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A Mutually Facilitative Relationship Between Learning Names and Learning Concepts in Preschool Children: The Case of Artifacts

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Two studies investigated the relationship between learning names and learning concepts in preschool children. More specifically, we focused on the relationship between learning the names and learning the intended functions of artifacts, given that the intended function of an artifact is generally thought to constitute core conceptual information about an artifact's category. We asked whether learning the intended function of a novel artifact facilitates retention of its name and whether learning the name of a novel artifact prompts the search for information about its intended function. In Experiment 1, 3- and 4-year-old children better retained the names of novel artifacts when the intended functions of these artifacts were revealed. The comparison condition involved providing perceptually relevant and conceptually irrelevant information about the objects. In Experiment 2, 4-year-old children who were provided with the names of novel artifacts were more likely to seek out information about the objects' functions than children provided with conceptually irrelevant information about the artifacts. Together, the studies demonstrate the intimate and mutually facilitative relationship between names and concepts in young children.

Some have argued that young children's naming of objects involves forming associations between names and some of the perceptual properties (e.g., the shape) of the objects to which they refer (Imai, Gentner, & Uchida, 1994;

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Landau, Smith, & Jones, 1998; Smith, Jones, & Landau, 1996). Others, however, such as Bloom (2000), Cimpian and Markman (2005), Mandler (2004), Nelson (1974), and Soja, Carey, and Spelke (1992), have argued that children attach names to concepts in the process of language acquisition and that the perceptual properties shared by exemplars of a category do not adequately specify such concepts, even in the simplest case of concepts of objects. For example, Mandler (2004) writes, "The most crucial aspect of the relation between preverbal concepts and words is that language is mapped onto concepts and not onto perception or sensorimotor schemas" (p. 243). Such a view suggests the two complementary questions that are explored in this paper. One, when children are provided with conceptual information about a novel object, will they be more likely to learn the name of that object than when such information is withheld? Two, when children are given the name of a novel object, will they be more likely to seek information about the kind of thing the object is than when the object is not named? Put more simply, the questions are whether conceptual information prompts the acquisition of names and whether names prompt the search for conceptual information. The first question is addressed in Experiment 1; the second, in Experiment 2.

Our investigations concern the names and concepts of artifacts. For such human-made objects, in particular, there is fairly widespread agreement that adults' concepts are closely linked to the objects' intended functions (e.g., Bloom, 2000; Keil, 1989; Miller & Johnson-Laird, 1976). For example, Rips (1989) showed that adults classify an object that looks like an umbrella but that was originally designed to be a lamp shade as a lamp shade. In adults' language, the name of an artifact category refers to all and only those things that are intended to function as members of the category (but see Malt & Johnson, 1992, for a different view). The shape or other perceptual attributes of the objects may vary substantially across members of the category, as when an analog grandfather clock and a digital traveling alarm clock are identified as members of a common basic-level category, and both called a "clock," presumably because they were designed for the same function—namely, to display the time of day. Some even argue that the function intended by the designer of an artifact should be considered the "essence" of an artifact concept in that the designer's intended function provides an explanation for the superficial features of members of the artifact category—such as their shape (Kelemen & Carey, 2007; see Bloom, 2000, for a related view). Others refer to the idea that representations of artifacts have a functional "core" (Truxaw, Krasnow, Woods, & German, 2006) or that functional information is more "conceptually central" than perceptual information (Diesendruck, Markson, & Bloom, 2003).

Recent evidence suggests that young children, like adults, take the function of an artifact to be a fundamental basis for how it is named and categorized (e.g., Diesendruck et al., 2003; Jaswal, 2006; Kelemen & Carey, 2007; Kemler Nelson & 11 Swarthmore College Students, 1995; Kemler Nelson, Russell, Duke, & Jones, 2000; Markson, Diesendruck, & Bloom, 2008). A number of earlier studies suggested that when functional information is pitted against perceptual information—the shape of the object particularly—young children ignore function in generalizing new artifact names (e.g., Gathercole, Cramer, Somerville, & Jansen op de Haar, 1995; Gentner, 1978; Graham, Williams, & Huber, 1999; Landau et al., 1998; Merriman, Scott, & Marazita, 1993; Smith et al., 1996; Tomikawa & Dodd, 1980). However, it now appears that those earlier studies overestimated the extent to which preschoolers take shape to be a preeminent cue to object names (e.g., Cimpian & Markman, 2005; Diesendruck et al., 2003) and underestimated the extent to which functional information can trump shape and other perceptual similarities as a basis for extending object names. In particular, when the function demonstrated for a novel artifact provides a plausible account of the structural properties of the object—that is, when the demonstrated function serves as a satisfying explanation of what the designer had in mind in rendering an object with the physical characteristics that are apparent—4-year-olds use that function as a basis for naming even when it is in conflict with perceptual similarity (Bloom, 2000; Kelemen & Carey, 2007; Kemler Nelson, Frankenfield, Morris, & Blair, 2000). This explanatory connection from intended function to object structure typifies most real-world artifacts but appears to be lacking in the artificial stimulus materials used in many of the studies that have dismissed the role of function in children's naming.

