterion) were comparable to those found by Samuelson and Smith (1999) using a similar methodology.

Additionally, many of the specific words were classified in the same manner as in Samuelson and Smith (1999). For example, like their participants, ours agreed that “ball” refers to an object category based only on shape, and that “crayon” refers to an object category based on shape and material.

Because the MCDI is a proxy for the content of children’s early vocabularies (Fenson et al., 2007), the patterns that exist within the corpus were informative in their own right. For example, the simple fact that sample sizes varied between the superordinate categories suggests that a typical 30-month-old has had more success in learning labels for members for some superordinate categories than other superordinate categories. Additionally, the fact that some the larger sample sizes were observed in superordinate categories that are not primarily organized by shape (e.g., foods, small household objects) suggests that children’s success in learning labels for category members did not result from the shape bias. It hints that by 30 months of age, children are effectively utilizing other word-learning strategies for these superordinate categories—or are on their way to doing so.

Also apparent in Figure 1 is the considerable variability in the distribution of category types between the superordinate categories. Shape-based object categories were most pervasive within the superordinate categories of animals, body parts, clothing, and vehicles, $\chi^2(7) = 35.01$, $p < .01$. Approximately 83% of animal labels were classified as referring to categories in which members have the same or similar shape. The same was true for 64% of body part labels, for 61% of clothing labels, and for 64% of vehicle labels. Within the superordinate categories of vehicles, material-based object categories were also pervasive, $\chi^2(7) = 48.30$, $p < .01$. Approximately 71% of labels for vehicles were classified as referring to categories in which members have the same or similar material. Perceptually ambiguous object categories were most pervasive in the superordinate categories of foods, $\chi^2(7) = 28.93$, $p < .01$. Approximately 53% of labels for foods were remained unclassified, suggesting that they do not refer to categories in which members have the same or similar shape, material, color, or any other perceptual feature.

Jones et al. (1991) reported that 79% artifact labels from the MCDI refer to shape-based object categories whereas only 68% of animal labels from the MCDI refer to shape-based object categories. Additionally, they reported that 93% of animal labels from the MCDI refer to object categories with characteristic textures whereas only 33% of artifact labels from the MCDI refer to object categories with characteristic textures. Taken together, their findings suggest that the class of artifacts is primarily organized by shape and that the superordinate category of animals is organized by both shape and texture. Furthermore, children’s behavior in ostensive label-learning contexts suggests that the superordinate category of foods is organized by material (Lavin & Hall, 2001). In contrast, our findings suggest that no single feature—shape or otherwise—organizes the class of artifacts or, for that matter, two of the superordinate categories that it encompasses (i.e., small household objects, toys). Our findings also suggest that the superordinate category of animals is organized primarily by shape and, to a lesser extent, by color.

Thus, there were some intriguing differences between our findings and those of previous research. We address possible reasons for these differences, and their implications, in the General Discussion. However, despite these differences, we remained confident in our use of adult participant ratings data to classify the content of children's developing vocabularies, given that we had replicated the findings of the study most closely related to ours (Samuelson & Smith, 1999).

Perceptually Simple Versus Perceptually Complex Object Categories

As mentioned, it was possible that a word could be classified as referring to an object category organized by multiple perceptual features. This was also the case in previous research (e.g., Jones et al., 1991; Samuelson & Smith, 1999). However, in these other studies, the frequencies of words referring to object categories organized by shape, material (or texture), and color were calculated independently. Thus, when Jones et al. (1991) determined that the superordinate category of animals is organized by both shape and texture, they did so because their findings indicated that the MCDI encompasses numerous labels for shape-based object categories and numerous labels for texture-based object categories. They did not calculate the number of labels for object categories organized by both perceptual features. However, 36-month-old children generalize object labels by both shape and texture when given cues to animacy (Jones et al., 1991; Jones & Smith, 2002). The question remains how they learn to do this. It is possible that, within the superordinate category of animals, numerous object categories are organized by both shape and texture. Children develop an "animal bias" directly from their exposure to these coregularities. However, it is also possible that shape and texture rarely jointly contribute to the organization of object categories within the superordinate categories of animals. If this were the case, then children might generalize by shape and texture because they have formed an animal conceptual prototype of sorts, an amalgamation of all the instances of animals to which they have been exposed.

To better understand how children come to generalize novel objects' labels by multiple features, we compared the proportions of all possible category types, including those that are perceptually simple (i.e., organized by a single perceptual feature) and those that are perceptually complex (i.e., organized by multiple perceptual features) across and within the superordinate categories. A few trends are noteworthy in Table 2. First, across superordinate categories, "shape-only" was the predominant category type. This provides an important point of clarification for the findings of previous research (e.g., Gershkoff-Stowe & Smith, 2004; Samuelson & Smith, 1999). It is not just the case that children learn the most labels for object categories based on shape; they learn the most labels for object categories based purely on shape. This may provide further insight as to why children develop the shape bias so early and apply it so rigidly (Samuelson et al., 2008): They are primarily exposed to regularities of only shape among the referents of the labels they learn.

Table 2. Results of comparisons of children's vocabulary growth between object category types within each superordinate category.

	Animals	Body parts	Clothing	Foods	Sm. items	Toys	Vehicles
Category type with fastest growth (Proportion of labels on MCDI)	Shape (0.40) Shape and color (0.38)	Shape (0.48)	Shape (0.52)	Ambiguous (0.52)	Ambiguous (0.46)	Ambiguous (0.40)	Shape and material (0.33)
ANOVA	$F(1.60, 11.98) = 10.65$ $p < .01$ $\eta_p^2 = 0.60$ Mauchly's $\chi^2(20) = 65.03$ $p < .05$ Greenhouse-Geisser: $\varepsilon = 0.27$	$F(2.08, 14.53) = 4.42$ $p < .01$ $\eta_p^2 = 0.28$ Mauchly's $\chi^2(20) = 84.83$ $p < .05$ Greenhouse-Geisser: $\varepsilon = 0.35$	$F(6, 42) = 20.62$ $p < .01$ $\eta_p^2 = 0.75$	$F(1.94, 13.61) = 28.80$ $p < .01$ $\eta_p^2 = 0.80$ Mauchly's $\chi^2(20) = 46.29$ $p < .05$ Greenhouse-Geisser: $\varepsilon = 0.32$	$F(6, 42) = 12.21$ $p < .01$ $\eta_p^2 = 0.64$	$F(6, 42) = 8.85$ $p < .01$ $\eta_p^2 = 0.56$	$F(6, 42) = 7.17$ $p < .01$ $\eta_p^2 = 0.51$

However, as can also be seen in Table 2, the distribution of simple and complex category types varied between superordinate categories. Specifically, there were between-category differences in the frequencies of shape-only object categories and “shape-plus” object categories (i.e., object categories organized by shape and another feature). For example, in the superordinate category of vehicles, there were more object categories based on shape and material (0.33) than shape-only object categories (0.21). In contrast, in the superordinate categories of body parts and clothing, the vast majority of words refer to shape-only object categories (0.48 and 0.52, respectively). Lastly, in the superordinate category of animals, there were comparable numbers of shape-only object categories (0.40) and object categories based on shape and color (0.38). This is significant because it suggests that, if children learn to generalize animal labels by shape and color (or texture) as the result of their word-learning experience, they do not do so because those perceptual features always cooccur among members.

