Grouping Affects Children's Interpretation of a Label for an Animal, but not for an Artifact

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Abstract

We conducted three experiments examining the effect of grouping on children's generalization of animal labels. In Experiment 1 (N = 96), first graders (*M* age = 6 years, 10 months) who had seen a novel animal grouped with similar animals generalized its trained label more broadly than those who had seen it by itself or grouped with dissimilar animals. Generalization of artifact labels was unaffected by condition. In Experiment 2, 4-year-olds (N = 96) also showed this pattern, but 3-year-olds (N = 96) showed no effects. In Experiment 3 (N = 48), 4-year-olds again showed the effect for animal labels in a design that eliminated alternatives to a grouping explanation. At least by age four years, children tend to judge that members of a group of similar animals belong to the same category, and this judgment affects how they interpret a label that is introduced for a member of the group. Explanations for why children tend to make these judgments and the implications for accounts of children's word learning are discussed.

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When children hear a novel label for an object, they must solve the problem of representing the category of objects that the word denotes (Quine, 1960). Typically, when determining this representation, they focus on the object's shape (Diesendruck & Bloom, 2003; Imai, Gentner, & Uchida, 1994; Landau, Smith, & Jones, 1988, 1992; Smith, Jones, & Landau, 1992) and/or its function (Kemler Nelson, Frankenfield, Morris, & Blair, 2000; Kemler Nelson, Russell, Duke, & Jones, 2000; Truxaw, Krasnow, Woods, & German, 2006). They also tend to focus on properties of the object that have been observed to co-occur in the past (e.g., having feathers and a beak) (Mervis, 1987; Merriman, Schuster, & Hager, 1991) and avoid extending the label to objects that they can already identify by another label (Markman & Wachtel, 1988; Merriman & Bowman, 1989).

The relative weight of these factors in children's label generalization decision depends on whether the label is a name for an animal or an artifact. From a very early age, children tend to require a match in texture when generalizing a label for an animal, but not when generalizing a label for an artifact (Booth & Waxman, 2002; Booth, Waxman, & Huang, 2005; Jones & Smith, 2002; Jones, Smith, & Landau, 1991; Yoshida & Smith, 2001). In experiments by Graham, Welder, Merrifield, and Berman (2010), 4-year-olds who were told that a training object was an animal tended to generalize the trained label based on shape, whereas those who were told that this same object was a tool tended to generalize the label based on function.

Consistent with domain-specific accounts of children's object categorization (see Bloom, 2000; Diesendruck & Peretz, 2013), preschoolers' knowledge about animals could influence their decision about whether to extend an animal label to something. For example, they know

that animals move on their own (R. Gelman, 1990), get larger and sometimes change form as they grow (Rosengren, Gelman, Kalish, & McCormick, 1991), and experience fluctuating biological states such as hunger and fatigue (Hatano & Inagaki, 1994). They also know that animals that belong to the same category tend to have the same internal parts (Diesendruck & Peretz, 2013). There have been no empirical tests of whether information about these properties or parts influences children's generalization of animal labels. However, Gelman and Wellman (1991) did find that 4-year-olds tended to judge that a familiar animal (e.g., dog) was no longer a member of its category, and so no longer an exemplar of its familiar label, if its insides were removed.

Children's decisions about whether to extend an artifact label to something could also be influenced by other knowledge about artifacts, such as that they are intentionally created by people (Diesendruck & Peretz, 2013; S. A. Gelman, & Bloom, 2000; S. A. Gelman & Kremer, 1991) and can have their categorical identities changed by people's actions on them (S. A. Gelman & Wellman, 1991; Keil, 1992; Siegel & Callanan, 2007). Also, children as young as five years old tend to conceive of artifact categories as having less definite boundaries than animal categories. When Rhodes and Gelman (2009) asked 5-year-olds whether various objects belonged to various categories and gave them the option of answering "sort of" instead of "yes" or "no", they were more likely to choose this option for artifacts than for animals.

There is some evidence that children are more likely to take a categorical stance toward a novel animal than toward a novel artifact. For example, like adults, preschoolers 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

some property of the referent is typical of the members of its category rather than just found in the individual referent (Gelman & Raman, 2003; Hollander, Gelman, & Star, 2002). Upon encountering a novel object, 3- and 4-year-olds are also more likely to request its categorical label if it is an animal and more likely to ask how it functions if it is an artifact (Kemler Nelson, Egan, & Holt, 2004).

Our goal was to examine whether another variable, group context, also affects children's categorization of animals differently than their categorization of artifacts. Given children's sensitivity to many of the ways in which these two types of categories differ, they may well respond differently to a group of novel animals than to a group of novel artifacts. The likelihood that a group consists of members of the same basic-level kind may differ for animals than for artifacts. It may be greater for animals because members of the same species tend to form socially-organized groups, such as families, flocks, or herds. Another possibility is that children's tendency to take a categorical stance toward a novel object may be so much stronger for animals than for artifacts (Brandone & Gelman, 2009; Goldin-Meadow et al., 2005) that they are more inclined to judge a group of animals to represent a single basic-level category than to make the same judgment about a group of artifacts. Thus, grouping may "invite" children to construct a category that includes every animal in the group, somewhat analogous to the way that naming serves as an invitation to construct a category that includes every object named (Balaban & Waxman, 1997; Fulkerson & Waxman, 2007). In contrast, grouping may not have this effect, or at least not as strong a one, on children's categorization of artifacts.

This proposal only has implications for groups of things that are moderately similar to one another. Regardless of ontological kind, if the members of a group are identical or very similar perceptually, children would tend to assign all of them to the same category. Also,

regardless of ontological kind, if the members of a group are highly perceptually dissimilar, children would tend to assign them to different categories (Davidson & Gelman, 1990; Diensendruck & Peretz, 2013; Jaswal and Markman, 2007). So, we tested two predictions. First, if children saw a novel animal depicted in a group of moderately similar animals, and then learned a label for it, their tendency to extend the label to other moderately similar animals would be greater than if they had seen the animal depicted alone or in a group of dissimilar-looking animals. Second, children would not show as strong an effect of this kind for artifacts.

