Children’s interpretation of a label for an individuated object: Dependence on age and ontological kind

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Abstract
Three experiments examined whether the experience of individuating an object would affect the way that children of different ages would interpret its label. Participants were asked to remember a novel object and pick it out from sets containing either two similar objects (similar condition) or no similar objects (dissimilar condition). They were then taught a label for the object and tested for how broadly they generalized it. Because children in the similar condition had formed a more detailed representation of the object, they were expected to generalize its label less broadly. For artifacts, this effect was observed in 4- and 5-year-olds as well as first and second graders, but not in 3-year-olds or adults. For toy animals, no age group showed this effect, and the three oldest groups of children showed the opposite effect. Various explanations for why the consequences of individuating an object for the interpretation of its label depend on age of the learner and the object’s ontological kind are discussed.

Keywords
Artifacts vs. animals, categorization, child word learning, individuation, semantic development

Although even very young children are able to learn a novel word after hearing it used for only one or two exemplars (Houston-Price, Plunkett, & Harris, 2005; Woodward,
Markman, & Fitzsimmons, 1994), younger children do not always interpret the word the same way as older children do. For example, after learning a novel verb for a novel action, 3-year-olds are less likely than 5-year-olds to extend the verb to the same action when performed by a different actor (Kersten & Smith, 2002) or addressed to a different object (Imai, Haryu, & Okada, 2005). When interpreting a label for a novel artifact, younger children tend to be affected less than older ones by a demonstration of a function of the artifact (Landau, Smith, & Jones, 1998; Merriman, Scott, & Marazita, 1993).

The current investigation examined another factor that may affect how children of different ages interpret a novel object label, namely, the amount of detail that the child includes in the representation of the labeled object. We hypothesized that if a child formed a detailed representation of an object before hearing a label for it, some of the details in this representation might make their way into the representation that the child formed for the category denoted by the object’s label. If so, the child would be less likely to generalize the label to objects that lacked these details. That is, the child would construct a narrower generalization for the label.

For example, suppose two children who had never seen a hammer nor heard the word hammer before were introduced to a ball peen hammer. Suppose one child primarily encoded the overall shape and general function of this object, but the other child encoded additional aspects of it, in particular, the ball shape on the end of the head. If the children were then told that this object was called a ‘hammer’, the first child would likely extend this label to most other types of hammers, but the other child might be unwilling to extend it to hammers that lacked the ball-shaped part.

To test this detailed representation hypothesis, we used an individuation procedure to increase the amount of detail that children might include in their representation of a novel object. The children were given tasks that required them to distinguish the object from very similar objects. Because they had to attend to details that contrasted the object with these similar foils, it was hypothesized that these details would become part of their representation of the object.

Other children performed tasks that only required distinguishing the object from dissimilar objects. Because these tasks did not require attention to detail, it was hypothesized that these children’s representation of the object would contain fewer details. Both the latter group (the dissimilar condition) and the former group (the similar condition) were taught a label for the object, then tested for how broadly they extended the label. If our procedures succeeded in affecting the amount of detail children included in their representation of the object, then the prediction of the detailed representation hypothesis is that those in the similar condition would extend the label less broadly than those in the dissimilar condition. Because it was possible that younger children might differ from older ones in how much attention they gave to such details, we tested this prediction in several age groups.

Our proposal that the level of detail in a child’s representation of an individual object might influence his or her interpretation of a categorical label for the object is consistent with the claim that children show dimensional inertia (Hammer & Diesendruck, 2005; Merriman, 1999) or attentional persistence (Kersten, Goldstone, & Shaffert, 1998; Kruschke, 1996) in word learning. Both of these terms have been used to describe the tendency for people who have learned to attend to a particular stimulus dimension when
interpreting one or several words to continue to attend to the same dimension when interpreting other novel words. For example, Kersten et al. (1998, Experiment 3) taught adults pairs of verbs for the movements of a bug-like creature. One verb referred to a movement in which the creature moved its legs in a particular pattern and traveled along a particular path. The other verb referred to a movement that involved a different type of leg movement and a different path. Thus, it was possible to learn to distinguish the verbs by attending to just leg movement or just path. The participants showed better learning of the leg movements associated with each verb if they were first taught a pair of verbs for other movements of the creature that differed in type of leg movement, but not in path.