Trajectories of Children's Vocabulary Acquisition

The content of the corpus represented what labels children could possibly learn. Next, we explored which words children actually learn and when they

do so. Specifically, we examined how the trajectories of children's vocabulary acquisition varied according to the perceptual organization of the superordinate categories.

Rationale for Analytic Approach

We first compared children's vocabulary sizes (at Times 1 and 8) between the superordinate categories of interest (e.g., animals vs. body parts) as well as the category types (e.g., shape-based vs. material-based). We first ran these analyses using children's raw vocabulary sizes and then using the proportions those values represented of (a) children's total sampled vocabularies and (b) the superordinate category sample sizes from the corpus. We considered children's raw vocabulary sizes to be measures of their absolute success in word learning within a superordinate category. Furthermore, it has been shown that children's vocabulary sizes predict the strength of their word-learning biases as well as the rate of their subsequent vocabulary acquisition (e.g., Bates, Bretherton, & Snyder, 1988 ; Jones & Smith, 2002; Rice, 1980 ; Smith et al., 2002). In fact, experimental evidence suggests that this relationship exists within superordinate categories and is causal in nature: Training in labels for members of object categories and superordinate categories increases children's ability to learn labels for additional members of those categories, and children's performance on label-generalization tests increases in proportion to the number of labels for members in which they have been trained (Smith et al., 2002; Thom & Sandhofer, 2009). Thus, for multiple reasons, there was value in knowing the number of words children knew within each superordinate category and in comparing those numbers between superordinate categories.

We ran analyses on children's *total sampled proportions* to determine the distribution of children's vocabularies across superordinate categories at specific measurement intervals and how that distribution might change across measurement intervals. For example, it would be telling if the proportion of total sampled vocabularies represented by labels for shape-based object categories decreased between Time 1 and Time 8, even if children's raw rates of vocabulary growth remained the same; this might suggest that children's ability to learn labels for other category types was improving relative to their ability to learn labels for shape-based object categories, and that they had developed, or would soon develop, additional word-learning strategies.

We ran analyses on children's *sample size proportions* to determine how many words they had learned of all that were possible. Because sample sizes differed between superordinate categories and category types, it was important to know if children were approaching the limits of the MCDI within the superordinate categories that had smaller sample sizes. However, these values could not fully capture children's word-learning success. For example, a child who knows 50% of possible labels for vehicles and 25% of the possible labels for foods is still better at learning labels for foods than for vehicles.

Although each set of analyses provided unique insight into our research question, we focused on the results of those on children's raw vocabulary sizes. Our rationale in doing so was rooted in the assumptions of the MCDI. As established, the MCDI was developed from numerous naturalistic and experimental studies on children's vocabulary acquisition (Fenson, 2007). Sample sizes represent the number of words children are likely to learn out of all that are possible; They are not arbitrary caps. If, according to the MCDI, a child knows fewer labels for vehicles than for animals, it is not thought to result from between-category differences in sample sizes but from between-category differences in their word-learning experiences or in their word-learning successes. It was possible that any between-category differences in children's vocabulary sizes that we observed would mirror between-category differences in sample sizes, but this was not a given as there was variability in the size and content of individual children's vocabularies.

Vocabulary Sizes

Figure 1 presents children's raw vocabulary sizes within each superordinate category at each measurement interval. As can be seen, children's vocabulary sizes appear to have varied between measurement intervals and between superordinate categories. These apparent effects were confirmed by a 7 (superordinate category) $\times$ 2 (Time 1 vs. Time 8) repeated-measures analysis of variance (ANOVA). The analysis revealed a statistically significant main effect of measurement interval, $F(1, 6) = 16.72, p < .01, \eta_p^2 = 0.73$. Regardless of superordinate category, children knew more labels at Time 8 than at Time 1. The analysis also yielded a statistically significant main effect of superordinate category, $F(1.57, 9.415) = 38.85, p < .01, \eta_p^2 = 0.87$. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(20) = 55.31, p < .01$; Therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.26$). Post-hoc tests with a Bonferroni correction ($\alpha = .05$) indicated that, regardless of measurement interval, children knew more labels for foods ($M = 45.17; SD = 17.42$) than for animals ($M = 29.43; SD = 11.48$), body parts ($M = 21.14; SD = 6.85$), clothing items ($M = 15.93; SD = 6.94$), toys ($M = 7.43; SD = 1.86$), and vehicles ($M = 10.50; SD = 3.13$). They knew more labels for animals than for clothing items, toys, and vehicles. They knew more labels for small household items ($M = 33.64; M = 12.84$) than for clothing items, toys, and vehicles. Lastly, they knew more labels for vehicles than for toys. No other statistically significant differences were indicated.

The ANOVA also yielded a statistically significant measurement interval $\times$ superordinate category interaction, $F(1.58, 9.50) = 15.28, p < .01, \eta_p^2 = 0.96$. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(20) = 39.59, p < .05$; Therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.26$). In Figure 1, it appears that differences in children's vocabulary sizes between the superordinate

categories became more exaggerated over time. Tests of simple main effects with a Bonferroni correction ($\alpha = .05$) indicated that, at Time 8 only, there were statistically significant differences in children's vocabulary sizes between the superordinate categories of animals ($M = 34.71$; $SD = 8.72$) and body parts ($M = 23.71$; $SD = 4.08$), between the superordinate categories of animals and small household items ($M = 40.14$; $SD = 8.32$), and between the superordinate categories of clothing ($M = 19.57$; $SD = 5.27$) and vehicles ($M = 12.43$; $SD = 1.94$). All other statistically significant differences in children's vocabulary sizes between object category types that were indicated across measurement intervals were indicated at both Time 1 and Time 8. However, the effects were greater at Time 8 than at Time 1.

