General and Specific Word Knowledge as Predictors of Children's Categorization

Rachel M.Whipple

Carnegie Mellon University

Running Head: General and Specific

Abstract

There is a debate in the literature as to whether young children's categorization abilities are more closely related to their general productive vocabulary or their specific word knowledge. The present study examines this relationship in children 18 to 26 months of age. Specifically, it tests the hypothesis that children's understanding of individual words is more closely related to their category performance than the overall size of their productive vocabulary. Twenty children at 19 months (range= 18-20 months) and 25 months of age (range= 24-26 months) participated in the study. Children's category performance was assessed using an object manipulation task with novel objects. Half of the children received novel names for the novel objects, and half did not. Two measures were then assessed: children's knowledge of the novel names in a comprehension test, and children's productive vocabulary outside of the laboratory, as measured by a parental checklist. Consistent with previous findings, the results indicate that children with larger productive vocabularies show more advanced categorizing. More importantly, however, the data suggest that children who received names for the novel objects outperformed children who did not receive the names, regardless of the size of their productive vocabulary. These findings suggest that hearing object names help children categorize objects, and may be a better predictor of children's category performance than their productive vocabulary.

General and Specific Word Knowledge as Predictors of Children's Categorization

Children experience rapid advances in their cognitive and linguistic abilities toward the end of their second year. One important cognitive skill that appears during this time is their ability to categorize objects. Researchers have observed that when young children are presented with two distinct categories of objects in an object manipulation task, they may exhibit spontaneous sorting behavior in which they sequentially touch, and sometimes spatially group, first one and then the other set of objects (e.g. Riccuiti, 1965; Starkey, 1981; Sugarman, 1981). This dual sorting behavior, involving both classes of objects, indicates that children are able to recognize the similarities and differences between category members (Riccuiti, 1965; Sugarman, 1981). According to Sugarman (1981), this advanced sorting behavior indicates that children are able to "extend a class to a set of discrete elements." Researchers suggest that this implies representational thought. That is, children are able to conceptualize that several things that exist are from the same category and are the same "kind" of thing (Riccuiti, 1965; Sugarman, 1981).

Numerous researchers have used an object manipulation task to study age related changes in category development. Categorization performance is found to increase with age. For example, Starkey (1981) examined children's categorization abilities at six, nine, and 12 months of age. He found that categorization behaviors were absent at six months of age, however by 12 months of age, children reliably sequentially touched three or four objects from one category. Also, he found that dual category behavior, in which children spatially group two categories of objects separately or sequentially touch both categories of objects, had not yet appeared at 12 months of age. Based on these results, Starkey suggested that selective manipulation of one class of objects emerged somewhere between

nine and 12 months of age. Using the same task, Sugarman (1981) documented an increase in children's abilities to dual categorize two classes of objects from 18 to 36 months. She found that by 36 months, children were reliably able to selectively touch or group both sets of objects. Additionally, Riccuiti (1965) found a sharp increase in advanced category behavior at 18 months of age, which he explained as possibly an effect of sampling variation or a methodological flaw. More recently, however, other researchers have documented a similar increase around this age (e.g. Gopnik & Meltzoff, 1987; Poulin-Dubois, Graham, & Sippola, 1995). Current research has focused on the relationship between cognitive development and concurrent increases in categorization abilities.

One important milestone that usually occurs around 18 months of age is a period of accelerated vocabulary growth, known as the vocabulary spurt. During this time, children add new words to their productive vocabularies at an accelerated rate (Benedict, 1979). The vocabulary spurt is not an entirely universal phenomenon, but for most children it usually occurs between 18 to 20 months of age, or after they have over 50 words in their productive vocabularies (Gershkoff-Stowe & Smith, 1997; Goldfield & Reznick, 1990). Several researchers have investigated the developmental relationship between this linguistic advancement and concurrent developments in categorization. For example, Gopnik and Meltzoff (1987) reported a close temporal association between the development of advanced categorization skills and the onset of the vocabulary spurt. All of the children in their study demonstrated advanced category behavior before or at the same time as the onset of the vocabulary spurt, suggesting that children need to have achieved certain cognitive milestones in order to experience a vocabulary spurt. Further,

they suggested that infants reflect the knowledge that objects belong in categories by naming and grouping objects. Poulin-Dubois, Graham, and Sippola (1995) also found that children experienced a significant improvement in categorization skills at the onset of the vocabulary spurt. Their findings additionally support Gopnik and Meltzoff's (1987) claim that the advancement of these cognitive abilities is temporally related to the onset of the naming explosion.

