A Developmental Study of Asymmetry in Generic Meaning

by

Jenna Hedglen

A Thesis Submitted in Partial Fulfillment of the

Requirements for the Degree of Bachelor of Arts

With Honors in Psychology from the

University of Michigan

2010

Advisors: Amanda Brandone and Susan A. Gelman, PhD.

Abstract

Generic statements (e.g., "Tigers have stripes") express generalizations about categories. Adults demonstrate an asymmetry at the core of generic meaning, such that although generic statements imply high prevalence levels, they require little evidence to be judged true (Cimpian et al., under review). The present paper examines this asymmetry developmentally. Results showed that preschoolers interpret generic statements in much the same way as adults do. Both age groups interpreted generic statements about novel animal kinds (e.g., "Sapers have wings") as referring to the vast majority of the kind. However, they accepted the same statements to be true at considerably lower prevalence levels. This asymmetry was stronger for adults than preschoolers. Additionally, for both ages this asymmetry was shown to be special to generic meaning, as it was not present for "some"-, "most"-, or "all"-quantified statements. These results provide important insight into the amazing capacities of the developing mind.

A Developmental Study of Asymmetry in Generic Meaning

An important cognitive task is to form generalizations about categories (e.g., tigers have stripes, tigers are mammals, etc.). The ability to make generalizations about a kind allows one to readily grasp a concept and further understand the way in which it is incorporated into the world. One of the primary means of expressing generalizations is through generic nouns (e.g., *lions* have manes). Generic statements differ notably from non-generic statements in that they refer to a *kind* rather than to specific individuals (e.g., this lion, the lions at the Detroit Zoo). Generics have long been an object of study by linguists, philosophers, and psychologists alike because they not only offer insight into the ways in which we understand the world, but also offer various interpretations of the connection between a property and a kind.

A generic statement is a linguistic expression of knowledge about a category (e.g., birds lay eggs). By organizing knowledge and guiding inferences about the unknown, a generic statement provides information about a kind. For example, once it is known that a kind (e.g., birds), demonstrates a property (e.g., lay eggs), one is able to infer that other members of that kind also exhibit the property, even if the members were previously unknown to the individual. Thus, generic statements are important sources for obtaining information about a phenomenon; it is through generic language, after all, that one learns that “cows say moo”, “dogs have four legs”, and “turtles are slow”.

Complex nature of generics

Generic statements often apply to nearly all members of a category and imply that a trait is relatively enduring, timeless, and inherent, as in “Tigers have stripes” (Carlson & Pelletier, 1995). For this reason, it is intuitive to interpret a generic statement as applying broadly to a kind. However, conceptualizing generic meaning can be a complex process, as there are many generic statements that do not apply broadly to all members of a kind. Thus, generics also allow for exceptions. For instance, a statement such as “Birds lay eggs” presents an interesting paradox. ‘Laying eggs’ is a distinguishing feature of birds yet this property is not present in a majority of the population, as only reproductively functioning, adult, female birds lay eggs (Shipley, 1993). Therefore, while it is intuitive to interpret generic statements as indicating that most, if not all, members of a kind share the noted property, many generic statements are unlikely to be based solely on frequency information.

Cimpian, Brandone, and Gelman (under review) explored this asymmetry in generic meaning. They used novel animal kinds in order to eliminate the possibility that prior knowledge would guide participants’ responses. The experimenters found that generic statements have extremely strong implications yet require little evidence to be judged true. In one task, adult participants were given a statement about a novel animal kind in either generic (e.g., “Lorches have purple feathers”) or “most” (e.g., “Most lorches have purple feathers”) form and were asked to estimate the percentage of category members that displayed the target feature (e.g., “What percentage of lorches have purple feathers?”). In another task, a separate group of adult participants were told that a specified percentage of category members (ranging from 10 to 90%) displayed the target feature (e.g., “30% of lorches have purple feathers”). Participants were then asked to judge whether corresponding generic or “most”-quantified statements (e.g., “Lorches have purple feathers”; “Most lorches have purple feathers”) were true or false. Cimpian et al. found that, in the first task, participants in the generic condition generated extremely high implied prevalence levels (roughly 95%), whereas in the second task, participants endorsed the generic statements even at fairly low-frequencies (roughly 65%). In other words, participants interpreted novel generic statements as referring to nearly all members of a kind in one task, yet judged the same statement to be true at a wide range of prevalence levels in the other task (even frequencies as low as 10%).

Furthermore, Cimpian et al. (under review) also demonstrated that this asymmetry between the prevalence implied by a generic sentence and the prevalence required for it to be acceptance as true is specific to generics. When "most"-quantified generalizations were tested (e.g., "Most lorches have purple feathers"), the prevalence that led participants to accept these statements was almost identical to the prevalence implied by them (roughly 80%). Thus, participants' judgments concerning the quantifier "most" failed to demonstrate an asymmetry. This may be due to the fact that "most" refers to a somewhat fixed quantity that was judged alike throughout the two tasks. Thus, Cimpian et al. concluded that, in comparison to the quantifier "most", generics are unique in that they are often judged true based on weak evidence, yet they imply high prevalence levels.

Of interest in the present study is the way in which *children* interpret generics: Do children demonstrate the same asymmetry as adults? This is an interesting question to ask developmentally because of the complex and challenging nature of generics. If young children demonstrate the same asymmetry as adults in their understanding of generic meaning, it would suggest that children are capable of completing complex cognitive functions that are paradoxical in their nature. This finding would provide further evidence of the amazing capacities that young children demonstrate.

Children's use and comprehension of generics

Generics are effective in language learning because generalizing information about a kind may help to create distinctions between categories, essentially pointing children toward a richer appreciation of the deeper meaning of a concept (Waxman, 1999). For example, it is by means of generic noun phrases that children learn particular facts about the physical characteristics, eating habits, and behaviors of animals. Thus, generic noun phrases facilitate language acquisition by providing direct links for kind representations.

