Research Article

CHILDREN'S RELIANCE ON CREATOR'S INTENT IN EXTENDING NAMES FOR ARTIFACTS

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Abstract—*When children learn a name for a novel artifact, they tend to extend the name to other artifacts that share the same shape—a phenomenon known as the shape bias. The present studies investigated an intentional account of this bias. In Study 1, 3-year-olds were shown two objects of the same shape, and were given an explanation for why the objects were the same shape even though they were intended to be different kinds. The shape bias disappeared in children provided with this explanation. In Study 2, 3-year-olds were shown triads of objects, and were either given no information about the function of a named target object, told the function that object could fulfill, or told the functions all three objects were intended to fulfill. Only in the third condition did children overcome a shape bias in favor of a function bias when extending the name of the target object. These findings indicate that 3-year-olds' shape bias results from intuitions about what artifacts were intended to be.*

When young children learn a name for a novel object, they tend to extend that name to other artifacts that share the same shape—a phenomenon known as the shape bias (Landau, Smith, & Jones, 1988). One of the central debates in the literature on word learning concerns the nature of this bias. One proposal is based on the notion that children's categories are not stable constructs, but rather are dynamic representations, computed on-line (Jones & Smith, 1993). According to this proposal, children's naming of objects is driven by low-level, "dumb" attentional mechanisms that focus children's attention on contextually salient characteristics of objects (Smith, 1999). Studies supporting this account have shown that children consistently extend labels on the basis of shape, even at the expense of taxonomic or functional similarity (Baldwin, 1992; Gentner, 1978; Graham, Williams, & Huber, 1999; Imai, Gentner, & Uchida, 1994; Landau, Smith, & Jones, 1998; Merriman, Scott, & Marazita, 1993; Smith, Jones, & Landau, 1996).

An alternative is that children name an object on the basis of intuitions about the kind of thing the object is (e.g., Bloom, 2000; Carey, 1985; Gelman & Diesendruck, 1999; Keil, 1989). According to this account, an object's perceptual properties, including shape, are a good cue to the kind of thing it is, but other more conceptually central properties might override shape in children's naming decisions. And indeed, children extend names on the basis of the deeper properties that objects share, sometimes overriding physical similarity (Kemler Nelson, 1995; Kemler Nelson, Frankenfield, Morris, & Blair, 2000; Kemler Nelson, Russell, Duke, & Jones, 2000).

A version of this alternative that applies specifically to the domain of artifacts is that children's naming is based on their intuitions about a creator's intent and how it relates to the design of an object (Bloom, 1996, 2000). Some studies have shown that children take information about a creator's intent into consideration in naming artifacts and representations (Bloom & Markson, 1998; Gelman & Bloom, 2000; Gelman & Ebeling, 1998). From this perspective, shape is relevant only because sameness of shape is an excellent cue to sameness of intent. (It is unlikely that something would be shaped exactly like a chair, for instance, if it was not created with the intent for it to be a chair.) Consequently, unless convinced otherwise, children will tend to infer that two objects have the same shape just because they were created with the same intent, and hence belong to the same artifact kind.

We explored this hypothesis in two studies, both with 3-year-old children. In the first study, we asked whether children would relinquish a shape bias in naming artifacts if they were exposed to a convincing explanation that indicated why two objects were the same shape, yet was consistent with their being created with distinct intentions. In the second study, we investigated whether an intentional explanation for why two dissimilar-looking objects were of the same kind would lead children to overcome a shape bias. In other words, Study 1 investigated whether intentions can lead children to view two similarly shaped objects as not being of the same kind, whereas Study 2 investigated whether intentions can lead children to view two dissimilarly shaped objects as being of the same kind.