The results of an investigation by Hartin and Merriman (2016) are consistent with these proposals for children 5 years and older, although their experiments were not intended to test these proposals. Their experiments were designed to test the so-called detailed representation hypothesis, which is that if children attend to a detail that distinguishes one object from similar objects, they will tend to not generalize a label for the first object to objects that lack that detail. Results for children's generalization of artifact labels supported this hypothesis, but results for children's generalization of animal labels did not. The authors speculated that this unexpected effect resulted because the procedure for directing children's attention to a detail of an object involved presenting the object in a group of similar objects. The children may have inferred from the grouping of similar animals that each member belonged to the same category, but not have drawn this inference from the grouping of the artifacts.

The goal of the current experiments was to test the animal grouping hypothesis directly. If children encounter a novel animal in a group of moderately similar animals, they will consider each member of the group to belong to the same category. Consequently, if taught a label for the one animal, they will extend it to the other members of the group. They will also extend it more readily to other similar animals. Xu and Tennenbaum (2007) found that preschoolers generalized

a label from a novel language more broadly if they had heard it used for three moderately similar exemplars (e.g., Dalmatian, terrier, and mutt) than if they heard it used for only a single exemplar (e.g., Dalmatian). We also tested the hypothesis that children would not respond the same way to artifacts. Their generalization of a label for a novel artifact would not be affected by whether they had encountered it in a group of moderately similar artifacts.

Our paradigm differed from that of Hartin and Merriman (2016) in two important ways. First, it not only included a similar group and a dissimilar group condition, but also included a no group condition in which the target object was encountered by itself several times before the label was introduced for it. We predicted that for animals, but not for artifacts, children in the similar group condition would generalize the label more broadly than those in the no group condition or the dissimilar group condition. Secondly, no attempt was made to draw children's attention to the target object or to some distinctive detail of this object before the label was trained for it. According to the animal grouping hypothesis, merely encountering an animal in a group of moderately similar animals should compel them to decide that each member of the group belongs to the same category.

Experiment 1 tested first graders (6- and 7-year-olds). Hartin and Merriman (2016) found that this age group generalized a label for an animal more broadly if they had first picked out the animal from similar rather than dissimilar animals. Experiment 2 examined 3- and 4-year-olds' performance. Hartin and Merriman (2016) found no evidence that either of these groups considered the grouping of similar animals to be an invitation to form a category out of them. Experiment 3 addressed potential alternative explanations for the performance of 4-year-olds in Experiment 2.

Experiment 1

Participants

Ninety-six first graders (*M* = 6 years, 10 months; range = 6 years, 3 months to 7 years, 6 months) were recruited from grade schools in middle- to upper-class regions of the Midwest United States. Half were taught labels for artifacts and half were taught labels for animals. Within each of these groups, 16 (8 boys) were randomly assigned to one of three grouping conditions: similar group; dissimilar group; and no group. Each cell in this 2 (ontological kind: animal vs. artifact) x 3 (grouping: similar, dissimilar, and none) design was matched for age in months.

Materials and procedures

Every child received four trials. On each trial, the child viewed three color photographs, learned a label for one of the objects that had been depicted in each of the photographs, and then generalized the label to other objects. Each photograph included the novel object that would later be used to train the label (the training object). In the no group condition, the training object was the only object in each photograph. In the similar group and dissimilar group conditions, two comparison objects also appeared in each photograph. In the similar group condition, the comparison objects were perceptually similar to the training object and did not change across the three photographs. In the dissimilar group, the comparison objects were perceptually-dissimilar to the training object and varied across the three photographs. (Note that in Experiment 3, the comparison objects remained the same across the three photographs in both conditions; only the perceptual similarity of the comparison objects to the training object varied.) Figures 1a and 1b show the photographs presented on each trial in the similar group and dissimilar group conditions for the children who were taught animal labels. Figures 2a and 2b show the corresponding photographs for the children who were taught artifact labels. Over the entire set of

trials in the similar and dissimilar group conditions, each training object and each comparison object appeared in three photographs.

The children were tested individually in a quiet room in their school. Before each trial the child was told, "We are going to look at some pictures. I want you to look at them closely." The three photographs for the trial were then presented one at a time on a laptop screen. Each photograph was presented for eight seconds with no delay between presentations. In the similar and dissimilar group conditions, every time a photograph was presented, the child was told, "Look at these," or "Take a good look at these." In the no group condition, the child was told, "Look at that," or "Take a good look at that." After viewing the third photograph, children in every condition were shown the actual training object that had been depicted in the photographs, and were told, "Do you know what this is called? It's called a zav. It's a zav. Can you say zav? [Child repeats label.] Right, this thing is called a zav." A different novel label (*zav, mosby, blicket, pilson*) was used on each trial.

The training object was removed from view, and the child was asked whether the label could be extended to various objects. This test was broken into two parts. The first part involved presenting the training object, two objects that were perceptually similar to it, and one object that was perceptually dissimilar to it (see Figure 3). For children in the similar group condition, but not the other conditions, one of the perceptually-similar objects had appeared next to the training object in the three photographs that they had just viewed. No child in any condition had seen the other perceptually similar object or the perceptually dissimilar object in the test set before.

The experimenter arranged the four test objects in a random order, then asked, "Do you think any of these are (whatever the label had just been trained, e.g., zavs)?" After the child made his or her selection(s), the experimenter said, "Are there any more?" Once the child was

finished making selections, the experimenter said, “Now I’m going to show you more things.” The experimenter then tested the child’s extension of the label to three other objects in the same manner. Each of these objects was perceptually similar to the training object (see Figure 3). For children in the similar group condition, but not the other conditions, one of these objects had appeared next to the training object in the three photographs that they had just viewed. No child in any condition had seen the other two objects before.

Results

On every trial, the maximum number of objects that children could select in the label generalization test was seven. However, because no child ever selected the perceptually dissimilar object, the effective maximum was six. Also, every child tended to select the training object on every trial, so the effective minimum was one. Thus, label generalization scores ranged from 1 to 6. Mean scores are summarized in Figure 4. A 2 (ontological kind: animal vs. artifact) x 3 (grouping: similar vs. dissimilar vs. none) factorial analysis of variance of the mean scores yielded a significant ontological kind x grouping interaction, F (2, 90) = 4.62, $p < .02$, partial η^2 = .09. Results were as predicted. First, there was no effect of grouping among children who learned labels for artifacts, F (2, 90) < 1, but there was a large effect among those who learned labels for animals, F (2, 90) = 9.81, $p < .001$, partial η^2 = .18. Whereas the mean number of artifacts that children selected was nearly the same in each grouping condition (range = 4.02 to 4.14), children in the similar group condition selected more animals (M = 4.88, SD = .91) than children in either the dissimilar group condition (M = 3.14, SD =1.27), t (30) = 3.98, Bonferroni p = .001, d = 1.57, or the no group condition (M = 3.28, SD = 1.60), t (30) = 3.66, Bonferroni p = .003, d = 1.23. The mean number of animal selections in the latter conditions did not differ, t (30) = 0.32, Bonferroni p = 1.00.