From as early as 2 years of age, children think and talk about kinds using generic noun phrases (Gelman, 2003; Roeper, Strauss, & Pearson, 2006) and by age four, children produce generics as frequently as adults (Chambers, Graham, & Turner, 2008). Moreover, there are a multitude of findings that argue for a capacity to produce and interpret generics early in language acquisition. Developmentally, children start using generics significantly earlier than explicit quantifiers such as "all", "some", and "most" (Gelman, 2003). Furthermore, Hollander, Gelman, and Star (2002) have shown that generic statements are understood prior to specific quantifiers, and that quantified statements are initially treated as though they are generics.

That children acquire generics before quantifiers is intriguing for two reasons First, in comparison with generics, quantifiers are used to express a more or less fixed prevalence (Carlson, 1977). For instance, "most" refers to a majority of a kind (e.g., "Most birds fly"); "all" implies an inclusive amount of a kind (e.g., "All tigers are mammals"); and "some" refers to at least a minority of a kind (e.g., "Some mosquitoes carry the West Nile virus"). In contrast, generic statements are much more ambiguous. There is no straightforward mapping between the prevalence of a property and the use of generic form (Leslie, 2008). In addition, unlike quantified statements, generics are not marked linguistically. Thus, children must learn to associate this complex range of conditions with the *absence* of a quantifier (Gelman, 2003). Ultimately, the fact that children acquire generic meaning more readily than quantifiers shows an amazing capacity for complex knowledge, as quantifiers offer a much more straightforward interpretation in comparison to generics.

The fact that generic meaning is acquired early has important implications for knowledge acquisition. Generalizations facilitate the fast-mapping of a property onto a kind (Gelman, 2003) by allowing a child to make inferences and ultimately *generalize* the property as occurring in other members of a kind. Additionally, a child's ability to comprehend and produce generics without a lexical clue demonstrates an amazing capability to distinguish generic meaning from other semantics. Most intriguing, however, is a child's ability to comprehend and produce generic language without any indication of prevalence. However, it remains an open question how exactly children interpret generic statements. Gelman, Star, and Flukes (2002) provide evidence that children interpret generics as referring to many members of a kind, since children interpreted generics as intermediate between the quantifiers "some" and "all". But when do children understand that generic statements may also refer to only a few members of a kind, as in "mosquitoes carry the West Nile virus"? Do they first interpret generics as referring to many members of a kind and only later understand the subtle semantic implications of generics? Or do children understand from an early age that generics are capable of representing a broad range of prevalence levels? Adults demonstrate an interesting interpretation of generics, as they generate high percentages to best represent a generic statement, yet will accept these same statements as true at low percentages (Cimpian et al, under review). I am interested in whether or not preschool children demonstrate a similar asymmetry. If so, it may provide evidence that young children are capable of understanding the complex semantics of generics early on in language acquisition.

Present Study

The present studies aim to address the developmental origins of the asymmetry in generic statements demonstrated in adults by Cimpian and colleagues. Two experiments were conducted, one with adults and another with preschoolers. The design was modeled after that of Cimpian et al. (under review). Samples of novel animal kinds were presented in two tasks. In the *implied frequency* task, participants were asked to indicate which of four samples of a novel creature (at varying prevalence levels) best represents a corresponding generic, “some”-, “most”-, or “all”-quantified sentence. In the *truth condition* task, participants were shown one sample of a novel creature displaying a target feature (at one prevalence level) and were asked to indicate whether the corresponding generic, “some”-, “most”-, or “all”-quantified statement is “right” or “wrong”. The purpose of the tasks was to determine if the asymmetry in generic meaning demonstrated in adults by Cimpian and colleagues extends to preschoolers.

I hypothesized that both adults and preschoolers would demonstrate an asymmetry at the core of generic meaning. That is, I predicted that in the implied frequency task, preschoolers and adults would interpret novel generic statements as referring to the vast majority of the kind, whereas in the truth condition task, they would accept the same generic statements as true at considerably lower prevalence levels. In addition, I hypothesized that, in contrast to generic statements, those expressing quantified generalizations would not show this asymmetry. I predicted that for both preschoolers and adults, the prevalence needed to accept all-, some-, and most-quantified sentences in the truth condition task would be roughly equivalent to the frequency they imply.

Experiment 1

Method

Participants. Thirty-two undergraduates (10 males, 22 females) were recruited from the Introduction to Psychology subject pool at a large public university.

Design. Each participant received two tasks, the *implied frequency task* and the *truth condition task*. The implied frequency task consisted of 16 items and the truth condition task consisted of 32 items. Each task consisted of four wording conditions: generic, “some”, “most” and “all”. Both task and wording conditions were within-subject factors.

Materials. I developed 32 novel animal kinds (e.g., dorbs), each with a key distinctive feature (e.g., stripes). There were 4 types of distinctive features: body pattern (e.g., striped), body color (e.g., blue), body part (e.g., wings), and part color (e.g., orange ears) (see Table 1). The feature types were equally distributed over the 32 kinds, such that 8 animal kinds displayed each of the 4 feature types (yielding 32 total kinds). For each novel kind, samples consisting of 6 individuals (e.g., 6 dorbs) were created. The number of individuals displaying the distinctive feature within each sample varied by the following frequency levels: 0 out of 6 (0%), 2 out of 6 (33%), 4 out of 6 (67%), and 6 out of 6 (100%). Thus, for example, there were four different samples of dorbs, varying in the percentage of individuals displaying stripes (See Figure 1).

Procedure. Each participant received the two tasks in a counterbalanced order, 16 participants saw the implied frequency task first and 16 participants saw the truth condition task first. The participants were tested in groups.

Implied frequency task. For each item, participants were asked to indicate which of four samples best represents a corresponding statement (e.g., “Which of these pictures best shows that Dorbs have stripes?”) Materials were presented in pre-printed booklets.

In order to convey that participants needed to select one of the four samples, I included two practice tasks. The first task involved selecting a picture that matched the experimenter’s question (e.g., finding bananas from a set of four foods). The second task involved selecting a set based on a precise quantification term provided by the experimenter (e.g., “What’s the best picture to show that two Daxes have ears?”). In this task, participants had direct experience selecting a set at each of the four frequency levels (0 out of 6, 2 out of 6, 4 out of 6, and 6 out of 6). This was particularly important when I extended the research to children (see Experiment 2).