More recent than the debate about whether functional information is central to young children's artifact concepts is a partially related controversy about whether, like older children and adults, preschoolers adopt "the design stance" (Dennett, 1987) toward artifacts. Roughly speaking, this is the disposition to believe that the function for which an artifact was originally designed is the deepest determiner of the object's identity and its characteristics. Central evidence that adults adopt the design stance comes from studies showing that when an artifact is described as designed for one purpose but used for another, adults opine that the object's "real" category membership and use are determined by its intentional functional origins—as shown by German and Johnson (2002), Kelemen (1999), Kelemen and Carey (2007), and Matan and Carey (2001). There is controversy among the same authors as to whether preschoolers show parallel effects. Still, others have joined this controversy, providing data from different paradigms that seem to constitute positive evidence for the design stance in

young children by showing that matters of intentional design matter to preschool children in their naming and conceptualization of artifacts (e.g., Asher & Kemler Nelson, 2008; Diesendruck et al., 2003; Gelman & Bloom, 2000; Jaswal, 2006; Kemler Nelson, Frankenfield, et al., 2000; Kemler Nelson, Holt, & Egan, 2004). The debate among these investigators does not bear directly on the current work, except to provide an indication that the proposal that function is privileged over appearance in young children's concepts of artifacts has been largely presumed by a number of recent investigators, who have moved on to the question of whether the function that is privileged is necessarily the design function as opposed to a different conventional use. In the real world, of course, these two functions are rarely in conflict.

In summary, a growing number of investigators believe that, even in children, the function of members of an artifact category is more intimately and deeply connected to the artifact kind than are perceptual properties, such as shape. This is the working assumption that we adopt in the present article. We shall refer to the function of an artifact as being at the "core" of a child's concept of an artifact. Such a view does not entail that perceptual similarity is irrelevant to how artifacts are categorized and named by children, because salient perceptual properties, such as shape, are thought to provide useful cues to the functions of artifacts (e.g., Bloom, 2000; Markson et al., 2008). The latter proposal is a natural consequence of the position that the usual and intended function of an artifact accounts for many of its apparent structural features. Thus, when the function of an artifact is unknown, as is often the case when the object is unfamiliar, shape can provide a useful fallback criterion for categorization (e.g., Bloom, 2000; Nelson, 1974; Soja, Carey, & Spelke, 1992). Still, an object's appearance provides neither a necessary nor a sufficient condition for how children categorize it (Cimpian & Markman, 2005). In this sense, perceptual properties appear to play at best a peripheral role in children's concepts of artifacts.

Nelson's (1974) early theorizing about the intimate relation between names and concepts in young children was tightly tied to her view that functional information was at the core of young children's concepts of objects. In this way, the present proposal and the following studies were anticipated by her work over 30 years ago. However, there is a critical difference. Whereas Nelson suggested that functional information is at the core of all object concepts, we think it critical to distinguish concepts of artifacts from concepts of other objects, such as natural kinds. In our view, functional information is at the core of concepts of artifacts almost exclusively (although it may extend to body parts also), not concepts of all objects, and this seems to be true for the concepts of young children as well as those of adults (Greif, Kemler Nelson, Keil, & Gutierrez, 2006). In fact, a number

of the early empirical demonstrations that seemed to be problematic for Nelson's (1974) theory pertained to names for natural kinds rather than names for artifacts (e.g., Bowerman, 1977).

In this article, we will investigate whether concepts (i.e., core conceptual information) prompt the acquisition of names by young children by asking whether functional information about unfamiliar artifacts facilitates learning the objects' names. In a related manner, we will explore whether names prompt the acquisition of concepts (i.e., core conceptual information) by young children by asking whether providing names for unfamiliar artifacts motivates a search for their functions.

EXPERIMENT 1

Does providing functional information about novel artifacts facilitate the learning of their names? Some suggestive evidence comes from Kemler Nelson and O'Neil (2005). In a study with the primary purpose of investigating how parents answer children's questions about the identity of objects, an attempt was made to include some objects that were familiar to their young children in function, but whose name was unknown, and some for which the opposite was true. Although it was easy to find objects meeting the first set of criteria, it was almost impossible to find objects of the second sort. When parents were asked whether their children knew the name and/or the function of objects preselected for the possibility that they might be unfamiliar to some 4-year-olds, 96% of the cases in which children were said to know one, but not the other, were cases in which children knew only the function. Although the survey was by no means exhaustive, this observation suggests there may be few artifact names that the child retains without the names being attached to conceptual information.

Of possible relevance also is a set of studies by Booth and Waxman (2002) showing that, in 14-month-olds, object names serve as effective cues to categories of unfamiliar artifacts only when the function of at least one exemplar has been demonstrated. Booth and Waxman attribute this effect to the possibility that names facilitate categorization only when the "core meaning" associated with the objects can be discerned. Although the issue in their studies is not the retention of artifact names, still the suggestion that functional information renders names of artifacts especially salient or powerful is compatible with the hypothesis under study in Experiment 1.