However, if these claims hold true, what are the implications for children who fail to demonstrate a rapid increase in their productive vocabulary? In Goldfield and Reznick's (1990) longitudinal study, five out of 18 children did not demonstrate a vocabulary spurt. Were those five children unable to achieve advanced categorization skills? Research by Gershkoff-Stowe, Thal, Smith, and Namy (1997) suggests otherwise. They failed to replicate Gopnik and Meltzoff's (1987) finding that the onset of the vocabulary spurt was strongly related to the emergence of advanced categorization skills. Instead, they suggested that increased categorization abilities should be more closely related to children's word comprehension rather than production. They reasoned that if, as Gopnik and Meltzoff (1987) suggested, children reflect their understanding of categories by word production, then it follows that this knowledge would be first reflected in word comprehension which typically precedes production (Ingram, 1974). In support of this idea, Gershkoff-Stowe et al. (1997) additionally compared children who were "late-talkers," with a small productive vocabulary, to children who were matched in age and also children who were matched in productive vocabularies. They found that the late-talkers reliably outperformed the vocabulary-matched children in a categorization task, but did not perform reliably differently than the age-matched children. This finding further supports

the idea that comprehension, rather than production, is more closely associated with the emergence of advanced categorization behavior.

Riccuiti, Thomas, and Riccuiti (1999) added further support to the claim that children's comprehension of words is closely related to their categorization abilities. In their study, children were presented with an object manipulation task in which they were encouraged to sort common objects for which they had names (e.g. cup, shoe). They found that children's advanced category behavior in this task was highly correlated with their knowledge of the labels for the common objects. Additionally, Waxman and Markow (1995) found that giving infants novel names for objects helped them categorize these objects. They suggested that labels may help infants form categories of objects, as giving several different objects the same label implies that they are the same "kind" of thing.

Taken together, the literature presents contradictory evidence concerning what factors are related to changes in children's categorization abilities. Is the emergence of advanced categorization abilities more closely related to children's productive vocabulary, as Gopnik and Meltzoff (1987) and Poulin-Dubois et al. (1995) suggested? Or, is comprehension a better predictor of children's categorization skills, as Gershkoff-Stowe et al. (1997) suggested? A related question, based on Riccuiti and colleagues' (1999) findings, is how specific word knowledge is related to children's ability to categorize. The purpose of the current study is to address these questions exploring whether understanding and labeling novel objects facilitates children's ability to categorize those objects at different stages of productive vocabulary growth.

Specifically, the present study compares the categorization skills of children during and after the vocabulary spurt using a standard object manipulation task (Riccuiti, 1965;

Sugarman, 1981). In order to locate children who were either experiencing the vocabulary spurt, or who had already passed through this linguistic milestone, children from two age groups were initially recruited: 18-20 months, and 24-26 months of age. These age groups were selected on the basis on Goldfield and Reznick's (1990) findings that most children experience the vocabulary spurt between 18-20 months, and further experience a decline in the rate of vocabulary growth at 24 months when children begin to put words together in sentences. Because age is not always an accurate predictor of vocabulary, once recruited on the basis of age, children were instead compared on the basis of productive vocabulary size. Children in the High Vocabulary group had greater than 150 words in their productive vocabulary, as measured by a parental checklist, while children in the Low Vocabulary group had less than 150 words in their productive vocabulary. We chose 150 words as a cut-off point because research has indicated that children who are beginning the vocabulary spurt have generally less than 150 words in their productive vocabulary (Goldfield & Reznick, 1990).

All children were presented with an object manipulation task to assess their categorization skills. The objects presented to the children in the task were novel objects. To investigate the relationship between specific word knowledge and categorization, half of the children in each age group received novel names for the experimental objects prior to the object manipulation task (Name condition) and half of the children were exposed to but did not receive names (No Name condition). A comprehension task was used to obtain a measure of whether children in the Name condition understood the names assigned to the experimental objects. Children in the No Name condition were not tested on their understanding of the names, but were again presented with the novel objects in a

comparable control task. Additionally, parents completed a detailed vocabulary checklist estimating the size of the child's productive vocabulary. These vocabulary measures, yielded, first, a comprehension score of the novel words used in the study, and second, an overall productive vocabulary estimate. Taken together, these two measures allowed examination of the relationship between children's word comprehension and production abilities and their categorization skills.