According to the animal grouping hypothesis, children in the similar group condition should have tended to judge that every animal in the group belonged to the same category. Consequently, they should have extended the label that had been trained for one member of the group to the other two members of the group. Children in the other two conditions should not have shown as strong a tendency to extend the label to these other two perceptually similar animals because they had not seen them depicted in a group with the labeled animal. A 3 (grouping) x 2 (ontological kind) factorial analysis of variance was conducted on the mean number of selections of just these two perceptually similar objects, averaged across the four test trials. As predicted, the grouping x ontological kind interaction was significant, F (2, 90) = 5.39, p = .006, partial η^2 = .11. There was no effect of grouping among children who learned labels for artifacts, F (2, 90) < 1, but there was a large effect among those who learned labels for animals, F (2, 90) = 10.66, p < .001, partial η^2 = 19. The means for artifacts were nearly the same in each grouping condition (range = 1.25 to 1.28). The means for animals were greater in the similar group condition (M = 1.66, SD = .38) than in the dissimilar group condition (M = 0.70, SD =.60), t (30) = 4.56, Bonferroni p < .001, d = 1.91, or the no group condition (M = 1.05, SD = .71), t (30) = 2.92, Bonferroni p = .02, d = 1.07. The latter two conditions did not differ, t (30) = 1.65, Bonferroni p = .33. The probability that children would extend the trained label to a perceptually similar animal was .83 if it had been depicted in a group with the training animal, but only .44 if the children had never seen any perceptually similar animal grouped with the training object.

The broader animal label extension shown by children in the similar group condition was not simply a matter of their greater tendency to select the animals that they had seen in the photographs, however. They also selected the other perceptually similar animals in the test sets more often (M = 2.31, SD = .51, max = 3) than either the children in the dissimilar group

condition (M = 1.53, SD = .80), t (30) = 3.30, Bonferroni p = .006, d = 1.16, or the children in the no group condition (M = 1.44, SD = .96) t (30) = 3.23, Bonferroni p = .009, d = 1.30.

Discussion

The results supported the hypothesis that first graders interpret the grouping of animals as an invitation to represent them as members of the same category. According to this hypothesis, when children see a group of moderately similar animals, they form a categorical representation that includes each animal. This category tends to be broader than the one they usually form in response to seeing an animal. Consequently, when a label is introduced for one of the members of the group, the children generalize it more broadly than they would otherwise. Consistent with this account, children in the similar group condition generalized the trained animal label more broadly than those in either the dissimilar group or no group conditions.

There was no evidence that first graders interpreted the grouping of artifacts in a similar fashion. They showed comparable levels of artifact label generalization in each grouping condition.

The results also supported the proposal that if children in the similar group condition tended to decide that the trained label was a label for each member of the animal group that they had seen, then they would be more likely to extend the label to other perceptually similar animals (see Xu & Tennenbaum, 2007). This proposal is based on the assumption that in forming their representation of the label's category children emphasize properties that the members of the group share and de-emphasize properties that distinguish one member of the group from another.

The children showed the same pattern of animal label generalization as the first graders in Hartin and Merriman (2016). Thus, for first graders, the predicted effect of group context does not depend on asking the children to distinguish one animal from other animals in the group; the

children showed the effect when merely asked to look at the groups of animals. Also, the finding that the no group condition of Experiment 1 performed like the dissimilar group condition supports the conclusion that children changed their usual approach to interpreting a label for an animal after encountering it in a group of similar animals, but not after encountering it in a group of dissimilar animals.

Regarding children's generalization of artifact labels, the null effect of grouping condition contrasts with Hartin and Merriman's (2016) finding that first graders generalized a label for an artifact less broadly if they had first encountered it in a similar group than in a dissimilar group. This finding was expected, however, because our procedures did not satisfy the conditions covered by the detailed representation hypothesis. Children were not required to attend to a detail of the training artifact that distinguished it from the other artifacts in a group. Therefore, those in the similar group condition were expected to store a representation of the training artifact that contained no more detail than the representation stored by children in the other two conditions. Because these representations did not differ, grouping condition had no effect on how broadly the children generalized an artifact label.

Experiment 2 used the same procedures as Experiment 1 to test the animal grouping hypothesis in preschoolers. The developmental origins of the animal grouping hypothesis are unknown. Preschoolers' categorization and labeling of animals differ in several ways from their categorization and labeling of artifacts (Diesendruck & Pretz, 2013; Graham et al., 2010; Jones et al., 1991; Kemler Nelson et al., 2004). So the impact that grouping has on preschoolers' categorization and label generalization might also be different for animals than for artifacts.

In Hartin and Merriman (2016), 3- and 4-year-olds' generalization of animal labels was not affected by grouping. However, as already noted, their experiments were not designed to test

the animal grouping hypothesis. When the preschoolers in their experiments were asked to search for the training object in a bucket of objects and then decide whether various objects were identical to it, they might not have thought of the training object and the two comparison objects as constituting a group. Also, even if some did construe the objects as a group, they may have been blocked from deciding that the objects belonged to the same category because the instructions encouraged them to focus on differences between the objects.

Experiment 2

Participants

Ninety-six 3-year-olds (*M* = 3 years, 7 months; range = 3 years, 1 month to 3 years, 11 months) and 96 4-year-olds (*M* = 4 years, 7 months; range = 4 years, 1 month to 4 years, 11 months) were recruited from preschools in middle- to upper- class regions of the Midwest United States. Within each age group, 48 children were taught labels for artifacts and 48 were taught labels for animals. These groups were further subdivided into three conditions (N= 16 each): similar group; dissimilar group; and no group. These conditions were gender balanced and matched for age in months.

