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Generic language facilitates children's cross-classification

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Abstract

Four studies examined the role of generic language in facilitating 4- and 5-year-old children's ability to cross-classify. Participants were asked to classify an item into a familiar (taxonomic or script) category, then cross-classify it into a novel (script or taxonomic) category with the help of a clue expressed in either generic or specific language. Experiment 1 showed that generics facilitate 5-year-olds' and adults' cross-classification when expressed at an appropriate level of generalization (e.g., “foods,” “birthday party things”), whereas Experiment 2 showed that such effects disappeared when labels were at an inappropriate level of generalization (e.g., “pizzas,” “balloons”). Experiments 3 and 4 offered additional controls. Taken together, the findings demonstrate that language can guide and direct children's multiple categorizations.

Keywords

cross-classification; generic language; categorization; generalization; cross classification

A central problem children face is organizing the world around them into categories. For example, the pet “Fido” can be categorized as a dog. However, items belong to multiple categories, often many simultaneously (e.g., dogs, animals, things on a farm). We refer to the ability to classify a single item into more than one category as “cross-classification.” For example, a desk can be cross-classified into both the taxonomic category of furniture based on its functional properties (Markman, 1989) and the script category of “things at school” based on the role it plays in a daily classroom routine (Nelson, 1986). The present study examines how children learn to cross-classify, particularly the role that generic language (language referring to categories) plays in facilitating the ability to cross-classify items into taxonomic and script categories.

Classification and Cross-Classification

Although children's knowledge and use of different types of categories for classification are well-documented in the conceptual development literature (Murphy, 2002), few studies have truly examined cross-classification or how it is learned. For example, many classification studies have required children to form different types of categories using a diverse set of

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items, but not to classify the same items into multiple categories (Lucariello, Kyratzis, & Nelson, 1992; Smiley & Brown, 1979). Or studies have used a between-participants design to show how different children, but not the same groups of children, can form different types of categories under varying circumstances (Waxman & Namy, 1997). Cross-classification, however, involves classifying the same item into different types of categories.

Recently, by directly assessing cross-classification, Nguyen and colleagues have found that by preschool, children, like adults, can use both taxonomic and script systems of categorization to cross-classify items from several domains, including food, furniture, animals, clothing, and toys. For instance, children can spontaneously cross-classify a cake into both the taxonomic category of food and the script category of “things at a birthday party.” Nguyen and colleagues have tested this ability by allowing children the opportunity to cross-classify a target item into two categories that are presented on separate trials, so that different categories are not pitted against each other. On one trial, children see a target (e.g., cake), a choice that shares a taxonomic relationship with the target (e.g., hot dog), and an unrelated choice (e.g., socks). On another trial, children see the same target (e.g., cake), now presented with a choice that shares a script relationship with the target (e.g., present), and an unrelated choice (e.g., shampoo). Cross-classification is demonstrated when children successfully select the taxonomic choices on the taxonomic trials and the script choices on the script trials for the same item (Nguyen & Murphy, 2003; Nguyen, 2007). Blaye & Jacques (2009) and Blaye & Bonthoux (2001) demonstrate a closely related ability called categorical flexibility, or switching in succession between two category representations of an item the researcher has made simultaneously available to children.

While these studies have documented children's ability to cross-classify, little is known about how they learn to do it. As Gelman (2009) notes, cognitive development research frequently focuses on children's knowledge and/or capabilities without further examination of how either are gained. Related research on cognitive flexibility suggests language may play a role in children's expression of flexible cognition, including the ability to switch strategies or responses as a result of changes in task demands (Deák, 2003; Jacques & Zelazo, 2005). An important way children may learn to cross-classify is through linguistic input from others in their environment, a possibility emphasized in Clark's research on children's lexical acquisition. Clark has argued that adults introduce children to words in daily conversation that highlight different conceptual perspectives one might take with regard to an item. For example, depending upon conversational goals, a dog might be referred to as the dog, Rover, or the family pet. The words children adopt from such conversations may in turn affect how they decide to categorize items (Clark, 2003; Clark, 1997; Clark & Svaib, 1997).

Generic Language

The present work focuses on a form of linguistic input children receive about categories that may be especially influential in children's cross-classification: generic noun phrases, also called generics. These phrases are broad statements that refer to a category as a whole and convey information about properties of the category that are timeless or definitional (e.g., “a cat has whiskers,” or “oranges are round”) (Dahl, 1975). Generics apply to the category broadly (e.g., cats in general) as opposed to particular members of the category (e.g., one cat, some cats) (Carlson & Pelletier, 1995; Prasada, 2000; Prasada & Dillingham, 2006, 2009). Children commonly hear parents use generic noun phrases and can produce appropriate generics on their own by approximately 2.5 years of age (Gelman, Goetz, Sarnecka, & Flukes, 2008; Gelman, Chesnick, & Waxman, 2005; Hollander, Gelman, & Star, 2002; Gelman, Hollander, Star, & Heyman, 2000; Gelman, Coley, Rosengren, Hartman, & Pappas, 1998; Pappas & Gelman, 1998). Comprehension studies have shown

that young children understand that generics express truths that extend beyond the available context (Gelman & Bloom, 2007), correctly interpret generics versus nongenerics (Chambers, Graham, & Turner, 2008; Cimpian & Markman, 2008, 2009; Gelman & Raman, 2003; Hollander et al., 2002), and retain this distinction in long-term memory (Gelman & Raman, 2007).