Our proposal is also consistent with research showing that the experience of comparing or contrasting an object with similar objects can influence children’s generalization of a label for the object (Gentner & Namy, 1999; Merriman, Schuster, & Hager, 1991; Namy & Gentner, 2002; Xu & Tenenbaum, 2007). For example, Xu and Tenenbaum (2007) found that preschoolers and adults generalized a novel label from an unfamiliar language less broadly if they were shown one exemplar (e.g., shown a Dalmatian and told it was called a ‘fep’ in a puppet’s language) than if they were shown three diverse exemplars (e.g., told that ‘fep’ was a name for a Dalmatian, terrier, and mutt). They generalized the label even less broadly if they were shown three highly similar exemplars (e.g., told that ‘fep’ was a name for each of three Dalmatians).

Object comparison experiences can affect a child’s interpretation of a label even if these experiences occur before the label is introduced. In experiments by Merriman et al. (1991), 3-year-olds and adults examined one of two sets of objects that could be subdivided based on covarying features. For example, in Experiment 3, one group examined a set that contained four novel animals that each had a dark blue body, purple hair, and round ears and four novel animals that each had an aqua body, no hair, and pointed ears. A second group examined a set that contained some of these same animals, but was organized by size and the presence vs. absence of legs (i.e., four were small and four-legged and the other four were large and legless). After the objects were removed, a label was introduced for one of the objects that had been a member of both sets. Both the children and adults generalized the label to objects that matched the labeled object in color, hair, and ear type more often if they had examined the set organized by these properties than if they had examined the other set. Exposure to an object set presumably caused the salience of the properties that organized the set to increase so that these properties were given more weight in participants’ decisions about the nature of the category that the label expressed.

We report three experiments that tested the hypothesis that the experience of individuating a novel object (i.e., distinguishing it from similar objects) would cause children to generalize a label for the object less broadly than if they had not individuated the object. Experiment 1 tested the hypothesis in 3-year-olds, 4-year-olds, and first graders. Experiment 2 tested it in first graders with an altered procedure. Experiment 3 tested it in 5-year-olds, 8-year-olds, and adults with the same procedure as Experiment 1. It was expected that children who were asked to distinguish similar objects would be more likely than those who were asked to distinguish dissimilar objects to attend to particular details of the training object during the search and recognition task. Specifically, those in the similar condition would be more likely to attend to details that were helpful in distinguishing the training object from the similar foil objects.
We tested our hypothesis using both artifacts and animals. An object individuation experience might well affect children’s interpretation of a label for an artifact differently than their interpretation of a label for an animal. Children use and comprehend labels for animals differently than they do labels for artifacts. Preschoolers tend to require a match in shape and texture when generalizing a label for a novel animal, but tend to require only a match in shape when generalizing a label for a novel artifact (Booth & Waxman, 2002; Jones & Smith, 2002; Jones et al., 1991; Yoshida & Smith, 2001). Also, from a very early age, they know that a person or animal, but not an artifact, can be represented as both an individual by a proper noun (e.g., ‘Zav’) and as a member of category by a count noun (e.g., ‘a/the zav’) (Gelman & Taylor, 1984; Katz, Baker, & Macnamara, 1974; Macnamara, 1982). This knowledge that the proper noun/count noun distinction maps onto the individual/category distinction for animals might cause the effect that we are hypothesizing to be different for animals than for artifacts. For example, the effect might be weaker if children have learned to reserve the details in their representation of an individual animal for its proper name, and so tend to keep these details from becoming part of what is expressed by the animal’s category name.

Both preschoolers and adults are more likely to use generic language (e.g., ‘They have large eyes.’ or ‘A luzak looks like a CD player.’) to describe a novel animal than to describe a novel artifact (Brandone & Gelman, 2009; Goldin-Meadow, Gelman, & Mylander, 2005). They intend this kind of language to communicate that a property is typical of the members of its category rather than restricted to an individual member (Gelman & Raman, 2003; Hollander, Gelman, & Star, 2002). Gelman and colleagues interpret these findings as evidence that children are more likely to take a categorical stance toward an animal than toward an artifact. If so, then the effect of object individuation on children’s interpretation of an object’s label might not be the same for animals as for artifacts.