STUDY 1

This study presented children with a situation in which two objects had the same shape, but there was an explanation that indicated why they were the same shape even though they were intended to belong to different kinds. There is one common case in the real world in which same-shape objects do not get the same name—objects and their containers or covers. Gloves are the same shape as hands, violin cases the same shape as violins, and so on, but this sameness of shape has a plausible intentional motivation, one that does not entail that the objects were created with the same intent. That is, people understand that gloves are the same shape as hands because they are intended to enclose hands, not to be hands, and hence—by hypothesis—people are not tempted to call gloves "hands." We explored a parallel case in this study.

Method

Participants

Thirty-two 3-year-olds (M = 3 years 6 months, range: 2 years 11 months–4 years 0 months) participated in the study. There were 17 boys and 15 girls. Sixteen children were randomly assigned to each of the two conditions. Mean ages did not differ statistically between conditions.

Stimuli

The stimuli consisted of four triads of novel objects (see Fig. 1). Each triad consisted of a target object and two test objects: (a) a *shape-match*, an object that was similar in shape to the target and that could be opened and serve as a container for the target, and (b) a *mate-*

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Fig. 1. The four triads of objects used in Study 1. The object in the center of each triad is the target, the object to its left the shape-match (container), and the object to its right the material-match.

rial-match, an object that was made of the same material as the target, but had a different shape. All the stimuli were manufactured in the laboratory specifically for the experiment.

Procedure

Children were tested individually by a female experimenter in a quiet room at their preschool. In both conditions, the experimenter first showed the child the three objects in the triad. She then showed the target object to the child and said, "This is a fendle. See what it looks like. See what shape it is, and look at what it's made of, too. This one is a fendle." *Fendle* was one of four novel phonological strings used as labels. The other three were *blicket*, *jop*, and *dax*. The two conditions differed in what was said and done after this introduction.

In the *control* condition, after introducing the target object, the experimenter announced, "I'm going to put my fendle *here*. This is where I'm *putting* my fendle." The target was then placed underneath the shape-match, and taken out from underneath it. In other words, it was never revealed to the children in this condition that the shape-match could be opened and serve as a container for the target object.

In the *container* condition, after introducing the target object, the experimenter announced, "I'm going to put my fendle *in here*. This is where I *keep* my fendle." The target was then placed inside the shape-match, and then taken out from inside of it. In other words, it was made clear to the children in this condition that the shape-match was actually a container for the target object.

In both conditions, the experimenter next verbally highlighted the similar shape of the target and the shape-match, and the similar material of the target and the material-match. She pointed to the shape-match and said, "This one looks like that one. See, this one is the same shape as that one." She then pointed to the material-match and said, "This one feels like that one. See, this one is made of the same stuff as that one." The three objects were then returned to their original locations, with the target in the center, and the experimenter asked the test question: "Remember how I showed you a fendle? There's another fendle here. Can you give me another fendle?" The same procedure was repeated for each of the four triads.

In both conditions, the target was always placed in the center, and the left-right position of the test objects was counterbalanced. There were two different presentation orders of the triads, which were assigned randomly across subjects.

Results and Discussion

The dependent measure was the mean number of times, out of the four triads, that children extended the novel label to the shape-match.

There was a significant effect of condition on the number of shape-match selections, $F(1, 30) = 4.23$, $p < .05$ (see Table 1). Children in the control condition, on average, chose the shape-match for 3.3 of the four triads, which was significantly more than would be predicted by chance, $t(15) = 3.75$, $p < .002$. Children in the container condition, on average, chose the shape-match for 2.2 of the four triads, which did not differ significantly from chance, $t(15) = 0.67$, $p > .05$.

Table 1. *Mean number and standard deviation of shape-match selections in both studies*

Study and condition	Mean (%)	*SD*
Study 1		
Container	2.2 (55%)	1.3
Control	3.3 (83%)[a]	1.4
Study 2		
Label-only	2.8 (70%)[a]	1.0
Label + possible function	2.2 (55%)	1.2
Label + intended function	1.2 (30%)[b]	0.9

Note. Chance performance was 2 shape-match selections.
[a]In these conditions, there were significantly more shape-match selections than expected by chance, $p < .01$.
[b]In this condition, there were significantly fewer shape-match selections than expected by chance, $p < .01$.