Taken together, these findings indicate that children's vocabulary sizes were the largest in the superordinate categories of foods, animals, and small household items, and they were the smallest in the superordinate categories of clothing items, toys, and vehicles. They also indicate that some between-category differences in children's vocabulary sizes emerge over time. For example, at Time 1, children had comparable vocabulary sizes in the superordinate categories of animals and small household items, but by Time 8, their vocabulary sizes for the superordinate category of household items had eclipsed their vocabulary sizes for the superordinate category of animals. Similarly, at Time 1, children had comparable vocabulary sizes for the superordinate categories of animals, clothing, and vehicles, for the superordinate categories of small household items and clothing and vehicles, but, by Time 8, their vocabulary sizes in the superordinate categories of animals and small household items had eclipsed their vocabulary sizes in the superordinate categories of clothing and vehicles. This suggests that the content of children's vocabularies becomes less evenly distributed between the superordinate categories over time.

Proportions

Two additional 7 (superordinate category) $\times 2$ (Time 1 vs. Time 8) repeated-measures ANOVAs were conducted on children's total sampled proportions and sample size proportions, respectively. The first ANOVA revealed a statistically significant main effect of superordinate category, $F(1.16, 8.12) = 18.98$, $p < .01$, $\eta_p^2 = 0.73$. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(20) = 102.16$, $p < .01$; therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.19$). Post-hoc tests with a Bonferroni correction ($\alpha = .05$) indicated that, regardless of measurement interval, children's total sampled proportions were larger for the superordinate category of foods ($M = 0.33$; $SD = 0.07$) than for the superordinate categories of body parts ($M = 0.16$; $SD = 0.03$), clothing ($M = 0.12$; $SD = 0.03$), small household items ($M = 0.24$; $SD = 0.05$), toys ($M = .06$; $SD = 0.01$), and vehicles ($M = 0.8$; $SD = 0.01$). Children's total sample proportions were larger for the superordinate category of animals ($M = 0.28$; $SD = 0.13$) than for clothing,

small household items, toys, and vehicles. They were marginally different from the superordinate category of body parts. Their total sampled populations were larger for small household items than for body parts, clothing, toys, and vehicles. Their total sampled proportions were larger for the superordinate categories of body parts and clothing than for the superordinate categories of toys and vehicles. Lastly, their total sample proportions were larger for the superordinate category of vehicles than toys. No other statistically significant differences were indicated.

The analysis did not yield a statistically significant effect of measurement interval. Regardless of superordinate category, children's total sampled proportions were comparable between Time 1 and Time 8. Additionally, no statistically significant interaction was indicated. However, trends suggested that children's total sampled proportions for the superordinate category of animals decreased (0.33 vs. 0.22) whereas their total sampled proportions within the superordinate categories of foods and small household items increased between Time 1 and Time 8 (0.31 vs. 0.35 and 0.21 vs. 0.26, respectively). Children's total sampled proportions for the remaining superordinate categories were stable between Time 1 and Time 8.

These findings largely echoed the findings from our analyses on children's raw vocabulary sizes. Children's total sampled proportions were largest for the superordinate categories of foods, small household items, and animals, and they were smallest for the superordinate categories of toys and vehicles. This pattern appeared to be consistent between Time 1 and Time 8; however, trends suggested that children's total sampled proportions for the superordinate category of animals decreased over time, whereas their total sample proportions for all other superordinate categories increased. Indeed, at Time 1, children's vocabulary sizes for the superordinate categories of animals and small household items were quite disparate, but by Time 8, they were identical. Our findings establish that, by 24 months of age, children are effective animal label learners. However, they also hint that, by 30 months of age, their success in learning labels for small household items and for members of other superordinate categories eventually begins to match (or potentially eclipse) their success in learning labels for animals. This pacing of acquisition is something that cannot be determined just by looking at the composition of the MCDI.

The second ANOVA revealed a statistically significant main effect of measurement interval, $F(1, 7) = 18.56, p < .01$, partial $\eta_p^2 = 0.73$. Regardless of superordinate category, children's sample size proportions were larger at Time 8 than at Time 1. The analysis also yielded a statistically significant main effect of superordinate category, $F(6, 42) = 10.54, p < .01$, $\eta_p^2 = 0.60$. Post-hoc tests with a Bonferroni correction ($\alpha = .05$) indicated that, regardless of measurement interval, children's sample size proportions were larger for the superordinate categories of vehicles ($M = 0.77$; $SD = 0.20$) and body parts ($M = 0.76$; $SD = 0.21$) than for the superordinate categories of clothing ($M = 0.60$; $SD = 0.23$), foods ($M = 0.70$; $SD = 0.29$), small household items ($M = 0.64$; $SD = 0.21$), and toys ($M = 0.54$; $SD =$

0.11). Their sample size proportions were larger for the superordinate category of foods and animals than for the superordinate categories of clothing and toys. Lastly, their sample size proportions were larger for the superordinate category of small household items than toys. No other statistically significant differences were indicated.

The ANOVA also yielded a marginally statistically significant measurement interval $\times$ superordinate category interaction, $F(6, 42) = 2.13, p = 0.07, \eta_p^2 = 0.23$. Trends suggested that that, at Time 1 only, there were differences in children's sample size proportions between superordinate categories of vehicles ($M = 0.64$; $SD = 0.30$), clothing ($M = 0.48$; $SD = 0.30$), toys ($M = 0.43$; $SD = 0.20$), foods ($M = 0.57$; $SD = 0.30$), and small household items ($M = 0.50$; $SD = 0.30$). There were differences in children's sample size between the superordinate category of body parts ($M = 0.67$; $SD = 0.31$) and foods. All other differences in children's vocabulary sizes between object category types that were indicated across measurement intervals also appeared to be present at both Time 1 and Time 8.