Materials and procedures

The materials and procedures were the same as in Experiment 1.

Results

The mean numbers of selections in the label generalization test are summarized in Figure 5. Because a 2 (age) x 2 (ontological kind) x 3 (grouping) factorial analysis of variance of these means yielded a significant 3-way interaction, F (2, 180) = 4.30, p = .015, partial η^2 = .05, separate 2-way analyses of variance were conducted for each age group. For the 3-year-olds, no main effects or interactions were significant, all F's < 1. In every ontological kind x grouping

cell in the design, the 3-year-olds tended to extend the trained label to its training object and every perceptually similar object in the test set (M = 5.30, SD = .84; effective maximum = 6). In contrast, 4-year-olds showed a significant ontological kind x grouping interaction, F (2, 90) = 10.42, $p < .001$, partial $\eta^2 = .19$. Simple effects tests indicated that although grouping condition did not affect their generalization of labels for artifacts, F (2, 90) < 1, it did affect their generalization of labels for animals, F (2, 90) = 17.49, $p < .001$, partial $\eta^2 = .28$. Whereas the mean number of artifacts that 4-year-olds selected was approximately the same in each grouping condition (range = 4.63 to 4.83), those in the similar group condition selected more animals (M = 5.70, SD = .91) than those in either the dissimilar group condition (M = 3.58, SD =1.06), t (30) = 5.97, Bonferroni $p < .001$, d = 2.15, or the no group condition (M = 4.22, SD = 1.30), t (30) = 4.16, Bonferroni $p < .001$, d = 1.32. The mean number of animal selections in the latter conditions did not differ, t (30) = 1.80, Bonferroni p = .24.

According to the animal grouping hypothesis, children in the similar group condition should have shown a strong tendency to judge that the two other animals that had been depicted in the group with the training animal belonged to the same category as the training animal. This was clearly the case for 4-year-olds, whose mean number of selections of these two animals, averaged across test trials, was 1.92 (SD = .22). Four-year-olds in the other two grouping conditions selected these two animals less often (for dissimilar group, M = 1.12, SD = .41, t (22.93, equal variance not assumed) = 6.89, Bonferroni $p < .001$, d = 2.43; for no group, M = 1.33, SD = .46, t (21.36, equal variances not assumed) = 4.64, Bonferroni $p < .001$, d = 1.64). The children in these conditions had never seen these animals depicted in a group with the training animal. Thus, the probability that 4-year-olds would extend the trained label to a

perceptually similar animal was .96 if they had seen photographs of it in a group with the training animal, but only .61 if they had not.

The broader animal label extension shown by 4-year-olds in the similar group condition was not simply a matter of their greater tendency to select the animals that they had seen in the photographs. They also selected the other perceptually similar animals more often (M = 2.78, SD = .29) than either the 4-year-olds in the dissimilar group condition (M = 1.52, SD = .67), t (20.36, equal variance not assumed) = 6.97, Bonferroni $p < .001$, d = 2.44, or the 4-year-olds in the no group condition (M = 1.94, SD = .82) t (18.58, equal variance not assumed) = 3.87, Bonferroni p = .003, d = 1.37.

Discussion

The results supported the animal grouping hypothesis for 4-year-olds, but not for 3-year-olds. The null result for the 3-year-olds was consistent with Hartin and Merriman (2016)'s finding of no effect of group similarity on 3-year-olds' generalization of animal labels. However, the result for 4-year-olds contrasted with their findings. In Hartin and Merriman (2016), 4-year-olds showed a trend in the opposite direction (p = .07), that is, toward broader generalization of a label for an animal if they had first picked the animal out from a perceptually dissimilar group than if they had first picked it out from a perceptually similar group.

The contrast in results for the 4-year-olds is most likely attributable to differences in method. The current method is the better procedure for testing the animal grouping hypothesis because it involves merely presenting a group of animals before teaching a label for one of the animals in the group. Hartin and Merriman (2016)'s method, which was designed to test the effect of attending to distinctive features, drew the child's attention to differences between the animal that would later be labeled and the other animals next to it. It is likely that when the other

animals in the group were perceptually similar, some 4-year-olds in their study did not extend the label to the other animals because they lacked the distinctive details of the labeled animal.

One possible problem in Experiments 1 and 2 is that the comparison objects – the objects that appeared in the photographs next to the training object – remained the same across the photographs presented on a trial in the similar group condition, but did not remain the same in the dissimilar group condition. Therefore, before learning the label for the training object, the similar condition had not only seen this object depicted in more homogeneous groups, it was also the only condition to have seen this object depicted in a group that did not change from photograph to photograph. Although we doubted that the latter experience was why the similar group generalized animal labels more broadly than the dissimilar group, we ran a new experiment in which both groups saw the training animal depicted in a group of animals that did not change from photograph to photograph. That is, in both conditions, the second and third photographs presented on a trial just depicted different arrangements of the three animals from the first photograph. Experiment 3 only involved 4-year-olds, only used the animal stimuli, and only included the similar group and dissimilar group conditions.

Another possible problem in the previous experiments is that the similar group condition was the only one in which the comparison objects that had appeared in the photographs were always presented as objects in the generalization test that immediately followed label training. In the dissimilar group condition, these objects were eventually presented in a label generalization test, but never in the test immediately after learning a label for the object with which these objects had been grouped. In Experiment 3, the comparison animals that had appeared in the photographs were not included in the sets of animals presented in the test of label generalization. So for every trained label, the children were asked to consider whether it was a

label for five rather than seven animals. Also, instead of presenting all five animals as a set at test, each was presented one at a time in a random order at test.

Experiment 3

Participants

Forty-eight 4-year-olds (*M* =4 years, 8 months; range = 4 years, 4 months to 4 years, 11 months) were recruited from preschools in middle- to upper-class regions of the Southeastern United States. All children were taught labels for toy animals and were randomly assigned to one of two conditions (*N* = 24 each): similar group and dissimilar group. The conditions were balanced for gender and matched for age in months.

Materials

The animal training and test objects from Experiments 1 and 2 were used again. The photographs of animals for the similar group condition were also the same as those from the previous experiments except that the photographs were reshot on a white background. For the dissimilar group condition, completely new photographs of animals were developed. These were also shot against a white background. As in the previous experiments, each of the three photographs in a set contained a training animal and two comparison animals from different categories. Unlike the previous experiments, the same three animals appeared in each of the three photographs; only their spatial arrangement varied (see Figures 6a and 6b).

