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The Influence of Shape on Young Children's Taxonomic Assumption

Ilana Frank

A Thesis

in

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of

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ABSTRACT
The Influence of Shape on Young Children's Taxonomic Assumption

Ilana Frank

The main purpose of this research was to investigate the role played by shape in young children's extension of object labels in a noun-category bias task. In one experiment, 2-year-old children were shown a standard and were asked to choose between a dissimilar superordinate category match, and an item that was taxonomically unrelated to the standard but highly similar in its overall shape, as established by adult ratings. In another experiment, 2-year-old children were asked to choose between a thematic match and a dissimilar superordinate category match. In each experiment half of the standards were labelled with a novel noun and half were not. Children in the first experiment chose significantly more shape matches in the label condition than in the no label condition. In the second experiment, children chose equally between thematic matches and category matches in both conditions. After children with side biases were removed from this analysis, the results showed that category matches were chosen at above chance levels in the label condition, but not in the no label condition. While findings of the two experiments suggest that both shape and category membership are important factors in children's early word extension, the results of the first experiment support the hypothesis that shape is dominant over category membership in determining word extension in 2-year-olds.

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Children learn language in a remarkably short period of time. They begin to show their understanding of words and short phrases by 9 months, and typically start producing words by the beginning of the second year. Fifteen-month-olds can produce ten words on average (Nelson, 1973), and children typically experience a vocabulary spurt between the ages of 17 and 22 months (Benedict, 1979; Bloom, 1973). This rapid vocabulary development during the first two years of life is mainly attributed to the acquisition of object words, which account for over 50% of the early lexicon (Benedict, 1979; Nelson, 1973).

In learning the meanings of object words, children must come to realize that object words label categories of things. For example, a child learning the word "key" would have to realize that the word does not refer to the thematic relationship between a key and a door, to properties of the key such as its coldness, or to the action of the key in opening a door. The child must instead realize that the word "key" refers to a specific object, as well as to other members of the same category. If children were to entertain such a wide range of hypotheses about the meanings of words, then word learning would be a much more difficult and slow process (Quine, 1960). Because children's vocabulary does develop so rapidly, some researchers have postulated that children make use of biases, or basic expectations about how labels are extended to objects of like kind, to free them of the need for extensive hypothesis-testing about each new word they must learn.

Noun-Category Bias

One type of bias that has been suggested is the noun-category bias, or taxonomic constraint. Markman and Hutchinson (1984) proposed that children limit the possible meanings of nouns to refer mainly to categorical relations. That is, children expect object labels to refer to groups of objects "of a kind", and when they are asked to extend a new label, they tend to search for objects of the same kind. In order to test this hypothesis, researchers have typically made use of a forced-choice match-to-sample technique. Children are presented with a target picture (e.g. dog) and are asked to choose between a thematic associate (e.g. bone) and a taxonomic associate (e.g. cat). These studies are predicated on the assumption that children appreciate both categorical and thematic relations among objects (Fenson, Cameron, & Kennedy, 1988; Smiley & Brown, 1979).

Several studies have tested preschoolers' responses to this type of task. Markman and Hutchinson (1984) found that when the task was accompanied by a general instruction ("See this? Find another one that is the same as this."), 4- and 5-year-old children chose thematic associates as often as taxonomic associates. However, when the instructions included a novel word ("See this? This is a fep. Find another fep that is the same as this fep."), children preferred the taxonomic associates. The taxonomic associates used in this study were at the superordinate level of categorization, in which objects are relatively diverse and not highly similar to one another (e.g. animals). Markman and Hutchinson's findings suggest that preschool children constrain the meaning of new nouns to refer mainly to

objects that are related categorically.

Waxman and Gelman (1986) used a classification task instead of a match-to-sample task to explore the role of novel labels in superordinate classification. It had already been shown (Gelman & Baillargeon, 1983; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976) that preschool children tend to have difficulty sorting objects into taxonomic categories at the superordinate level. Waxman and Gelman (1986) found that both 3- and 4-year-olds' sorting of items at the superordinate level improved in the presence of novel labels. However, 4-year-olds were also responsive to cues other than labels to help focus their attention on taxonomic relations. Thus, they were sensitive to the presentation of typical category instances, such as horse, dog and duck, and they were also responsive to explicit instructions to think of these typical instances as a group of things belonging together. In contrast, 3-year-olds could not make good use of these cues to help them classify items taxonomically.

Waxman and Kosowski (1990) confirmed the novel label finding for 3- and 4-year-olds using a forced-choice match-to-sample task more stringent than that used by Markman and Hutchinson (1984). Four alternatives were presented to children in their study, two thematic and two taxonomic at the superordinate level. For example, when the target was a squirrel, the thematic alternatives were an acorn and a tree, and the taxonomic alternatives were a cat and a mouse. It was found that children responded taxonomically in the label condition, even in the presence of two thematic alternatives. Children in the no label condition

performed at chance.

If children's tendency to make taxonomic choices in the presence of a novel noun indeed reflects a strategy to help them learn the meanings of new words, this bias should be present early in language development. One should then expect novel labels to function as effective clues to taxonomic relations for children even younger than 3 or 4 years of age. Therefore, several researchers have begun investigating the noun-category bias in younger children. Some of these researchers have looked at younger children's taxonomic responding with basic level categories (such as a cat with another cat) rather than superordinate, since according to Rosch and her colleagues, the basic level of categorization is the one in which category members have the most features in common without being confused with members of other categories (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). Basic level categorization has also been found to be the easiest for preschoolers (Mervis & Crisafi, 1982).

Using a three-item match-to-sample task, Markman and Hutchinson (1984) demonstrated that children aged 2 to 3 years chose equally between thematic and basic-level category matches when no label was provided. They were, however, much more likely to select categorically when the target picture was given a novel label. In contrast, Bauer and Mandler (1989), using a similar match-to-sample task, demonstrated that children 16 to 31 months of age had a preference for taxonomic choices on basic-level object triads in both label and no label conditions. One explanation for the high overall rate of taxonomic responding in

Bauer and Mandler's (1989) study is that training trials were provided, during which children's taxonomic choices were nonverbally reinforced. Using a five-item match-to-sample task which included two thematic choices and two category choices at the superordinate level, Waxman and Kosowski (1990) randomly assigned 2.5-year-old children to a no label condition, a novel noun condition, or a novel adjective condition. (In the novel adjective condition they were told, "See this? This is a fopish one. Can you find another one that is fopish?".) Children's first and second choices were recorded. It was found that children in the novel noun condition were more likely to select both of the category choices than children in either of the other two conditions, supporting the presence of the noun-category bias at the superordinate level in younger children.

Travis and Ross (1992) also administered a forced-choice task at the superordinate level to 2-year-olds. In their first experiment, Travis and Ross found a slight tendency toward taxonomic responding in both the label and no label conditions, with no effect of labelling on the children's overall rate of taxonomic responding. As in Bauer and Mandler's (1989) study, the general tendency toward taxonomic responding may have been due to Travis and Ross's reinforcement of infants' taxonomic choices during training trials. The authors therefore conducted a second study, using novel objects instead of familiar ones and giving no reinforcement during training. The same pattern of results found in their first experiment was obtained.

The Contribution of Perceptual Similarity

It is clear that there remains some ambiguity about the nature of the noun-category bias in 2-year-olds, both at the basic level and at the superordinate level of categorization. Even with preschool age children, the precise nature of the taxonomic constraint remains unclear. For instance, what characteristics or dimensions are children using in order to make judgments about whether objects are of the same taxonomic kind? The results of several recent studies have suggested that perceptual features may represent an important dimension for young children in their attempts to learn about categories. For instance, Fenson, Cameron and Kennedy (1988) tested the relative importance of perceptual and categorical similarity in 26-month-olds' picture-matching. They found that perceptual similarity was the most important factor for children making these matches; when perceptual resemblance was minimal, most of the children were unable to recognize matches at the superordinate or basic level. Similarly, Fenson, Vella and Kennedy (1989), in a reinforced match-to-sample task, found that 26-month-olds were unable to identify taxonomic matches if they had no perceptual basis, although 34-month-olds were able to do so.

There is also empirical evidence for the importance of perceptual features in categorization in a linguistic context. Clark (1973) found that young children's overextensions are based largely on shape, such as calling a horse "doggie" because it resembles a dog. Landau, Smith and Jones (1988) explored three dimensions of perceptual similarity, namely shape, size and texture, to assess their

relative importance in the word extension behaviour of 2- and 3-year-old children and adults. All three groups weighted shape more heavily than size or texture, and this "shape bias" increased in strength from 2 years through adulthood. In young children the bias towards shape was much stronger in word extension tasks than in nonword classification tasks, where size and texture also received considerable interest. The authors suggested that children's behaviour on this task reflects a 'shape bias' whose development originates in language learning.

Jones, Smith and Landau (1991) have explored the generality of this shape bias by asking whether children are less likely to use shape when naming some kinds of objects than when naming others. In their study both 2- and 3-year-old children classified eyeless objects by shape, but objects with eyes by both shape and texture. The authors contend that young language learners possess a fair amount of knowledge about the conditional relations between kinds of perceptual properties.

Using shape as a clue to word extension would be a useful strategy for children for several reasons. Shape is detectable on the surface and is also a good predictor of category relationship, especially at the basic level (Mervis & Rosch, 1981). Even at the superordinate level, shape similarity is somewhat predictive of taxonomic relationship. Children may be forced to rely heavily on perceptual similarity to help them establish taxonomic relationships when they know little about the functions or behaviour of objects (Baldwin, 1992). In addition, since parents use many basic level terms in their speech to children, extending labels on

the basis of shape should make it easier for children to learn these terms.