In our study, 4-year-olds (Experiment 1A) and 3-year-olds (Experiments 1B) were presented with the novel names of four objects with unfamiliar functions. After a brief intervening activity and without forewarning, they were tested for their ability to produce and comprehend the names of the

objects. In the Function condition, the functions of the objects were demonstrated and performed when the objects were named. In the Fact/Shape condition, the objects were manipulated in a context that highlighted some of their perceptual properties, and, in addition, children were provided with incidental (conceptually irrelevant) information about the objects when they were named. Accordingly, the Fact/Shape condition both drew attention to some of the perceptual properties of the object and, in parallel with the functional information in the Function condition, provided some novel information about the object. We predict that the children will be more likely to retain the names of the objects in the Function condition than in the comparison condition because only those in the Function condition will have core conceptual information on which to "hang" the artifacts' names.

Experiment 1A

Method

Participants. Thirty-two children, 16 boys and 16 girls, participated in the study. The mean age of the participants was 4 years, 5 months (range = 3 yr 10 mo to 5 yr 1 mo). Children were all attending private nursery schools in an upper-middle-class suburb of a major city in the Northeast. Parents gave written consent, and verbal consent was obtained from each participant on the day of the study.

Materials. Stimulus materials were four unfamiliar objects. Two of the objects were created in the laboratory for previous studies, and two were purchased at retail stores. The two store-bought objects were assigned novel functions that would be appropriate for preschoolers, but these functions still provided plausible accounts of the objects' structures and thus plausibly constituted the intended functions of these objects for children (see Kemler Nelson, Frankenfield, et al., 2000, for the importance of these criteria). A novel name was given to each of the objects. The names and functions of the objects are provided in Table 1.

In the Fact/Shape condition, a 20×30-inch flat board was used to highlight some of the objects' perceptual properties when they were introduced. Attached to the board's yellow background were black cutouts in the shapes of the bases of the four objects, so that the board appeared almost like an empty puzzle board into which could fit four independent pieces (i.e., the four objects). When an object was placed correctly on its matching cutout, the cutout was no longer visible.

TABLE 1
Object Names, Functions, and Facts for Experiment 1

Object	*Name*	*Function*	*Fact*
Ball launcher	*Fil*	"To hit balls into the air"	"My brother gave this to me."
Cherry pitter	*Pank*	"To put holes in pieces of Play-Doh"	"I found this in a closet."
Circle drawer	*Luz*	"To draw circles on paper"	"My friend has one like this too"
Strap wrench	*Tob*	"To turn other things around"	"This came in a red box."

Experimental design. Participants were randomly assigned to either the Function condition or the Fact/Shape condition. The order of objects for presentation, production test, and comprehension test was randomly assigned. Distractors for object pairs in the comprehension test consisted of one of the other objects that had been named. Distractors were randomly determined, but they were sampled without replacement, and no pair of objects was used for more than one trial for any participant. The same 16 randomly determined orders of objects for presentation, production test, and comprehension test were used in the two conditions.

Procedure. Each child participated in a single session lasting approximately 20 minutes. The sessions were conducted in a private, familiar room at the child's nursery school. The session included four phases: object presentation, distraction task, production test, and comprehension test.

Participants were presented with the objects one at a time. For each object, the experimenter named the object, and asked the child to repeat the name (e.g., "This is a *pank*. Can you say that, a *pank*?"). In the Function condition, the experimenter then described and demonstrated the object's function (e.g., "You use a *pank* to hit balls into the air.") and instructed the child to try out the function. In the Fact/Shape condition, the experimenter offered incidental information about the object (e.g., "My brother gave me this *pank*."), described and demonstrated where the object belonged on the board by putting it on its appropriate template, and then instructed the child to follow suit. Thus, children in both conditions had the opportunity to see the objects handled and to handle them themselves. Additionally, all children heard some new information about the objects, but the information was conceptually relevant only in the Function condition.

Throughout introductions to the objects in both conditions, the experimenter also gave the child "filler" (conceptually irrelevant) information about the object (e.g., "I like my *pank*.") in order to repeatedly expose the child to the object's name. In both conditions, the name of each object was used by the experimenter 14 times, and the child was prompted to

repeat or use the object's name three times. Each participant was exposed to each object for approximately 3 minutes, and the exposure time did not differ systematically between the two conditions. Each object was removed from view before the presentation of the next one. Finally, after the introduction of all four objects, the objects' names were briefly reviewed in order of their presentation. Children were never forewarned that a memory test would follow.

A distraction task followed the naming of the objects, in which the experimenter read a short book for approximately 2 minutes to each participant. Next, participants were asked to recall the name of each object. In the Function condition, the experimenter presented the object, reminded the child of the object's function (e.g., "Remember, you use this to draw circles on paper.") and asked the child for the name of the object. In the Fact/Shape condition, the experimenter presented the object, reminded the child of the incidental information about the object (e.g., "Remember, I found this in a closet."), and asked the child for the name of the object. If the child's production was incorrect, or the child failed to produce anything, the child was reminded of the object's name.

For the comprehension test, which always followed the production test, objects were presented in randomly constituted pairs. No child saw the same pair of objects more than once. Participants were asked to point to the test object named by the experimenter (e.g., "Which one is a *tob*?"). Only one name was tested for each object pair, and each new name was tested once, for a total of four queries.