Procedures

The procedures were the same as in the previous experiments, except for the test of label generalization. On each trial, after children had viewed the three photographs and heard the novel label for the particular training animal that had appeared in the photographs, they were shown only five of the seven test animals. The animals that had appeared in the photographs as comparison animals (i.e., as grouped with the training animal) were not included. Also, rather

than presenting subsets of the test objects and asking the child to choose the exemplars of the trained label, the test objects were presented one at a time and the child was asked, "Do you think this is a zav (or whatever the training label had been)?" Order of presentation of the different types of test objects (e.g., training animal, perceptually similar animals, perceptually dissimilar animal) varied from across trials.

Results and Discussion

On every trial, the maximum number of animals that children could select in the label generalization test was five. However, because no child ever selected the perceptually dissimilar animal, the effective maximum was four. Also, every child selected the training animals on every trial, so the effective minimum was one. Thus, label generalization scores ranged from 1 to 4.

Consistent with the animal grouping hypothesis, children in the similar group condition extended the trained label more broadly (M = 3.78, SD = .32) than children in the dissimilar group condition (M = 2.29, SD = .53), t (38, equal variances not assumed) = 11.75, $p < .001$, d = 3.39. This result challenges alternatives to the grouping explanation for the patterns of animal name generalization in the previous experiments. At least for 4-year-olds, there was no evidence that the effect of grouping condition was due to differences in how much the comparison animals in a group changed from photograph to photograph or in how soon the comparison animals were tested after they had been presented in the photographs.

General Discussion

The predicted effect of grouping was observed in first graders (Experiment 1) and 4-year-olds (Experiments 2 and 3), but not 3-year-olds (Experiment 2). The two older groups tended to generalize a label for a novel animal more broadly if they had first seen it depicted in a group with two perceptually similar animals than if they had first seen it depicted alone or in a group

with two perceptually dissimilar animals. This effect was specific to animals; children's generalization of a label for a novel artifact was not affected by condition. Regarding the 3-year-olds, there was no evidence that their generalization of a label for either an animal or artifact was affected by condition.

According to the animal grouping hypothesis, when children see a group of similar animals they tend to decide that each member of the group belongs to the same category. They do not make the same decision about a group of similar artifacts. Our results provide support for these claims in children as young as 4 years old. The decision that these children made about the group of similar animals influenced their interpretation of a label that was subsequently introduced for a member of the group. The children formed a broader category for the label's extensions than they would have otherwise. We claim that they did this because they gave greater weight to the features that the labeled animal shared with the other members of the group and less weight to the features that distinguished the animal from the other members of the group (Xu & Tennenbaum, 2007).

Two explanations for why children develop a tendency to abide by the animal grouping hypothesis seem plausible. These explanations are not incompatible; each could partially account for it. First, the tendency may reflect a statistical regularity in children's experience. The groups of similar animals that they encounter (either directly or through various media) may have a higher likelihood of consisting of members of the same basic level category than do the groups of similar artifacts that they encounter. Many of the homogeneous animal groups that they encounter may tend to be such things as families, flocks, and packs. Members of the same species tend to form stable groups and interact with one another much more often than they interact with similar-looking animals from other species. Children may only rarely encounter

mixed-category groups of similar-looking animals, such as a picture of some birds and bats together. By comparison, the homogeneous artifact groups that they encounter may not have as high a likelihood of containing exemplars of only one category. Although children undoubtedly encounter such groups (e.g., a pile of shoes or a box of crayons), these encounters may not be that much more frequent than encounters with groups of similar artifacts that do not all belong to the same category (e.g., cups and glasses; pens and pencils; toy cars and trucks).

Another possibility is that the tendency to abide by the animal grouping hypothesis is related to children's greater tendency to take a categorical stance toward a novel animal than toward a novel artifact (Brandone & Gelman, 2009; Goldin-Meadow et al., 2005). Any object, whether an animal or an artifact, can be thought of as an individual or as representative of its category. When thinking of an object as representative of its category, one attends to properties of it that one considers to be diagnostic of its category. This way of thinking is assumed to underlie a child's generic reference to a single object (e.g., "They have stripes.") When thinking of an object as an individual, one does not think about whether the properties one notices are diagnostic of its category. This way of thinking is assumed to underlie a child's non-generic reference to a single object (e.g., "It has stripes.") Just as children are more likely to think of a novel object categorically if it is an animal than if it is an artifact, they may be more likely think of a group of similar things as representative of a category if the things are animals than if they are artifacts.

This proposal implies that not only would children be more likely to make generic references to individual animals than to individual artifacts, they would also be more likely to make generic references to groups of similar animals than to groups of similar artifacts. It also

implies that a child would be more likely to attend to properties that all members of the group of animals share than to attend to properties that all members of the group of artifacts share.

One question that both of our proposed explanations must address is why children in the no group and dissimilar group conditions did not respond to the sets of perceptually similar animals *that were presented at test* in Experiments 1 and 2 by deciding that all of the animals in the sets had the same name. Two factors likely mitigated against this decision. First, the first test set that was presented on each test trial contained one perceptually dissimilar object; the set was not entirely composed of perceptually similar objects. Second, children likely interpreted the pragmatics of the test question (e.g., "Do you think any of these are zavs?") as implying that it was reasonable to decide that some of the perceptually similar animals might not have the same name. Also, even if there was some tendency for children in the no group and dissimilar group conditions to infer that the perceptually similar animals in the test sets all had the same name, children in the similar group may have had a stronger tendency because of the experimental manipulation (i.e., from seeing the groups of these animals in the photographs).

Although we propose that children who abided by the animal grouping hypothesis decided that the animals in the similar group were exemplars of the same category, we are not claiming that they necessarily made a conscious inference or engaged in symbolic reasoning. They may well have done so, which would be consistent with rationalist or theory theory accounts of word learning (Bloom, 2000; Booth and Waxman, 2002). However, it is also possible that their decision was the result of the activation of learned associations between representations of object labels, perceptual properties of objects, and relations between objects. This possibility would be consistent with emergentist accounts of children's word learning (Colunga & Smith, 2008; Merriman, 1999a; Merriman, 1999b; Smith, Colunga, & Yoshida,

2010). One could develop an emergentist model that learns to direct attention to the properties that animals in a group share, but not to the properties that artifacts in a group share. This attentional habit would develop once the child had a sufficient number of experiences seeing a group of similar animals, happening to attend to the properties that the animals shares, and then observing that these properties co-occurred with a particular label or some other cue that the animals belonged to the same category. Such a model would presuppose that whenever a child saw a group of similar artifacts and happened to attend to the properties the artifacts shared, the child would less often observe the properties to co-occur with a label or some other cue that the artifacts belonged to the same category.