The main effect of measurement interval was not surprising: As their vocabulary sizes for the superordinate categories grew over time, so too did the proportion those vocabulary sizes represented by the corresponding superordinate category sample size. It is evident that, across superordinate categories, children had learned the majority (but not all) of the words that were possible by the end of data collection: The mean sample size for all superordinate categories at Time 8 was 0.79 ($SD = 0.09$). Again, this was to be expected based on the age of the children and the specified age range of the MCDI (Fenson et al., 2007). However, sample size proportions did vary between superordinate categories. Children's sample size proportions were the largest for the superordinate categories of animals, body parts, and vehicles, and were the smallest for the superordinate categories of clothing, small household items, and toys. In some instances, the sample size of a superordinate category appeared to be inversely related to children's sample size proportion. For example, the superordinate category of vehicles had the second smallest sample size, but exhibited the largest mean sample size proportion while the superordinate category of small household items had the second largest sample size, but exhibited the smallest mean sample size proportion. This presented the possibility that children's vocabulary sizes were approaching the limits on the MCDI more quickly in the superordinate categories with smaller sample sizes, and that between-category differences in sample sizes were responsible for between-category differences that we observed in children's raw vocabulary sizes. However, this conclusion was challenged by the fact that the superordinate category of toys had the smallest sample size and exhibited the smallest mean sample size proportion. Additionally, the superordinate categories of foods and animals had two of the three largest sample sizes and exhibited larger-than-not mean sample size proportions. Lastly, many of the differences in children's sample size proportions that were present at Time 1 appeared to disappear by Time 8. Taken together, these findings suggest that

the sample sizes of the superordinate categories were less related to children's sample size proportions, and that, towards the end of data collection, children's vocabulary sizes in most superordinate categories were approaching the limits of the MCDI at comparable rates. We acknowledge that differences in sample size might have contributed to the findings of our other analyses. However, for the reasons outlined, we do not believe they are wholly responsible for them.

Rates of Vocabulary Growth

Next, we compared rates of vocabulary growth across all sessions (Time 1 through Time 8) between the superordinate categories. As can be seen in Figure 1, the steepness of children's vocabulary growth appeared to vary between superordinate categories. These apparent effects were confirmed by a one-way repeated-measures ANOVA, $F(1.92, 13.47) = 16.59, p < .01, \eta_p^2 = 0.70$. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(20) = 48.60, p < .05$; Therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.32$). Post hoc tests with a Bonferroni correction ($\alpha = 0.05$) indicated that children learned more labels for foods ($M = 17.88; SD = 9.05$) than for body parts ($M = 5.25; SD = 5.43$), clothing items ($M = 7.00; SD = 3.73$), toys ($M = 2.38; SD = 2.67$), and vehicles ($M = 3.63; SD = 2.82$). They learned more labels for animals ($M = 9.75; SD = 6.56$) than for toys. Trends suggested that they learned more labels for animals than for small household items ($M = 14.50; SD = 10.00$), $p = .09$. Lastly, they learned more labels for clothing items than toys and vehicles.

Overall Vocabulary Size

As established, we made our comparisons according to age rather than vocabulary size, to be consistent with existing work (e.g., Jones et al., 1991; Lavin & Hall, 2001). However, given that some studies (e.g., Bates, Bretherton, & Snyder, 1988; Gershkoff-Stowe & Smith, 2004; Smith et al., 2002) have shown that vocabulary size is a strong predictor of rate of vocabulary growth, we investigated how this relationship might have played out in our data. To do so, we performed a median split according to children's overall vocabulary size at Time 1. We reran our analyses for the "smaller" and "larger" vocabulary groups, respectively. We found that the distribution of vocabulary sizes and rates of growth between superordinate categories was comparable between vocabulary groups and to those found in the entire sample. For example, in both vocabulary groups, children learned more words in the category of animals, foods, and small household items. As we would expect, children in the larger vocabulary group had larger vocabulary sizes in each category at Time 1 and Time 8 than did children in the small vocabulary group. Conversely, children in the smaller vocabulary group exhibited more growth in each category between Time 1 and Time 8 than did children in the larger vocabulary group. Therefore, overall vocabulary size impacted the number of words that children knew and ultimately learned, but not

the distribution of those words among the categories of interest.

In sum, the results of all between-category comparisons indicate that children knew and learned more words for members of the superordinate categories of animals, foods, and small household items. It is significant that children were experiencing their greatest success in learning labels for members of these particular superordinate categories, which varied in their perceptual organization (according to the ratings of adult participants): Whereas shape-based object categories were most prevalent within the superordinate category of animals, perceptually ambiguous object categories were most prevalent within the superordinate categories of foods. Additionally, shape-based and material-based objects, and perceptually ambiguous object categories were equally prevalent within the superordinate category of small household items. It is unlikely that any single word-learning strategy—shape bias or otherwise—can account for children's impressive vocabulary acquisition within these all of superordinate categories.

Evidence from experimental studies using ostensive label-learning paradigms (e.g., Lavin & Hall, 2002; Jones & Smith, 2002; Jones et al., 1991) suggest children begin utilizing category-specific word-learning strategies around three years of age. However, our findings based on naturalistic vocabulary data suggest that they utilize, or are at least are on their way to developing, certain category-specific word-learning strategies at 30 months of age—and perhaps even earlier. Furthermore, our findings indicate which category-specific word-learning strategies they might develop earlier (e.g., foods, small household items, animals) versus later (e.g., clothing, toys, vehicles).

Coded Content of Children's Vocabularies

Next, we coded the content of individual children's vocabularies using the classifications of the words in the corpus derived from adult ratings. This allowed us to compare the trajectories of children's vocabulary acquisition—both across and within superordinate categories—in finer detail.

Across Superordinate Categories

First, we tabulated the number of words known by children, at each measurement interval that were classified as referring to shape-based, material-based, color-based, and perceptually ambiguous object categories. As can be seen in Figure 2, children's vocabulary sizes appear to have varied between measurement intervals and between category types. To examine these apparent effects, we conducted a 4 (object category type) $\times$ 2 (Time 1 vs. Time 8) repeated-measures ANOVA. As in earlier analyses, there was a statistically significant main effect of measurement interval, $F(1, 6) = 17.74, p < .01, \eta_p^2 = 0.75$. The analysis also yielded a statistically significant main effect of object category type, $F(1.56, 9.35) = 51.91, p < .01, \eta_p^2 = 0.90$. Mauchly's test indicated that the

Figure 2. Mean vocabulary sizes within superordinate categories as a function of measurement interval. Bars represent standard error.

assumption of sphericity had been violated, $\chi^2(20) = 66.61$, $p < .01$; Therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.52$). Post hoc tests with a Bonferroni correction ($\alpha = .05$) indicated that regardless of measurement interval, children knew more labels for shape-based object categories ($M = 86.93$; $SD = 31.45$) than for material-based object categories ($M = 31.50$; $SD = 11.71$), color-based object categories ($M = 24.36$; $SD = 11.14$), and perceptually ambiguous object categories ($M = 59.07$; $SD = 19.94$). They also knew more labels for perceptually ambiguous object categories than for material-based object categories and color-based object categories. No other statistically significant differences were indicated.