If shape information is important to young children in their efforts to learn object words, then shape may also be an important factor in predicting children's performance in the noun-category bias task. As will be recalled, results of previous noun-category bias tasks with younger children remain ambiguous. In addition, it remains unclear how children come to determine that two objects are of the same taxonomic kind when doing such a task. One factor which may have had a substantial influence in previous research on the noun-category bias is the degree of resemblance between the standard and each of the two corresponding matches. The thematic associate rarely looks like the standard, while the taxonomic associate usually does. Even the superordinate level associates can share a good degree of shape similarity with the standards, especially as compared with the objects that are thematically related. For example a car and a truck, which belong to the same superordinate category of vehicle, share a good deal more shape similarity than a car and a road. Since children do appear to pay attention to shape in word learning contexts, they may be choosing the taxonomic matches more often than the thematic matches in noun-category bias tasks not because of their categorical relationship but because they are similar in shape. In fact, it is possible that hearing a novel label alerts children to perceptual features rather than to categorical relationships.

Two very recent studies conceived independently of the present study have yielded results bearing on the question of the importance of shape similarity in

children's noun-category bias. Using a forced-choice match-to-sample task, Baldwin (1992) tested a group of children between 3 and 5 years of age in three different experiments exploring children's attention to thematic relations, shape similarity and taxonomic relations in the presence of a novel label. In the first experiment she pitted thematic relations against shape similarity, and found that when no label was heard, children preferred thematic choices. In the presence of a novel label, however, children made significantly more shape choices than when no label was heard. In the second experiment, in which she pitted thematic relations against taxonomic relations and minimized shape similarity, she found that while children preferred thematic choices in the no label condition, a novel label led to a significant increase in taxonomic responding, although not at levels above chance. In a third experiment pitting taxonomic relations against shape similarity, Baldwin found that children preferred taxonomic choices in the no label condition, but the use of novel labels led to a slight but insignificant increase in children's responses based on shape. Item analyses did indicate, however, that shape matches were chosen significantly more often in the presence of a novel label. Baldwin concluded that while shape had some importance for children in their decisions about word extension, in the absence of shape information, the children could also take taxonomic kind into consideration.

Imai and Gentner (1993) tested 3-year-olds and 5-year-olds in a similar task with label and no label conditions. In their study, each child had three alternatives to choose from: taxonomic, shape, and thematic. Children in both age

groups chose shape alternatives most frequently in the label condition and preferred thematic alternatives in the no label condition. While taxonomic responding was always at chance or less, a significant increase in taxonomic responding was observed between 3- and 5-year-olds in the label condition. The authors suggest that young children initially focus on shape similarity when extending words, and gradually shift their focus to "deeper" taxonomic relations.

Lexical Style

Individual differences in children's early patterns of language acquisition may represent another influence on children's noun-category bias. Nelson (1973, 1981) has found individual differences in the emphasis on nouns in children's early productive vocabulary. She has proposed that some children have a **referential** style which leads them to concentrate on learning the names of objects, while others have an **expressive** style which leads them to use language as a tool for transmitting social information (Nelson, 1975). Nelson argues for this division by relying on two forms of evidence: 1) differences in the proportion of nouns in young children's productive lexicon, and 2) the correlation of these differences with other linguistic features which support such a division.

In her longitudinal study of the early stages of language development in 18 children, Nelson (1973) found that children fell into two groups based on the proportion of nouns in the first 50 words produced: those children for whom common nouns made up half the lexicon were labelled **referential**, and those for whom common nouns made up less than half the lexicon were labelled **expressive**.

She found that the referential children had a higher maximum rate of vocabulary growth, were more likely to have a productive vocabulary spurt at around 50 words, were more likely to request names for objects, and had larger spoken vocabularies at 2 years of age. Using the same classification system, Klein (1980) found that referential children used language to point out objects more often than expressive children, while expressive children more often used language to comment on a situation, call for attention or accompany an action. Children classified as expressive have also been found to use more pronouns and short phrases (Goldfield, 1985, 1986; Klein, 1980; Nelson, 1973).

Nelson (1973, 1981) argues that differences in lexical style are the result of different approaches to language learning. She argues that referential children hypothesize that language is used to refer to objects, and so use single words, talk about objects and build a vocabulary of object labels. Expressive children, on the other hand, aim at conveying more complex relational meanings, and so use pronouns and phrases rather than single words. Nelson argues that the existence of individual differences in lexical style shows that children do not operate under universal constraints on language learning, such as the noun-category bias.

It is possible, however, that differences in lexical style lead to systematic variations in children's performance on a noun-category bias task. For instance, since referential children seem to pay close attention to object labels, they might also pay more attention to superordinate relationships when they think they are learning a new word. Another possibility is that referential children pay special

attention to perceptual features when they are learning a new word (Poulin-Dubois, Graham & Riddle, 1992).

The Present Study

The main goal of the present series of experiments was to investigate the influence of shape similarity on 2-year-old children's choices in a noun-category bias task. The first experiment reported consisted of a rating study carried out with adults in order to control for the shape similarity of the stimuli to be used with children in the two subsequent experiments.

In the second experiment, taxonomic knowledge was pitted against shape similarity in a noun-category bias task. Two-year-old children were shown a standard (e.g., apple) and were asked to choose between a superordinate taxonomic match (e.g., tea biscuit) and, in place of the traditional thematic match, a picture of an object which resembled the standard in overall shape, but was not at all taxonomically related to the standard (e.g., ball). Because the object of the experiment was to pit shape information crosscutting taxonomic boundaries against purely conceptual knowledge, it was decided that superordinate matches would be used, since objects related at the superordinate level of categorization tend to share less perceptual resemblance than objects related at the basic level. In addition, the superordinate matches were specifically chosen to be as perceptually dissimilar as possible to the corresponding standards, so that they would prevent children from recourse to perceptual cues.

If the noun-category bias in actual fact reflects a bias towards similar

shapes in linguistic contexts, then hearing a novel label would serve to guide children's attention towards objects that are similar in shape to the standard, even if there is no taxonomic relationship between the two objects and even in the presence of a true taxonomic alternative. If, however, young children's noun-category bias serves to highlight conceptual knowledge of categorical relationships, it was expected that children would choose more taxonomic matches in the label condition even in the presence of a salient shape match. It was further expected that when no label was heard, children would not show a preference for one or the other alternative.

The purpose of the third experiment was to determine whether the noun-category bias would be replicated when thematic matches were pitted against dissimilar superordinate category matches. In this close approximation of the traditional noun-category bias task, children were shown the same series of standards as was used in the previous experiment, but were asked to choose between the corresponding superordinate associates and competing thematic associates. In this experiment it was expected that if young children are able to recognize categorical relationships even in the absence of any shape similarity, then the presence of the novel label would lead them to choose more superordinate category matches. If, however, young children typically choose superordinate matches in noun-category bias tasks due to the perceptual similarity these usually share with the standards, then it was expected that in this experiment the novel noun would not lead the children to show a preference for

the superordinate matches, given their minimal shape similarity with the standards. In addition, since Bauer and Mandler (1989) and Travis and Ross (1992) both failed to demonstrate the noun- category bias in 2-year-olds and instead noted an overall preference for superordinate matches, it was acknowledged that in this study as well, children might show an overall preference for the superordinate associates, with no effect of label.

In addition to the goal of clarifying the role of shape similarity in children's noun-category bias, another goal of this series of experiments was to determine the relationship between children's linguistic style and their decision-making on noun-category bias tasks. Specifically, it was expected that if referential children are more focused on taxonomic relationships in the context of word learning, they should choose more superordinate matches in the label condition in both studies. Alternatively, if children are good word learners because they pay special attention to perceptual features, then referential children should choose more shape matches in the presence of a novel label in the experiment pitting shape matches against taxonomic matches.

Experiment 1

In order to isolate the influence of shape on young children's performance in the noun-category bias task, the shape matches to be used in Experiment 2 were selected to contain a high degree of shape similarity with the standards, and the superordinate matches to be used in both Experiments 2 and 3 were chosen to contain a low degree of shape similarity with the standards. This rating study therefore had two goals: 1) to make sure that the shape matches created for Experiment 2 were indeed judged by adults to be more similar to the standards than were the competing superordinate matches, and 2) to make sure that both the thematic and superordinate matches to be used in Experiment 3 were judged by adults to have an equivalent low degree of shape similarity with the standards.

Method

Subjects

Ten English-speaking adults, four males and six females (mean age = 27 years, range = 22 to 41 years), agreed to participate in this rating study. These subjects were all students and staff at Concordia University and were paid for their participation. (See Appendix A for consent form.)

Materials

Fifty-six 11.25 cm. x 11.25 cm. cards bearing coloured drawings of objects were used to generate ratings in this study. These drawings included the two sets of stimuli presented to children in the two subsequent experiments (see Appendix B for the list of pictures used in Experiment 2 and Appendix C for the list of

pictures used in Experiment 3). Fourteen of the drawings were of familiar objects referred to as standards, and the remaining drawings were related to these standards in one of three different ways: 14 represented objects associated thematically with the standards, such as an apple with a knife, 14 were pictures of objects unrelated to the standards but sharing a high degree of shape similarity with the standards, such as an apple with a ball, and 14 were pictures of objects related taxonomically (at the superordinate level) to the standards but sharing little shape similarity, such as an apple with a tea biscuit.