As in previous research (Rakison & Butterworth, 1998; Sugarman, 1981), sequential touching was used as a measure of children's category performance. The logic behind using sequential touching as a measure of categorization is that if children sequentially touch objects within a category more often than chance, it suggests that they recognize commonalties between the objects. That is, they see these objects as related by category (Mandler, Fivush, & Reznick, 1987). Two methods of examining categorization through sequential touching were used. First, I looked at whether children were systematically touching the objects within a category. Then, I examined the sophistication of children's categorization by classifying children as single or dual categorizers. Children who were single categorizers only systematically touched objects from one category within an object set, while children who were dual categorizers systematically touched both categories of objects within the set. Dual categorization is a more advanced behavior, as it indicates that children are not only recognizing the commonalities between objects in one category, but also the differences between two categories of objects (Sugarman, 1981).

I looked at how children's categorization was related to their productive vocabulary as well as their comprehension of the individual experimental words. Three hypotheses were tested. First, in accordance with previous research (Poulin-Dubois et al, 1995), I

hypothesized that children with larger productive vocabularies would show more advanced categorization than children with smaller productive vocabularies. However, following Riccuiti et al.'s (1999) finding that children's knowledge of objects names was closely related to their ability to categorize them, I predicted that learning the specific names of individual objects would help children categorize them. Thus, I hypothesized, in addition, that children from both the High and Low vocabulary groups in the Name condition would outperform children in the No Name condition. This would lend support to the idea that children's comprehension of words is more closely related to their categorization abilities than their productive vocabulary (Gershkoff-Stowe et al., 1997). Finally, I hypothesized that children with low vocabularies would benefit more from receiving names for the objects than children with larger productive vocabularies. I reasoned that children during the vocabulary spurt are just beginning to show advanced category performance, and labeling the objects might further highlight relationships between them, as Waxman and Markow (1995) suggested. Thus, I expected that children in the Name condition in the Low vocabulary group would outperform children in the Name condition in the High vocabulary group.

Method

Participants

A total of 20 children, 10 boys and 10 girls, from the Pittsburgh area participated in the study. Parents initially received a letter describing the study, and were subsequently contacted by telephone. All of the children were learning English as their first language, and were from middle-class families. Children were given a stuffed animal or a child-size T-shirt for participating in the study.

Two age groups were tested: 10 children were 19 months (range= 18- 20 months) and the remaining 10 children were 25 months (range = 24-26 months). Parents completed the MacArthur Communicative Developmental Inventory (Fenson, et al., 1993), a checklist of words typically found in young children's vocabularies. This checklist provided a measure of the children's productive vocabulary. Within both age groups, children were divided into two vocabulary groups: the High Vocabulary group and the Low Vocabulary group. Children who had greater than 150 words in their productive vocabulary were assigned to the High Vocabulary group, and children who had less than 150 words in their productive vocabulary were assigned to the Low Vocabulary group. Eleven children total were in the High Vocabulary group and nine children were in the Low Vocabulary group. Because children were randomly assigned to condition by age initially, the vocabulary groups were not equivalent in both conditions. These two vocabulary groups were then compared on their ability to categorize the experimental objects.

Materials

The stimuli consisted of three sets of novel objects. Each set contained two distinct categories of four non-identical objects. Thus, children were presented with a total of eight novel objects per set. The novel objects in each set varied in terms of size, shape, color, and texture. Photographs of the novel objects in each set can be found in Appendix A. Additionally, novel names were assigned to the experimental objects, which were counterbalanced across objects (see Appendix B).

Procedure

Each child participated in one experimental session, which lasted approximately 30 minutes. Parents were present for the entire session. Children either sat on their parents'

lap or next to them on a couch facing a table. The experimenter was seated across the table from the parent-child dyad. Sessions were videotaped for later coding. In the beginning of the experimental session, the parent completed the MacArthur Communicative Developmental Inventory. The experimenter used this time to engage the child in free play, which allowed the child to become more accustomed to the experimenter and the laboratory.