The ANOVA also yielded a statistically significant category type $\times$ measurement interval interaction, $F(1.62, 0.71) = 51.91$, $p < .01$, $\eta_p^2 = 0.58$. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(20) = 13.24$, $p < .01$; Therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.54$). In Figure 2, differences in children's vocabulary sizes between the category types appear to become more exaggerated over time. Tests of simple main effects with a Bonferroni correction ($\alpha = .05$) indicated that there were statistically significant differences in children's vocabulary sizes between material-based categories and color-based categories at Time 8 only. Additionally, all differences in children's vocabulary sizes between object category types that were statistically significant at Time 1 (e.g., shape-based vs. perceptually ambiguous) became more extreme by Time 8.

Proportions

To round out the picture of children's vocabulary sizes for category types,

we conducted an additional 4 (object category type) $\times$ 2 (Time 1 vs. Time 8) repeated-measures ANOVA on children's total sampled proportions. The first ANOVA revealed a statistically significant main effect of time interval, $F(1, 7) = 5.82, p < .05, \eta_p^2 = 0.46$. Regardless of category type, children's vocabulary sizes represented larger proportions of their total sampled vocabularies at Time 8 than Time 1. The analysis also yielded a statistically significant main effect of category type, $F(1.18, 8.29) = 6.74, p < .01, \eta_p^2 = 0.89$. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(5) = 20.88, p < .01$; Therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.40$). Post-hoc tests with a Bonferroni correction ($\alpha = .05$) indicated that, regardless of measurement interval, children's total sampled proportions were larger for shape-based object categories ($M = 0.56; SD = 0.10$) for all other category types. Children's total sampled proportions were larger for ambiguously organized object categories ($M = 0.37; SD = 0.07$) than for material-based object categories ($M = 0.18; SD = 0.04$) and color-based object categories ($M = 0.18; SD = 0.53$). Lastly, children's total sampled proportions were larger for material-based object categories than for color-based object categories.

There was no statistically significant interaction between measurement interval and category type. However, trends suggested that children's total sampled proportions for shape-based object categories decreased between Time 1 (0.59) and Time 8 (0.53). In contrast, trends suggested that children's total sampled proportions for material-based, color-based, and ambiguously organized object categories increased between Time 1 and Time 8 (0.16 vs. 0.20, 0.12 vs. 0.15, and 0.31 vs. 0.36, respectively). Thus, there was some indication that children's vocabulary sizes for shape-based categories represented a smaller proportion of total sampled vocabularies relative to their vocabulary sizes for other category types.

An final one-way repeated measures ANOVA revealed statistically significant differences in children's vocabulary growth between category types, $F(1.66, 11.61) = 10.81, p < .01, \eta_p^2 = 0.61$. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(5) = 15.81, p < 0.01$; Therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.55$). Post hoc tests with a Bonferroni correction ($\alpha = .05$) indicated that, between Time 1 and Time 8, children learned more labels for shape-based object categories ($M = 31.38; SD = 20.59$) than for material-based object categories ($M = 12.75; SD = 9.19$). Trends suggested that children learned more labels for shape-based object categories than for color-based categories ($M = 11.63; SD = 8.19$), $p = 0.06$. They learned more labels for perceptually ambiguous object categories ($M = 11.63; SD = 12.75$) than for material-based object categories. No other statistically significant differences were indicated.

Thus, children knew and learned more labels for shape-based object categories than for any other category type. This pattern appeared to be consistent between Time 1 and Time 8; However, trends suggested that children's total sampled

proportions for shape-based object categories decreased over time whereas their total sample proportions for all other category types increased.

Perceptually Simple Versus Perceptually Complex Object Categories

Next, we examined how children's trajectories of vocabulary acquisition varied according to the complexity of perceptual organization of object categories by comparing children's vocabulary sizes (at Times 1 and Time 8) and rates of vocabulary growth (between Time 1 and Time 8) between all category types. As can be seen in Figure 3, children's trajectories of vocabulary acquisition appear to vary as product of measurement interval and category type. A 7 (object category type) $\times$ 2 (Time 1 vs. Time 8) repeated-measures ANOVA on children's vocabulary sizes confirmed that these effects were statistically significant. At no point during data collection did children know labels for object categories based on both material and color; Therefore, this object category type was excluded from our analyses. As in previous analyses, there was a statistically significant main effect of measurement interval, $F(1, 6) = 16.31, p < .01, \eta_p^2 = 0.73$. There was also a statistically significant main effect of object category type, $F(1.39, 8.31) = 67.15, p < .01, \eta_p^2 = 0.92$. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(20) = 66.61, p < .01$; Therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.23$). Post hoc tests with a Bonferroni correction ($\alpha = .05$) indicated that, regardless of measurement interval, children knew more labels for shape-only object categories ($M = 51.86; SD = 16.43$) and ambiguously organized object categories ($M = 59.07; SD = 36.37$) than for all other category types. They knew

Figure 3. Mean vocabulary size for object categories for which shape, material, or color partially or exclusively contributes to their perceptual organization at each measurement interval. Bars represent standard error.

more labels for material-only object categories ($M = 13.71$; $SD = 4.66$) and object categories based on shape and color ($M = 17.29$; $SD = 8.49$) than for color-only object categories ($M = 4.21$; $SD = 1.95$) and for object categories based on shape, material, and color ($M = 3.21$; $SD = 1.80$). They knew more labels for object categories based on shape and material ($M = 14.57$; $SD = 6.23$) than for object categories based on shape, material, and color. Finally, they knew more labels for color-only object categories than for object categories based on shape, material, and color. No other statistically significant differences were indicated.

The ANOVA also yielded a statistically significant measurement interval $\times$ category type interaction, $F(1.36, 8.14) = 10.79$, $p < .01$, $\eta_p^2 = 0.64$. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(20) = 58.83$, $p < .05$; Therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.23$). In Figure 3, it appears that differences in children's vocabulary sizes between object category types became more exaggerated over time. Tests of simple main effects with a Bonferroni correction ($\alpha = .05$) indicated that, at Time 8 only, there were statistically significant differences in children's vocabulary sizes between shape-only object categories ($M = 60.88$, $SD = 9.31$) and perceptually ambiguous object categories ($M = 71.63$; $SD = 4.20$). All other statistically significant differences in children's vocabulary sizes between object category types that were indicated across measurement intervals were indicated at both Time 1 and Time 8; However, the effects were greater at Time 8 than at Time 1.