Finally, children might respond to our individuation procedure differently for animals than for artifacts. They may believe that when an animal appears among similar animals, this grouping is a cue that all of them are members of the same basic-level category. Animals are often found in species-homogeneous groups such as families, herds, flocks, or schools. The belief that each member of a group of similar-looking animals has the same basic-level name would work against the hypothesized effect of being asked to distinguish one animal from similar nearby animals. We could find no research on whether children interpret the grouping of similar animals as a category-homogeneous group, or whether they might also interpret the grouping of similar artifacts in this fashion. Similar artifacts are also sometimes found in basic-level groups, for example, a set of knives or books, although our intuition is that this occurrence is not as frequent as it is for animals. Because of this possibility, children might well interpret the grouping of similar things to be a cue that the things have the same basic-level name when the things are animals, but not when the things are artifacts.

**Experiment 1**

**Method**

**Participants.** Thirty-two 3-year-olds ($M = 42$ months, range = 37–47; 16 boys), 32 4-year-olds ($M = 52$ months, range = 48–59; 15 boys), and 32 first graders ($M = 88$ months,
range = 80–95; 13 boys) participated. Children were recruited from preschools and grade schools in middle- to upper-class regions of northeast Ohio. Nearly all participants were Caucasian. Half of the children in each age group were assigned to the similar condition and half were assigned to the dissimilar condition. Every child received a sticker for participating.

**Materials.** The main objects used in this experiment included four sets of novel artifacts and four sets of novel toy animals. Each set consisted of nine objects: a training object, two similar foil objects, two dissimilar foil objects, and four generalization objects (see Figures 1 and 2). The objects ranged in size from 6 to 10 inches in height and were constructed from common materials found at a local craft supplies store. For example, construction of the target object in set A of Figure 2 involved knitting yarn and stuffing it with cotton filling, attaching a kitchen sponge to its base, gluing pieces of felt fabric to the front, and attaching a pipe-cleaner to the top. Construction of the most similar object in set A of Figure 2 involved sewing together pieces of cotton fabric and stuffing it with cotton filling, as well attaching a sponge, pieces of felt fabric, and a pipe cleaner. The

**Figure 1.** Training objects used in Experiments 1 and 2.
Figure 2. The artifacts (top) and animals (bottom) used in each task.
dissimilar object was a 6-inch long metal bracket, slightly bent to alter its shape. Other materials used were styrofoam and papier maché shapes (base and top parts in sets C and D), copper pipe insulated in rubber tubing (set B), and various fabrics to portray different textures (e.g., felt and cotton fabrics).

The toy animals were created by altering certain parts in the artifacts, such as adding facial features (eyes, nose, and mouth), replacing wheels with legs, replacing the sponges in the aforementioned object set with legs, replacing the propellers in one object set with feet, and replacing knobs in one object set with fish-fins cut from crafting material. Object size, color, shape, and texture were not altered.

Conditions differed only with respect to the foil objects that were used in the search and recognition tasks. These foil objects were expected to affect the children’s individuation of the training objects. In the similar condition, the two foil objects had the same overall shape as the training object, but differed in size. One also had the same texture as the training object. In the dissimilar condition, the two foil objects differed from the training object in size, shape, texture, and color.

The four label generalization objects were the same in each condition: an object that matched the training object in size and shape, but not texture (the most similar object); two objects that matched the training object in shape, but not size or texture (the less similar objects); and an object that had a completely different shape than the training object (the dissimilar object). Additional materials included a 2-foot high tub filled with 15 common objects (e.g., shoe, toy car, ball), which was used in a search task, and three 1-foot high plastic buckets, which were used in a recognition task.

Procedure. The children were tested individually in a quiet room in their preschool. Half of the children were assigned to the similar condition and half were assigned to the dissimilar condition. Additionally, half were trained and tested only with the artifact sets and half, only with the toy animal sets. The child sat at a table next to the experimenter. On the floor next to the experimenter, out of the child’s view, was the tub of objects used for the search task, the buckets used for the recognition task, and a cardboard box containing the objects used for the label tasks. Four trials were administered, each involving a different set of training, foil, and generalization objects. Half of the children received the trials in one order and half received them in the opposite order. On every trial, four tasks were administered in the following order: search, recognition, label training, and label generalization.

1. Search. After establishing rapport, the experimenter said, ‘We are going to play a game with some funny looking things that you probably haven’t seen before. I’m going to show you some things and hide them. You’ll have to find them. So make sure you look at the things real closely when I bring them out.’ The experimenter showed the child the training object, and told the child to look at it closely to try to remember what it looked like. The child was then instructed to close his or her eyes so that the experimenter could hide the training object. (The training object was referred to as ‘this/that thing’, ‘it’, or ‘the one’ throughout the search and recognition tasks.) The experimenter placed the training object and the two foil objects into the tub of search objects. The child was asked to open his or her eyes.
and look in the tub to find the training object. All the children retrieved the correct object. The tub of objects was removed from view. The child was again instructed to look at the training object closely in order to remember what it looked like.