This study is a 2 x 2 between-subjects design, with vocabulary size and condition as the two factors. Children from each age group were randomly assigned to one of two experimental groups: A Name condition and a No Name condition. Within each condition, children were instead compared on the basis of vocabulary size. Children in both conditions participated in three segments of the experiment after the initial free-play time: a familiarization phase, a comprehension task, and a categorization task.

Familiarization Phase

During the familiarization phase, both groups of children saw three sets of objects. Each set was comprised of two categories containing four non-identical novel objects each. Children in the Name condition were introduced to one novel exemplar from each category per set. Thus, the children were presented with a total of six objects, one at a time, during the familiarization. A novel name (e.g. “dax”) was assigned to each of the six exemplars. The order of presentation of the stimuli and the novel names assigned to the objects were counterbalanced across children. The experimenter repeated the novel name of the object at least six times while performing one of three actions with the object. The experimenter would either put the object down a clear plastic tube, put it through a small basketball hoop, or “give it a ride” in a small plastic cup. For example, the experimenter would say,

"Look at what the dax can do!" while putting the object through the basketball hoop. The children were encouraged to imitate the action with the object. Presenting the names of the objects while performing an action not only kept the children's interest in the object, but also allowed the experimenter to present the name of the object in a naturalistic setting. The action paired with each novel object was counterbalanced.

To control for the amount of exposure to the novel objects, children in the No Name condition were presented with the novel objects using the same procedure, but did not receive names for the objects. Instead, while performing an action with the object, the experimenter referred to the object as "this or that." For example, the experimenter would say, "Look at what this can do!" while putting the object down the plastic tube.

Comprehension Task

Immediately following the familiarization phase, children in the Name condition were tested on their comprehension of the novel names. The six stimuli that were labeled during the familiarization phase were randomly arranged on the table in front of the child. Using the novel names, the experimenter asked the child to identify each of the novel objects. For example, the experimenter would say, "Where's the dax?" The experimenter identified the correct object if the child was unable to locate it after the first attempt or if the child did not respond to the request. When scoring the comprehension measure, the response was counted as correct if the child chose the appropriate object during the first attempt.

Because children in the No Name condition did not receive names for the novel objects, they were not tested on their comprehension. However, in order to control for the amount of exposure both groups had to the stimuli, the children in the No Name condition

were presented an array of the six objects they saw in the familiarization phase. The experimenter asked the children to show her each of the objects. The experimenter would say, "Can you show me one?"

For both children in the Name condition and the No Name condition, the experimenter and the parent gave children only positive feedback during both the familiarization phase and the comprehension task.

Categorization Task

The categorization task was identical for children in both the Name and the No Name conditions. Individual children were presented with two classes of four objects randomly arranged on a tray. The child was encouraged to play with the objects for 2.5 minutes. The parent was instructed to place his or her hands on either side of the tray to encourage sorting, however no specific instructions were given to the child. Rather, the experimenter encouraged the child to "fix these things up." This prompt has been used previously to elicit classification behavior in young children (Gershkoff-Stowe et al., 1997). The experimenter and the parent did not give any specific feedback to the child, and did not name or focus attention to any of the objects. This procedure was repeated for each of the three sets of objects. The same two categories of objects were always paired together in an object set, but the order of presentation of the object sets was counterbalanced across children.

Coding

Sequential touching was used as a measure of children's category performance. Each touch that a child made to an experimental object was coded. The experimenter coded touches the child made with his or her hand directly to the object, and also coded

when a child touched one object with another object. The experimenter recorded which specific object was touched and to which category it belonged. The touches were recorded in the order in which they occurred so that it was clear if the children sequentially touched the objects from one or both categories. The primary investigator initially coded all of the data. An independent coder then coded sequential touching in one object set from six of the children in the study. Percent agreement was 78% between the two coders.

A Mean Run Length analysis was used as a measure of children's sequential touching of the experimental objects. This analysis has been used in previous categorization studies (e.g. Mandler et al., 1987; Rakison & Butterworth, 1998). The Mean Run Length indicates whether children are sequentially touching objects greater than chance level (1.75). Chance level is the run length expected if objects from two sets of four objects were touched at random. A mean run length, based on the number of total touches the child made and the number of times the child touched each category of objects, was computed for each child for each object set. An average mean run length value was computed for children. Thus, there were three mean run length values, one for each object set, for children in both the Name condition and the No Name condition.