Any spontaneous questions about the stimulus objects were also recorded.

Results and Discussion

Children in the Function condition correctly produced more than twice as many names ($M = 1.44$ of a possible 4, $SD = 0.86$) as those in the Fact/Shape condition ($M = 0.69$, $SD = 0.77$). This difference in production is reliable, $t(30) = 2.51$, $p < .02$.

On the comprehension test, children in the Function condition were accurate on an average of 3.63 items of a possible 4 ($SD = 0.72$) and those in the Fact/Shape condition, on an average of 3.38 items ($SD = 1.09$). Comprehension performance did not differ significantly between the two groups, $t(30) = 0.77$, $p > .05$. Both children in the Function condition, $t(15) = 9.04$, $p < .005$, and in the Fact/Shape condition, $t(15) = 5.06$, $p < .005$, performed above chance in comprehension.

To inspect individual performances, the number of children in each condition who correctly produced and who correctly comprehended the names

of 0, 1, 2, 3, or 4 objects is shown in Table 2. To enable a χ^2 test for independence between condition and number of names produced, the results from production were collapsed into two categories: children producing fewer than 2 object names and children producing 2 or more names. The resulting statistic, $\chi^2(1) = 3.82$, fell just short of significance at the .05 level in a two-tailed test, suggesting the same pattern that the parametric test more clearly indicated already. The results from comprehension were also collapsed into two categories: children comprehending 3 or fewer names and children comprehending 4 names. The analysis showed no reliable effect of condition, $\chi^2(1) < 1.0$, in line with the t test for comprehension reported earlier.

Six (38%) of the 16 children in the Fact/Shape condition asked questions about the functions of the objects or made guesses about the objects' functions (e.g., "What is this for?" or "Does it swing?"). These six children asked an average of 2.33 questions each. None of the children in the Function condition asked questions about the objects.

These results clearly indicate that 4-year-old children provided with functional information about novel artifacts were more successful in their later production of the objects' names than those who were provided with incidental information and heightened perceptual information. The two groups did not differ significantly in their comprehension of the names, but this well

TABLE 2
Numbers of 4-Year-Olds (Experiment 1A) and 3-Year-Olds (Experiment 1B) Correctly Producing and Comprehending a Specific Number of Names

	Number of Names Retained				
	0	*1*	*2*	*3*	*4*
4-year-olds					
Production					
Name Condition	2	7	5	2	0
Fact/Shape Condition	8	5	3	0	0
Comprehension					
Name Condition	0	0	2	2	12
Fact/Shape Condition	0	2	1	2	11
3-year-olds					
Production					
Name Condition	6	3	4	3	0
Fact/Shape Condition	8	4	3	1	0
Comprehension					
Name Condition	0	0	3	1	12
Fact/Shape Condition	0	3	7	1	5

may be due to a procedural decision: Children who failed to produce or incorrectly produced an object name were provided with the correct object name immediately before the comprehension test.

The tendency for some children in the Fact/Shape condition to ask questions about the functions of the objects may also be an interesting result. Seemingly, these children were unsatisfied with the incidental and perceptual information they received about the objects and instead sought functional information. This may be an indication that the children were seeking conceptual information to attach to the new names.

Experiment 1B

In Experiment 1A, 4-year-olds were more successful in retaining novel artifact names when provided with functional information than when provided with incidental and perceptual information. Will younger children perform similarly? The possibility that they might not derives from two different proposals. One is the possibility that conceptual information is just not as central to how younger children learn object names as it is to older children. Two is the more specific possibility that there are developmental differences in the centrality of function to artifact kinds, such that functional information plays a lesser role in the artifact concepts of 3-year-olds than those of older children (as suggested, for example, by Landau et al., 1998). However, if neither of these proposals is correct, we might expect that children younger than those in Experiment 1A would still show an advantage in retaining novel names of artifacts introduced with functional information. To investigate these alternatives, the procedure of Experiment 1A was repeated with children approximately 1 year younger, 3-year-olds.

Additionally, a small but potentially important change was made in the procedure. In Experiment 1A, children who failed to produce or incorrectly produced an object name test were provided with the correct object name. Any differences between conditions in the comprehension test, which immediately followed the production test, could have been obscured by this practice. In fact, the children in both conditions performed above chance. For this reason, in Experiment 1B, children were not provided with the correct object name when they failed to recall or incorrectly recalled an object name during the production test.

Method

Participants. Thirty-two children, 16 boys and 16 girls, participated in the study. The mean age of the participants was 3 years, 9 months (range = 3 yr 3 mo to 4 yr 1 mo). Children were all attending private nursery

schools in an upper-middle-class suburb of a major city in the Northeast. Parents gave written consent, and verbal consent was obtained from each participant on the day of the study.

Materials. Stimulus materials were identical to those used in Experiment 1A.

Experimental design. The experimental design was identical to that of Experiment 1A.

Procedure. The procedure was the same as that used previously, with one exception. In the production test for Experiment 1B, children were not corrected for an omission or commission.