2. **Recognition.** The child was told that he or she was going to have to find the training object again, and so had to close his or her eyes. The experimenter put three upturned buckets on the table, then hid the training object under one bucket, and hid each foil object under the other two buckets. The child was asked to open his or her eyes, and then told that the training object was under one of the buckets. The experimenter lifted the buckets one at a time, each time asking whether the object was the one the child had been asked to remember. The training object was always revealed last. Only two children ever incorrectly identified a foil object as the training object. These errors were corrected. Every child recognized the training object after it was revealed from under the bucket. After the recognition task, the buckets and foil objects were removed from view.

3. **Label training.** Holding the training object in front of the child, the experimenter said, ‘Do you know what this is called? It’s called a zav. It’s a zav. Can you say zav? [Child repeats it.] Right, this thing is called a zav.’ A different novel label (zav, mosby, blicket, pilson) was used for each training object. The training object was then removed from view.

4. **Label generalization.** The experimenter said to the child, ‘I am going to show you some things, and I want you to tell me whether you think any of them is a (trained label, e.g., zav).’ The training object and the four generalization test objects were placed on the table in front of the child in random order. The child was asked, ‘Do you think any of these is a zav? Show me.’ After the child stopped picking, the experimenter said, ‘Are there any more zavs?’ If child said, ‘Yes’, the experimenter said, ‘Show me.’

**Results**

Children tended to select the training object and 0 to 3 similar objects on label generalization test trials; they chose the dissimilar object on fewer than 1% of the trials. The mean number of objects selected per label was first submitted to a 3 (age: 3-year-olds vs. 4-year-olds vs. first graders) × 2 (condition: similar vs. dissimilar) × 2 (ontological kind: artifact vs. animal) factorial analysis of variance. Because the 3-way interaction was significant, $F(1, 84) = 12.43, p < .001, \eta^2 = .13$, results for each ontological kind were analyzed separately. For the artifacts, the age × condition interaction was significant, $F(1, 84) = 7.55, p < .005, \eta^2 = .08$ (see Figure 3). Three-year-olds extended the trained labels just as broadly in the similar ($M = 3.31, SD = 0.56$) as in the dissimilar condition ($M = 3.31, SD = 0.51$), whereas each of the older groups chose fewer objects in the similar than in the dissimilar condition (4-year-olds: similar $M = 2.59, SD = 0.48$ vs. dissimilar $M = 3.59, SD = 0.55$, $F(1, 84) = 13.42, p < .001, \eta^2 = .14$; first graders: similar $M = 2.41, SD = 0.64$ vs. dissimilar $M = 3.85, SD = 0.35$, $F(1, 84) = 28.96, p < .001, \eta^2 = .26$). The effect of condition was comparable in the two older groups, $p > .10$.

For the tests involving toy animals, the age × condition interaction was also significant, $F(1, 84) = 7.46, p < .005, \eta^2 = .08$ (see Figure 4). As was the case with artifacts, condition did
Figure 3. Mean number of artifacts selected (+SE) in Experiment 1.

Figure 4. Mean number of animals selected (+SE) in Experiment 1.
not affect how broadly 3-year-olds extended the trained labels (similar $M = 3.50$, $SD = 0.52$ vs. dissimilar $M = 3.81$, $SD = 0.44$), $F (1, 84) = 1.31, p > .10$. Although the effect of condition on the 4-year-olds was not significant, the trend was in the same direction as for the artifacts (similar $M = 2.72$, $SD = 0.76$ vs. dissimilar $M = 3.21$, $SD = 0.63$), $F (1, 84) = 3.36, p = .07, \eta^2 = .04$. However, the first graders responded quite differently, selecting more animals in the similar ($M = 3.66$, $SD = 0.50$) than in the dissimilar ($M = 2.78$, $SD = 0.49$) condition, $F (1, 84) = 10.27, p < .001, \eta^2 = .11$.