The Mean Run Length analysis reveals whether children systematically touched the experimental objects at a level greater than chance. However, it does not provide information about how many objects from each category were touched, or whether children touched only one or both categories of objects. The Monte Carlo analysis, a more stringent measure of run length, was used to provide this type of detailed information. As in previous research (e.g. Starkey, 1981; Sugarman, 1983,) only children who touched at least three or four distinct items from one category during a run were included in this

analysis. New mean run lengths were computed for these children only including categorizing runs that fit the criteria. Additionally, this analysis determined whether children were single categorizers or dual categorizers in each of the object sets. The Monte Carlo program (Dixon, Woodard, & Merry, 1998) computes the number of categorizing runs of three or four items that would occur in a random draw that was repeated 10,000 times as a function of the number of total touches made. An alpha level of 0.10 was used in the Monte Carlo Analysis, following previous studies (Mandler et al., 1987; Rakison & Butterworth, 1998).

Results

Comprehension Measure

The comprehension measure was examined first for children in the Name condition: did children understand the novel words that were assigned to the objects in the task? Contrary to my efforts, children in the Name condition scored an average of 1.8 out of 6 (range= 0-6) correct responses in the comprehension task. This suggests that children were not demonstrating evidence that they understood the novel words in this task.

Object Salience Measures

I examined whether children had preferences for one set of objects over another set, and also whether they preferred one category of objects to another within each set. A 2x3 mixed design Analysis of Variance was performed with the three object sets as the within-subjects factor, and condition as the between-subjects factor to determine whether children preferred one set of objects over another. The analysis revealed no effect for condition ($\underline{F}(1,18) = 0.23$, $\underline{p} = 0.41$). However, the ANOVA indicated a significant difference between the number of touches children made to the three object sets ($\underline{F}$ (2,20) = 8.05, $\underline{p}$ =

0.001). Children touched the third object set, which were decorated cookie cutters and small "chip clips," significantly less than the other two object sets. The mean number of touches to object set 1 was 17.20, to object set 2 was 19.70, and to object set 3 was 13.95.

Children's preferences for individual object categories within an object set were also analyzed. Because there were no significant effects found for condition in the previous analysis, the number of touches to the two categories of objects within each object set was compared with three separate paired two-sample t-test. No significant differences were found between the categories in object sets 1 and 3 ($t(19) = -0.06$, $p = 0.95$; $t(19) = 0.15$, $p = 0.879$). In object set 2, which were decorated napkin rings and small cabinet handles, there was a significant difference between the two categories ($t(19) = 5.44$, $p < 0.001$). Children touched the rings significantly more than they touched the handles. However, because condition was not related to the salience effects, these effects were not examined in further detail.

Mean Run Length

A mean run length measure was computed to determine whether children were systematically touching the objects in the categorization task. A mean run length value was computed for children in both conditions, Name and No Name for each object set. I first looked at whether the children in both conditions were performing above chance level (1.75) in each object set using a t test. Children in both the Name and the No Name condition performed significantly above chance level for each of the three objects sets, with the exception of children in the Name condition for Object Set 1 ($t(8) = 1.44$, $p = 0.19$). However, although almost all children sequentially touched greater than chance

level, children in the Name condition had longer run lengths in the three object sets. That is, they touched systematically more frequently than children in the No Name condition.

Insert Figure 1 About Here

To compare the two conditions' performance overall, the mean run lengths across the three objects sets was collapsed and the mean run length of children in the Name condition to children in the No Name condition was compared (See Figure 2). Children in the Name condition had an average run length of 3.53, while children in the No Name condition had an average run length of 2.45. A paired two-sample t-test revealed a marginally significant difference between the two groups ($t(18) = 1.60$, $p = 0.06$). This suggests that children in the Name condition were categorizing more frequently than children in the No Name condition. This result suggests evidence to support our hypothesis that children in the Name condition outperform children in the No Name condition.

Insert Figure 2 About Here

In addition to examining the difference in categorization between children in both conditions, the relationship between children's productive vocabulary, whether they received names for the objects in the task, and their categorization was examined. The analysis found no main effect for productive vocabulary, contrary to the initial prediction. ($F(1,16) = 0.79$, $p = 0.387$). It was additionally hypothesized that novice word learners would benefit most from hearing novel names for the experimental objects. That is, children in the Low Vocabulary group in the Name condition would outperform children in High Vocabulary group in the Name condition.