Results and Discussion

Children in the Function condition correctly produced a mean of 1.25 names of a possible 4 ($SD = 1.18$) and children in the Fact/Shape condition, a mean of 0.81 names ($SD = 0.98$). Although the difference between conditions was in the same direction found for the 4-year-olds, it is not reliable, $t(30) = 1.14$, $p > .05$.

Children in the Function condition, however, comprehended significantly more object names ($M = 3.56$ of a possible 4, $SD = 0.81$) than those in the Fact/Shape condition ($M = 2.50$, $SD = 1.15$), $t(30) = 3.01$, $p < .005$. Children in the Function condition performed significantly above chance on the comprehension task, $t(15) = 7.68$, $p < .005$, but children in the Fact/Shape condition did not, $t(15) = 1.73$,$p > .05$.

More information about individual performances is contained in the bottom panel of Table 2, which shows the number of 3-year-olds producing and comprehending each possible number of object labels. In order to test for an effect of condition on production, the production results were collapsed into two categories: children producing fewer than 2 object names and children producing 2 or more names. A χ^2 test failed to show any reliable difference, $\chi^2(1) = 1.24$, $p > .05$, in line with the same failure in the parametric test reported above. The comprehension results were also collapsed into two categories: children comprehending 3 or fewer names and children comprehending 4 names. For this measure, a reliable effect of condition was evident, $\chi^2(1) = 6.15$, $p < .02$, reinforcing the earlier reported result from the t test on the comprehension results of the 3-year-olds.

Eight (50%) of 16 children in the Fact/Shape condition asked questions about the function of the objects or made guesses as to the objects' functions (e.g. "What does it do?" or "It can do this?"). These eight children asked an

average of 2.25 questions each. None of the children in the Function condition asked questions about the objects. Again, our interpretation is that a number of children were dissatisfied with the information supplied in the Fact/Shape condition, particularly because functional information—i.e., conceptually relevant information—was not forthcoming.

Finally, an analysis of variance (ANOVA) for a 2 (Condition) $\times$ 2 (Age) design was applied to the production scores for Experiments 1A and 1B combined, the single test that was comparable for the two age groups. The results revealed a main effect of Condition, $F(1, 60) = 5.96$, $p < .02$, no effect of Age, $F(1, 60) < 1.0$, and no interaction between Condition and Age, $F(1, 60) < 1.0$. The main effect of Condition reflects the finding that children in the Function condition correctly produced more names than children in the Fact/Shape condition when both age groups are combined.

Still, the clearer result from the 3-year-olds is the new finding that comprehension performance was superior in the Function condition relative to the Fact/Shape condition when the procedural adjustment was made in Experiment 1B. Unlike the finding for the 4-year-olds in Experiment 1A, only 3-year-olds in the Function condition performed above chance in comprehension. Thus, at least one test of word learning in each age group revealed the hypothesized pattern—namely, that providing core conceptual information (i.e., functional information) for artifacts facilitates children's acquisition of the objects' names. Having a kind concept onto which to attach a name increases the likelihood that children will learn the name that refers to the object.

EXPERIMENT 2

If learning a name is facilitated when it can be attached to conceptual information, can we demonstrate a conversely related effect—namely, that learning a name facilitates a search for conceptual information to attach to it? Nelson (1974) ends her classic paper on conceptual and language development with the following comments: "It is hypothesized . . . that the child, as well as the adult, will always search for the functional core when learning a new word. This question . . . remains one for future exploration" (p. 284). A strong version of this hypothesis is that hearing a new name plays a privileged role in prompting the child to seek conceptual information—privileged in comparison to getting other new kinds of information about an object.

There is evidence that when young children are provided a name for an unfamiliar artifact, they often do seek out information about the function

of the artifact. Kemler Nelson, Egan, and Holt (2004) found that when children's questions about the identity of novel artifacts (such as "What is it?") elicited only the objects' names, 3- and 4-year-old children were likely to seek further information about the objects over 50% of the time. (They never asked additional questions when initially provided functional information instead of a name.) In addition, in Experiment 1, we found that children in the Fact/Shape condition, who were initially given names without functional information, sometimes sought out that information. However, these findings do not provide a strong test of the hypothesis that names are prepotent as motivators to seek functional information about artifacts. Such a test will require a comparison between a condition in which new names are provided and a condition in which other sorts of new but conceptually irrelevant information about the objects are provided. Will names be more likely to prompt a conceptual search? The purpose of Experiment 2 is to test this hypothesis.

A number of studies reviewed by Woodward and Markman (1998) and Waxman (1998) suggest that naming objects facilitates categorization by infants and young children. For example, in a modified novelty-preference procedure, infants who hear a common count name applied to a series of familiar objects are more likely to treat as novel an instance of a different superordinate category than another instance of the superordinate category to which they have been exposed (Waxman & Markow, 1995). When the objects are unnamed during familiarization, such evidence for categorization does not obtain at the superordinate level. Eighteen-month-old infants are also more likely to form categories of novel objects when several of the objects are named than when they are not (Booth & Waxman, 2002). In preschoolers, Markman and Hutchinson (1984), as well as Waxman and Hall (1993), have shown that taxonomic categorization is more likely to occur when names are used. However, these studies provide only suggestive evidence that names elicit a search for concepts per se, because it can be argued that the categories primed by names are perceptually rather than conceptually based (e.g., Landau et al., 1998). Attempts to resolve this issue have met with mixed results (e.g., Baldwin, 1992; Cimpian & Markman, 2005; Imai, Gentner, & Uchida, 1994; Golinkoff, Shuff-Bailey, Olguin, & Ruan, 1995).