Procedure

Each subject was shown 42 pairs of these drawings, created by combining each standard picture with its corresponding thematic match, shape similarity match and taxonomic match. For each pair of pictures, subjects were asked to rate the degree of shape similarity shared by the two objects depicted (see Appendix D for the instructions to adult raters). Shape similarity ratings were thus generated for 14 standard-thematic pairs, 14 standard-shape pairs, and 14 standard-superordinate pairs.

Ratings were made using a 7-point Likert scale, with 1 representing very low similarity and 7 representing very high similarity (see Appendix E for ratings questionnaire). Because the pictures depicting standards and shape similarity matches were drawn with the intention of artificially maximizing their shape similarity while retaining their separate identities, subjects were asked to focus exclusively on the shape similarity in the drawings themselves, rather than on the

similarity between the actual objects depicted in the drawings.

Results

A t-test was performed to compare shape similarity ratings of the standard-superordinate pairs and the standard-shape pairs. As expected, the mean rating of the standard-shape matches (5.67, range = 2 to 7) was significantly greater than the mean rating of the standard-superordinate matches (1.87, range = 1 to 5), $t(9) = 17.69$, $p < .001$.

A second t-test compared shape similarity ratings of the standard-superordinate pairs and standard-thematic pairs. As expected, the mean rating of the standard-superordinate matches (1.87, range = 1 to 5) did not differ significantly from the mean rating of the standard-thematic matches (2.14, range = 1 to 7), $t(9) = 1.88$, $p > .05$.

These results indicate that according to adult raters, the shape matches created for this series of studies are in general highly similar to the standards, while the superordinate matches and thematic matches share minimal similarity with the standards. In addition, the standards and superordinate matches share the same low degree of similarity as do the standards and thematic matches. Thus, these stimuli were deemed appropriate to use in the two subsequent studies, in which degree of shape similarity is defined as an independent variable in order to assess its influence on children's noun-category bias.

Experiment 2

The purpose of this experiment was to determine how children would generalize a novel label in a noun-category bias task when dissimilar superordinate matches were pitted against unrelated shape matches. It was expected that if novel labels call young children's attention to shape rather than to taxonomic kind, then they would prefer to choose shape matches over superordinate matches in the presence of a label. A second goal of this study was to determine how children's vocabulary level and linguistic style would relate to performance in the noun-category bias task.

Method

Subjects

Fifty-one English-speaking children, 28 males and 23 females (mean age = 24.48 months, range = 23.33 to 25.33 months), participated in this study. They were recruited by consulting hospital birthlists provided by the Conseil de la Santé et des Services Sociaux de la Région de Montréal Métropolitain. Three of the children, two females and one male, could not complete the task and were not included in the analyses. Although no formal assessment of socioeconomic status was made, information provided on the consent forms indicates that a wide range of parental occupations was represented (see appendix F for sample consent form).

Materials

Forty-two 11.25 cm. x 11.25 cm. cards bearing coloured drawings of objects

were used for this study. The drawings consisted of 14 standards, 14 taxonomic matches at the superordinate level, and 14 taxonomically unrelated shape matches. The superordinate matches were chosen for this experiment because they contained minimal shape similarity with their corresponding standards, as confirmed by the results of the adult rating study described above. The shape matches were drawn so as to maximize their similarity to the corresponding standards, again as confirmed by the adult rating study.

The drawings were presented to children on an apparatus specially designed to resemble a puppet theatre. The apparatus measured 46.25 cm. high, 61.25 cm. wide and 37.5 cm. deep, and was enclosed at the front and sides and open in the back. It had a ledge in front to hold the pictures, and a small window towards the top. The apparatus rested on a large table, and each child was seated in front of it in a baby seat attached to the table. Three hand puppets, named Doggie, Snowy and Hippo, were used in the study to help maintain children's interest in the task.

Following the task, parents were asked to complete the MacArthur Communicative Development Inventory for Toddlers (Fenson, Dale, Reznick, Thal, Bates, Hartung, Pethick & Reilly, 1991), a standardized instrument designed to assess toddlers' productive language. The instrument consists of two parts; the first contains a 680 word vocabulary production checklist, and the second contains 125 items designed to assess morphological and syntactic development.

Procedure and Design

Each child spent a brief period of time becoming accustomed to the testing room. During this time the study was explained to the parent(s), and a consent form was filled out. The child was then placed in the baby seat, with one parent seated at the child's left and the experimenter at the child's right. An assistant sat behind the apparatus to operate the hand puppets. The entire experimental procedure was videotaped.

In a departure from other noun-category bias studies, a within-subjects design was used for this experiment. The advantages of having the children serve as their own controls included maximizing the statistical power of the design and providing some control for extraneous variables influencing children's choices on the task. Thus, each child was administered both a label and a no label condition. Once the child was seated, the experimenter handed the child a picture, known as the standard. If the trial were one in which the standard was given a nonsense label, the experimenter said, for instance, "See this? Doggie (or Snowy, or Hippo) calls this a Fadas. Can you give the Fadas to Doggie?" Attributing the nonsense word to the puppet was done in order to avoid invoking the effects of a possible mutual exclusivity bias in children (Markman & Wachtel, 1988). (See Appendix G for the list of novel labels used.) If the trial were one in which the standard was not to be labelled, the experimenter said, "See this? Can you give it to Doggie (or Snowy or Hippo)?" In each case the child was encouraged to hand the picture to the puppet, who was waiting in the window of the apparatus. The picture was then

placed on the window ledge so that it could still be seen by the child. The experimenter then said, "Can you give Doggie another Fadas like this Fadas?" or, for nonlabelled trials, "Can you give Doggie another one like this one?", pointing again to the standard. The experimenter then placed two additional pictures side by side on the ledge, and encouraged the child to give one picture to the puppet to match the standard. For each trial, one picture placed on the ledge depicted a superordinate taxonomic match to the standard and one picture depicted a taxonomically unrelated shape match to the standard. For instance, when the standard was a snake, the taxonomic match was a cow and the shape match was a skipping rope. (See Appendix B for the list of triads used in this experiment.) The child's choice of picture, taken to be the first picture handed by the child to the puppet, was recorded by the experimenter on a response sheet. (See Appendix H for a copy of the response sheet.) Another coder reviewed the videotapes of 20% of the subjects to record their choices, and reliability was computed between the two coders. (See Appendix I for instructions for coding picture choices.)

All participants were administered a total of 14 trials. For each child, seven consecutive trials were labelled, and the other seven consecutive trials were not labelled. Each child received a different randomized protocol of the 14 picture triads, with the stipulation that each picture triad be presented in the label condition and in the no label condition an equal number of times across children. In order to control for order effects, half of the children received labelled trials first and the other half received nonlabelled trials first. The side on which the

superordinate and shape matches were presented was counterbalanced across the 14 trials.

In order to determine whether children recognized the objects that the pictures were intended to depict, they were asked to identify each of the 42 pictures after the matching task was completed. The names produced in response to these queries were recorded by the experimenter.

Parents of children who completed the matching task were asked to complete the MacArthur Communicative Development Inventory for Toddlers (Fenson et al., 1991), either at home or in the laboratory. The information collected in Part I of this instrument, on the words children produced, was used in order to determine how children's word knowledge influenced their decision-making on the noun-category bias task.

Results

The two coders were in agreement on 99.35% of the 154 trials they both coded. Agreement was reached by discussion on the remaining trials. A 2 (Order) x 2 (Condition) mixed analysis of variance with repeated measures on condition was conducted on the number of shape matches chosen by children. The analysis revealed no effect of order and no order by condition interaction. As shown in Table 1, the main effect of condition was significant: The mean percentage of shape responses in the label condition (55.51%) was higher than the percentage of shape responses in the no label condition (44.49%), $F(1,46) = 10.76$, $p < .005$. A comparison against chance responding (50%) indicated that the percentage of

Table 1

Mean Percentages of Shape Choices for the Complete Picture Set in Experiment 2

	Labelling Condition	
Subject Group	Label	No Label
All Subjects		
M	55.51%* a	44.49%* a
SD	21.44%	18.71%
Non-Biased Subjects		
M	58.10%* a	44.29% a
SD	22.17%	19.62%

* Different from 50%, $p < .05$

a = Significant main effect, $p < .05$

shape choices in the label condition was significantly greater than chance, $t(47)=1.75$, $p<.05$ (one tailed). In addition, the percentage of shape choices in the no label condition was significantly lower than chance, $t(47) = -2.04$, $p<.05$ (one tailed). Thus, when triads were labelled with nonsense words, children were more likely to choose shape matches than perceptually dissimilar superordinate matches. T-tests revealed no differences between girls and boys in their selection of shape choices, for this analysis and for all subsequent analyses. (See Appendix J for source tables for all analyses of variance in Experiment 2.)

A large number of children seemed to show a bias toward one side of the apparatus when making their choices. Therefore, children who chose 11 or more pictures out of 14 on one side ($p<.05$ on a binomial test) were considered to have side preferences exceeding chance levels. Since this pattern suggested that these children were responding randomly, the 18 subjects classified as having a side preference (38% of the total) were removed from the sample and a second 2(Order) x 2 (Condition) mixed analysis of variance with repeated measures on condition was conducted in order to determine whether the pattern of results would remain the same. The analysis again revealed no effect of order and no order by condition interaction. As shown in Table 1, the main effect of condition was again significant: The mean percentage score for shape responses in the label condition (58.10%) was higher than the score for shape responses in the no label condition (44.29%), $F(1,28) = 11.00$, $p<.005$. A comparison against chance responding indicated that the percentage of shape choices in the label condition

was significantly greater than chance, $t(29) = 2.00$, $p < .05$ (one tailed). The percentage of shape choices in the no label condition was marginally below chance, $t(29) = -1.59$, $p < .10$ (one tailed). Thus, the pattern of results did remain the same after eliminating children with side preferences: when triads were labelled, children reliably chose more shape matches than superordinate matches.