In this work, we focus on generic noun phrases as potentially instrumental in the development of children's category knowledge. Prior research has demonstrated that generics help children make the connection between categories and their properties. In induction studies, 4-year-olds are sensitive to the language used to introduce category-relevant information that can serve as the basis for inductive inferences. For example, generic compared to nongeneric language leads children to generalize novel properties more broadly to members of a familiar category. For example, the phrase “bears like to eat ants” leads to broader inferences than the phrase “some bears like to eat ants” (Gelman, Star, & Flukes, 2002). The same is true of references to members of a novel category (e.g., “pagons are friendly” vs. “these pagons are friendly”; Chambers, et al. 2008). Four- to 5-year-olds' naming extensions are also influenced by whether properties are expressed in generic (“bants have stripes”) or nongeneric (“this bant has stripes”) terms, with generic wording encouraging children to extend labels more often to new instances of a category that possess the stated property (Hollander, Gelman, & Raman, 2009).

It is still unclear whether generic noun phrases also help children cross-classify a single item into two contrasting *categories* to which it belongs. Generics may do so by referring to categories as a whole rather than referring to individual items in the categories, thereby drawing children's attention to the categorical nature of the alternative (second) category. Linguistic cues that emphasize the categorical nature of the intersecting groups are hypothesized to improve performance. However, it may be that simply hearing the relevant category would be sufficient to boost cross-classification, regardless of whether that label refers to particular individuals by means of a specific noun phrase (e.g., “these animals are sols”) or the whole category by means of a generic noun phrase (e.g., “animals are sols”). Moreover, attributing impact to any labeling effect assumes that this category information is not already salient to children. Generics may not be facilitative if such information is already accessible.

To examine this possibility, we designed four experiments comparing the effect that generic versus specific noun phrases have on children's cross-classification of items. In these experiments, we focused on 4-year-olds, 5-year-olds, and adults as a developmental comparison. We selected these child age groups because previous research shows that generic language plays a crucial role in the development of category knowledge during this period (Gelman et al., 2002; Chambers et al., 2008; Hollander et al., 2009).

Our methodological approach was modeled after Gelman et al. (2002), who used pictures and a clue book to teach participants a novel property about an exemplar using generic or nongeneric phrases. In the present experiments, we used similar materials, asking participants to classify items into a familiar (taxonomic or script) category and then to cross-classify them into a different, novel (script or taxonomic) category. As in previous research on cross-classification (Nguyen & Murphy, 2003; Nguyen, 2007), we focused on both taxonomic and script categories, as opposed to one or the other, because true cross-classification requires classifying a single item into two different category systems. For example, classifying an item into varying levels of a taxonomy is not, strictly speaking, cross-classification. In the present study, to facilitate cross-classification into the novel category, participants were given a clue book. Critically, clues in this book were expressed either in generic or specific language, depending on the participants' condition assignment.

In Experiment 1, we test the prediction that generics will help children's cross-classification when they are expressed at the appropriate level of generalization (e.g., “foods,” “birthday party things”). In Experiment 2, we provide a control by using labels that are not at an appropriate level of generalization (e.g., “pizzas,” “balloons”). If generics expressed at the appropriate level of generalization have a facilitative effect on cross-classification, participants in Experiment 1, but not Experiment 2, should be more likely to cross-classify in the generic versus specific condition. Experiments 3 and 4 were designed as additional controls. Specifically, Experiment 3 rules out the possibility that the generic advantage is due to a pragmatic effect, and Experiment 4 demonstrates that the experimental task used in the prior studies assesses cross-classification, rather than merely classification of items into a single category.

Experiment 1

In Experiment 1 we examine the effect of generics on cross-classification by using terms relevant to the generalization being called for. Thus, for taxonomic classifications, the cues were superordinate-level labels (e.g., “foods”), and for script classifications, the cues were script-level phrases (e.g., “birthday party things”). In this study, we examined whether the level of terms in the clues is relevant to generalizations that participants make in the generic versus specific conditions. We predict that generic terms will aid cross-classification (e.g., “foods are mips” will be more informative than “these foods are mips”).

Method

Participants—Seventy-two children and 38 adults participated. Participants within each age group were randomly assigned to one of two conditions: generic or specific. The generic condition included 20 4-year-olds (10 females; mean age 4-5, range 4-1 to 4-10), 17 5-year-olds (7 females; mean age 5-6, range 5-0 to 6-5), and 19 adults (10 females; mean age 19-7, range 18-3 to 21-1). The specific condition included 19 4-year-olds (9 females; mean age 4-6, range 4-0 to 4-11), 16 5-year-olds (6 females; mean age 5-6, range 5-1 to 6-5), and 19 adults (13 females, mean age 20-0, range 18-5 to 22-5).