To further evaluate individual patterns of response across the four triads in each condition, we classified the children in terms of the consistency of their shape-match selections. Children were classified as "shape biased" if they selected the shape-match on three or four of the triads, and as "not biased" if they selected the shape-match on less than three of the triads. Thirteen of the 16 children in the control condition were shape biased, compared with 8 of the 16 children in the container condition, $\chi^2(1, N = 32) = 3.46$, $p = .063$. In other words, showing children that the shape-match was actually a container for the target object lessened considerably their tendency to consistently extend names by shape similarity. In fact, although the distribution of shape-biased and not-biased children in the control condition was significantly different from the distribution expected by chance, $\chi^2(1, N = 16) = 18.62$, $p < .001$, that was not the case in the container condition ($p > .1$).

One could argue that the revelation of the hollow interior of the shape-match in the container condition made it less similar to the target object than was the case in the control condition. Nonetheless, it is important to note that in both conditions, the experimenter emphasized and explicitly pointed out to the children the overall shape similarity between the target and the shape-match and the material similarity between the target and the material-match. It seems that children's switch from mostly shape-match choices in the control condition to random responding in the container condition resulted primarily from whether the target object was placed underneath or inside the shape-match object. This sensitivity suggests that the children were looking for an explanation for their naming decisions, and when provided with a hint toward such an explanation, they readily incorporated it.

However, Study 1 did not show that intuitions about intentions can lead children to override a preference for shape. Doing so would require providing children not only with reasons not to choose by shape, but also with reasons to choose on the basis of some other dimension. In Study 2, we manipulated the reasons children might have to extend names by some criterion other than shape.

STUDY 2

In this study, 3-year-olds were shown triads of objects: a target object and two test objects. One of the test objects was similar in shape to the target but could not perform its function, whereas the other test object was different in shape from the target, but could perform its function. The critical manipulation regarded whether and how information about the function of the objects was provided.

In the *label-only*, baseline condition, the experimenter simply named the target object and asked the children to extend the name to one of the test objects. In the *label + possible function* condition, the function of the target object was introduced as something the object "can do," and the children were left to infer whether the test objects could also perform the function. We included this condition as an attempt to replicate the procedure used in previous studies in which children were found to neglect function in favor of shape (Landau et al., 1998; Merriman et al., 1993; Smith et al., 1996). Finally, in the *label + intended function* condition, the experimenter labeled the target object, and then described and demonstrated what the target and test objects were "made for." We hypothesized that in this last condition children would show the strongest tendency to overcome a shape bias and extend the target object's label to the test object similar in function to the target object.

Method

Participants

Fifty-one 3-year-olds (M = 3 years 5 months, range: 2 years 9 months–4 years 0 months) participated in the study. There were 24 boys and 27 girls. Seventeen children were randomly assigned to each of the three conditions. Mean ages did not differ statistically among conditions.

Stimuli

The stimulus set consisted of four triads of novel objects (see Table 2). Each triad consisted of a target object and two test objects: (a) a *shape-match*, an object that was similar in shape to the target but could not perform its specified function, and (b) a *function-match*, an object that was different in shape from the target but made of a material that afforded the target's function. All objects were manufactured in the laboratory specifically for the experiment.

Procedure

Children were seen individually by a female experimenter at their preschool. In all three conditions, the experimenter first showed the child the target object, labeled it, and then presented the two test objects simultaneously. The difference among the conditions was in what was said and done as the objects were introduced. We illustrate the procedures here using the *wug* triad (see Table 2).

In the label-only condition, the experimenter introduced the target object and said, "Let me show you a wug. Look at this; it's a wug." She put down the target object, and then picked up the two test objects and laid them down in front of the child exclaiming, "Look at these!" Child and experimenter played briefly with the objects. The experimenter then pointed to the target object and said, "Remember I told you that this is a wug. One of these [pointing to the test objects] is also a wug. Which one of these two is a wug?"