It could be argued that in order to confidently interpret children's choices, one must be reasonably certain that children recognized the pictures they were being asked to match together. For this reason, children's picture identification data were taken into account in two subsequent analyses. (Due to a fatigue effect, some children did not name every picture, or could not be administered this part of the study.) Since children often produced words or phrases which did not exactly match the target word, for example saying "cereal" for bowl or "pants" for shorts, criteria were developed to decide if a picture was indeed recognized or not. Two coders then used these criteria to determine independently whether each of these words indicated recognition of the object. Reliability was computed on this coding for the whole sample, and agreement was achieved for 87.96% of the data. The criteria were refined in order to settle coders' disagreements, and agreement reached 97.46%. The remaining disagreements were resolved by discussion. (See Appendix K for instructions to coders of picture recognition data.)

It was decided that triads with standards or superordinate matches recognized by fewer than 50% of subjects would be eliminated from the next

series of analyses. This 50% level was chosen as it is a commonly used cutoff point in deciding whether a task is mastered by children of a certain age. It was further decided that nonrecognition of shape matches is problematic only in cases where children indicate that they think the shape match is actually the same object as the standard, such as calling the crayon "bottle" in the triad made up of bottle, crayon, and bowl. In this case, children may be matching the bottle and crayon together based on a perceived taxonomic relationship (two bottles) instead of responding on the basis of the shape similarity they share. Other instances of nonrecognition or of misidentification of the shape match were considered acceptable, since even if the child thought that the object was something other than what was intended, the shape similarity was still perceivable to the child, and the child still had to cross a taxonomic boundary when choosing the shape match.

There were no triads which elicited identity matches in over 50% of children. Therefore, it was decided that instead of the 50% cutoff, a 25% cutoff would be used in order to test the effects of eliminating triads with the highest number of identity matches. Another 2 (Order) x 2 (Condition) mixed analysis of variance with repeated measures on condition was conducted with all subjects included, removing problematic triads. Two triads were removed due to nonrecognition of the standards 'soap' and 'skirt'. Children produced a wide variety of labels for the soap picture, such as a box, bed, table, or present. They tended to identify the picture of the skirt as an umbrella or a lamp. Three triads were removed due to a high proportion of identity matches (butterfly-bow, bottle-

crayon, and bike-glasses). The analysis revealed no effect of order and no order by condition interaction. The main effect of condition was again significant: As indicated in Table 2, the mean percentage score for shape responses in the label condition (58.85%) was higher than the score for shape responses in the no label condition (43.96%), $F(1,46) = 11.02$, $p<.005$. A comparison against chance responding indicated that the percentage of shape choices in the label condition was significantly greater than chance, $t(47) = 2.44$, $p<.05$ (one tailed). The percentage of shape choices in the no label condition was significantly less than chance, $t(47) = -1.74$, $p<.05$ (one tailed). Thus, the pattern of results remained similar after the removal of problematic triads.

A similar analysis in which problematic triads were removed was also conducted for those subjects who did not have side preferences. One triad was removed due to nonrecognition of the standard (soap), and three triads were removed due to identity matches (butterfly-bow, bottle-crayon, and snake-jump rope). The 2 (Order) x 2 (Condition) mixed analysis of variance revealed no effect of order and no order by condition interaction. The main effect of condition was not significant: The mean percentage score for shape responses in the label condition (58.67%) was not significantly higher than the score for shape responses in the no label condition (49.67%), $F(1,28) = 2.76$, $p>.05$ (See Table 2). A comparison against chance responding, however, indicated that the percentage of shape choices in the label condition was significantly greater than chance, $t(29) = 1.90$, $p<.05$ (one tailed). The percentage of shape choices in the no label

Table 2

Mean Percentages of Shape Choices for the Known Picture Set in Experiment 2

	Labelling Condition	
Subject Group	Label	No Label
All Subjects		
M	58.85%* a	43.96%* a
SD	25.16%	24.11%
Non-Biased Subjects		
M	58.67%*	49.67%
SD	25.05%	19.86%

* Different from 50%, $p < .05$

a = Significant main effect, $p < .05$

condition was not significantly less than chance, $t(29) = -.09$, $p > .05$ (one tailed). Thus, when children with side preferences were removed and problematic triads were eliminated, leaving only the least questionnable data, the significant main effect of labelling was lost, but the high percentage of shape choices in the label condition resembled that found in the previous analyses, while in the no label condition children chose shape and superordinate responses in about equal proportions.

Item analyses were conducted in order to determine whether the triads elicited more shape responses in the label condition than in the no label condition for a significant number of subjects. When all subjects and all triads were included, 10 out of the 14 triads elicited more shape choices in the label condition than in the no label condition. A two-tailed t-test indicated that triads elicited significantly more shape choices in the label condition (55.70%) than in the no label condition (45.39%), $t(13) = -3.06$, $p < .01$. In addition, the percentage of subjects choosing shape matches in the label condition was significantly above chance, $t(13) = 2.63$, $p < .05$ (one tailed). The percentage of subjects choosing shape matches in the no label condition was significantly below chance, $t(13) = -1.98$, $p < .05$ (one tailed). Thus, when all subjects and all triads were included, the results of the item analysis resembled the results of the corresponding analysis of variance in showing that children paid more attention to shape in the presence of a novel label.

A similar two-tailed t-test conducted only on those subjects without side

preferences yielded the same pattern of results: triads elicited significantly more shape choices in the label condition (58.10%) than in the no label condition (44.29%), $t(13) = -3.23$, $p < .01$. Out of the total 14 triads, 11 elicited more shape matches in the label condition than in the no label condition. The percentage of subjects choosing shape matches in the label condition was again significantly above chance, $t(13) = 3.58$, $p < .005$ (one tailed). The percentage of subjects choosing shape matches in the no label condition was significantly below chance, $t(13) = -1.80$, $p < .05$ (one tailed). Thus, when subjects with side biases were removed, the item analysis results still followed the same pattern.

Another item analysis was conducted on all subjects, but removing the same five triads which were removed from the corresponding analysis of variance because of a high proportion of identity matches or nonrecognition of standards or superordinate matches. The two-tailed t-test again indicated that across all the triads, the mean percentage of subjects choosing shape matches in the label condition (58.66%) was significantly higher than the mean percentage of subjects choosing shape matches in the no label condition (44.10%), $t(8) = -2.79$, $p < .05$. Of the nine triads included in this analysis, six elicited more shape matches in the label condition than in the no label condition. The percentage of subjects choosing shape matches in the label condition was again significantly above chance, $t(8) = 5.59$, $p < .005$ (one tailed). The percentage of subjects choosing shape matches in the no label condition was not significantly below chance, $t(8) = -1.08$, $p > .10$ (one tailed).

The last item analysis was done after removing side preference subjects, in addition to eliminating the same four problematic triads as were eliminated from the corresponding analysis of variance. Thus, this item analysis was conducted on what one might consider the least questionnable data. The two-tailed t-test again indicated that the mean percentage of subjects choosing shape matches in the label condition (58.67%) was significantly higher than the mean percentage of subjects choosing shape matches in the no label condition (46.00%), $t(9) = -2.24$, $p = .05$. Seven out of the 10 triads elicited more shape matches in the label condition than in the no label condition. The percentage of subjects choosing shape matches in the label condition was again significantly above chance, $t(9) = 2.79$, $p < .05$ (one tailed). The percentage of subjects choosing shape matches in the no label condition was not significantly below chance, $t(9) = -.99$, $p > .10$ (one tailed).

In summary, the four item analyses conducted mirror the findings of the first three analyses of variance on subjects' choices. When shape similarity was pitted against superordinate category membership in this noun-category bias task, children chose more shape matches in the presence of a novel label than in its absence. In order to correlate children's choices on the task with their productive vocabulary and linguistic style, difference scores were computed for each child by subtracting the number of shape responses in the no label condition from the number of shape responses in the label condition. These difference scores were correlated with children's total vocabulary scores as measured by the MacArthur

Communicative Development Inventory for Toddlers (Fenson et al., 1991), as well as with the proportion of nouns in their vocabulary as a measure of linguistic style. While most parents were cooperative, data on vocabulary is missing for 20 subjects. Spearman correlations were computed both including and excluding side preference subjects. No significant correlations were found. Thus, in this study, children's choices of shape or superordinate matches did not seem to be related to their vocabulary level or to the proportion of nouns in their vocabulary. It seems likely that because so many children responded strongly to shape in the presence of a label, vocabulary size and percentage of nouns did not act as strong predictors of children's choices.

In order to determine whether children with side preferences differed from their non-side preference counterparts in any consistent way, independent t-tests comparing these two groups of children on age, vocabulary level and percentage of nouns in the vocabulary were conducted. The results revealed no significant differences between the two groups on any of these variables. Similarly, a chi-square test revealed no significant difference in the number of males and females in the two groups.