A separate group of 18 adults (14 females; mean age 18-11, range 18-0 to 22-2) and 10 children (6 females; mean age 4-7, range 4-0 to 4-11) helped select the stimulus materials for the study. None participated in the experiment.

All participants were recruited from preschools and a university located in the Southeastern United States. The participants were from a predominantly European-American, middle-class background.

Materials—Stimuli included 64 black and white line drawings of items from different taxonomic and script categories. Taxonomic categories were people, food, animals, and clothing, while the others were based on scripts related to school, the doctor's office, a birthday party, a picnic, a farm, the beach, summertime, and wintertime. All items were selected from a larger set of stimuli based on category typicality ratings provided by an independent group of 18 adults. These adults were asked to rate whether an item was a typical instance of a given category on a scale ranging from 1 (not at all typical) to 7 (very typical). Only items with a mean rating of 4.5 or higher were included in the final set of stimuli to ensure that they were typical members of their respective categories.

Next, an independent group of 10 children participated in a categorization task to ensure children could identify the category membership of items in the final set of stimuli. In this task, children were shown items, one at a time, and were asked if each item belonged to a given taxonomic and script category (e.g., “Is a cake a food?” “Is a cake a birthday party

thing?”). Children were able to correctly identify which items were taxonomic ($M = 90\%$, $SD = 8\%$) and which items were script ($M = 88\%$, $SD = 7\%$).

Next, half of these stimuli were organized into two “clue books,” one for the generic and one for the specific condition. Each of the eight pages of the clue books included two adjacent drawings and a corresponding clue printed underneath, expressed either in generic language (e.g., “foods are mips,” “animals are sols”) or specific language (e.g., “these foods are mips,” “these animals are sols”), depending upon the condition.

The other half of the stimuli was organized onto eight 20×15 inch picture boards. Four drawings were arranged horizontally on each board: one taxonomic item (e.g., food--egg, animal--zebra); one script item (e.g., birthday party things--present, farm things--tractor); one item that could be cross-classified into both taxonomic and script categories (e.g., birthday party food--cake, farm animal--cow); and one irrelevant item (e.g., hairbrush, spoon).

Procedure—Participants were tested individually for approximately 15 minutes by a researcher at their preschool or in a laboratory. Both conditions involved a picture pointing task. The researcher introduced participants to the task by saying, “We’re going to play a game with this book & these boards. These boards have pictures on them. For each board, I’m going to ask you two questions. You can pick your answers off the board. The questions are kind of hard because I’ll be using new words that you’ve never heard before. So, you’re going to need some help answering the questions. So that’s why we have this book over here; it’s the clue book. The clue book tells you things you need to know to help you answer the questions. The clue book gives you important information, but it won’t tell you everything you need to know...”

Next, to familiarize participants with the procedure, a warm-up picture board was presented, consisting of a green square, a blue circle, a red square, and a red circle. Participants were asked two questions that involved finding matching items on the board (“Can you find a circle?” and “Can you find a red shape?”). They were allowed to pick more than one picture for each question, and they were allowed to pick the same picture(s) for both questions. If participants selected an incorrect picture, they were given corrective feedback and the question was repeated (“No, I don’t think that’s a circle. Can you find a circle?”). Four children selected incorrect pictures, whereas all adults selected the correct pictures for these questions.

Testing began immediately after the warm-up. For each of the eight test trials, the researcher presented participants with a picture board and labeled each of the items, and then asked two questions. The first question required participants to find exemplars on the picture board from a category with a familiar label (either taxonomic or script). The following is an example of what participants heard during a trial involving a familiar taxonomic category: “Here is a hairbrush, an egg, a cake, and a present. Can you find a food (taxonomic category)?” If participants chose a picture, they were then asked, “Can you find another food?” until they indicated there were no more. The second question required participants to find exemplars on the picture board from a different category with a novel label (either taxonomic or script). If the familiar category was taxonomic in the first question, the novel category was script in the second question, and vice versa. For example, participants heard, “Which ones are sygs (script category of birthday party items)? Let’s look at the clue book to see if it can help us answer the question.” Depending upon the condition, the researcher referred to the clue book with clues expressed in either generic or specific language. For example, participants in the generic condition heard, “Birthday party things are sygs.” Participants in the specific condition heard, “These birthday party things are sygs.” After

looking at the clue book, participants heard, “Can you find a *syg*? It's okay for you to pick the same picture(s) again.” If participants chose a picture, they were then asked, “Can you find another *syg*?” until they indicated there were no more. In this example, the category-relevant choices for the first question about “food” are egg and cake while the category-relevant choices for the second question about “*syg*” are present and cake. Thus, cake is cross-classified into the categories of food and birthday party items.