A final one-way repeated measures ANOVA revealed statistically significant differences in children's vocabulary growth between category types, $F(1.39, 9.76) = 14.59$, $p < .01$, $\eta_p^2 = 0.68$. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(20) = 65.83$, $p < .05$; Therefore, the degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.23$). Post hoc tests with a Bonferroni correction ($\alpha = .05$) indicated that, between Time 1 and Time 8, children learned more labels for ambiguous categories ($M = 23.38$; $SD = 12.73$) and for shape-only object categories ($M = 15.50$; $SD = 26.09$) than for all other category types. Trends suggested that children learned more labels for object categories based on shape and material ($M = 6.50$; $SD = 4.04$) and for object categories based on shape and color ($M = 8.00$; $SD = 5.32$) than for categories based on shape, material, and color ($M = 1.38$; $SD = 1.41$), $p = .06$ for both comparisons. No other statistically significant differences were indicated.

Taken together, these findings indicate that, at Time 1 children knew comparably large numbers of labels for shape-only object categories and for perceptually ambiguous object categories. In this instance, the composition of children's vocabularies deviated from the composition of the corpus, which contained more labels for perceptually ambiguous object categories (0.34) than for shape-only object categories (0.29). However, between-category differences in their vocabulary sizes emerged over time: By Time 8, children knew more labels for perceptually ambiguous object categories than for shape-only object categories.

Thus, our findings suggest that at around 24 months of age, children have had comparable success in learning labels for both category types. Only as they approach 30 months of age do they begin exhibiting greater success in learning labels for ambiguously organized object categories. These findings suggest that children's success in learning labels for shape-only object categories comes online earlier than their success in learning labels for ambiguously organized categories. Only later in development does their ability to learn labels for ambiguously organized categories eclipse their ability to learn labels for shape-only object categories. Again, we found evidence of a phenomenon that is not apparent in the content of the MCDI.

Also noteworthy was the fact that children's trajectories of vocabulary acquisition varied as a product of the number of perceptual features contributing to the organization of the object categories: They knew and learned more labels for shape-only object categories than for object categories based on shape and one other feature (material or color). In turn, they knew and learned more labels for object categories based on shape and one other feature than for object categories based on shape and two other perceptual features (material and color). These findings were consistent with the ranking of category types found in the corpus and suggest that the complexity of an object category's perceptual organization may predict children's success in learning its label. However, this only appears to be true for object categories organized at least in part by shape: Children's acquisition of labels for material-only object categories and for color-only object categories was on par with their acquisition of labels for perceptually complex object categories. The pronounced differences in children's vocabulary sizes and rates of vocabulary growth between shape-only object categories and shape-plus object categories present the possibility that the shape bias might not promote the acquisition of labels for all shape-based object categories to the same degree.

Within Categories

The findings of our between-category comparisons suggest that children might be successfully adapting their label-learning strategies between certain superordinate categories; however, our within-category comparisons of children's vocabularies coded according to perceptual features suggested that, even until 30 months of age, the shape bias is largely responsible for their vocabulary acquisition. The findings also presented the possibility that the between-category differences in children's trajectories of vocabulary acquisition did not result from differences in their ability to utilize category-specific word-learning strategies, but from differences in the effectiveness of the shape bias for each category due to the number of labels for shape-based object categories that they encompassed. We address this possibility in the next section.

If the shape bias were the only word-learning strategy that children were utilizing, then we would expect children to have learned more labels for shape-based object categories within each superordinate category—regardless of its perceptual

organization. To examine this possibility, we calculated children’s vocabulary growth within each object category within each superordinate category. As can be seen in Figure 4, within each superordinate category, children’s vocabulary growth appears to have varied between object category types. Because we were primarily interested in the within-category differences in vocabulary growth, we conducted a series of seven repeated-measures ANOVAs and relevant post hoc tests with a Bonferroni correction ($\alpha = .05$). Table 3 presents the results of these analyses. For every superordinate category, children learned the most labels for “typical” object category types for that superordinate category. For example, within the superordinate category of animals, children learned the most labels for object categories based either only on shape, or on both shape and color. Labels for these object category types represented 40% and 38% of the labels for animals on the MCDI, respectively. Within the superordinate category of foods, children learned the most labels for perceptually ambiguous object categories. Labels for this object category type represented 52% of labels for foods on the MCDI.

The fact that the types of labels that children knew and learned varied between superordinate categories suggests that their word-learning strategies also varied between superordinate categories—along with their effectiveness in utilizing those strategies. However, it was still the case that shape contributed, at least in part, to the perceptual organization of the object categories children for which children were learning the most labels. It was possible that the shape bias was still responsible for their success in learning labels for members of these superordinate categories; However, it was unlikely this was true in all superordinate categories (e.g., foods).

Figure 4. Mean vocabulary size for each object category type at each measurement interval. Bars represent standard error.

Discussion

In the current study, we tracked children's vocabulary development at 3- to 4-week intervals between 24 and 30 months of age. We found differences in children's vocabulary sizes and rates of vocabulary growth, and the types of words children were learning, between seven superordinate categories with diverse perceptual organization. Our findings suggest that children were employing multiple word-learning strategies, including the shape bias. The shape bias is a robust phenomenon that lasts throughout early development: Children continue to generalize novel objects' labels by shape in some instances even as they add other word-learning strategies to their repertoire (Jones et al., 1991; Jones & Smith, 2002; Lavin & Hall, 2001; Smith, 2000, 2001). We were not surprised to find evidence of it in the content of children's vocabularies, but we were surprised by the other kinds of word-learning strategies that children appeared to be employing. From laboratory studies using ostensive word-learning paradigms (e.g., Lavin & Hall, 2001), we know that 36-month-olds will generalize novel objects' labels by nonshape perceptual features (e.g., texture or color) in certain instances (e.g., when they believe the novel object is a food). For this reason, we expected to find some evidence—either across the categories or within them—of children's increasing attention to nonshape perceptual features when generalizing novel objects' labels, but this was not the case.

There are a few possible interpretations of these findings. The first is that children's flexibility in word learning has some limits until they are older than 30 months of age. In other words, children might not consistently generalize novel objects' labels by nonshape perceptual features until late in their third year of life. A second interpretation of this finding is that 24- to 30-month-old children do generalize novel objects' labels by nonshape perceptual features in some instances, but for reasons that are independent of the perceptual organization of the categories to which the novel objects belong. For example, children might generalize labels for novel foods by texture or color based on their understanding of the function of foods (e.g., nourishment). However, evidence of this word-learning strategy might not be found in the content of children's food vocabularies. This possibility would be consistent with our findings that children knew and learned the most labels for foods, a superordinate category that is extensively perceptually ambiguous. It is unlikely that one perceptual feature (or set of perceptual features) conveys the information "for nourishment." Thus, many of the object categories within the superordinate category of foods might be difficult to classify. Nevertheless, children's understanding of the function of foods might have promoted their acquisition of food labels. Both of these possibilities carry theoretical implications, which we discuss in the next section.