Experiment 3

The main purpose of this experiment was to modify the traditional noun-category bias task by presenting children with a choice between thematic matches and taxonomic matches which have been selected to be dissimilar in shape to the standards. If novel labels highlight taxonomic relationships for young children independently of shape information, then this experiment should replicate previous findings that children choose more superordinate matches in the presence of a novel label. If, however, novel labels highlight only shape similarity for children of this age, then the novel labels in this experiment should not increase children's taxonomic responding. Such a result would support the notion that in previous studies, a taxonomic effect has been found because shape and taxonomic relationship were confounded.

A second goal of this study was to determine how children's vocabulary level and linguistic style relates to performance on the noun-category bias task.

Method

Subjects

Thirty-three English-speaking children, 17 males and 16 females (mean age = 24.41 months, range = 23.72 to 25.13 months), were recruited for this study by consulting hospital birthlists provided by the Conseil de la Santé et des Services Sociaux de la Région de Montréal Métropolitain. Two male children could not complete the task and were not included in the analyses. As in Experiment 2, while no formal assessment of socioeconomic status was made, information

provided on the consent forms indicates that a wide range of parental occupations were represented. (See Appendix F for sample consent form.)

Materials

Forty-two 11.25 cm. x 11.25 cm. cards bearing coloured drawings of objects were used for this study. Twenty-eight of these were the same as those used in the previous experiment, namely the standards and their superordinate matches. The new pictures consisted of the thematic matches, which replaced the shape matches of Experiment 2. For instance, for the standard picture of an apple, the thematically related picture of a knife replaced the perceptually similar ball. The thematic matches to the standards were chosen to be as similar as possible to those used in other noun-category bias experiments with young children. The choice of these thematic matches, however, was necessarily constrained by the fact that the standards themselves had already been chosen to correspond with the shape matches developed for use in Experiment 2. It was also necessary that the thematic matches contain as little shape similarity with the corresponding standards as did the superordinate matches, as confirmed by the results of the adult rating study described earlier (see Appendix C for the list of triads used in this experiment).

The apparatus and hand puppets used in Experiment 2 were also used in this study, and parents again were asked to complete the MacArthur Communicative Development Inventory for Toddlers (Fenson et al., 1991) following the testing.

Procedure and Design

The procedure and design used for this study were identical to the one used in Experiment 2, except that the shape matches were replaced by thematic matches. Reliability was again computed on the responses of 20% of the subjects. (See Appendix L for sample coding sheet.)

Results

The two coders were in agreement on 98.98% of the 98 trials they both coded, and agreement on the remaining trials was reached by discussion. A 2 (Order) x 2 (Condition) mixed analysis of variance with repeated measures on condition was conducted on children's choices of superordinate matches. The analysis revealed no effect of order and no order by condition interaction. The main effect of condition was not significant: The mean percentage score for superordinate responses in the label condition (53.46%) was not significantly higher than the score for superordinate responses in the no label condition (53.00%), $F(1,29) = .10$, $p > .05$. As shown in Table 3, a comparison against chance indicated that the percentage of superordinate choices in the label condition was not significantly greater than chance, $t(30) = 1.27$, $p > .10$ (one tailed). Similarly, the percentage of superordinate choices in the no label condition was not significantly greater than chance, $t(30) = 1.20$, $p > .10$ (one tailed). Thus, children chose no more superordinate matches when triads were labelled with nonsense words than when the triads were not labelled. In addition, children chose about equally between superordinate and thematic matches in both

Table 3

Mean Percentages of Superordinate Choices for the Complete Picture Set in Experiment 3

	Labelling Condition	
Subject Group	Label	No Label
All Subjects		
M	53.46%	53.00%
SD	15.19%	13.90%
Non-Biased Subjects		
M	58.73%*	52.38%
SD	15.41%	14.70%

* Different from 50%, $p < .05$

conditions. T-tests revealed no differences between girls and boys in their selection of superordinate choices, for this analysis and for all subsequent analyses. (See Appendix M for source tables for all analyses of variance in Experiment 3.)

As in Experiment 2, a number of children favoured one side of the apparatus over the other when making their choices. Again, children who chose 11 or more pictures out of 14 on one side were considered to have side preferences exceeding chance levels, and were eliminated from the following analysis. Thirteen subjects, or 42% of the sample, were eliminated in this way. Another 2 (Order) x 2 (Condition) mixed analysis of variance with repeated measures on condition was conducted, and the analysis again revealed no effect of order and no order by condition interaction. The main effect of condition was again not significant: The mean percentage score for superordinate responses in the label condition (58.73%) was not significantly higher than the score for superordinate responses in the no label condition (52.38%), $F(1,16) = 1.97$, $p > .10$. However, a comparison against chance responding (see Table 3) indicated that the percentage of superordinate choices in the label condition was significantly greater than chance, $t(17) = 2.40$, $p < .05$ (one tailed). The percentage of superordinate choices in the no label condition was not significantly different from chance, $t(17) = .69$, $p > .10$ (one tailed). Thus, the results obtained after removing children with side preferences are similar to those in the previous analysis, in that children did not make more superordinate choices in the label condition than in the no label

condition. Children's superordinate responding was at greater than chance levels, however, when triads were labelled.

It seems reasonable to argue that in order to have a chance of perceiving the thematic relationships as well as the superordinate relationships, children must first clearly recognize the objects being depicted in those relationships. It was therefore decided that triads with standards, thematic matches or superordinate matches recognized by fewer than 50% of subjects would be eliminated from the next series of analyses. Two coders used the criteria developed for this purpose in Experiment 2 to decide whether children's labels in response to the picture recognition task indicated recognition of the object (see Appendix K for instructions to coders of picture recognition data). Reliability was computed on this coding for the whole sample, and agreement was achieved for 96.17% of the data. Remaining disagreements between coders were settled by discussion.

A 2 (Order) x 2 (Condition) mixed analysis of variance with repeated measures on condition was then conducted with all subjects included, removing problematic triads using the criteria described. Three triads were removed due to nonrecognition of standards, thematic matches or superordinate matches (soap, bib and snake). The analysis again revealed no effect of order and no order by condition interaction. The main effect of condition was again not significant: The mean percentage score for superordinate responses in the label condition (52.06%) was not significantly different from the score for superordinate responses in the no label condition (53.69%), $F(1,29) = .04$, $p > .05$. As indicated

Table 4

Mean Percentages of Superordinate Choices for the Known Picture Set in Experiment 3

	Labelling Condition	
Subject Group	Label	No Label
All Subjects		
M	52.06%	53.69%
SD	18.70%	15.52%
Non-Biased Subjects		
M	58.36%*	55.95%
SD	18.65%	17.95%

* Different from 50%, $p < .05$

in Table 4, a comparison against chance responding indicated that the percentage of superordinate choices in the label condition was not significantly greater than chance, $t(30) = .61$, $p > .10$ (one tailed). The percentage of superordinate choices in the no label condition was not significantly greater than chance, $t(30) = 1.26$, $p > .05$ (one tailed). Thus, when all subjects were included and problematic triads were removed, it was found that labelling did not increase children's superordinate responding, and children's superordinate responding in the label and no label conditions was at chance levels.

A similar analysis in which the same three problematic triads were removed was conducted only for those subjects who did not have side preferences. The 2 (Order) x 2 (Condition) mixed analysis of variance revealed no effect of order and no order by condition interaction. The main effect of condition was once again not significant: The mean percentage of superordinate responses in the label condition (58.36%) was not significantly higher than the percentage of superordinate responses in the no label condition (55.95%), $F(1,16) = .14$, $p > .05$. A comparison against chance responding indicated that the percentage of superordinate choices in the label condition was significantly greater than chance, $t(17) = 1.90$, $p < .05$ (one tailed). The percentage of superordinate choices in the no label condition was not significantly greater than chance, $t(17) = 1.41$, $p > .05$ (one tailed). (See Table 4.) Thus, when an analysis of variance was done on the least questionable data, eliminating both problematic triads and children with side preferences, it was found that while the increase in superordinate responding in

the label condition was not significant, children chose superordinate matches at greater than chance levels in the label condition but not in the no label condition.

Item analyses were conducted in order to determine whether the triads elicited more superordinate responses in the label condition than in the no label condition for a significant number of subjects. A two-tailed t-test conducted with all triads and all subjects indicated that the mean percentage of subjects choosing superordinate matches in the label condition (53.55%) was not significantly higher than the mean percentage of subjects choosing superordinate matches in the no label condition (52.78%), $t(13) = -.16$, $p > .05$. Only 6 of the 14 triads elicited more superordinate responses in the label condition than in the no label condition. The percentage of subjects choosing superordinate matches in the label condition was also not significantly above chance, $t(13) = .93$, $p > .05$ (one tailed), nor was the percentage of subjects choosing superordinate matches in the no label condition significantly above chance, $t(13) = .80$, $p > .10$ (one tailed). Thus, the item analysis did not reveal any effects of labelling.

An item analysis excluding children with side preferences also yielded nonsignificant results, although the mean percentage of superordinate responding in the label condition (58.73%) was marginally above chance, $t(13) = 1.52$, $p < .10$. Superordinate responding in the no label condition (52.38%) was not significantly above chance, $t(13) = .52$, $p > .10$. Of the 14 triads, just 5 elicited more superordinate choices in the label condition than in the no label condition. Item analyses removing the three problematic triads for both the whole sample and for

subjects without side preferences also yielded no significant effects.

In summary, both subject and item analyses suggest that when the shape similarity between standards and superordinate matches in a noun-category bias task is minimized, 2-year-old children do not respond with more superordinate choices in the presence of a label than when there is no label. However, subject analyses suggest that there seems to be a tendency for children to make superordinate choices at higher than chance levels in the presence of a label.