Following these practice tasks, participants began the primary task. For a given item set, participants saw four samples of creatures from the same animal kind. The frequency of the distinctive feature within each sample varied, with one sample at each of the four frequency levels. The order in which the samples were presented on the page was systematically varied. Participants were asked to indicate which of the four samples best represents the given information. In the generic wording condition, participants were asked questions in generic form: “What’s the best picture to show that Ackles have spikes?” In the “some” wording condition, participants were asked “some”-quantified questions: “What’s the best picture to show that some Taifels have pink feathers?” In the “most” wording condition, participants were asked “most”-quantified questions: “What’s the best picture to show that most Ollers have green bodies?” Finally, in the “all” wording condition, participants were asked “all”-quantified questions: “What’s the best picture to show that all Noobs have hair?”

Wording conditions (generic, “some”,” most”, and “all”) were presented in blocks. Each block consisted of four item sets—one from each of the four feature types (e.g., pattern, color, part, part color). Block order was counterbalanced using a Latin Square design. Two sets of items were created, with 16 items in each set for a total of 32 items. Sixteen participants received the first set of items and 16 participants received the second set of items.

Truth condition task. The truth condition task differed from the implied frequency task in that for each item, participants only saw one sample of an animal kind and were asked to indicate whether a corresponding statement (e.g., “Ackles have spikes.”) was “right” or “wrong” (See Figure 2). Materials were presented in pre-printed booklets.

In order to convey that the statements could be either “right”’ or “wrong”, participants were given a practice task. It consisted of two pages, one designed to elicit a “right” response (a picture of bananas with the statement “This is a picture of bananas.”) and one designed to elicit a ‘wrong” response (a picture of a white house with the statement “This house is blue”).

Following the practice items, the primary task began. On each item, participants saw a single sample of an animal kind. The frequency level at which the key feature was displayed in each kind varied at the following levels: 0 out of 6, 2 out of 6, 4 out of 6, and 6 out of 6. Participants were asked to indicate whether a corresponding statement was ‘right’ or ‘wrong’. The corresponding statements were in one of the following wording conditions: generic (e.g., “Dontrets have purple tummies”), “some” (e.g., “Some Twanos have green bodies.”), “most” (e.g., “Most Ludinos have tails.”), or “all” (e.g., “All Dorbs have stripes.”).

Wording conditions (generic, “some”, “most”, and “all”) were presented in blocks of eight items. Each block contained two items at each frequency level (0, 2, 4, and 6 out of 6) and two items from each feature category (pattern, color, part, and part color). Block order was counterbalanced using a Latin Square design. All participants saw the same set of 32 items.

Results and Discussion

The goal of the analysis was to test whether (a) there is an asymmetry between the truth conditions of generics and the frequency they imply and (b) whether this asymmetry is special to generics, as compared to the quantifiers “some”, “most”, and “all”. To directly compare the “right or “wrong” responses in the truth condition task with the numeric (0, 2, 4, or 6 out of 6) responses in the implied frequency task, I converted responses on the two tasks to the same metric.

In the truth condition task, I calculated the average score that led to “right” responses for each participant. I refer to this as the *prevalence level*. Thus, for a given participant, items that were judged as “right” were assigned a value (0, 2, 4, or 6) that corresponded with the number of individuals displaying the key trait (0, 2, 4, or 6 out of 6). These values were then averaged within each wording condition (generic, “some”, “most”, and “all”). For example, in the generic wording condition, if a participant circled “right” for samples that showed 2, 4, and 6 individuals displaying the distinctive feature, then the average frequency that led to “right” responses would be 4 for the generic condition.

In the implied frequency task, I calculated the average score that each participant endorsed for each wording condition. I also refer to this as the *prevalence level*. For example, in the generic wording condition, if a participant endorsed two samples that showed 4 individuals displaying the distinctive feature and two samples that showed 6 individuals displaying the distinctive feature, the participant would receive an average value of 5 for the generic condition.

I compared participants’ scores in the implied frequency and truth condition tasks with a repeated-measures analysis of variance (ANOVA) that included wording condition (generic vs. “some” vs. “most” vs. “all”) as a within-subject factor. Results revealed a main effect of wording, $F(1, 32) = 288.38$, $p < .001$, qualified by a task x wording interaction, $F(1, 32) = 23.31$, $p < .001$. The generic, “all”, “some”, and “most” wording conditions were all significantly different from each other (all *p*s < .001) and the pattern of results was in the predicted direction: the average prevalence (across the two tasks) was greatest in the “all” condition ($M = 5.93$, SE =

.06), followed by the generic (M = 5.55, SE = .13), “most” (M = 4.29, SE = .06), and “some” (M = 3.04, SE = .10) conditions, respectively.

Bonferroni-adjusted post-hoc tests were used to evaluate the task x wording interaction. Results confirmed the predicted asymmetry and that this asymmetry is unique to generics. As can be seen in Figure 3, the predicted asymmetry was present in the generic condition: the average frequency that led participants to accept generics in the truth condition task was significantly lower than the average frequency implied by them in *the implied frequency task* $F(1,32) = 20.00$, $p < .001$. In contrast, the opposite effect was found for the “some” and “most” conditions: the average frequencies that led participants to accept the quantifiers “some” and “most” in the truth condition task were significantly greater than the average frequencies implied by them in the implied frequency task (both ps < .01). Finally, there was no effect of task in the “all” condition: the average frequency leading participants to accept statements with the quantifier “all” in the truth condition task was equivalent to the average frequency implied by them in the implied frequency task $F(1,32) = 1.42$, $p = .24$. Thus, the generic condition alone displayed the predicted asymmetry between tasks. When adults were given a generic statement in the implied frequency task, they most often endorsed the samples displaying a high prevalence (67% or 100%) of the key trait, whereas in the truth condition task, they accepted the same generic statements at frequencies as low as 33%.

Experiment 2

The purpose of Experiment 2 was to test whether the asymmetry observed in Experiment 1 was present in preschoolers.

Method

Participants. Thirty-two preschoolers (12 males, 20 females) ranging in age from 4.06 to 4.99 years (*M* = 4.26 years) were recruited from preschools in and around a small Midwestern city. Children were tested individually in a quiet room in their school.