Theoretical Implications

One account of vocabulary acquisition, sometimes referred to as the attentional learning account, proposes that children develop word-learning strategies through attention and associative learning. Its proponents argue that children are sensitive to the correlated perceptual features among members of object categories; over time, their attention tunes to shape because they hear and learn numerous labels for shape-based object categories, which belong to a diverse array of superordinate categories (Jones et al., 1991; Jones & Smith, 2002; Smith, 2000, 2001; Smith et al., 2002). Eventually children begin to automatically attend to novel objects' shape in word-learning contexts, making them more likely to map and generalize its label by shape. Within this framework, children's word learning evolves because their linguistic experience increases, and with it, their exposure to the correlated perceptual features among members of superordinate categories (Jones & Smith, 2002; Jones et al., 1991; Smith, 2000, 2001; Thom & Sandhofer, 2009). Children's attention eventually tunes to these perceptual features just as it does to shape. These category-specific attentional biases create greater flexibility in their word learning, and allow them to diversify their vocabularies. It is proposed that this process can occur for any superordinate category regardless of its perceptual organization, provided that children have sufficient exposure to its perceptual regularities through their linguistic experience (Smith, 2000).

The attentional learning account predicts that the amount of children's exposure to the perceptual regularities of object categories and superordinate categories should influence the timing of onset, as well as the strength, of their attentional biases (Smith, 2000/2001). Support for this prediction comes from the finding that children develop category-general attentional biases before they develop category-specific ones (Jones et al., 1991); Presumably this is because their linguistic experience provides them with more exposure to the perceptual regularities of object categories across superordinate categories than within them. Support for this prediction also comes from the finding that the strength of children's attentional biases depends on the amount of their linguistic experience within relevant object categories or superordinate categories (Gershkoff-Stowe & Smith, 2004; Jones & Smith, 2002; Smith et al., 2002; Thom & Sandhofer, 2009).

Our findings expand on other studies by suggesting that the number of perceptual features correlated among category members might also influence the timing of onset and strength of children's attentional biases. Older children (8 to 13 years of age) and adults are able to use multiple perceptual features as cues in visual problem-solving tasks, but they struggle to do so when the tasks involve more than two cues (Imai & Garner, 1965; Montanelli, 1975). It is possible young children experience something similar: The number of perceptual features shared among category members might impact their ability to detect the correlations, and thus, impact the development of biases to attend to those perceptual features; This could explain the "ranking" that we observed of

children's trajectories of vocabulary acquisition within superordinate categories based only on shape, based on shape and one other feature, and on shape and two other features. This possibility would be consistent with the *less is more* hypothesis, which predicts that children's resources constraints limit their ability to entertain complex probabilistic predictions (Newport, 1990).

It is also possible that both the number and nature of the perceptual features correlated among category members influence the timing of onset and strength of children's attentional biases. Montanelli (1975) found that children's use of multiple perceptual features as cues in visual problem-solving tasks was influenced by the salience of the cues: Children's performance was faster in trials when shape was most valid as a cue than in trials when it was the less valid as a cue. Montanelli posited that "it is possible that when children find the cue they prefer is also the most valid, they respond quickly, relying primarily on the preferred cue, but when the preferred cue is not the most valid, they spend more time looking at all the cues, in an attempt to decide how to use them" (p. 310). A parallel process might occur for young children when learning words: When shape is the only perceptual feature shared among category members, and therefore the most valid cue to category membership, they detect the correlation quickly; When shape is one of multiple perceptual features shared among category members, and therefore as valid a cue to category membership as other perceptual features (or less valid a cue), they detect the correlation more slowly. Differences in the detectability of correlations to children might translate into differences in the development of their attentional biases and in the trajectories of their vocabulary acquisition. This could explain our paradoxical finding that shape-based categories were not equal in terms of children's acquisition of labels for their members. When shape is paired with other perceptual features, children perceive it in a different light.

The attentional learning account predicts that category-specific attentional biases can develop for any superordinate category regardless of its perceptual organization (Smith, 2000, 2001). However, we found no evidence suggesting that children utilize, or would develop, attentional biases for nonshape perceptual feature (or sets of non-shape perceptual features). Previous research (e.g., Thom & Sandhofer, 2009) suggests that 20-month-old children can develop biases to attend to nonshape perceptual features (e.g., color) as the result of laboratory training, but our findings suggest that they do not do so as a result of their everyday linguistic experience before they are 30 months of age. Indeed, our findings hint that, in some superordinate categories (e.g., foods), children do not develop attentional biases at all. Children were successfully learning labels for foods, but the labels that children knew and learned within the superordinate categories were not those that should be necessary to tune their attention to nonshape perceptual features nor were they reflective of a bias to attend to nonshape perceptual features when generalizing labels for members.

Also challenging for the attentional learning account is the fact that

children's vocabulary sizes were the smallest, and their rates of vocabulary growth the slowest, within superordinate categories that were extensively based on shape (e.g., body parts, clothing). Based on the current conceptualization of the shape bias (Gershkoff-Stowe & Smith, 2004; Jones et al., 1991; Landau et al., 1988; Samuelson & Horst, 2007; Samuelson & Smith, 1999; Smith et al., 1992; Smith & Samuelson, 2006), we might have expected children's vocabulary acquisition to be more aggressive within the superordinate categories that are comprised of numerous shape-based object categories than within superordinate categories that are comprised of fewer shape-based object categories (e.g., foods, small household items). However, we observed the opposite pattern of results. Our findings suggest that, in addition to the shape bias, other factors might facilitate (or impede) children's vocabulary acquisition within some shape-based superordinate categories.

Ontological Knowledge Account

A competing account of children's vocabulary acquisition proposes that ontological knowledge is responsible for children's word-learning strategies (Bloom, 2000; Booth & Waxman, 2002a; Booth & Waxman, 2002b; Booth et al., 2005; Keil, 1994; Diesendruck & Bloom, 2003; Diesendruck et al., 2003; Gelman, 1988; Mandler & McDonough, 1998). Within this framework, children's early attention to shape is "not because of a direct correlation with categories, but because it is causally related to deeper conceptual qualities of objects from a broad range of ontological categories. For example, shape is intimately tied both to the functions of artifacts and to the behaviors in which animate objects can engage" (Booth & Waxman, 2002a; p. B13; see also Bloom & Markson, 1998; Soja et al., 1991). Children develop category-specific word-learning strategies because their ontological knowledge increases (Diesendruck & Bloom, 2003; Diesendruck et al., 2003; Kemler Nelson et al., 2000).