In fact, Smith et al. (1996) have suggested that, with regard to artifacts, providing names actually decreases the probability that children will generalize on the basis of common function compared to the case in which no names are used. According to their "dumb attentional" hypothesis, young children specifically attach names to salient perceptual features rather than conceptually relevant information about function, and they do so even when functional information influences their performance in a nonname

condition. However, in a comparison of name and nonname conditions, Kemler Nelson, Frankenfield, et al. (2000) failed to replicate Smith et al.'s finding in 2- and 3-year-olds and observed the opposite pattern in 4-year-olds, consistent with the current hypothesis.

Here, we adapt the procedure of Kemler Nelson, Egan, et al. (2004), and use children's persistence in the search for information about the identity of novel artifacts as an index of their tendency to seek out conceptual information. We compare two conditions. In the Name condition, whenever a child asked an open-ended question, such as "What is it?", about an object, the experimenter responded by giving only the object's name. In the Incidental Information condition, the same question was answered by providing only incidental (nonconceptually relevant) information about the object (e.g., "It's something my brother gave me."). If hearing names for artifacts particularly motivates a search for conceptual information, then we predict that, following the experimenter's initial response, children will be more likely to follow up with further questions specifically designed to elicit functional information about the artifacts when the children have been provided names than when they have been provided other new kinds of information about the objects.

Method

Participants. Participants were 48 children, 20 girls and 28 boys, attending preschool in an upper-middle-class suburb of a major northeastern city. Parents gave written consent for their children to participate in the study, and the children themselves gave oral consent. The mean age of the sample was 4 yr 7 mo, with a range of 3 yr 10 mo to 5 yr 2 mo.

An additional eight children at least began the experimental session. Of these, six asked no questions at all and usually refused to complete the session. Another additional two asked some questions but never the open-ended question that prompted the experimental manipulation.

Materials. Twelve objects, unfamiliar to young children in name and function, were used. Four of them had been constructed for previous studies in our laboratory, and eight of them were store-bought. Although some of the functions of the store-bought items were modified to make them more suitable for children, still those functions were chosen such that they provided plausible accounts of the structures of the objects, so that the children would find them plausible as the object's intended functions (see Kemler Nelson et al., 2000). The names and functions of the various test objects are shown in Table 3.

TABLE 3
Object Names, Functions, and Incidental Information for Experiment 2

Object	*Name*	*Function*	*Incidental information*
Snap line	*Amblow*	"Makes straight lines on a piece of paper"	"It's something my brother gave me."
Ball dispenser	*Becket*	"Lets one ball come out at a time"	"It's something I found in my basement."
Meatball maker	*Crullet*	"Makes balls out of pieces of Play-Doh"	"It's something I lost last week."
Ball launcher	*Filsap*	"Hits balls into the air"	"It's something my uncle took a picture of yesterday."
Massager	*Garflom*	"Flattens a towel"	"It's something I spent a lot of time looking for."
Table sweeper	*Hartup*	"Picks up rice off the table"	"It's something my cousin got in the mail."
Patty maker	*Kaylosh*	"Makes Play-Doh flat and round"	"It's something my brother/sister used to have one of."
Circle drawer	*Luzak*	"Draws arcs and circles"	"It's something my mom thinks is really neat."
Strap wrench	*Nuntob*	"Turns other things around"	"It's something that was in my car."
Olive pitter	*Riepank*	"Makes holes in pieces of Play-Doh"	"It's something my friend got for his/her birthday."
Flour sifter	*Taiffel*	"Sifts flour"	"It's something I haven't seen for a long time."
Stamp roller	*Vinsel*	"Rolls out stamps"	"It's something my dad let me borrow."

Experimental design. Children were assigned at random either to a Name condition or to an Incidental Information condition, differing in the kind of information the experimenter first supplied when children asked an open-ended question (such as "What is it?") about the identity of the objects.

Procedure. Children were brought individually to a small, quiet room at the preschool for a session that lasted no more than 20 minutes. During a preliminary period, the child was introduced to a puppet that was used to demonstrate question-asking about object identity. The puppet "whispered" questions to the experimenter, who told the children that the puppet had asked "What is it?" about two novel objects, not used in the test phase. The experimenter whispered to the puppet an inaudible reply. For the second training object, after responding to the initial query, she asked the puppet if he had any further questions about the object. This was done to demonstrate that asking multiple questions about a single object was acceptable.

In the test phase, objects were arranged around the room in a random order, and children were invited to select an object to ask the experimenter about. Once a selection was made, the experimenter prompted, "What questions do you have about that thing?" if the child failed to spontaneously inquire. If needed, an additional prompt reminded the children that they could ask questions just as the puppet had. Once a child asked a question about an object, the experimenter invited further questions about it. If no further questions occurred, the child was asked to select another object until all objects had been chosen.