The eight test trials were organized into two orders of presentation, each including two blocks. In one order, A, the first block included four familiar taxonomic/novel script categories and the second block four familiar script/novel taxonomic categories. The same trials were used in the other order, B, except now the first block was presented as the four familiar script/novel taxonomic categories and the second block was presented as the four familiar taxonomic/novel script categories.

Results and Discussion

A “1” was assigned when participants selected the target cross-classifiable item (e.g., cake) for both questions about the familiar and novel categories. A “0” was assigned when participants selected the target cross-classifiable item for only one or none of the two questions. A cross-classification summary variable was created by summing scores across the eight trials. Preliminary analyses were conducted to examine possible effects of gender and order and revealed no significant findings.

A 3×2 analysis of variance (ANOVA) for factors age (4-year-olds, 5-year-olds, adults) and condition (generic, specific) showed a main effect of age, $F(2, 109) = 19.63$, $\eta_p^2 = 0.27$, $p < .001$. Both 5-year-olds ($M = 74\%$, $SD = 23\%$) and adults ($M = 88\%$, $SD = 18\%$), who did not differ from each other, were significantly more accurate than 4-year-olds ($M = 53\%$, $SD = 33\%$), with Tukey post-hoc analyses yielding $ps < .001$. Notably, there was a main effect of condition, in which participants in the generic condition ($M = 77\%$, $SD = 28\%$) were more accurate at cross-classification than participants in the specific condition ($M = 66\%$, $SD = 30\%$), $F(1, 109) = 6.18$, $\eta_p^2 = 0.05$, $p = .015$. There was no interaction of age and condition. (See Figure 1.)

To further clarify the role of generic language in cross-classification, we analyzed participants' selection of the non-cross-classifiable member of the novel category. One concern is that this task may be more about category learning than cross-classification. For example, stating that “foods are mips” may simply teach participants what belongs to this novel category rather than facilitate cross-classification. If generic language only indirectly facilitates cross-classification (but directly facilitates category learning in this task), there should be a significant difference in participants' selection of the other, non-cross-classifiable member of the novel category (e.g., french fries for the mip trial) in the generic and specific conditions. However, if generic language directly facilitates cross-classification, there should be no significant difference in participants' selection of the other, non-cross-classifiable member of the novel category between generic and specific conditions.

A “1” was assigned when participants selected the non-cross-classifiable member of the novel category. Otherwise, a “0” was assigned. A summary variable was created by summing scores across the eight trials. A 3×2 ANOVA for factors age (4-year-olds, 5-year-olds, adults) and condition (generic, specific) revealed only a main effect of age, $F(2, 104) = 18.64$, $\eta_p^2 = 0.26$, $p < .001$. Both 5-year-olds ($M = 96\%$, $SD = 7\%$) and adults ($M = 95\%$, $SD = 8\%$), who did not differ from each other, chose the non-cross-classifiable member of the novel category more often than 4-year-olds ($M = 78\%$, $SD = 22\%$), with Tukey post-hoc analyses yielding $ps < .001$.

Of particular interest is the lack of a main effect of condition, and the absence of an interaction of age and condition. Participants in both generic and specific conditions ($M_s = 91\%, 89\%$, $SD_s = 15\%, 17\%$) were equally likely to select the non-cross-classifiable member of the novel category. This similarity between the two conditions is notable and reinforces the argument that this task taps into the role of generic language in cross-classification, not just concept learning.

Experiment 2

Experiment 2 was designed as a control study. In this study, we provided labels not relevant to the appropriate level of generalization. Thus, these labels should not be helpful in cross-classification.

Method

Participants—Sixty-four children and 55 adults participated. Participants in each age group were randomly assigned to one of two conditions: generic or specific. For the generic condition, there were 17 4-year-olds (9 females; mean age 4-7, range 4-0 to 4-11), 15 5-year-olds (8 females; mean age 5-4, range 5-0 to 5-9), and 29 adults (16 females; mean age 19-2, range 18-5 to 23-5). For the specific condition, there were 19 4-year-olds (8 females; mean age 4-6, range 4-0 to 4-11), 13 5-year-olds (6 females; mean age 5-4, range 5-0 to 5-9), and 26 adults (14 females, mean age 21-0, range = 18-3 to 23-10). As in Experiment 1, all participants were recruited from preschools and a university located in the Southeastern United States. The participants were from a predominantly middle class, European-American background, and none had participated in Experiment 1.

Materials—Materials were the same as those in Experiment 1, except that the superordinate-level clue terms (e.g., “foods,” “animals”) in the clue books were replaced with basic-level terms (e.g., “pizzas” and “broccoli”; “lions” and “guinea pigs”).

Procedure—The procedure was identical to Experiment 1, including the warm-up questions, which all of the participants answered correctly.