Design. Preschoolers received one of two tasks, either the implied frequency task or the truth condition task. Thus, in contrast to Experiment 1, task was a between-subjects variable in Experiment 2. Each task included four within-subject wording conditions: generic, "some", "most", and "all".

Materials. The materials in both the implied frequency task and the truth condition task were identical to those in Experiment 1, with the addition of a puppet, stickers, and a page consisting of a smiling face and a frowning face. These materials were added in order to make the tasks developmentally appropriate for preschoolers.

Procedure. Each participant saw one task. Sixteen participants saw the implied frequency task and 16 participants saw the truth condition task. Participants were tested individually.

Implied frequency task. Preschoolers were given the same procedure as the adults in Experiment 1, with the exception of a few minor changes in order to accommodate for developmental needs.

The experimenter introduced each preschooler to a puppet named Droid and recited the following script:

> Droid is an alien from outer space. On Droid's planet, there are lots of different kinds of animals. He is making a picture book to teach kids about the different kinds of animals on his planet. But Droid has a problem; he can't decide which pictures to put in his book! He needs your help to tell him which pictures to put in the book. So can you help

> him by looking at the pictures Droid brought and putting a sticker on the picture that you think is the best one for him to use in his book?

Preschoolers were corrected in the practice tasks if they responded incorrectly (adults were not corrected if they answered incorrectly because they were tested in groups). Of the 16 participants in the implied frequency task, one child needed assistance in choosing the correct answer.

In the primary task, participants were asked to indicate which of 4 samples best represents a corresponding statement, as in Experiment 1. However, the experimenter read the statements aloud to each participant and asked him or her to indicate the "best" picture by placing a sticker on it (e.g., "Droid wants to show kids that Dontrets have purple tummies. Which of these pictures best shows that Dontrets have purple tummies? Put your sticker on that picture!").

Truth condition task. Preschoolers were given the same procedure as the adults in Experiment 1, with the exception of a few minor changes in order to accommodate for developmental needs.

The experimenter introduced each preschooler to a puppet named Droid and recited the following script:

> This is Droid! He is an alien from outer space and he's trying to learn about some new animals, but he needs your help. Sometimes Droid says things that are right and sometimes he says things that are wrong. So he's going to tell you something about each kind of animal and your job is to tell him if he is "right" or "wrong" by pointing to a smiling face (right) or a frowning face (wrong).

Preschoolers were given the same two practice sets as adults in Experiment 1, however preschoolers were corrected if they responded incorrectly. Of the 16 participants in the truth condition task, two needed assistance in choosing the correct answer during the practice tasks.

In the primary task, preschoolers were asked to examine a sample and indicate whether the corresponding statement was “right” or “wrong”, as in Experiment 1. However, the experimenter read the statements aloud the preschoolers and asked them to answer “right” or “wrong” by pointing to a smiling face (right) or a frowning face (wrong). For example, preschoolers heard “Droid says that Dontrets have purple tummies. Is Droid right, or is he wrong? Point to the smiling face if he’s right and the frowning face if he’s wrong.”

Results and Discussion

As in Experiment 1, the goal of the analysis was to test whether (a) there is an asymmetry between the truth conditions of generics and the frequency they imply and (b) whether this asymmetry is special to generics, as compared to the quantifiers “some”, “most”, and “all”. To directly compare the “right or “wrong” responses in the truth condition task with the numeric (0, 2, 4, or 6 out of 6) responses in the implied frequency task, I converted responses on the two tasks to the same metric. Thus, preschoolers’ responses were recorded in the same manner as in Experiment 1. In the truth condition task, for each participant I calculated the average score that led to “right” responses. In the implied frequency task, I calculated the average score that each participant endorsed for each wording condition.

I compared participants’ scores in the implied frequency and truth condition tasks with a repeated-measures analysis of variance (ANOVA) that included wording condition (generic vs. “some” vs. “most” vs. “all”) as a within-subject factor. Results revealed a main effect of wording condition, $F(1, 32) = 24.09$, $p < .001$. The “all” ($M = 5.70$, SE = .11) and “some” ($M =$

3.93, SE = .23) conditions were significantly different from each other and from the generic (*M* = 5.11, SE = .15) and "most" (*M* = 4.92, SE = .17) conditions (all *p*s < .01). The generic and "most" conditions were not significantly different from each other (*p* = 1.00).

Although the interaction between task and wording condition was not significant, *F*(1, 32) = 1.19, *p* = .32, Bonferroni-adjusted planned comparisons were conducted to evaluate whether the predicted asymmetry was present in the generic condition. Results revealed a marginal effect of task in the generic wording condition, *F*(1,32), *p* = .054. That is, the average prevalence that led preschoolers to accept a generic in the truth condition task was marginally lower than the average prevalence implied by one in the implied frequency task (see Figure 4). This effect was non-significant for the "all", "some", and "most" wording conditions (all *p*s > .08).

Thus, preschoolers demonstrated an asymmetry in generic meaning similar to the adults in Experiment 1. Although preschoolers did not treat the wording conditions of "all", "some", and "most" differently between tasks, they displayed a marginal difference between tasks in the generic condition. Therefore, results suggest that, like adults, preschoolers assumed that generic statements apply to the majority of individuals in a sample yet judged the same generic statements to be true even when a minority displayed the relevant trait.

General Discussion

The purpose of the present studies was to examine the ways in which adults and children interpret novel generics. Specifically, do adults and preschoolers demonstrate an asymmetry in their understanding of novel generics such that generics imply that a property is highly prevalent yet they are considered true even at extremely low prevalence levels?

Experiment 1 revealed that adults displayed the predicted asymmetry. When given a generic statement, adults most often endorsed the samples displaying the feature at a high-prevalence level (e.g., 67%, 100%). In contrast, they accepted the same generic statements as true even for samples demonstrating much lower-prevalence levels (e.g., 33%). For example, when given a choice of four samples of varying prevalence levels of reesles with the corresponding statement "Reesles have blue bodies", adults most often chose the sample with the highest prevalence (100%) displaying blue bodies, indicating it as the best representation of the statement. However, when given the same statement with only one sample of reesles (at one of the four prevalence levels), participants accepted the statement as true at levels as low as 33%. Thus, although adults interpret generics as implying high-prevalence levels, they accept the same generics at low-prevalence levels.