Answers to a child's first open-ended question about an object's identity (e.g., "What is it?" or "What's this?") depended on the child's condition. In the Name condition, the response was always and only a novel name. In the Incidental Information condition, it was a sentence that did not provide any information about the object's name or function (e.g., "It's something my friend got for her birthday."). Different kinds of incidental information were provided for different objects, as shown in Table 3. All other types of questions were answered with correct and relevant information in both conditions.

Results and Discussion

A mean of 6.08 objects (of a possible 12) elicited open-ended questions (e.g., "What is it?") in the Name Condition ($SD = 3.74$), and a mean of 7.12 objects (of a possible 12) elicited open-ended questions in the Incidental Information condition ($SD = 4.04$). The difference is not reliable,

$F(1, 46) < 1.0$. Trials on which such a question was asked of an object constitute the Informative Trials for further analysis, because only they elicited different kinds of feedback from the experimenter.

We examined children's follow-up responses that occurred (or failed to occur) after the experimental manipulation (i.e., on all Informative Trials). For simplicity of scoring, only the first follow-up response (if any) to an object was considered. As shown in Table 4, the kinds of responses following the experimental manipulation were classified into nine categories: (a) *Q-Function*: an open-ended question about the object's function, such as "What does it do?"; (b) *G-Function*: a specific guess about the object's function, almost always uttered quizzically; (c) *Part*: a question or statement about an object part; (d) *Looks-like*: a question or statement about what the object "looks like"; (e) *Category*: a guess about the category membership of the object; (f) *Name*: a specific request for the object's name ("What is it called?"); (g) *Identity*: a second ambiguous question about the identity of the object, "What *is* it?", usually with emphasis on *is;* (h) *None*: a failure to follow up with any question or statement; and (i) *Other*: a question or statement that did not fit any of the other categories (e.g., "Why is it red?", but more usually a comment or question that was irrelevant to the object or to any information—including incidental information—that had been provided about the object). Table 4 shows, for all Informative Trials, the percentage of responses that fell into each of the categories described above, separately for the Name and Incidental Information conditions.

Because the data summary in Table 4 collapses over all participants, regardless of the number of Informative Trials per participant, it does not lend itself appropriately to statistical analysis. Accordingly, in order to analyze the results, proportional scores were computed based on the number of

TABLE 4
Percentage of All Informative Trials Characterized by Children's Different Follow-Up Response in the Two Experimental Conditions

Follow-up response	*Name condition*	*Incidental information condition*
Q-Function	30	13
G-Function	6	9
Part	1	2
Looks-like	1	2
Category	1	2
Name	0	5
Identity	4	12
None	53	47
Other	4	8

Informative Trials that occurred for each participant. To begin to address the issue of interest, we computed for each child the proportion of the child's Informative Trials that yielded a follow-up question about function (counting no more than one possible follow-up per object). We included in these proportions both those trials on which the child formulated a general follow-up question about the object's function (*Q-Function*) and those on which the child produced a specific guess about the object's function (*G-Function*). We did not include follow-up questions that were only ambiguous requests for functional information (*Identity*), namely "What *is* it?", because they could sensibly be requests for names rather than functions in the Incidental Information condition only.

The mean proportions of all Informative Trials per participant that elicited a follow-up request for functional information were .49 ($SD = .35$) in the Name condition and .24 ($SD = .29$) in the Incidental Information condition. The difference is reliable, $t(46) = 2.44$, $p < .025$. The finding is consistent with the hypothesis that providing names promotes a search for conceptually relevant (i.e., functional) information about novel artifacts.

However, it is possible that this method of computing the tendency to follow up with functional questions, although the most straightforward, might inflate any difference between conditions. This is because Informative Trials that yielded *Name* questions, sensible only in the Incidental Information condition, and *Identity* questions, sensibly asked about object names only in that same condition, were included in the counts of Informative Trials—perhaps deflating the ratios of functional questions to Informative Trials in the Incidental Information condition. For that reason, we performed a more stringent analysis of the tendency to follow up with functional questions. In the new analysis, the numerators of the proportions included *Q-Function* and *G-Function* follow-ups (as previously), but the denominators consisted of all Informative Trials with the exception of those that elicited *Name* and *Identity* follow-ups. The new mean proportions were .53 ($SD = .39$) in the Name Condition and .26 ($SD = .29$) in the Incidental Information condition, and the difference is again reliable, $t(46) = 2.72$, $p < .01$. Twelve of 24 children in the Name Condition and 4 of 24 children in the Incidental Information condition had mean proportions greater than .5. This difference also is reliable, $\chi^2(1) = 6.00$, $p < .02$. Thus, the corrected functional scores bolster the conclusion that providing the name of a novel artifact prompts a search for core conceptual information about the object's function.