Just as in Hartin and Merriman (2016), there was no evidence that 3-year-olds' generalization of an animal label was affected by the kind of group in which the labeled animal had been encountered. This age group may not consider animal grouping to be an invitation to place the members of the group in the same category. The two explanations that we have discussed regarding older children's performance – detection of a statistical regularity and development of a strong categorical stance toward animals – may both have an experiential requirement. Three-year-olds may not yet have had enough experiences with animal groups to learn that animal grouping is a cue to categorization. They may also need more experiences with play, media, and/or conversation that highlights animal categories (e.g., hearing generic references to animals, Gelman, Goetz, Sarnecka, & Flukes, 2008) before their categorical stance toward animals becomes strong enough to prompt them to interpret animal grouping as a cue to categorization.

Conceptual development may also play a role. Over the preschool years, children show an increasing tendency to think of animals as similar in behavior and internal structure to human

beings (Herrmann, Waxman, & Medin, 2010; Rigney & Callanan, 2011). Once this anthropocentric way of thinking about animals is established, children may expect members of an animal category to show just as strong a tendency to form groups with one another as members of the people category do.

Alternatively, 3-year-olds may have some tendency to use animal grouping as a cue to categorization, but a ceiling effect prevented them from showing it in Experiment 2. The 3-year-olds in the no group and dissimilar group conditions showed a strong tendency to generalize the trained label to the perceptually similar animals in the test set (see Figure 4). So even if the 3-year-olds in the similar group had decided that the three animals they saw in the photographs belonged to the same category, this decision may not have increased their already-strong tendency to generalize the label to animals that resembled the training animal. Also, 3-year-olds may just be too strongly influenced by the similarities that they notice among the animals in a test set when deciding which ones to include in the label's extension.

Children's tendency to interpret animal labels differently from artifact labels is well established (Booth & Waxman, 2002; Booth et al., 2005; Diesendruck & Peretz, 2013; Graham et al., 2010; Jones & Smith, 2002; Jones et al., 1991; Yoshida & Smith, 2001). Many studies have shown that the relative weight that they give to various object properties (e.g., shape, texture, and function) differs for the two types of labels. The current investigation and that of Hartin and Merriman (2016) are unique in demonstrating that the effect that another independent variable has on how these properties are weighted can also depend on type of label. Using an analogy from multiple regression analysis, whereas previous studies have documented how ontological kind can have a direct effect on children's interpretation of an object label, we have demonstrated that ontological kind can also moderate the effect that another variable has on

children's interpretation of an object label. In this case, the other variable was whether the object had appeared in a group of similar objects. To provide a more complete account of the processes by which children of different ages construct the meaning of novel words, future research should examine both direct and indirect effects of ontological kind in these processes.

It is not uncommon for children to encounter groups of animals in various media. If animal grouping is indeed an invitation to construct a category that includes every member of the group, it could play an important role in children's categorization of animals and their interpretation of animal labels. An encounter with a group of similar animals of the same kind could keep them from constructing too narrow a category for the animal kind, and thus, keep them from underextending the label for the kind. Or in cases where a child had already constructed too narrow a category for an animal kind, encountering a group of similar animals that belonged to that category might serve to correct this error.

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Figure 1a: Photographs of animals presented in similar group condition of Experiments 1 and 2.

Figure 1b: Photographs of animals presented in dissimilar group condition of Experiments 1 and 2.

Figure 2a: Photographs of artifacts presented in similar group condition of Experiments 1 and 2.

Figure 2b: Photographs of artifacts presented in dissimilar group condition of Experiments 1 and 2.

Figure 3: Example of different objects that appeared in the test trials.