Results and Discussion

The same scoring procedure and data analytic approach from Experiment 1 were applied to Experiment 2 to examine the effect of generic language on cross-classification. A 3×2 (age $\times$ condition) ANOVA revealed only a main effect of age, $F(2, 118) = 48.09$, $\eta_p^2 = 0.46$, $p < .001$. There was a significant difference between adults ($M = 84\%$, $SD = 20\%$) and 4-year-olds ($M = 39\%$, $SD = 32\%$) and between adults and 5-year-olds ($M = 32\%$, $SD = 28\%$), with Tukey post hoc analyses yielding p 's $< .001$. There was no significant difference between the two child age groups, nor was there a main effect of condition, nor an interaction of age and condition.

Next, we compared cross-classification performance in Experiment 1 versus Experiment 2 to determine the impact of label level (superordinate in Experiment 1; basic in Experiment 2). A $3 \times 2 \times 2$, (age: 4-year-olds, 5-year-olds, adults) $\times$ condition (generic, specific) $\times$ experiment (1, 2) ANOVA showed main effects for age, $F(2, 228) = 56.50$, $\eta_p^2 = 0.34$, $p < .001$, and experiment, $F(1, 228) = 32.77$, $\eta_p^2 = 0.31$, $p < .001$. These main effects were moderated by two interactions, the first being between age and experiment, $F(2, 228) = 9.62$, $\eta_p^2 = 0.81$, $p < .001$. Follow-up independent sample t -tests showed that 5-year-olds performed significantly better in Experiment 1 (with relevant labels) than in Experiment 2 (with irrelevant, basic-level labels), $t(59) = 6.28$, $p < .001$. The other age groups did not show any cross-experiment effects. (See Figure 2.)

The second interaction was between condition and experiment, $F(1, 228) = 4.62$, $\eta_p^2 = 0.21$, $p = .033$. Follow-up independent sample t-tests showed a significant difference in cross-classification performance between Studies 1 and 2 in the generic condition but not in the specific condition, $t(115) = 3.36$, $p = .001$. (See Figure 3.)

Experiment 3

Experiment 3 was designed to address an alternative interpretation to the studies thus far -- one related to pragmatic inferences (Grice, 1975). Children in the specific condition may have used Gricean maxims of relevance to infer their answers. That is, when children heard the non-generic wording (e.g., “these foods are mips”), they may have inferred that the researcher was implying that the novel word applied *only* to the instances in the clue book (“these *and only these* foods are mips”). If so, then children may have inferred that foods on the picture board are *not* “mips,” thereby yielding worse performance. This pragmatic inference would have differentially affected performance in the non-generic wording condition, due to the pragmatic implications of the word “these.”

We therefore designed a version of the task in which children received specific wording (e.g., “these foods are mips”), yet nonetheless were predicted to correctly generalize to the test items on the picture board. In this study, we used the same wording from the specific condition as in Experiment 1 (e.g., “these foods”), but we varied the clue pictures so that they would match the test pictures at the basic level (e.g., if the clues were watermelon and potato chips, the test items included a different watermelon and different potato chips). As discussed with respect to Experiment 2, we would assume that these basic level categories (e.g., watermelon, potato chips) are already accessible to children, so that regardless of wording, children should correctly generalize to the new test instances and cross-classify them. In contrast, if there is a Gricean rule barring children from making this kind of inference, the specific language should imply, for example, that only the particular foods on the clue page are “mips.”

Method

Participants—Participants were 16 4-year-olds (8 females; mean age 4-5, range 4-0 to 4-11), 16 5-year-olds (8 females; mean age 5-6, range 5-0 to 5-11), and 16 adults (8 females, mean age 19-7, range 18-4 to 22-5). Participants were recruited from the same population as Experiments 1 and 2 but had not participated in either of them.

Materials—Materials were the same as those used in the specific condition of Experiment 1, except clue pictures were varied so that they were from the same basic-level category as the test pictures. That is, the picture board remained the same as in Experiment 1, but clues in the clue books were replaced with basic level items to match the picture board. For example, if taxonomic items on the picture board were an egg and cake, the taxonomic clue book in Experiment 1 included an apple and soup, whereas the taxonomic clue book in Experiment 3 included a different egg and a different cake. In selecting drawings of the basic level clues, special care was used to choose ones that were not identical to the drawings on the picture board. For example, the appearance of the two cakes differed based on their decorations, number of layers, and whether they were presented on a plate.

Procedure—Procedure was identical to the specific condition in Experiment 1, including the warm-up questions, which everyone answered correctly.

Results and Discussion

The same scoring procedure from Experiment 1 was used in Experiment 3. The percentage of cross-classification was extremely high in Experiment 3 for 4-year-olds, 5-year-olds, and adults. Each age group's performance in Experiment 3 was compared to their respective age group's performance in the specific condition in Experiments 1 and 2. There was a significant difference in performance between the three studies for each of the age groups considered separately: 4-year-olds, $F(2, 51) = 12.44$, $p < .001$, 5-year-olds, $F(2, 42) = 11.96$, $p < .001$, and adults, $F(2, 58) = 18.28$, $p < .001$. Each age group performed significantly better in Experiment 3 compared to Experiments 1 and 2, which did not differ from each other. Tukey post hoc analyses yielded $ps < .01$. (See Figure 4.)