Two further analyses were performed to eliminate alternative accounts of the tendency just described. One possibility is that children might have taken as unresponsive the kind of answers they received to their open-ended questions in the Incidental Information condition and that this might have simply discouraged them from asking follow-up questions. If this were the

case, then the greater proportion of functional follow-ups in the Name condition might be the result of a greater number of failures to follow-up in the Incidental Information condition. However, this possibility seems unlikely to us because the information supplied by the adult (e.g., "My brother gave this to me.") in the latter condition does provide the child with new information about the object and thus, at least in a strict sense, is not unresponsive. Moreover, a perhaps equally sensible possibility is that if children in the Incidental Information condition had taken the adult's initial statement to be unsatisfactory, they would have been more likely—not less likely—to ask additional questions.

Fortunately, it is possible to turn to the data to address a concern that failures to follow up occurred with different frequency in the two experimental conditions. We computed for each child the proportion of all Informative Trials on which failures to follow up (*None*) occurred. The mean proportion was .41 ($SD = .41$) in the Name Condition and .45 ($SD = .35$) in the Incidental Information condition. The difference is not reliable, $t(46) < 1.0$. Exactly 9 of 24 children in each condition had proportions greater than .5. So, there is no evidence that children in the Incidental Information condition failed to follow up more than children in the Name condition.

A final issue is whether there were more responses classified as *Other* in the Incidental Condition than the Name Condition, perhaps because the incidental information given to children prompted them to ignore the stimulus materials altogether. However, *Other* responses were generally rare. One child in the Incidental Information condition provided 6 of them, but no other child (of the remaining 5 children in each of the conditions who produced any *Other* responses) provided more than 2. The mean proportion of all Informative Trials on which *Other* responses occurred was .05 ($SD = .19$) in the Name condition and .06 ($SD = .12$) in the Incidental Information condition, a difference that was not reliable, $t(46) < 1.0$. Thus, there is no indication that *Other* follow-up responses were more frequent in the Incidental Information condition.

GENERAL DISCUSSION

We have reported two studies that reveal the intimate relationship between names and core conceptual information for young children. In Experiment 1, we showed that providing preschool children with conceptually relevant information about novel objects facilitated their learning the names of these objects. Having conceptual information about an object improved the ability of 4-year-old children to produce the new name of the object and the

ability of 3-year-old children to comprehend the new name of the object. In Experiment 2, we provided a demonstration of a kind of complementary relationship between names and concepts: Providing children with the names of novel objects promoted children's search for conceptual information about the objects. When a novel object was named, children sought out the object's function—we suggest, because they were looking for conceptual information (*What kind of thing is this*?) to link with the name. Thus, young children are motivated to learn new names for new concepts and to seek new concepts for new names. These results are consistent with the views of those who have argued that the meanings of object names for young children are conceptually saturated rather than perceptually based (e.g., Bloom, 2000; Cimpian & Markman, 2005; Kemler Nelson et al., 2000; Mandler, 2004; Nelson, 1974; Soja, Carey, & Spelke, 1992).

We believe that the particular operationalization of the demonstrations we have reported makes a strong case for our conclusions. Specifically, in looking at the relationship between names and concepts, we have investigated the relationship between names for artifacts and concepts grounded in the functions of these artifacts. It seems likely that our demonstrations would have failed had it been the case that the concepts children are motivated to attach to the names of artifacts were not functional properties of those artifacts, and vice versa. Accordingly, our background assumption that even young children's concepts of (and names for) artifacts are closely tied to the functions of those artifacts is itself strengthened by the current findings.

Thus, in addition to providing new, direct evidence of the important link between names and conceptual information in the minds of young children, we have provided new, indirect evidence that is relevant to the ongoing debate about the nature of the information that children attach to artifact names in particular. A well-known suggestion of Smith et al. (1996; see also Landau et al., 1998, among others) is that preschool children link the names of objects to the objects' salient perceptual features—often their shape. Were that the case, children in Experiment 1 who were given rich information about the perceptual features of the named artifacts (both handling and inspecting them) in the Fact/Shape condition should have been at no disadvantage in retaining the names of these objects relative to children in the Function condition. Similarly, children in Experiment 2 hearing the names of the objects whose perceptual features were easily apprehended should not have been further motivated to seek out information specific to how the objects functioned. Rather, the various results reported in this paper are consistent with the alternative view that young children's artifact names get attached to the functions or conceptual categories of the objects.

In summary, drawing on the background assumption that functional information is at the core of artifact concepts, we have provided new evidence about the relationship between names and concepts in young children. We have shown that preschool children seek to map names to concepts and concepts to names. An as yet unanswered question is whether the mutually facilitative relation between names and core conceptual information that we have demonstrated in young children in the case of artifact kinds would obtain in other conceptual domains, such as that of biological kinds. Theorists such as Mandler (2004) likely would expect analogous effects. However, whereas the conceptual information that constitutes the "essence" of an artifact kind is presumably the artifact's intended function (Bloom, 2000; Kelemen & Carey, 2007), it is more difficult to identify the conceptual information that constitutes the "essence" of a biological kind, particularly for young children. It is almost certainly ill-specified (Carey, 1985). For this reason, it is not easy for us to imagine how one would arrange tests parallel to those implemented here for the case of animals. Still, it would be interesting to try to investigate the relation between children's concept learning and their name acquisition in a domain other than artifacts.

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