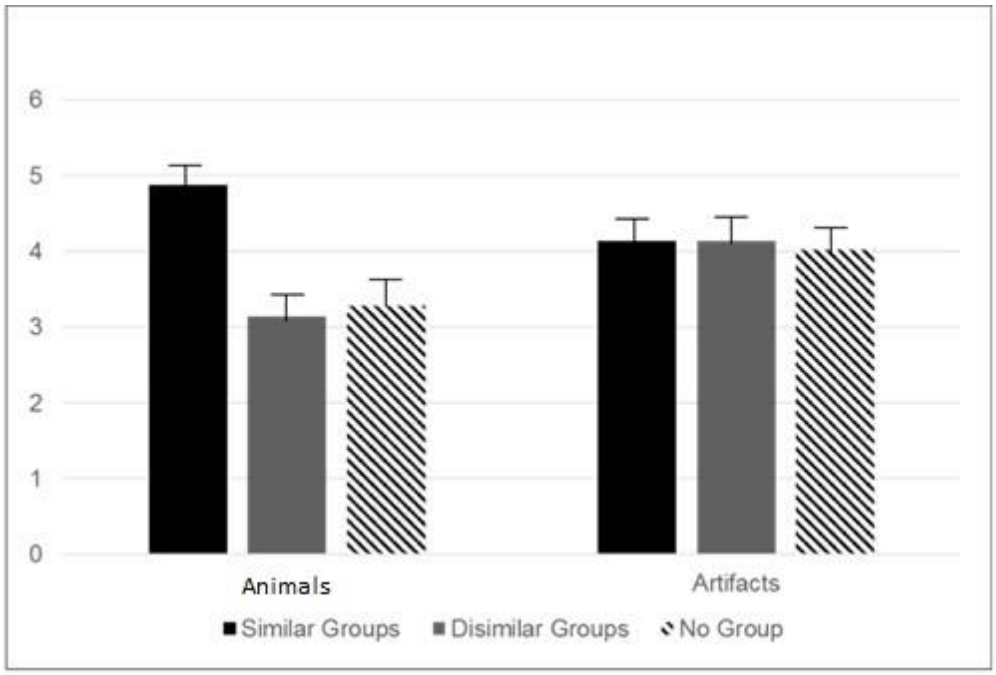
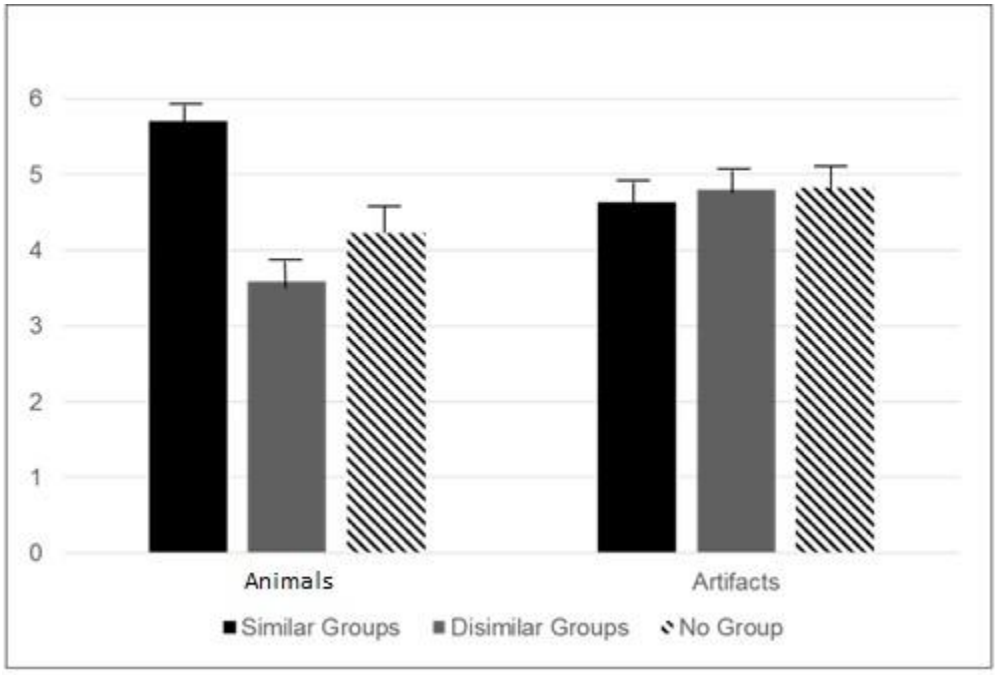
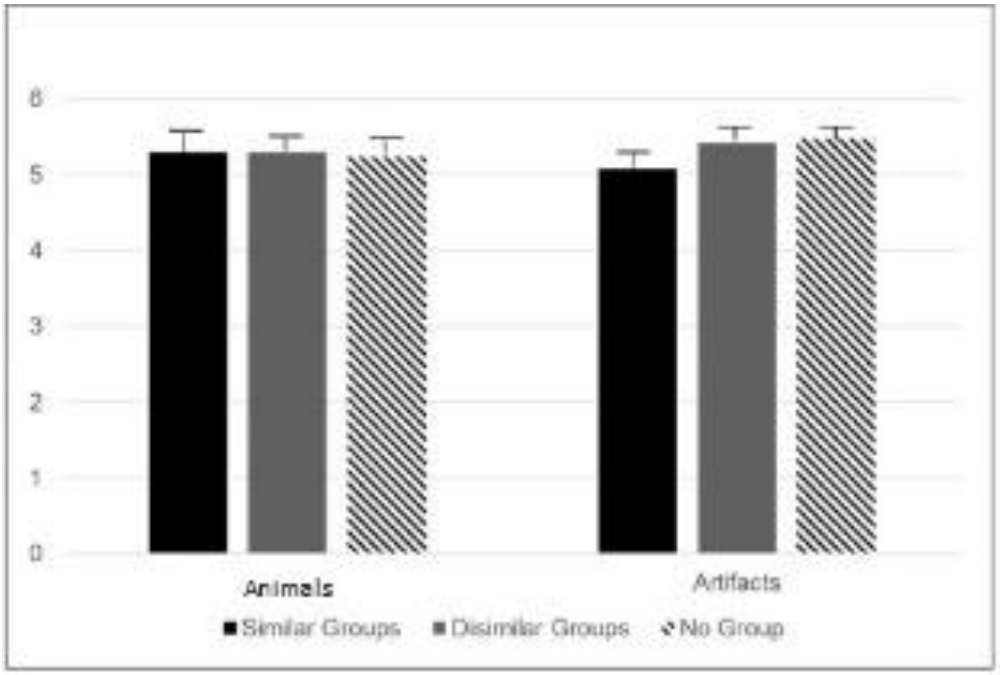


Figure 4: Mean number of objects (+SE) selected by children in Experiment 1.



Four-Year-Olds



Three-Year-Olds

Figure 5: Mean number of objects (+SE) selected by children in Experiment 2.