Our findings are consistent with this account in that they suggest that, in many instances, children were not relying on any perceptual feature or sets of perceptual features when learning labels for members of the superordinate categories of interest. For example, their acquisition of labels for perceptually ambiguous object categories matched that of their acquisition of labels for shape-based object categories (and outpaced their acquisition of labels for object categories based purely on shape). It is possible that children were relying on their ontological knowledge when learning labels for members of superordinate categories that encompass numerous perceptually ambiguous object categories (e.g., foods). As discussed, this knowledge might center on the function of the superordinate category (Diesendruck et al., 2003; Gelman & Bloom, 2000; Kemler Nelson, 1995; Kemler Nelson et al., 2000; Mandler, 1992; Mandler & McDonough, 1998). However, it could also center on its other characteristics. It is also possible that children were relying on their ontological knowledge

when learning labels for members of superordinate categories that were less perceptually ambiguous. This would explain why children knew and learned surprisingly few members of extensively shape-based superordinate categories. As noted, previous research (e.g., Mandler, 1992; Rakison & Poulin-Dubois, 2001; Rakison & Poulin-Dubois, 2002) suggests that the superordinate category of vehicles is bound by function (e.g., transportation). Children in the current study might not have developed this ontological knowledge yet, and their acquisition of labels for vehicles was slow as a result.

These two accounts of vocabulary acquisition are typically pitted against each other (see Smith & Samuelson, 2006 and Booth et al., 2005 for articulation of both sides of this debate). Being descriptive in nature, the current study cannot resolve this issue. However, our findings do present the possibility that, during a certain period of development, both attentional learning and ontological knowledge might account for children's vocabulary acquisition, and that 24- to 30-month-old children's use of these kinds of word-learning strategies varies between superordinate categories. This idea has also been proposed by others (e.g., Hills et al., 2009; Gelman & Koenig, 2003; Keil & Batterman, 1984; Sheya & Smith, 2006). Thus, our findings add to the body of research suggesting that the better question to ask is when, and for which superordinate categories, each kind of word-learning strategy develops.

Classifications of Superordinate Categories

Our secondary objective was to verify the perceptual organization of the superordinate categories by using the same methodology (i.e., adult ratings of perceptual similarity) to classify the members of each category. We took very special care to mirror our measures to those of previous studies (e.g., Gershkoff-Stowe & Smith, 2004; Samuelson & Smith, 1999). In many ways, we replicated their findings. For example, we found similar proportions of labels of shape-based, material-based, and color-based object categories across superordinate categories and classified many of the specific words from the corpus in an identical manner. However, we also found a few surprising differences in the specific breakdown of object category types within the superordinate categories between our study and previous work (e.g., Jones et al., 1991; Jones & Smith, 2002). Recall that Jones et al. (1991) and Jones and Smith (2002) found that superordinate category of animals is primarily based on shape and texture, whereas we found it is primarily based on shape and color. It is important to note that pilot data obtained using the same answer options and similar question framing indicated a similar pattern of results. As such, we are confident in the validity of our findings. What caused these differences in findings between the current study and of previous studies? We propose they resulted from small, but perhaps meaningful, differences in our methodologies. For example, Jones et al. (1991) evaluated the similarity of objects in texture rather than in material. Texture and material are often treated

as equivalents (e.g., Jones & Smith, 2002). Our findings suggest that doing so might be problematic. Perhaps we would have observed the same results as these previous studies if we had included “texture” as an answer option rather than “material.” These studies also framed their questions to participants differently. For example, Jones et al. (1991) asked participants to determine the specific perceptual features that were shared among category members (e.g., rounded vs. angular shape). We never asked participants to specify which specific shape, color, or material was shared among category members. Thus, our findings also suggest that the classification of the perceptual organization of superordinate categories using adult ratings might be influenced, to some extent, by how participants are asked to think about their members (Russell et al., 2016). This possibility suggests that determining the perceptual organization of object categories and superordinate categories is a complex process and an objective that cannot be met by any single methodology. Nevertheless, by classifying the superordinate categories using the same methodology, our findings allowed for appropriate and meaningful between-category comparisons of perceptual organization as well as of children’s trajectories of vocabulary acquisition. They also provide a foundation for future research to build upon.

Additional Considerations and Suggestions for Future Work

We have articulated the value of the MCDI and justified our use of it to analyze the content of children’s vocabularies. However, we acknowledge that both the measure and our methodology have their limitations. The content of children’s vocabulary, no matter how it is measured, can reveal much about their successes in learning words in their daily lives. It can speak to, but not confirm, how children approach word learning in the moment. Our findings present some intriguing possibilities regarding children’s use of category-specific word-learning strategies between 24-30 months of age. However, these possibilities must be validated with experimental research using ostensive label-learning paradigms. Future research should examine the nature of children’s strategies for learning labels for foods, as our findings suggest they do not take the form of a bias to attend to a perceptual feature. Future research should also examine how children generalize labels for body parts and clothing items, as children’s word-learning strategies within these superordinate categories that have not been tested in the laboratory. We might also predict that children develop category-specific word-learning strategies in these superordinate categories later than in superordinate categories in which they exhibit larger vocabulary sizes. Additionally, it would be interesting to retest categories already tested in previous research, using the information found in this study. Do children generalize labels for animals by shape and texture or by shape and color when both options are provided? Furthermore, does children’s generalization vary between object categories within superordinate categories? For example, if the object category of apples

is based on shape, and the object category of bananas on shape and color, do we see differences between children's word-learning strategies when asked to learn "a type of apple" versus "a type of banana?" Based the findings of the current study, we might expect children's label generalization to vary between these instances—provided they have had sufficient linguistic experience within the relevant object categories.

Summary of Contribution

The findings of the current study paint a nuanced picture of the content of 24- to 30-month-old children's typical vocabularies by comparing the proportions of known labels for object category types within the superordinate categories of interest as well as the proportions of known labels for simple versus complex object categories. Whether looking across or within the superordinate categories, the content of children's vocabularies is more varied than what is suggested by previous research. Our findings refine our understanding of how the shape bias helps children build their initial vocabularies and how other word-learning strategies help them diversify their vocabularies. In so doing, they inform the theoretical debate regarding the nature of children's word-learning strategies and emphasize the necessity of using naturalistic and laboratory data to answer our questions on this topic. Finally, the current study provides several clear directions for future work and a foundation upon which it can be built.

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Conflict of Interest Disclosure

The authors affirm there was no conflict of interest.

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Research Ethics Statement

All procedures involving human subjects were approved and monitored by the Institutional Review Board (IRB) at California State University, Northridge.

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