As in Experiment 2, in order to correlate children's choices on the task with their productive vocabulary and linguistic style, difference scores were computed for each child by subtracting the number of superordinate responses in the no label condition from the number of superordinate responses in the label condition. These difference scores were correlated with children's total vocabulary scores as measured by the MacArthur Communicative Development Inventory for Toddlers, as well as with the proportion of nouns in their vocabulary. A Spearman correlation which included all subjects with productive language data as well as all triads yielded a positive correlation between superordinate difference scores and the percent of nouns in children's vocabulary: $r(20) = .41$, $p < .05$. Superordinate difference scores were also negatively correlated with total vocabulary at a marginally significant level, $r(20) = -.34$, $p = .059$. These correlations are in opposite directions from one another, probably because children with lower total vocabulary levels tend to be those with a higher proportion of nouns in their vocabulary ($r(20) = -.30$, $p = .086$). The above correlations indicate that children

with a greater percentage of nouns in their vocabulary tended to make more superordinate choices in the label condition than in the no label condition.

Spearman correlations conducted only on subjects with no side preferences were consistent with the above pattern, but were only marginally significant: Superordinate difference scores were marginally correlated with percent of nouns in the vocabulary, $r(13) = .39$, $p = .075$, and with total vocabulary, $r(13) = -.37$, $p = .085$. The restricted sample size for this correlation yielded a decrease in statistical power, which probably accounts for the loss of the significant correlation.

As in Experiment 2, there was no evidence that children with side preferences differed from their non-side preference counterparts in any consistent way. Independent t-tests comparing the two groups of children revealed no significant differences in age, vocabulary level, or percentage of nouns in the vocabulary. A chi-square test revealed no significant difference in the number of males and females in the two groups.

General Discussion

Research exploring children's noun-category bias has generally yielded the finding that in the presence of a novel label, preschool children pay more attention to taxonomic relationships than to thematic relationships (Markman & Hutchinson, 1984; Waxman & Gelman, 1986; Waxman & Kosowski, 1990). The results of studies with younger children are not as straightforward. Some researchers have demonstrated the novel label effect with children under three years of age at the basic level (Markman & Hutchinson, 1984) or at the superordinate level of categorization (Waxman & Kosowski, 1990), while others have found an overall preference for taxonomic relationships regardless of the presence or absence of a novel label (Bauer & Mandler, 1989; Travis & Ross, 1992).

The goals of the present study were 1) to investigate younger children's performance on a noun-category bias task by testing children aged 2 years, 2) to control for and investigate the role played by shape similarity in young children's noun-category bias, and 3) to examine the relationship between linguistic style and children's performance on this task.

The first step in interpreting the results of the two experiments with children is to determine which data sets constitute the "valid" data. No other researchers have reported on side preferences, and none have controlled for children's recognition of the stimulus pictures. Therefore, it seems reasonable to compare the overall results of this study to the findings of other researchers

without taking side preferences or picture recognition into account. It is equally valid, however, to determine to what degree the findings hold up when the data are analyzed more rigourously.

The overall results of Experiment 2, including all subjects and all items, showed that in the presence of a label, children chose significantly more shape matches than when no label was heard. In addition, shape matches were chosen in the label condition at greater than chance levels, and in the no label condition at below chance levels. When children with demonstrated side preferences and items that were problematic were both eliminated from the analyses, the main effect of labelling condition was lost, but the finding that shape matches were chosen in the label condition at greater than chance levels remained. When no label was provided, children chose about equally between shape matches and dissimilar taxonomic matches.

The results of Experiment 3, including all subjects and all items, showed that children did not make significantly more superordinate choices in the label condition than in the no label condition. Children chose about equally between thematic and superordinate choices in each condition, and their responding in both conditions was at chance level. The results after eliminating children with side preferences and removing problematic triads showed a similar lack of significant difference in responding between the two conditions. In the presence of a novel label, however, the children chose the taxonomic matches at greater than chance levels, while in the no label condition, they chose about equally between

the thematic choices and dissimilar taxonomic choices.

Taken together, the results of the two experiments suggest a coherent pattern in young children's word extension behaviour. First, it seems that 2-year-olds are indeed guided by shape similarity in extending novel labels. When the children in Experiment 2 believed they were learning a new word, they were willing to choose the shape matches even when they knew the objects similar in shape cut differed in taxonomic kind. Conversely, they paid less attention to the taxonomic matches in the presence of a novel label. This finding suggests that young children take shape into consideration as an important factor when extending object labels.

Second, the results of Experiment 3 show that when taxonomic relations were pitted against thematic relations, children were able to extend novel labels to objects from the same superordinate category, despite the fact that shape similarity was controlled and made equivalent in the thematic and taxonomic choices. This result suggests that 2-year-old children do have some access to knowledge about superordinate category membership even when the category members are highly dissimilar from one another in shape. This finding seemed to be particularly true of children who had a more referential linguistic style: the higher the proportion of nouns in the children's vocabulary, the more they increased their taxonomic responding from the no label condition to the label condition. The more referential children may have more nouns in their vocabulary because they are paying special attention to categorical information when

presented with word learning situations.

Two-year-old children thus seem to be relying on both shape similarity and category membership when extending a novel label. When shape is pitted against category membership, shape seems to take precedence as a clue for word extension. In the absence of shape information, however, children 2 years of age do show some ability to make use of more abstract conceptual information when extending words.

The data from these two experiments are consistent with the findings of traditional noun-category bias studies done with children of preschool age. When preschoolers in previous studies chose more taxonomic matches than thematic matches in the label condition, they may have been responding based on shape similarity, since the taxonomic matches typically resembled the standards, or alternatively they may have been responding based on the deeper taxonomic relationship between the objects. It is also possible that they were using a combination of the two types of strategy in their attempts to extend words.

The results of Experiment 3, in which thematic matches were pitted against taxonomic matches, show some consistency with the results of the second experiment conducted by Baldwin (1992), in which she also pitted thematic matches against taxonomic matches where shape similarity with the standards was minimized. Her finding that the use of novel labels led to a significant increase in 3- to 5-year-old children's level of taxonomic responding is consistent with the present finding that 2-year-old children made taxonomic choices in the label

condition at greater than chance levels. In addition, it provides support for the argument that in word learning contexts, children older than 2 years can focus on taxonomic relations even in the absence of shape similarity. It is somewhat puzzling, however, that the children in Baldwin's experiment did not choose taxonomic matches at above chance levels. If children improve over time in their ability to use conceptual information in word extension, one would expect that like the 2-year-olds in the present Experiment 3, the older children in Baldwin's study would have made taxonomic choices at above chance levels in the label condition. Since the children in Baldwin's experiment chose about equally between thematic and taxonomic matches in the label condition, one can only say that the label pulled children away from the thematic matches, and not necessarily toward the taxonomic matches. Since Baldwin used line drawings instead of coloured pictures and did not test children's recognition, it is possible to conjecture that the children in her study did not always recognize the taxonomic matches. In addition, Baldwin tested only 10 subjects per condition in her experiment. The use of a familiar picture set, in addition to a within-subject design and a larger sample size, may have facilitated the finding of the present study that 2-year-olds chose taxonomic matches at greater than chance levels in the presence of a label.

An additional limitation of Baldwin's study is that 3- to 5-year-old children were collapsed into one group. It remains unclear whether there might be a developmental shift between the ages of 3 and 5 years which was masked by

including all the children in one group. Thus, there is still a need to determine the developmental course of children's ability to use abstract information about taxonomic relationships in word learning contexts between 2 and 3 years of age.

The results of Experiment 2, pitting shape similarity against taxonomic relations, are consistent with the recent findings of Imai and Gentner (1993) in demonstrating the primacy of shape in a word learning context. In their study, given a choice between shape, taxonomic, and thematic alternatives, both 3- and 5-year-olds selected shape alternatives at above chance levels in the word condition, while taxonomic selections were made at levels below chance. This finding resembles the present findings with 2-year-olds in Experiment 2, and suggests that the primacy of shape in word extension tasks extends well beyond the age of 2 years. The third experiment in Baldwin's (1992) series also provides some evidence that 3- to 5-year-olds increase their attention to shape in word learning contexts, although the effect is somewhat weaker in that study. It is possible that the different stimuli used in the different studies account for some of the variance in the results.

Imai and Gentner (1993) also report in their study that 5-year-olds made significantly more taxonomic choices in the word condition than in the no word condition, while 3-year-olds did not. Based on this finding they argue that there is a developmental shift between the ages of 3 and 5, in which there is an increase in the attention paid to abstract categorical information. It may be, however, that while 3-year-olds are indeed capable of accessing taxonomic information and

would do so under different circumstances, the presence of a powerful shape alternative in Imai and Gentner's study led them to ignore taxonomic relationships in favour of shape. Thus, a developmental shift in the ability to respond to taxonomic relationships in word learning contexts between the ages of 3 and 5 years cannot be clearly established until 3-year-olds are compared with 5-year-olds on a task in which shape similarity matches are not available to overshadow the taxonomic matches. A developmental shift in attention to taxonomic information seems more likely to occur between the ages of 2 and 3 years, when children learn a great deal about object words and taxonomic relationships, than between the ages of 3 and 5 years.