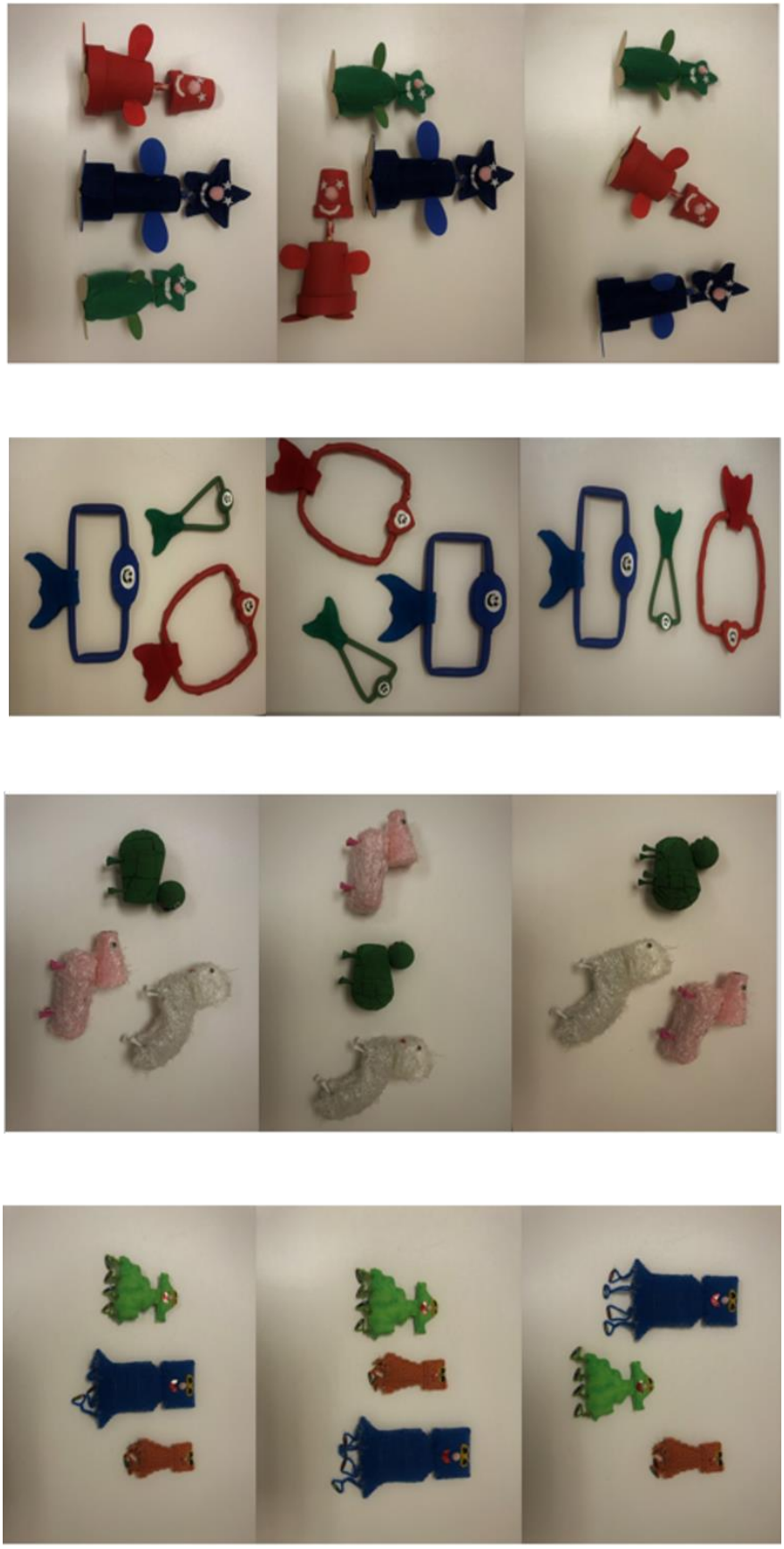


Figure 6a: Photographs of animals presented in the similar condition of Experiment 3.

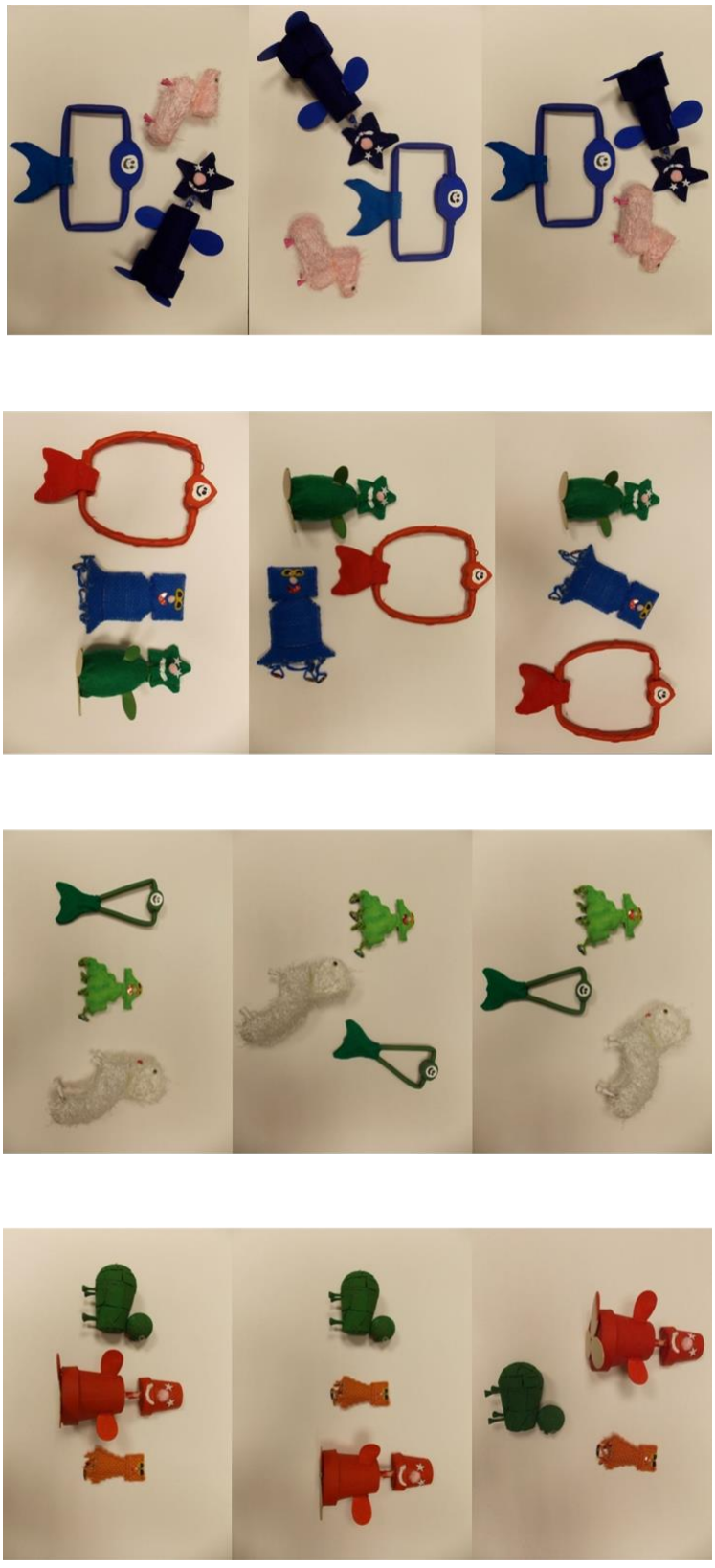


Figure 6a: Photographs of animals presented in the dissimilar condition of Experiment 3.