Interestingly, the "some" and "most" wording conditions also revealed significant effects of task. These effects, however, were in the opposite direction of the generic condition. Thus, when choosing the best representations of "some" and "most" in the implied frequency task, adults most often chose lower prevalence levels than the levels they accepted in the truth condition task. For example, the prevalence level chosen most often for the "some" condition in the implied frequency task was 33% while the prevalence levels of 67% and 100% were often accepted as suitable representations in the truth condition task. This finding is consistent with the concept of scalar implicature, or the idea that the norms of cooperative communication are violated when one uses an expression indicating a weaker interpretation (e.g., "some") when one actually intends to refer to something stronger (e.g., "most", "all") (Noveck, 2001). For example, in keeping with this view, the results show that adults expect the quantifier 'some' to indicate at least some but typically less than half (33%); however, on the truth condition task they do not reject some-quantified statements at higher prevalence levels (67% and 100%).

Additionally, adults demonstrated a main effect of wording. This indicates that they interpreted each wording condition as being distinct. Specifically, they interpreted “some” as less than “most”, “most” as less than generic, and generic as less than “all”.

Most relevant to the present study, however, is the data from the preschoolers. Results showed that preschoolers are sensitive to distinctions in the meaning of “some”, “most”, generic, and “all”, as they displayed a main effect of wording condition. Like adults, they successfully differentiated the “all” and “some” conditions from the generic and “most” conditions. Unlike adults, however, they treated “most”-quantified and generic statements equivalently. This finding is not surprising, as “most” is considered the closest quantifier to the generic form (Carlson, 1977). Although preschoolers failed to show a distinction between the “most” and generic conditions, results show that they were able to appropriately interpret “most”/generic as less than “all” but more than “some”. This finding is consistent with data from Gelman et al. (2002), in which both 4-year-olds and adults treated the scope of generics as intermediate between “some” and “all”.

Given that the preschoolers demonstrated sensitivity to the wording conditions, the question of asymmetry remains: Do preschoolers demonstrate an asymmetry in the generic form that is similar to that of adults? Results showed that preschoolers indeed displayed the predicted asymmetry in the generic wording condition. That is, there was a marginal effect of task in the generic wording condition only. Although the evidence for the asymmetry was stronger for the adults in Experiment 1 than for the preschoolers in Experiment 2, the asymmetry was demonstrated by both samples, indicating that the preschoolers treated generics in much the same way as did the adults.

There are at least two possible explanations for the finding that the preschoolers demonstrated a weaker asymmetry than the adults. One possibility is that there is a legitimate conceptual difference between adults and preschoolers that is driving this result. Given the complexity of generic meaning, this would not be surprising. Although by the age of 4 children are able to understand and produce generic language (Chambers et al., 2008), they have had less experience with the complex nature of generics than adults and therefore may have a less established understanding of generics' implications and truth conditions. Furthermore, as Gelman (2003) notes, adults presumably have access to a richer set of linguistic and pragmatic skills when distinguishing between generic and non-generic statements. Therefore, the difference in performance between the preschoolers and adults may reflect a less mature understanding of generic meaning in preschoolers.

Alternatively, the weaker asymmetry demonstrated by the preschoolers may be explained by the relatively small sample size. Due to individual differences in the performance of the preschoolers, the data in Experiment 2 are less consistent than those of the adults in Experiment 1. Thus, an effort to collect more data for Experiment 2 may result in more consistent responses.

Explanations and implications of the asymmetry

The asymmetry demonstrated in generic meaning relates not only to linguistic paradoxes but also to conceptual inconsistencies. Language is the primary means through which individuals learn about the world around them, and therefore serves as a primary source of knowledge during cognitive development. It is through language, for example, that a child learns that "fish live in the water", "stoves are hot", "sharks attack humans", and "cows say moo". While it is plausible that children may learn these properties through observation or experience, it is through language, specifically generic language, that they are able to conceptualize the words and refer to them as kinds. For example, once children are able to categorize a fish as a kind of animal that lives in the water, they understand this generalization about the *kind* ‘fish’ as representing most, if not all, of the *kind*. This assumption can prove problematic in generic language when other statements in the same modality refer to a trait that represents a minority of a kind. For instance, to a language learner who understands generics as representing a majority, the generic statement “sharks attack humans” implies that most, if not all, sharks attack humans, when in actuality, most sharks do not attack humans. This phenomenon establishes the asymmetry that is at the core of generic meaning. Thus, an individual who demonstrates this asymmetry understands that in many cases, a generic statement refers to the majority, but that this is not necessarily true in all cases.

While the asymmetry between the truth conditions of generics and the prevalence they imply may be evident, the question of how this asymmetry might develop remains. One proposal is that generic statements concerning high-prevalence features (e.g., “dogs have four legs”) are the most prototypical, implying to a language-learner that any new generic one hears is also about a high-prevalence feature (Cimpian et al., in press). During language acquisition, such strategies may be employed by children when mapping a property onto an abstract kind. For instance, when children learn that “cows say moo”, they learn that this is a prototypical feature of all (or most) cows. They may then extend this ‘rule’ to future generic statements, assuming that any new generic they hear pertains to a high-prevalence feature as well. This is problematic when one considers generic statements that are accepted as true even at low prevalence levels.

The conceptual inconsistencies in generic meaning are also relevant when considering real-world phenomena. Generalizations are the basis for determining stereotypes, as they are a common means of categorizing and labeling various *kinds* (Gelman, Taylor, Nguyen, Leaper, & Bigler, 2004). Stereotypes exist because of the connections that individuals draw between a property and a kind, ultimately generalizing a property onto the entirety of a kind. Thus, the problematic nature of generic knowledge also exists in stereotypes; a stereotypical statement may be accepted as true even when based on little evidence, such as "Blondes aren't smart". Once a generalization is believed to be true, it may lead to an expectation that the vast majority of individuals in a kind display the property, even when it was originally based on a few instances. Furthermore, due to the flexible nature of generics' truth conditions, a stereotype may persist even when contradicted by significant counterevidence (Cimpian et al., 2010). In other words, because generics are accepted as true at low-prevalence levels, the stereotype that "Blondes aren't smart" may still persist even when presented with multiple contradictions.