In most of the analyses in the present Experiment 2 it was found that children chose shape responses at below chance levels in the no label condition. By extension, they chose the alternative taxonomic choices at above chance levels. This finding is somewhat curious given that in the standard noun-category bias studies in which thematic relations were pitted against taxonomic relations, children usually chose about equally in the no label condition (Markman & Hutchinson, 1984; Waxman & Kosowski, 1990). The results are consistent, however, with Baldwin's (1992) experiment pitting shape against category membership. In that study children also preferred taxonomic matches to shape matches in the no label condition. One explanation for these findings is that when no label is heard, children make their choices based on whatever knowledge they already possess about the relationships between the items presented. In this case,

when told "find another one", children may know that the taxonomic match is conceptually related to the standard while the shape match is not. Support for this argument comes from another of Baldwin's (1992) experiments, in which children chose thematic matches over shape matches in the no label condition. Again, they may have recognized the conceptual relationship between the thematic matches and the standards and thus chose them more often than the shape matches. It is possible that in standard noun-category bias tasks as well as in the present Experiment 3, children chose equally between the thematic and taxonomic matches in the no label condition because they had knowledge about the conceptual relationship represented by each one. If this is the case, then it is all the more striking and meaningful that when children heard a novel label in the present Experiment 2 and in Baldwin's studies, they were pulled away from the conceptual relationship and towards shape similarity. It should also be noted that children's ability to put their knowledge to use may also depend on the particular triads used in each different experiment.

An unexpected difficulty encountered in this study was that approximately 40% of the children in each experiment demonstrated side preferences at above chance levels. In Experiment 3, the presence of side-biased children influenced the final results more than did the presence of unrecognized triads. In the label condition, the mean percentage of superordinate choices only changed from 53.46% to 52.06% when unrecognized triads were removed, but increased to 58.73% when side preference subjects were removed. It seems that side

preference children may indeed have been responding randomly, and the inclusion of their data in the analyses contributed to the overall pattern of nonsignificant results in Experiment 3. Their removal allowed the more systematic pattern of above chance superordinate responding in the label condition to be detected. In Experiment 2, it seems that the shape effect in the label condition was sufficiently strong to be detectable even when side preference subjects were included in the analyses.

It remains unclear how the side preference children differed from the others, and for this reason one must remain cautious about generalizing the results of this study to all 2-year-olds. Analyses revealed no differences between side preference children and the other children in age, gender, vocabulary level or linguistic style. Other possibilities which could not be easily tested include temperamental differences, intelligence level, experience with picture books, and differences in attention span. While no other researchers have reported side preferences, few have tested children younger than preschool age and none have tested a group of children with a mean age as low as 24.5 months. Because the children in this study were so young, warm-up trials using simple colour matches or something similar might have been useful in showing the children that they could successfully choose pictures from both sides of the apparatus. Another solution to this problem might be to use the less demanding preference-looking paradigm with children this young instead of the more demanding forced-choice technique.

The results of the present series of experiments suggest that while 2-year-old children are already guided by taxonomic relationship in extending novel labels, shape takes precedence over category membership, as shown in Experiment 2. Further support would be given to these results if they were replicated with 2-year-olds with a different task, such as the preference-looking technique. In addition, given that there remains some doubt about the course of development of children's attention both to shape and to more abstract category membership between the ages of 2 and 5 years, it would be useful to repeat the two experiments in this study with both 3- and 5-year-old children.

If 2-year-old children can extend novel labels based on deep taxonomic relationships when these are pitted against thematic relations, then they should be even more highly responsive to taxonomic relations when these are pitted against unrelated objects. A task pitting taxonomic relations against unrelated foils should lead to an increase in superordinate choices in 2-year-olds. Such a finding would lend further support to the idea that young children are capable of extending novel labels to category members even when no shape similarity is shared.

In Experiment 2, matches sharing only shape similarity with the standard were pitted against matches sharing only category membership. A future study might include matches sharing only shape similarity with the standard pitted against basic level matches, which usually contain both taxonomic and shape information. While children in the present study preferred shape associates when they heard a novel label, it is possible that in the presence of a basic level

taxonomic alternative which contains both shape and category information, children would make more basic level choices. Such a finding would lend support to the idea that young children can weigh the relative contributions of both types of information in a fairly complex manner.

The finding that there was a correlation between children's linguistic style and their likelihood of choosing taxonomic matches in the presence of a novel label in Experiment 3 suggests that children are not all equally aware of categorical relations by 2 years of age. Thus, it seems that age 2 may be a transitional age in the development of attention to categorical information in the context of word learning. An avenue for future study would therefore be to determine whether children at the age of 12 or 13 months, when language production emerges, are able to focus on categorical relations. If the age of 2 years is indeed transitional, then research with younger children should reveal an ability to focus on shape similarity, but a lack of attention to categorical relations.

The complex process of identifying the various influences on children's word extension behaviour will help to elucidate how children so quickly and successfully converge on the correct meanings of object labels.

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Appendix A

Consent Form for Adult Rating Study

In this study, we are examining adults' assessment of shape similarity. The study consists of a single session lasting approximately 30 minutes. During this time you will be asked to complete a questionnaire concerning the appearance of various drawings presented by the experimenter. Upon completion of the entire session you will be paid $5.00 for your participation. All of your responses will remain confidential. The experimenter will be glad to answer any questions about the purpose of this study after the session is over. Thank you for your participation.

Diane Poulin-Dubois, Ph.D.
Associate Professor
Department of Psychology

Ilana Frank, B.A.
M.A. Candidate

I have read the above description of this study and I understand that my participation will remain confidential. I understand that I am free to discontinue my participation at any time.

I hereby agree to participate in this study.

Signature

Date

Subject # ___ ___

Appendix B

List of Triads Used in Experiment 2

Standard	Shape Match	Superordinate Match
1. butterfly	hair bow	tiger
2. apple	ball	tea biscuit
3. hat	cake	shirt
4. banana	phone receiver	strawberry
5. soap	small box	toothbrush
6. baby bottle	large crayon	bowl
7. palm tree	duster	plant
8. bicycle	glasses	truck
9. baseball cap	duck's face	shorts
10. ice cream cone	hand puppet	tomatoes
11. snake	skipping rope	cow
12. pleated skirt	lampshade	trousers
13. donut	wheel	slice of bread
14. garden chair	ostrich	table

Appendix C

List of Triads Used in Experiment 3

Standard	Thematic Match	Superordinate Match
1. butterfly	flower	tiger
2. apple	knife	tea biscuit
3. hat	head	shirt
4. banana	monkey	strawberry
5. soap	bathtub	toothbrush
6. baby bottle	highchair	bowl
7. palm tree	bird	plant
8. bicycle	child	truck
9. baseball cap	head	shorts
10. ice cream cone	bib	tomatoes
11. snake	grass	cow
12. pleated skirt	closet	trousers
13. donut	plate	slice of bread
14. garden chair	person	table

Appendix D

Instructions to Adult Raters in Experiment 1

Similarity Rating Task

In this study, you will be shown 42 pairs of drawings. The drawings will be presented one pair at a time by the experimenter. Your task will be to rate the degree of SHAPE similarity between the two members of each pair, using the 7-point rating scale provided for each. If the two items of the pair look highly similar to each other in SHAPE, then you should circle the number 7. If the two drawings look moderately similar in SHAPE, then circle 4. If the SHAPE resemblance is minimal, then circle 1. Be sure to use the whole scale, circling any of the numbers from 1 through 7.

You may notice that the drawings are related to each other in ways other than shape. For example, they may represent items from the same category, such as a glass and a mug. For the purposes of this task, please IGNORE these other relationships, and focus ONLY on the SHAPE similarity.

In addition, please do not rate the similarity between these objects as they exist in the real world; instead, focus on the items as they are represented in **these particular pictures**.

Remember, the **more** the two pictures resemble each other in SHAPE, the **higher** the number you should circle on the scale. Please be careful not to skip any pictures.

Appendix E

Ratings Questionnaire Used in Experiment 1

Subject #: _____ Gender: _____ Age: _____

Pair #	Low Shape Similarity		Moderate Shape Similarity			High Shape Similarity	
1) apple - knife	1	2	3	4	5	6	7
2) bicycle - child	1	2	3	4	5	6	7
3) bottle - highchair	1	2	3	4	5	6	7
4) palm tree - plant	1	2	3	4	5	6	7
5) hat - cake	1	2	3	4	5	6	7
6) butterfly - tiger	1	2	3	4	5	6	7
7) skirt - closet	1	2	3	4	5	6	7
8) butterfly - flower	1	2	3	4	5	6	7
9) apple - cookie	1	2	3	4	5	6	7
10) hat - head	1	2	3	4	5	6	7
11) donut - tire	1	2	3	4	5	6	7
12) apple - ball	1	2	3	4	5	6	7
13) hat - shirt	1	2	3	4	5	6	7
14) cap - shorts	1	2	3	4	5	6	7
15) ice cream - bib	1	2	3	4	5	6	7
16) skirt - lamp	1	2	3	4	5	6	7

Pair #	Low Shape Similarity			Moderate Shape Similarity			High Shape Similarity
17) palm tree - duster	1	2	3	4	5	6	7
18) soap - bathtub	1	2	3	4	5	6	7
19) butterfly - bow	1	2	3	4	5	6	7
20) bottle - crayon	1	2	3	4	5	6	7
21) chair - ostrich	1	2	3	4	5	6	7
22) snake - jump rope	1	2	3	4	5	6	7
23) banana - phone	1	2	3	4	5	6	7
24) ice cream - tomato	1	2	3	4	5	6	7
25) chair - table	1	2	3	4	5	6	7
26) donut - bread	1	2	3	4	5	6	7
27) banana - strawberry	1	2	3	4	5	6	7
28) bottle - bowl	1	2	3	4	5	6	7
29) palm tree - bird	1	2	3	4	5	6	7
30) soap - toothbrush	1	2	3	4	5	6	7
31) skirt - pants	1	2	3	4	5	6	7
32) cap - duck	1	2	3	4	5	6	7
33) banana - monkey	1	2	3	4	5	6	7
34) chair - person	1	2	3	4	5	6	7
35) soap - box	1	2	3	4	5	6	7
36) cap - head	1	2	3	4	5	6	7