**Discussion**

Because the foils used in the search and recognition tasks were similar to the training object in the similar condition, but not in the dissimilar condition, only the children in the similar condition were expected to attend to the details of the training object that were helpful in distinguishing it from the similar foils. Consequently, these children were expected to give these details more importance in generalizing a label for the object, and so, would generalize the label to fewer objects than children in the dissimilar condition. Although 3-year-olds’ label generalization was unaffected by condition, 4-year-olds performed as predicted. The effect of condition on their label generalization was clearest with artifacts, but the same trend was evident with animals. Also consistent with our proposed effect of object individuation on label interpretation, first graders generalized labels for novel artifacts less broadly in the similar than in the dissimilar condition. However, they showed the opposite tendency in their generalization of labels for toy animals.

By first grade, children may have learned that when an animal is found in a group with similar animals, the grouping is a cue that they are members of the same basic-level category and so have the same basic-level name. Another possibility is that by first grade, children’s tendency to take a categorical stance toward an object is so much stronger for animals than for artifacts (Brandone & Gelman, 2009; Goldin-Meadow et al., 2005) that they are more likely to decide that a group of similar animals represents the same basic-level category than to decide this about a group of similar artifacts.

There is a less interesting alternative hypothesis, however, which was addressed by Experiment 2. In every condition in Experiment 1, the background objects used in the search task were 15 familiar artifacts. So in this task, children saw either three novel toy animals or three novel artifacts (the target object and two foil objects) mixed in among numerous familiar artifacts. First graders may have been sensitive to the contrast between animals and artifacts that was only evident in the tub of objects when the training object and foil objects were animals.

Moreover, they may have been especially sensitive to this contrast when these animals were similar, prompting them to shift attention away from the individuating features of the training animal to the features it shared with the similar foil animals. If so, this shift in attention in the similar condition may have caused them to generalize the label for the training animal more broadly than they otherwise would have.

Experiment 2 evaluated this explanation by testing first graders with procedures and materials that were the identical to those of Experiment 1, except that the 15 background objects used in the search task were familiar animals rather than
familiar artifacts. By switching the background objects, a contrast between animals and artifacts was now presented only when the training object and the two foil objects were artifacts. If the alternative hypothesis is valid, then this switch ought to cause the pattern of results shown by first graders to reverse. They should select more artifacts in the similar than in the dissimilar condition, but select fewer toy animals in the similar than in the dissimilar condition. On the other hand, if first graders’ tendency to interpret a group as representing a single basic-level category is greater for similar animals than for similar artifacts, then they should show the same selection tendencies as the first graders in Experiment 1.

**Experiment 2**

**Method**

**Participants.** Thirty-two first graders (M = 90 months, range = 82–96; 15 boys) participated. They were recruited from grade schools in middle- to upper-class regions of northeast Ohio. Nearly all participants were Caucasian. Half of the children in each age group were assigned to the similar condition and half were assigned to the dissimilar condition. Every child received a sticker for participating.

**Materials and procedures.** These were identical to those of Experiment 1, except that the 15 familiar artifacts in the tub were replaced by 15 familiar toy animals.

**Results and discussion**

A factorial analysis of variance of the mean number of objects selected in the label generalization task yielded a significant condition × ontological kind interaction, $F(1, 28) = 20.38$, $p < .001$, $\eta^2 = .42$. As in Experiment 1, the first graders selected fewer artifacts in the similar condition ($M = 2.72$, $SD = 0.78$) than in the dissimilar condition ($M = 3.59$, $SD = 0.46$), $F(1, 28) = 6.92$, $p < .02$, $\eta^2 = .20$, and selected more toy animals in the similar condition ($M = 3.53$, $SD = 0.49$) than in the dissimilar condition ($M = 2.28$, $SD = 0.84$), $F(1, 28) = 14.11$, $p < .001$, $\eta^2 = .34$. These results are not consistent with the alternative hypothesis. They support the hypothesis that first graders have some tendency to interpret a group of similar animals as representing a single basic-level category, but do not have the same tendency for a group of similar artifacts.

Taken together, the results from Experiments 1 and 2 suggest that both 4-year-olds and first graders will generalize a label for an artifact less broadly if they have first individuated the artifact than if they have not. Four-year-olds’ generalization of a label for an animal also shows a trend in this direction. However, first graders’ generalization of a label for an animal shows a significant reverse effect. Experiment 3 was conducted to examine the influence of object individuation on label generalization in children from other age groups, namely, 5-year-olds and second graders. We also included college students to establish a mature state reference point. The experiment involved the same procedures and materials as Experiment 1.
Experiment 3