The tendency to accept stereotypes without any experience with the *kind* stems from the powerful implications of generic statements. Because generics imply that a property is highly-prevalent, generalizations about a kind (stereotypes) tend to be understood as representing a majority. This can be problematic for children who are attempting to understand the world around them; they must make a decision to accept a generic statement as pertaining to the majority of a kind or to understand it as a less-typical property. The evidence that children interpret generic statements in much the same way as do adults implies that children are vulnerable to stereotypes; just as novel generics implied high-frequencies in the present study, novel stereotypes may be impressionable upon children as they making assumptions about and interpret the world around them.

Limitations and future research

A limitation of the present studies is the small sample sizes, particularly affecting the data of the preschoolers in Experiment 2, as mentioned above. Due to individual differences in performance, the data in Experiment 2 are less consistent than those of the adults in Experiment 1. Thus, an effort to collect more data for Experiment 2 may result in more consistent responses. Additionally, an extension of the present study to examine not only the responses of preschoolers and adults, but also an intermediate age group may offer additional insight into children's developing interpretation of generic meaning. Such research might include data from children at a slightly more advanced developmental stage (e.g., 6-year olds) in order to examine the progression of the asymmetry throughout cognitive development.

An additional possible limitation is that the ontological domain of the items might have modulated the size of the asymmetry. Just as in the Cimpian et al. (under review) study, the stimuli used in the present study were natural kinds – specifically animal kinds – which may uphold different conceptual structures than other domains, such as artifacts. Natural kinds may be more cohesive in comparison to artifact categories, as Gelman (2003) discusses. Unlike artifacts, natural kinds are alike in many dimensions, for instance, dogs have many common features such as tails, ears, wet noses, internal organs, diet, live birth, reproduction patterns, etc. Artifacts, on the other hand, demonstrate many qualities that can be easily manipulated, and therefore share fewer common features than animals. Drawing from an example by Cimpian et al. (under review), chairs do not have many universally common features; they can exhibit a great diversity of features such as being soft, hard, cushioned, tall, short, wheeled, wooden, metal, or plastic, but only require a few prerequisites to be considered a chair, such as providing a surface to sit upon. Thus, generic statements apply more broadly to categories that tend to be more homogeneous, such as natural kinds. Therefore, a stronger asymmetry may be demonstrated when addressing natural kinds, as in the present study. An interesting extension of the present study would be an examination of adults' and preschoolers' reasoning about novel artifact kinds. If novel artifacts demonstrate an asymmetry similar to novel animal kinds, then the argument for an asymmetry in generic meaning would be significantly strengthened.

Another interesting direction for further research addresses sensitivity to different kinds of properties. In the Cimpian et al. (under review) study, the experiementers examined the differing ways in which neutral, dangerous, and distinctive properties were interpreted. The researchers found that, in the truth condition task, participants accepted dangerous and distinctive properties at much lower prevalence levels than they did neutral properties, ultimately affecting the asymmetry between tasks. These findings suggest that the type of property may determine one's tendency to accept or reject a generic statement. Traits that are either dangerous or distinctive may be more salient in one's mind because they offer important information about the entity at hand. Important to the understanding of the ways in which children interpret generics in comparison to adults is whether they demonstrate similar interpretations of generic statements that indicate different kinds of properties. If they do demonstrate a similar sensitivity to properties, this would provide further evidence of the amazing capacities of children in language and knowledge acquisition.

Conclusion

Generic statements are a primary means through which one conveys knowledge about the world and makes associations between kinds. Though at times paradoxical, generic meaning is an essential element in language and knowledge acquisition. Given the complex nature of generics, the fact that young children demonstrate the capacity to understand and produce them is astounding. Perhaps even more astonishing, however, is that preschoolers demonstrate an asymmetry in generic meaning that is similar to adults, indicating that they are able to understand this complexity that is perplexing even to adults.

References

Carlson, G. N. (1977). *Reference to kinds in English*. (Unpublished doctoral dissertation). University of Massachusetts, Amherst.

Carlson, G. N., & Pelletier (1995). *The Generic Book*. Chicago, IL: The University of Chicago Press.

Chambers, C. G., Graham, S. A., & Turner, J. N. (2008). When hearsay trumps evidence: How generic language guides preschoolers' inferences about unfamiliar things. *Language and Cognitive Processes 23*, 749-766.

Cimpian, A., Gelman, S. A., & Brandone, A. C. (in press). Theory-based considerations influence the interpretation of generic sentences. *Language and Cognitive Processes*.

Cimpian, A., Gelman, S. A., & Brandone, A. C. (under review). Generic statements require little evidence for acceptance but have powerful implications.

Gelman, S. A. (2003). *The Essential Child: Origins of essentialism in everyday thought.* London: Oxford University Press.

Gelman, S. A., Star, J. R., & Flukes, J. E. (2002). Children's use of generics in inductive inferences. *Journal of Cognition and Development*, 3, 179-199.

Gelman, S., Taylor, M., Nguyen, S., Leaper, C., & Bigler, R. (2004). Mother-child conversations about gender: Understanding the acquisition of essentialist beliefs: I. Introduction. *Monographs of the Society for Research in Child Development*, *69*(1), 1-14.

Hollander, M. A., Gelman, S. A., & Star, J. (2002). Children's interpretations of generic noun phrases. *Developmental Psychology*, *38*, 883-894.

Leslie, S. J. (2008). Generics: Cognition and acquisition. *Philosophical Review, 117*(1), 1-47.

Noveck, I. A. (2001). When children are more logical than adults: Investigations of scalar implicature. *Cognition*, 78,165-188.

Roeper, T., Strauss, U., & Pearson B. Z. (2006). The acquisition path of the determiner quantifier *every*: Two kinds of spreading. In T. Heizmann, (Ed.) *Current issues in first language acquisition, vol 34* (pp. 97-129). Amherst, MA: Graduate Linguistic Student Association.

Shipley, E. F. (1993). Categories, hierarchies, and induction. In D.L. Medin (Ed.), *The psychology of learning and motivation. Advances in research and theory, vol. 30* (pp. 265-301). San Diego, CA: Academic Press.