In the label + possible function condition, the experimenter presented the target object and said, "Let me show you a wug. Look at this; it's a wug. It can hold coins. See, this is a wug and it can hold coins." The experimenter demonstrated the function as she was pre-

Table 2. *Triads of objects and functions used in Study 2*

Set	Target/function	Shape-match/function	Function-match
Bem	Hangerlike shape made of pipe cleaner/dusting	Hangerlike shape made of wire/hanging socks	Pyramidal makeup sponge
Wug	Hollow cylinder made of cork/holding coins	Solid cylinder made of styrofoam/sticking pins	Wooden rectangular box
Jop	Round plastic disk/cutting clay	Round disk made of felt/wiping up water	Sharp trapezoidal piece of wood
Dax	Blue cardboard open box/holding paper clips	Solid wooden block/"smooshing" clay	Triangular shallow container made of clay

senting the object. The experimenter then presented the two test objects, and asked the child to extend the name *wug*, exactly as in the label-only condition.

In the label + intended function condition, the experimenter presented the target object and said, "This is a wug; it was made for holding coins. See how it holds coins [function is demonstrated]." She then presented the two test objects and said, "See this one [pointing to shape-match]; it cannot hold coins because it was made for sticking pins [function is demonstrated]. See, it looks like this one [pointing to the target]; they are the same shape. It cannot hold coins because it was made for sticking pins [demonstrate function]." The experimenter then turned to the other object and said, "See this one [pointing to the function-match]; it can hold coins because it was made for holding coins [function is demonstrated]. See, it doesn't look like this one [pointing to the target]; they have different shapes. It can hold coins because it was made for holding coins." Finally, the experimenter asked the child, "Remember I told you that this [pointing to the target object] is a wug and it was made for holding coins. One of these [pointing to the test objects] is also a wug. Which one of these is a wug?" The order of presentation of the test objects was counterbalanced within and between subjects, such that for half the triads the experimenter introduced the shape-match first and for the other half the function-match first.

In all three conditions, the left-right placement of the test objects was counterbalanced. There were four different between-subjects orders of presentation of the triads, such that each triad was presented in all four ordinal positions.

Results and Discussion

The dependent measure was the mean number of times, out of the four triads, that children extended the novel label to the shape-match. (Note that the complement of this measure is the number of times children selected the function-match.)

An analysis of variance with condition, gender, and order of presentation of the triads as between-subjects factors revealed only a significant effect of condition on the number of shape-match selections, $F(2, 27) = 9.79$, $p < .005$ (see Table 1). A post hoc Scheffé multiple-comparisons test revealed that children in the label + intended function condition selected the shape-match less often than children in either of the other two conditions ($p < .05$). The Scheffé test further revealed that the frequency of shape-match selections in the label-only condition and in the label + possible function condition did not differ significantly.

Analyses against chance showed that children in the label-only condition, on average, chose the shape-match for 2.8 of the triads, which was significantly more than expected by chance, $t(16) = 3.57$, $p < .005$. Children in the label + possible function condition, on average, chose the shape-match for 2.2 of the triads, which was not significantly different than expected by chance ($p > .4$). Finally, children in the label + intended function condition, on average, chose the shape-match for only 1.2 of the triads, which was significantly less than expected by chance, $t(16) = -3.49$, $p < .005$. This latter finding means that children in the label + intended function condition chose the function-match significantly more than expected by chance.