Pair #	Low Shape Similarity			Moderate Shape Similarity			High Shape Similarity
37) donut - plate	1	2	3	4	5	6	7
38) snake - cow	1	2	3	4	5	6	7
39) bicycle - truck	1	2	3	4	5	6	7
40) ice cream - puppet	1	2	3	4	5	6	7
41) snake - grass	1	2	3	4	5	6	7
42) bicycle - glasses	1	2	3	4	5	6	7

Appendix F

Parental Consent Form for Experiments 2 and 3

Infant's name: _____ Birthdate: _____

Gender: _____ Exact gestational period: _____ Birth order:_____

Mother's name: _____ Father's name: _____

Address: _____ Telephone: _____(home)

_____ _____(work)

Mother's occupation: _____ Father's occupation: _____

In this study, we are examining children's cognitive and language development. We will show children pictures and ask them to select those pictures that belong together. The session will be videotaped and all data collected will be kept confidential.

_____ _____ _____

Diane Poulin-Dubois, Ph.D. Susan Graham, M.A. Ilana Frank, B.A.

The nature and purpose of this study have been satisfactorily explained to me and I agree to allow my child to participate. I understand that we are free to discontinue participation at any time and that the experimenters will gladly answer any questions that might arise during the course of the research.

_____ _____

Parent's signature Date

I would be interested in participating in future studies with my child (yes/no): ____

Subject #: _____ Researcher: _____

Appendix G

Novel Labels Used for Standards in the Label Condition in Experiments 2 and 3

Standard	Novel Label
1. butterfly	dobit
2. apple	kimen
3. hat	hogid
4. banana	toray
5. soap	honus
6. bottle	sakan
7. palm tree	umas
8. bicycle	tornad
9. baseball cap	nekin
10. ice cream cone	akid
11. snake	kitas
12. skirt	tosep
13. doughnut	fadas
14. chair	shiret

Appendix H

Coding Sheet for Children's Responses in Experiment 2

Subject #:_____ Date: _____ Examiner:____ Order:_____

	Standard	Shape	Superordinate	Position Chosen
1.	butterfly____	bow____	tiger____	L R
2.	apple____	ball____	cookie____	L R
3.	hat____	cake____	shirt____	L R
4.	banana____	phone____	strawberry___	L R
5.	soap____	box____	toothbrush____	L R
6.	bottle____	crayon____	bowl____	L R
7.	palm tree____	duster____	plant____	L R
8.	bicycle____	glasses____	truck____	L R
9.	hat____	duck____	shorts____	L R
10.	ice cream____	puppet____	tomato____	L R
11.	snake____	jump rope____	cow____	L R
12.	skirt____	lamp____	pants____	L R
13.	doughnut____	tire____	bread____	L R
14.	chair____	ostrich____	table____	L R

Appendix I

Instructions for Coding Children's Picture Choices in Experiments 2 and 3

The purpose of this coding is to establish which picture the child has chosen on each of the 14 different trials.

Always record only the item the child actually gives to the puppet.

For example, if the child points to, touches or names one or both pictures and then hands one to the puppet, record only the picture given.

Similarly, if the child picks up both pictures and tries to give them to the puppet, record only the one ultimately given by the child.

Appendix J

Source Tables for Analyses of Variance in Experiment 2

Table 1

All Subjects and All Triads Included

SOURCE	SS	DF	MS	F
Between Subjects				
Order	145.12	1	145.12	.29
Error	23324.26	46	507.05	
Within Subjects				
Condition	3404.90	1	3404.90	10.76***
Order x Condition	598.78	1	598.78	1.89
Error	14552.15	46	316.35	
Total	42025.21	95		

* $p<.05$
** $p<.01$
*** $p<.005$

Table 2

Non-Biased Subjects, All Triads Included

SOURCE	SS	DF	MS	F
Between Subjects				
Order	30.61	1	30.61	.05
Error	17945.58	28	640.91	
Within Subjects				
Condition	2860.54	1	2860.54	11.00***
Order x Condition	166.67	1	166.67	.64
Error	7278.91	28	259.96	
Total	28282.31	59		

* $p<.05$
** $p<.01$
*** $p<.005$

Table 3

All Subjects Included, Known Triads Only

SOURCE	SS	DF	MS	F
Between Subjects				
Order	18.91	1	18.91	.03
Error	29223.19	46	635.29	
Within Subjects				
Condition	6354.60	1	6354.60	11.02***
Order x Condition	1312.93	1	1312.93	2.28
Error	26515.97	46	576.43	
Total	34183.50	95		

* $p<.05$
** $p<.01$
*** $p<.005$

Table 4

Non-biased Subjects, Known Triads Only

SOURCE	SS	DF	MS	F
Between Subjects				
Order	15.00	1	15.00	.02
Error	17201.67	28	614.35	
Within Subjects				
Condition	1215.00	1	1215.00	2.76
Order x Condition	97.96	1	97.96	.22
Error	12312.04	28	439.72	
Total	30841.67	59		

* $p<.05$
** $p<.01$
*** $p<.005$

Appendix K

Instructions for Coding Recognition of Pictures

The purpose of this coding procedure is to determine whether the pictures are recognizable to the children.

In cases where children produce words that do not exactly match the target word, one needs to decide, based on their productions, whether they did indeed recognize the picture.

The following are cases when you should judge that yes, the child does recognize the picture:

1) The word produced is synonymous with the target word, e.g. "light" for "lamp".

2) The word refers to an associated item from the same superordinate category, e.g. "pants" for "shorts", or "cow" for "tiger". That is, as long as the word provided is, for instance, the name of another animal, or another item of clothing, it is acceptable as a demonstration of recognition.

You will need to be careful in cases where the name could be referring to a part of the object; e.g., calling a snake "elephant" might be because the snake looks like an elephant's trunk. Also, be careful in cases where the production might imply that the child is confusing the object with another object.

3) The child shows recognition by describing the function of the object, e.g. "eat" for bowl, or demonstrates the item or its function, such as pointing to his or her own shirt.

4) Child produces the sound an animal makes, such as "oink" for pig.

5) Child uses idiosyncratic word or baby language for an item, such as "um" for food.

6) Child uses a nonsense word, but uses it consistently for all the items in the same category, and only for that category, e.g. "dax" for all animals.

7) Proper names for human-type figures are acceptable.

Appendix L

Coding Sheet for Children's Responses in Experiment 3

Subject #:_____ Date: _____ Examiner: ___ Order: _____

	Standard	Thematic	Superordinate	Position
1.	butterfly___	flower___	tiger___	L R
2.	apple___	knife___	cookie___	L R
3.	hat___	head___	shirt___	L R
4.	banana___	monkey___	strawberry___	L R
5.	soap___	bathtub___	toothbrush___	L R
6.	bottle___	highchair___	bowl___	L R
7.	palm tree___	bird___	plant___	L R
8.	bicycle___	child___	truck___	L R
9.	hat___	head___	shorts___	L R
10.	ice cream___	bib___	tomato___	L R
11.	snake___	grass___	cow___	L R
12.	skirt___	closet___	pants___	L R
13.	doughnut___	plate___	bread___	L R
14.	chair___	person___	table___	L R

Appendix M

Source Tables for Analyses of Variance in Experiment 3

Table 1

All Subjects and All Triads Included

SOURCE	SS	DF	MS	F
Between Subjects				
Order	95.28	1	95.28	.38
Error	7218.74	29	248.92	
Within Subjects				
Condition	16.94	1	16.94	.10
Order x Condition	569.94	1	569.94	3.42
Error	4834.93	29	166.72	
Total	12735.83	61		

* $p < .05$
** $p < .01$
*** $p < .005$

Table 2

Non-Biased Subjects, All Triads Included

SOURCE	SS	DF	MS	F
Between Subjects				
Order	204.08	1	204.08	.82
Error	3990.93	16	249.43	
Within Subjects				
Condition	362.81	1	362.81	1.97
Order x Condition	566.89	1	566.89	3.08
Error	2947.85	16	184.24	
Total	8072.56	35		

* $p < .05$
** $p < .01$
*** $p < .005$

Table 3

All Subjects Included, Known Triads Only

SOURCE	SS	DF	MS	F
Between Subjects				
Order	388.03	1	388.03	1.49
Error	7573.86	29	261.17	
Within Subjects				
Condition	11.93	1	11.93	.04
Order x Condition	914.67	1	914.67	2.77
Error	9565.32	29	329.84	
Total	18453.81	61		

* $p<.05$
** $p<.01$
*** $p<.005$

Table 4

Non-biased Subjects, Known Triads Only

SOURCE	SS	DF	MS	F
Between Subjects				
Order	350.82	1	350.82	1.18
Error	4754.17	16	297.14	
Within Subjects				
Condition	283.09	1	283.09	.74
Order x Condition	834.57	1	834.57	2.17
Error	6146.06	16	384.13	
Total	12368.71	35		

* $p < .05$
** $p < .01$
*** $p < .005$