Overall, the high level of cross-classification in Experiment 3 undermines the suggestion that the earlier results were due to a pragmatic assumption that the non-generic wording ("these Xs") excluded the pictures on the picture board. It is thus unlikely that children in the specific condition in Experiments 1 and 2 used Gricean maxims of relevance to infer their answers.

Experiment 4

A potential concern regarding the studies reported thus far is that they may not demonstrate children's *cross*-classification, but rather assess simple classification ability. Recall that in both Experiments 1 and 2, for each trial, children were asked two questions: a familiar-word question (e.g., "Show me the food") and, following a clue, a novel-word question ("Show me the mips"). Poor performance on the novel-word question was attributed to difficulty with cross-classification. Alternatively, children's difficulty may have been due to the novel-word question per se, independent of the fact that it required shifting from a different initial category. To test this alternative, we created Experiment 4, providing children with the test questions but excluding the cross-classification aspect. Specifically, we presented children with the clue (e.g., "Foods/these foods are mips") and with the novel-word question ("Show me the mips"), but we did *not* include the preceding familiar-word question ("Show me the picnic things"). Thus, in Experiment 4, children were never asked to cross-classify, only to solve simple classification problems. Consequently, Experiment 4 was shorter than Experiment 1. Ideally, the number of questions would have been the same, but we do not believe the length of the task had any effect on performance because in Experiment 1, participants did as well in the second half ($M = 73\%$, $SD = 3\%$) of the experiment as in the first half ($M = 71$, $SD = 3\%$), $t(109) = .71$, $p = .45$.

A lack of significant difference for generic versus specific language in Experiment 4, despite the significant difference for generic versus specific language in Experiment 1, would support the argument that the original experiments truly addressed factors that affect cross-classification.

Method

Participants—Fifty-six children and 32 adults participated. Participants in each age group were randomly assigned to one of two conditions: generic or specific. The generic condition included 16 4-year-olds (8 females; mean age 4-5, range 4-0 to 4-11), 12 5-year-olds (5 females, mean age 5-3, range 5-0 to 5-10), and 16 adults (8 females, mean age 19-0, range 18-1 to 20-6). For the specific condition, there were 16 4-year-olds (9 females, mean age 4-6, range 4-0 to 4-11), 12 5-year-olds (7 females, mean age 5-7, range 5-1 to 5-11), and 16 adults (8 females, mean age 19-0, range 18-2 to 22-3). Participants were recruited from the same population as in the earlier experiments, but none had participated in any of them.

Materials—Materials were the same as in Experiment 1, except that the first questions about the familiar category were excluded. Thus, materials included only the second questions about the novel category.

Procedure—The procedure was identical to Experiment 1 except that the task began with the second question about the novel category. For example, children heard, “Here are french fries, a basket, a watermelon, and a TV. Which ones are mips? Let’s look at the clue book to see if it can help us answer the question.” Then, depending on condition assignment, children heard either a generic (e.g., “foods are mips”) or specific (e.g., “these foods are mips”) clue. Then, children were asked, “Can you find a mip?”

A similar modification was made to the warm-up such that only one question was asked (i.e., “Can you find a circle?”), which everyone answered correctly.

Results and Discussion

In Experiment 1, questions about the familiar categories were asked first and questions about the novel categories were asked second. In Experiment 4, the questions about the novel categories occurred first (since the questions about the familiar categories were excluded). Two 2×3 ANOVAs involving condition (generic, specific) and age (4-year-olds, 5-year-olds, adults) were conducted to examine children’s selection of the cross-classifiable item in response to the novel category question in each study. (See Table 1.)¹

Experiment 4 revealed no main effects or interaction. Most notably, the lack of a significant effect of condition suggests children were able to classify items into novel categories equally well when the language was generic or specific.

In contrast, results for Experiment 1 showed a main effect of condition, $F(1, 114) = 5.19$, $\eta_p^2 = 0.04$, $p = .02$, in which participants in the generic condition ($M = 80\%$, $SD = 24\%$) were able to classify items into the novel categories more accurately than participants in the specific condition ($M = 70\%$, $SD = 27\%$). There was also a main effect of age, $F(1, 114) = 16.63$, $\eta_p^2 = 0.226$, $p < .001$. There was a significant difference between all age groups with adults ($M = 90\%$, $SD = 17\%$) displaying the most accuracy, followed by 5-year-olds ($M = 75\%$, $SD = 21\%$), and then 4-year-olds ($M = 60\%$, $SD = 30\%$), with Tukey post hoc analyses yielding p ’s $< .05$. There was no interaction between condition and age. Overall, these results demonstrate there is a significant generic versus specific language difference in Experiment 1, but not in Experiment 4, suggesting that the original experiments indeed addressed factors affecting cross-classification, and that the effect of generic language on cross-classification is not entirely dependent on its effect on classification.