Method

Participants. Thirty-two 5-year-olds (M = 66 months, range = 63–69; 16 boys), 32 second
graders (M = 96.5 months, range = 95–98; 16 boys), and 64 college students (M = 18.89
years, range = 18–24) participated. We chose the two age groups based on the results of
Experiment 1. The age of 5 years was in between the age at which individuation was
observed to have a general effect (4 years) and the age at which it was observed to depend
on ontological kind (first grade). Testing second graders allowed us to determine whether
the dependence on ontological kind continued beyond first grade. Children were recruited
from kindergartens and grade schools in middle- to upper-class regions of northeast Ohio.
College students were recruited from Child Psychology and General Psychology courses.
Nearly all participants were Caucasian. Half of the participants in each age group were
assigned to the similar condition and half were assigned to the dissimilar condition. Chil-
dren received a sticker for participating and college students received extra credit in their
courses for participation.

Materials and procedures. These were identical to those of Experiment 1.

Results

The mean numbers of objects selected as exemplars of the trained label by each age
group are displayed in Figure 5 for artifacts and Figure 6 for toy animals. Adults
showed much greater between-participant variability in the number of objects they
selected (SD = 1.10) than did either the 5- or 8-year-olds (SD = 0.66 and 0.70, respec-
tively). Levene’s test of homogeneity of variance was significant, \( F(2, 125) = 13.63, p < .001 \). Because of this finding, adults’ and children’s responses were analyzed
separately.

In a 2 (condition: similar vs. dissimilar) \( \times 2 \) (ontological kind: artifact vs. animal) facto-
rial analysis of variance of the adult data no main effects or interactions were significant,
all \( F \)’s < 1. In contrast, a similar analysis of the child data, but with age as an additional
factor, yielded a robust condition \( \times \) ontological kind interaction, \( F(1, 56) = 15.01, p < .001, \eta^2 = .21 \). No other effects or interactions were significant.

For artifacts, children in the similar condition extended the trained label to fewer objects
(\( M = 2.92, SD = 0.65 \)) than children in the dissimilar condition (\( M = 3.45, SD = 0.50 \)),
\( F(1, 30) = 7.14, p < .05, \eta^2 = .19 \). For toy animals, children in the similar condition
extended the trained label to more objects (\( M = 3.56, SD = 0.55 \)) than children in the dis-
similar condition (\( M = 2.88, SD = 0.78 \)), \( F(1, 30) = 7.79, p < .01, \eta^2 = .21 \). This interaction
is similar to the one shown by the first graders in the previous experiments. In fact, when
the data from the first graders in Experiment 1 were included in a 3 (age: 5-year-olds vs.
first graders vs. second graders) \( \times 2 \) (condition: similar vs. dissimilar) \( \times 2 \) (ontological
kind: artifact vs. animal) analysis of variance, the condition \( \times \) ontological kind interaction
was significant, \( F(1, 92) = 13.97, p < .001, \eta^2 = .30 \), and this interaction did not vary with
age, \( F(2, 92) = 1.46, p > .20 \).
Figure 5. Mean number of artifacts selected (+SE) in Experiment 3.

Figure 6. Mean number of animals selected (+SE) in Experiment 3.
Discussion

Five-year-olds and second graders showed the same pattern of responses as the first graders in Experiments 1 and 2 had, but college students showed no effect of condition for either artifacts or toy animals. We can only speculate on why college students’ generalization of a label for an object was unaffected by whether or not they had first distinguished the object from similar objects. One possibility is related to adults’ tendency to remember more of the details of an object’s appearance than children do in some situations (Carroll, Byrne, & Kirsner, 1985; Cycowicz, Friedman, Snodgrass, & Duff, 2001; Newcombe, Rogoff, & Kagan, 1977). Unlike the children in our experiments, the adults may have retained just as much detail about the target object in the dissimilar as in the similar condition, and so interpreted the label for it no differently in the two conditions.

One piece of evidence is consistent with this conjecture, at least for artifacts. Adults in the dissimilar condition generalized the labels for artifacts less broadly than children in the dissimilar condition did ($M = 2.54, SD = 1.10$ vs. $M = 3.45, SD = 0.50$, respectively, $t(22.2, \text{equal variances not assumed}) = 3.09, p < .01$), suggesting that when they were not induced to encode detail, adults retained more detail in their representations of the training artifact than children did. For toy animals, the trend was in the same direction, but not significant ($M = 2.37, SD = 1.07$ vs. $M = 2.88, SD = 0.78$, respectively, $t(25.3, \text{equal variances not assumed}) = 1.51, p > .10$).