Waxman, S. R. (1999). The dubbing ceremony revisited: Object naming and categorization in infancy and early childhood. In D. L. Medin and S. Atran (Eds.), *Folkbiology* (pp. 233-284). Cambridge, MA: MIT Press.

Author Note

Jenna Hedglen, Department of Psychology, University of Michigan, Ann Arbor.

A special thanks to my mentors, Dr. Susan A. Gelman and Amanda Brandone, for collaborating with me on this project. They have offered valuable comments, suggestions, and guidance throughout every step of the process; I am forever grateful for their assistance. In addition to offering me valuable insight into the realm of psychology, I especially thank them for their kindness, patience, and friendship.

Table 1
Complete set of items used in Experiments 1 and 2.

Item name	**Key feature category**	**Key feature**
Item Set 1*:		
Reesle	Body color	Blue body
Floom	Body color	Orange body
Oller	Body color	Green Body
Glippet	Body color	Purple body
Crullet	Body pattern	Green spots
Plov	Body pattern	Purple zigzags
Modie	Body pattern	Blue spots
Brable	Body pattern	Bumpy skin
Dax	Body Part	Ears
Saper	Body Part	Wings
Ackle	Body Part	Spikes
Noob	Body Part	Hair
Taifel	Part color	Pink feathers
Scobbit	Part color	Red antennaes
Zorb	Part color	Purple wings
Luzak	Part color	Orange ears
Item Set 2*:		
Twano	Body color	Green body
Wug	Body color	Yellow boy
Gorp	Body color	Red Body
Mook	Body color	Blue body
Lorch	Body pattern	Blue spots
Jav	Body pattern	Red spots
Mox	Body pattern	Blue squares
Dorb	Body pattern	Striped body
Ellep	Body Part	Horns
Ludino	Body Part	Tails
Zoov	Body Part	Curly hair
Kazzle	Body Part	Horns
Dontret	Part color	Purple tummy
Fep	Part color	Orange necks
Kwep	Part color	Blue legs
Pomino	Part color	Orange horns

Note. *Item sets refer to the sets used in the implied frequency task. In the truth condition task, participants received all items

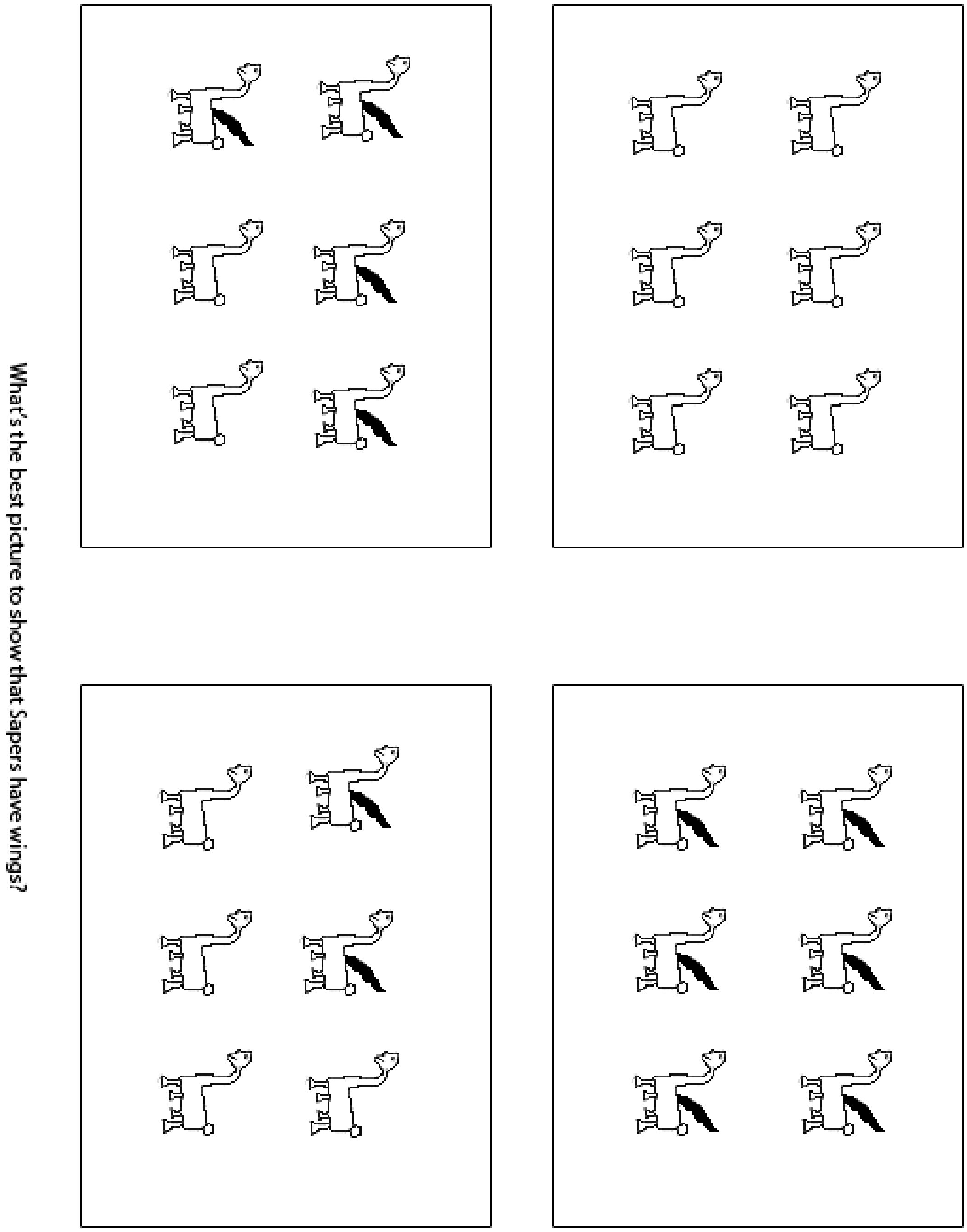

Figure 1. Sample item from the implied frequency task.