General Discussion

The present study examined the role of generic language in children’s cross-classification. We conducted four experiments comparing the effect of generic versus specific noun phrases on children’s cross-classification of items that belong to a taxonomic and script category. In these experiments, children were given the opportunity to classify an item into a familiar category (taxonomic or script), then cross-classify it into an alternative, novel category (script or taxonomic) with the help of clues expressed in generic or specific language. We predicted that if generics facilitate children’s cross-classification, children should cross-classify more when they hear clues expressed in generic than specific language. As predicted, Experiment 1 showed that generics expressed at an appropriate level of

¹Unlike the previous experiments, in Experiment 4, children were not asked to cross-classify, but rather to solve classification problems. Thus, the analyses reported in Table 1 are for classification, whereas earlier analyses looked at cross-classification.

generalization (e.g., “foods”, “birthday party things”) help children, particularly 5-year-olds, and adults cross-classify items more than do specific noun phrases. This was true when the novel category was taxonomic as well as script. In contrast, Experiment 2 revealed that this effect disappears when generics are expressed at an inappropriate level of generalization (e.g., “pizzas,” “balloons”). Experiment 3 ruled out a pragmatic interpretation of the condition effect. Finally, Experiment 4 demonstrates that the cross-classification aspect of the task poses difficulty beyond the simple classification required.

These findings are consistent with Shipley's (1993) suggestion that children readily form overhypotheses (e.g., different kinds of animals are homogeneous with respect to diet, locomotion, etc.). Thus, when children encounter a novel basic-level kind (e.g., tapirs), they assume that members of this kind will be alike with respect to dimensions characterizing other, familiar kinds—even before they learn about the properties of a single instance. Thus, the superordinate category (e.g., animal) is organized with respect to included *kinds* (e.g., dogs, cats, tapirs) rather than included *individuals*. Similarly, in the present experiments, superordinate categories direct attention to lower level categories rather than individuals and thus show a difference between generic and nongeneric language. In contrast, a strict class inclusion representation (in which individuals are represented at different levels of abstraction) would not provide a basis for a difference in generic and non-generic language at the superordinate level.

The finding regarding 4-year-olds in Experiment 1 warrants further discussion. In this experiment, generics did not help 4-year-olds cross-classify more than specifics. Four-year-olds' insensitivity to the distinction between generic and specific expressions is somewhat surprising given that past research has found that children of this age understand generics (Cimpian & Markman, 2009; Gelman & Bloom, 2007; Gelman & Raman, 2003; Hollander et al., 2002), even as they apply to novel categories (Chambers et al., 2008, Gelman & Bloom, 2007, Hollander et al., 2009). A possible explanation relates to the superordinate-level terms we used. While at the appropriate level of generalization, offering children new information about the broader level category, 4-year-olds may still have had difficulty interpreting these abstract terms. Gelman and O'Reilly (1988) found that 4-year-olds have substantial difficulty making inferences at the superordinate-category level (e.g., animal) compared to the basic level (e.g., dog), suggesting they may not have strong assumptions or expectations that members of a superordinate-category share similarities (Markman & Callanan, 1984). Past research showing the impact of generics on children's concepts have tended to use familiar basic-level animal categories such as bears and birds (Gelman et al., 2002) and novel basic-level animal categories (Chambers et al., 2008; Hollander et al., 2009). Future research should explore ways to improve 4-year-olds' interpretation and understanding of superordinate-level terms so that they can maximally benefit from learning how to cross-classify within the context of generic language.

The present study is the first to demonstrate how children learn to cross-classify when information about category membership is framed generically. As discussed earlier, while past research has documented children's ability to cross-classify familiar categories (Nguyen & Murphy, 2003; Nguyen 2007), little is known about how children actually learn to cross-classify using novel categories. Our findings shed light on this issue. In both generic and specific conditions, the experimenter taught children the appropriate cross-classification. However, in the specific condition, children tended to focus only on the individual mentioned and did not spontaneously extend the taught fact to the category as a whole. In the generic condition, children were better able to make use of the category mentioned. Therefore, input in both conditions taught the relevant fact, but only in the generic condition did it encourage children to focus on the category per se.

Our findings also show how generic language has a facilitative effect on cross-classification, not just on classification or category learning. For example, in Experiment 1, generics heightened children's attention to the second, alternative category, which could be used to cross-classify the cross-classifiable member of the novel category (e.g., watermelon on the mip trial). Yet this facilitative effect was not found for classification; children in the generic and specific conditions were equally likely to select the non-cross-classifiable member of the novel category (e.g., french fries on the mip trial). Also, in Experiment 4, when asked to simply classify items into novel categories, children performed equally well when the language was generic (e.g., "foods are mips") or specific (e.g., "these foods are mips"). This finding contrasts with that from Experiment 1, showing a significant advantage of generic language on children's cross-classification.