A second possibility is that adults, but not children, may believe that the details that they need to remember so as to keep track of an object as an individual are not relevant to the interpretation of a categorical label for the object. For example, they may realize that the details they remember about their own car, which help to avoid confusing it with other cars, are not important for representing what cars are (i.e., for representing what distinguishes a car from other kinds of vehicles).

Additional explanation is needed to account for the difference between adults’ and older children’s interpretation of labels for toy animals, however. Whereas the 5- and 8-year-olds generalized the trained label more broadly in the similar condition than in the dissimilar condition, adults’ label generalization was unaffected by condition. Again, we can only speculate, but adults may have decided that the groups of toy animals encountered in the experiment were not to be construed as representing naturally-occurring groups. Adults are more sophisticated than children about psychological research, as well as more suspicious of experimenters’ motives. The adults may not have judged the groups of similar animals to be like flocks or herds, but to be sets that the experimenter had arranged for some unknown purpose.

After all, the animals were not presented in a natural scene, but were found among other objects in a tub in the search task and then under separate buckets in the recognition task. Consequently, animal grouping had no impact on the adults’ label interpretations.

General discussion

Three experiments were conducted to determine whether the experience of individuating an object would alter children’s interpretation of a label for it. In Experiment 1, participants who were required to distinguish a training object from similar foils (the similar
condition) were expected to represent more of the object’s details than those who were only required to distinguish the object from dissimilar foils (the dissimilar condition). Consequently, those in the similar condition were expected to generalize a label for the object to fewer other objects than those in the dissimilar condition. Although 3-year-olds’ label generalization was not affected by condition, 4-year-olds performed as predicted for both artifacts and toy animals. Surprisingly, first graders performed as predicted for artifacts, but showed the opposite pattern for toy animals. In Experiment 2, this surprising pattern was replicated in first graders. In Experiment 3, 5-year-olds and second graders also showed this surprising pattern, but college students showed no effect for either artifacts or toy animals.

These results add to research demonstrating that children’s interpretation of a label can be affected by the opportunity to compare or contrast objects as well as to research showing that children consider different information when categorizing artifacts than when categorizing animals. Our hypothesis that children incorporate more detail in their interpretation of an object’s label if they first distinguish the object from similar objects received much broader support for artifacts than for animals.

One implication for accounts of children’s word meaning acquisition and category formation is that for 4- through 8-year-olds at least, the way that they represent an individual artifact can influence the representation that they construct for the artifact’s category. This finding fits with previous studies showing that the particular features that children emphasize when interpreting an object’s categorical label can be affected by opportunities to compare and contrast the object with other objects (Gentner & Namy, 1999; Merriman et al., 1991; Namy & Gentner, 2002; Xu & Tenenbaum, 2007). Moreover, as in Merriman et al. (1991), such an effect can occur even if the comparisons and contrasts occur before the label for the object is introduced.

One might question the relevance of our laboratory results for everyday word learning. After all, how often is a child asked to pick out an unfamiliar artifact from similar artifacts right before hearing a label for the artifact? However, according to the detailed representation hypothesis, any procedure that induces a child to attend closely to the details of an object should result in narrower label interpretation. Indeed, even if the details of an object just happen to capture a child’s attention, a narrower label interpretation should result. An important direction for future research will be to assess whether children who tend to remember more details about an object also tend to interpret a label for the object more narrowly, as well as whether the number of details that an individual child remembers about various objects predict how narrowly the child interprets the objects’ labels.

Future research is also needed to test whether artifact individuation affects the label interpretations of older children, adolescents, and the elderly, as well as whether younger adults or children under 4 years might ever show such an effect. Interestingly, the only other investigation to demonstrate that a label’s interpretation can be affected by object comparisons that occur before the label is introduced (Merriman et al., 1991) involved 3-year-olds and adults. That is, the very age groups that did not show an effect in the current investigation showed one in this previous investigation.

The question addressed by Merriman et al. (1991) was quite different from ours, and so too were the procedures. Their question was whether the discovery that
particular properties covaried in a set of objects would cause children to give greater weight to those properties in their interpretation of a label for one of the objects. Our question was whether object individuation would make children more likely to incorporate details of the object in their interpretation of its label. In Merriman et al.’s experiments, participants played with a set of similar objects in which particular features covaried, then learned a label for one of the objects. In contrast to the current paradigm, the object that was labeled had not been singled out during the presentation of the set. Also, their main finding did not concern how broadly participants extended the label, but whether they extended it to some objects more often than others (i.e., whether they favored objects that matched the labeled object on the features that had covaried in the set).