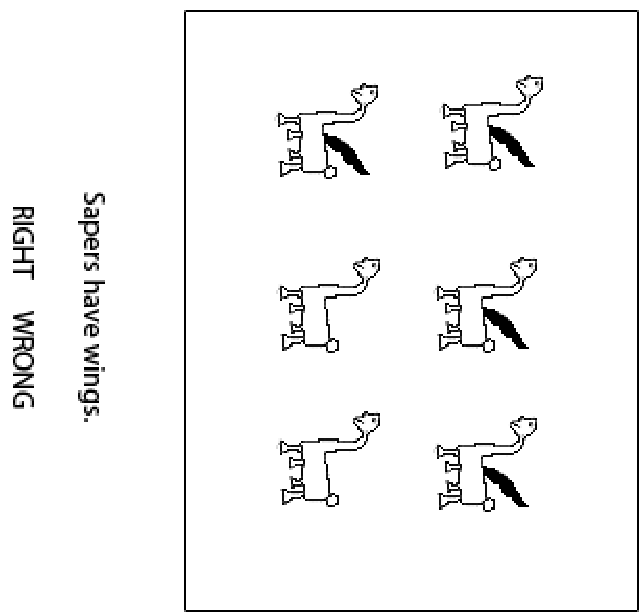

Figure 2. Sample item from the truth condition task.

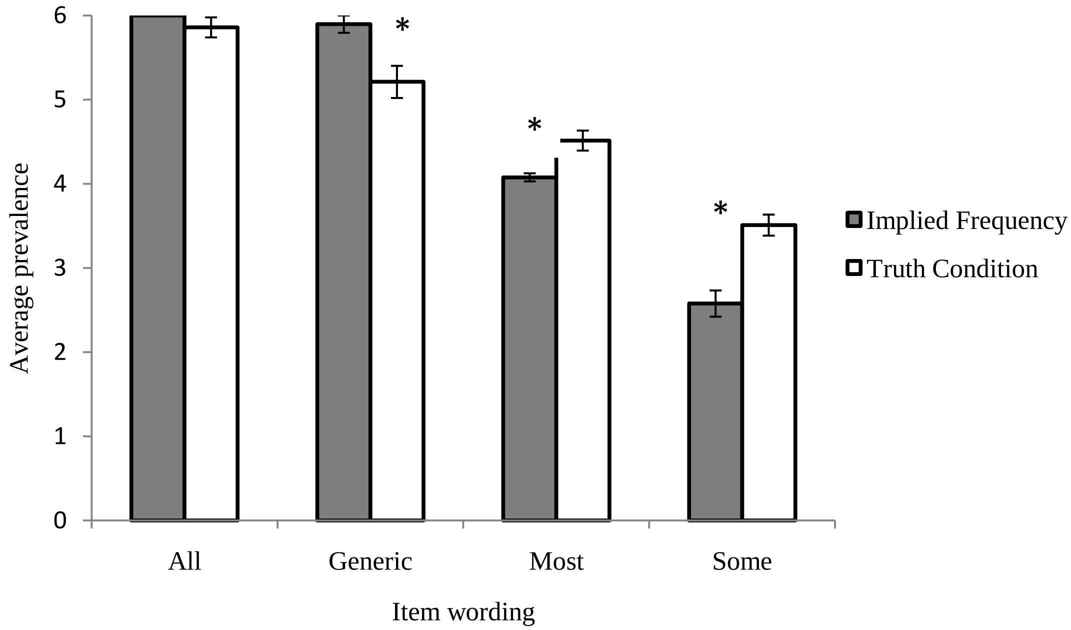

Figure 3. Experiment 1: the average prevalence implied by the statements (the implied frequency task, gray bars) vs. the average prevalence that led adults to accept the same statements (the truth condition task, white bars).

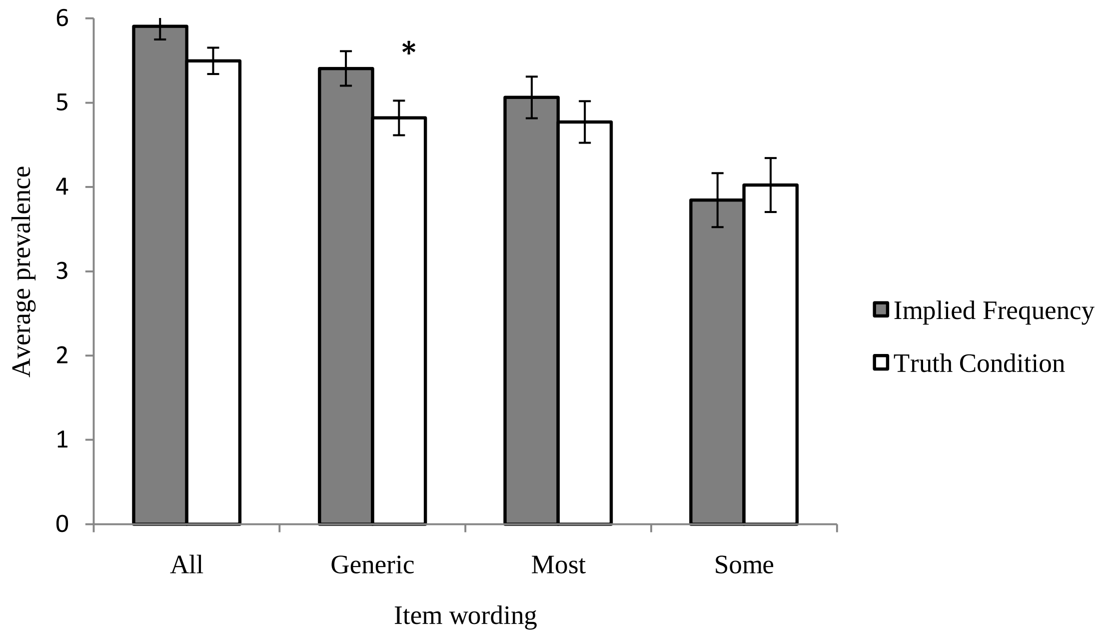

Figure 4. Experiment 2: the average prevalence level implied by the statements (the implied frequency task, gray bars), vs. the average prevalence that led preschoolers to accept the same statements (the truth condition task, white bars).