Our data also rule out the possibility that the generic boost in children's performance was due simply to a previously learned association between the cue word and the cross-classification response. For example, in Experiment 1, when children were asked, "Which ones are biks?" and heard the clue, "Beach things are biks," they may have been drawing from their script memory for "a day at the beach" in order to determine which items were biks. Although this strategy could lead children to cross-classify, it could not account for the finding that generics yield substantially better performance than non-generics. The learned-association explanation predicts that children should cross-classify at the same rate in the generic and specific conditions, because both the generic and specific noun phrase ("beach things," "these beach things") have the same associations. However Experiment 1 demonstrates an advantage in the generic condition over the specific condition, suggesting that priming the category as a whole (e.g., "foods are mips") enables participants to think beyond individual items and thereby encourages cross-classification.

This finding implies that priming the multiple categories to which an object belongs may facilitate thinking flexibly about that object. At first this may seem counterintuitive. Children are known to have a bias to construe categories as mutually exclusive and non-overlapping (Markman, 1989), so highlighting category membership might at first appear to encourage a more rigid construal of an item as belonging to just a single category. However, what is distinctive about our approach is that the category cue came second, after the participant had already formed an initial grouping. The task was designed so that, first, a single perspective on an item was elicited (e.g., this cake is food), before a second perspective was primed – either by means of an individual-eliciting cue in the specific condition (e.g., these birthday party things are sygs) or a category-eliciting cue in the generic condition (e.g., birthday party things are sygs). It is this second, category-eliciting cue in the generic condition that is powerful enough to facilitate a new, second perspective on the object (i.e., the novel category).

A set of questions for future research concerns the generality of the present findings to more challenging contexts. In the present study, children were taught one novel category that an item can be cross-classified into, to initially establish whether generic language can benefit cross-classification. To further strengthen the case for the influence of generics on cross-classification, future research could teach children two or more novel categories, including ones that are completely experimenter-defined.

Another important question is whether the learning conditions created in these experiments reflect how children learn about cross-classified concepts in the real world. That is, do children hear generics in their daily lives and use the category information conveyed for cross-classification? While these experiments cannot directly address this question, corroborating evidence from other studies suggests the applicability of this research. There is growing evidence that generics are common in everyday conversation, including parents'

speech to children and children's own speech by about 2.5 years of age (Gelman et al., 2008; Gelman et al., 2005; Hollander et al., 2002; Gelman et al., 2000; Gelman et al., 1998; Gelman, Taylor, & Nguyen, 2004, 2006; Pappas & Gelman, 1998). Generics are also pervasive across cultures (Gelman & Tardif, 1998; Goldin-Meadow, Gelman, & Mylander, 2005). In future research, it would be interesting to examine whether there is a correlation between the input that children receive from parents and the way that children talk about cross-classified concepts.

Overall, our findings are consistent with research showing that generic language influences children's conceptual representations including inductive inferences (Chambers et al., 2008; Cimpian & Markman, 2008, 2009; Gelman et al., 2002; Gelman, Raman, & Gentner, 2009) and word learning (Hollander et al., 2009). We contribute to this literature by documenting how generic language helps children connect an item to its multiple category memberships. Research by Gelman and Raman (2007) has found that preschoolers can retain generic information in long-term memory and later accurately recall sentences they originally heard during testing as either generic or specific. In relation to this study, if children are able to retain the connections between items and their categories over time, they should be able to create a large network of cross-classified concepts. These connections should also be strengthened as children continue to use these concepts (Nguyen, 2007; Nguyen & Murphy, 2003). It would be worthwhile for future research to examine children's long-term mental representations of cross-classified concepts learned through generic versus nongeneric language.

In conclusion, the present study demonstrates that generic language facilitates 5-year-olds' ability to cross-classify items into taxonomic and script categories. This is not to say that exposure to generic language is the only way to learn to cross-classify. Generics may be one of many ways to highlight cross-category membership for children. Generic language may also play an integral role in other cognitive processes (e.g., memory, executive functioning) that contribute to children's cross-classification. Future research should examine these possibilities.

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Figure 1.
Mean percentage of cross-classification in Experiment 1 by age group and condition.

Figure 2. Mean percentage of cross-classification in Experiments 1 and 2 by age group

Figure 3. Mean percentage of cross-classification in Experiments 1 and 2 by condition

Figure 4. Mean percentage of cross-classification in the specific condition for Experiments 1-3 by age group

Table 1
Mean percentage of classification in Experiments 1 and 4 (novel category question)

Experiment 1			
	Generic	Specific	Total
Age Group			
4-year-olds	61 (28)	59 (32)	60 (30)
5-year-olds	79 (17)	71 (25)	75 (22)
Adults	99 (3)	80 (20)	90 (17)
Total	80 (24)	70 (27)	75 (26)
Experiment 4			
	Generic	Specific	Total
Age Group			
4-year-olds	91 (16)	91 (13)	91 (15)
5-year-olds	92 (13)	88 (20)	90 (17)
Adults	100 (0)	91 (12)	95 (9)
Total	94 (12)	90 (15)	92 (14)

Note. Standard deviations are shown in parentheses.