Some possible explanations for why the 3-year-olds were not affected by object individuation are less plausible than others. First, one might propose that a 3-year-old’s interpretation of a categorical label for an object is always independent of any pre-existing representation of the object, but Merriman et al.’s (1991) results challenge this claim. Second, it is unlikely that the 3-year-olds in Experiment 1 simply failed to form a detailed representation of the target object in the similar condition. In this condition, they had little difficulty picking out this object rather than the similar foil objects in the tasks that preceded label training. So they must have retained at least enough detail about it to avoid confusing it with the similar objects.

One possible explanation is simply sampling error. Because there were only eight 3-year-olds in each condition × kind of object cell in Experiment 1, statistical power was rather low. Another possibility is that the 3-year-olds may just have been too strongly influenced by the similarities and differences that they perceived among the five objects that were placed before them in the test of label generalization. Even if they had retained a detailed representation of the training object, they may have tended to pick every object in the test set except the so-called dissimilar object because this object contrasted so strongly with all the other objects in the test set (see Figure 2). For each of the four test sets used in the experiment, the majority of 3-year-olds picked every object except the so-called dissimilar object, and 87.5% picked at least three of these four objects. Xu and Tenenbaum (2007) also found that the variation in label training affected 3-year-olds’ generalization of the label much less when test objects were presented as a set than when each test object was presented one at a time.

Yet another possibility is that after rejecting the similar foil objects in the search and recognition tasks, the 3-year-olds may not have attempted to understand why they had rejected these objects. That is, only the older children may have thought about the ways in which the training object differed from the similar objects, which strengthened the details in their representation of the training object. Because these details were not strengthened for the 3-year-olds, these details had little impact on their interpretation of a label for the object. The general tendency to spontaneously reflect on and attempt to explain one’s solutions to problems tends to increase over childhood (Karmiloff-Smith, 1992; Zelazo, 2004).

What about the finding that 5-year-olds, first graders, and second graders tended to generalize a label for a novel toy animal more broadly in the similar than in the dissimilar condition? This result is generally consistent with evidence that children’s
generalization of a label for an animal is influenced by different factors than their generalization of a label for an artifact (Booth & Waxman, 2002; Jones et al., 1991) and that they are more likely to take a categorical stance toward a novel animal than toward a novel artifact (Brandone & Gelman, 2009; Goldin-Meadow et al., 2005). Research on children’s induction of hidden attributes also shows that the distinction between artifacts and natural kinds tends to sharpen over the period from preschool to early elementary school (Gelman, 1988; Gelman & O’Reilly, 1988). However, previous research does not offer a ready explanation for why the experience of individuating a novel animal affected 4-year-olds differently than it did 5- through 8-year-olds.

An important question for future research is why the tendency to interpret a group of similar animals as representing a single basic-level category appears to develop sometime after the fourth birthday. One hypothesis is that by this age children have learned that when an animal is found in a group with similar animals, the grouping is a cue that they are members of the same basic-level category. Children may even tend to infer that the group is some kind of socially-organized group of conspecifics, such as a family, a flock, or a herd, although the hypothesis does not require that they draw this more specific inference. Another hypothesis, which is not mutually exclusive with the first, is that sometime after the fourth birthday children’s tendency to take a categorical stance toward an object has become so much stronger for animals than for artifacts (Brandone & Gelman, 2009; Goldin-Meadow et al., 2005) that they tend to decide that a group of similar animals represents the same basic-level category, but not decide this about a group of similar artifacts.

In addition to testing these and other possible hypotheses, future research should explore whether the apparent developmental change that we have observed to occur around the fourth birthday is related to other changes that occur around this age. One candidate for a conceptually related development is the increase that occurs around this age in the tendency to think of animals as similar in behavior and internal physical structures to human beings (Herrmann, Waxman, & Medin, 2010; Rigney & Callanan, 2011). As this anthropocentric way of thinking about animals becomes established, children may begin to use the grouping of similar animals as a cue that the animals are members of the same species based on their knowledge of human beings’ strong tendency to group with other human beings. Another change during early childhood that may be relevant is an increase in the tendency to consider that an object’s relation to other nearby objects, rather than just the object’s intrinsic properties, has some bearing on the meaning of a label for the object (Gentner, Anggoro, & Klibanoff, 2011).

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