In addition to conducting the parametric analyses, we classified children into three different types. Children who selected the shape-match for at least three of the four triads were classified as "shape biased" (as in Study 1). Children who selected the shape-match for less than two of the triads were classified as "function biased," because these children selected the function-match for at least three of the four triads. Finally, children who selected the shape-match for two of the triads were classified as "not biased." As can be seen in Table 3, most children in the label-only condition were shape biased, whereas most children in the label + intended function condition were function biased, $\chi^2(4, N = 51) = 16.97$, $p < .005$. In fact, the distributions of children in the label-only condition, $\chi^2(2, N = 17) = 12.23$, $p < .005$, and in the label + intended function condition, $\chi^2(2, N = 17) = 12.23$, $p < .005$, were to the same exact extent significantly different from the distribution expected by chance, although in opposite directions. The distribution of children in the label + possible function condition did not differ significantly from chance ($p > .3$).

Table 3. *Number of children classified as shape biased, not biased, and function biased in Study 2*

Condition	Shape biased	Not biased	Function biased
Label-only[a]	12	3	2
Label + possible function	8	5	4
Label + intended function[a]	2	3	12

[a]In these conditions, the distribution was significantly different from the distribution expected by chance, $p < .005$.

Taken together, the findings reveal a switch from mostly shape-based choices in the label-only condition to mostly function-based choices in the label + intended function condition. Simply providing children with functional information about the target object (i.e., the label + possible function condition)—as done in previous studies (Landau et al., 1998; Merriman et al., 1993; Smith et al., 1996)—was not enough to move them toward consistently extending the target's name to the function-match. In this condition, children chose between the test objects randomly. In fact, under some circumstances, even if 3-year-olds are provided this type of information about both the test and the target objects, they still do not overcome a shape bias (Graham et al., 1999). It seems that information about the possible function of an object may raise in children's minds the possibility that there might be a way to categorize and thus name objects other than simply by shape. This type of information, however, may not be enough to convince children to use an alternative naming strategy. For that, they may need the functional information to be embedded in an intentional account that makes function an integral part of what the object was meant to be.

GENERAL DISCUSSION

Study 1 showed that exposing children to a meaningful explanation for why two objects had the same shape and yet were of different kinds convinced them not to extend names on the basis of merely "superficial" shape similarity. Study 2 showed that for children to be convinced that two functionally similar objects are of the same kind and thus deserve the same name—irrespective of their physical appearance—the function has to be an integral and intentional characteristic of the objects. These findings support the idea that children name an artifact on the basis of intuitions about the intent of its creator (Bloom, 1996). Given that in most real-life cases the creator's intent is not readily available, children must rely on cues to the intent. An object's shape and function are examples of these cues. An object that has the specific shape of a chair and that serves primarily for one person to sit on was likely created to be a chair.

This account—backed by the present studies—may also help elucidate the conflicting findings as to whether children name objects on the basis of shape or functional similarity. Specifically, as discussed by Bloom (2000), previous studies may have differed in the extent to which children saw shape or function as a cue to the intent underlying the creation of the object. For instance, in the studies by Landau et al. (1998) and Smith et al. (1996), which found a shape bias, the functions—such as wiping up water—were simple and dependent only on the substances that the artifacts were made of. There was no motivation for children to believe that the objects were created with the express intent that they fulfill the functions demonstrated, leaving function in little position to override shape. In contrast, in Kemler Nelson's studies (1995; Kemler Nelson, Frankenfield, et al., 2000; Kemler Nelson, Russell, et al., 2000), which found a "function bias," the functions—such as painting four parallel lines—were highly specific and reflected intentional design (being able to paint parallel lines is not the sort of thing that an artifact can do by accident). Altogether, this account indicates that children's categorization of artifacts may be decisively influenced by how objects are described by adults, as well as by intrinsic factors such as the complexity, symmetry, and nonarbitrariness of an object's design and function (see, e.g., Prasada, Ferenz, & Haskell, 2002).

More broadly, the present findings support the notion that children's categories derive from richly inductive beliefs about the nature of things, rather than from on-line, dynamic considerations. In particular, children's naming of artifacts is not driven solely by dumb mechanisms of memory and attention, which guide children toward specific physically salient properties of objects. Instead, children name artifacts on the basis of theory-like intuitions of the kind of thing each object was created to be.

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