To look at the relationship between condition, productive vocabulary, and mean run length, a 3x2x2 mixed design Analysis of Variance was performed. The three object sets were the within-subjects variable, and condition and vocabulary group were the between-subjects variables. The first prediction was that children in the Name condition would outperform children in the No Name condition. Because there was only a prediction for an effect in one direction, a one-tailed t-test of the main effect of condition was used. This analysis indicated a trend supporting the prediction ($\underline{F}$ (1,16) = 1.85, $\underline{p}$ = 0.09). Figure 3 shows the mean run lengths for the two vocabulary groups by condition. Children in the Name condition had a longer mean run length, 3.53, compared to children in the No Name condition who had a mean run length of 2.45. This suggests that children in the Name condition touched systematically more than children in the No Name condition.

Additionally, an interaction was predicted between vocabulary and condition, such that children in the Low Vocabulary group in the Name condition would outperform children in the High Vocabulary group in the Name condition. Although the interaction was not significant ($\underline{F}$(1,16)= 0.66 $\underline{p}$ =0.43) , there is a trend in the data in the direction of this hypothesis (See Figure 3). In the Name condition, Low vocabulary children had a mean run length of 4.02 and High Vocabulary children had a mean run length of 2.79. In the No Name condition, children in the Low Vocabulary group had a mean run length of 2.48, and children in the High Vocabulary group had a mean run length of 2.43. Thus, children in the Low Vocabulary group who received names for the objects categorized more than all of the other groups in both conditions.

Insert Figure 3 About Here

Monte Carlo Analysis

The Monte Carlo Analysis was used to assess which children were single categorizers and which children were dual categorizers. Table 1 presents the percentage of the children who had runs that occurred above chance level that were single categorizers and the percentage that were dual categorizers for each object set, and the corresponding run lengths for these children.

Insert Table 1 About Here

The results from the Monte Carlo analysis indicate that overall, there were very few dual categorizers in either condition. The greatest number of dual categorizers was found in the No Name condition: 20% of the children, or 2 children total in the first object set, and 10% of the children, or one child, in the second object set. Only 10% of the children, one child, in the Name condition were dual categorizers, in the first object set. Among the dual categorizers, it appears from Table 1 that more children in the No Name condition (30% total) were dual categorizers than in the Name condition (10% total.) This is contrary to the hypothesis that children in the Name condition would show more advanced category performance than children in the No Name condition. However, there were more children in the High Vocabulary group in the No Name condition than in the Name condition. I therefore looked at the percentage of single and dual categorizers and their mean run lengths by vocabulary group, regardless of condition. The results of the Monte Carlo analysis by vocabulary size are shown in Table 2. There were more dual categorizers in the High Vocabulary group than in the Low Vocabulary group, independent of condition. Thus, children with larger vocabularies are showing more advanced category behavior, which supports the original prediction that children with larger productive

vocabularies would be more advanced categorizers than children with smaller productive vocabularies.

Insert Table 2 About Here

Discussion

The purpose of this study was to examine how children's comprehension of specific object words and their general productive vocabulary were related to their performance in a categorization task. The results suggest that children who heard names for novel objects touched these objects more systematically than children who did not hear names. We did not find a significant interaction between children's productive vocabulary and whether they received names for the individual objects. However, the mean run length for children in the Low Vocabulary group who received names was greater than children in the High Vocabulary group. This suggests that novice word learners, with lower productive vocabularies, may benefit more from hearing individual object names than children who are more experienced word learners.

We found no significant effect of productive vocabulary on children's category performance, contrary to our expectations. This result provides evidence contrary to Gopnik and Meltzoff's (1987) finding that children's productive vocabulary was highly correlated to their categorization abilities. It lends support to other research which has also failed to find a correlation between productive vocabulary and categorization (Gershkoff-Stowe et al., 1997). The results of the present study suggest that, instead, hearing labels for objects is a better predictor of children's category performance than their productive vocabulary.

One surprising finding was that although children in the Name condition did not demonstrate evidence of comprehending the individual object words, they did categorize more frequently than children in the No Name condition. This may indicate that just hearing labels for individual objects helped children categorize them; the children did not need to "comprehend" the object words. That is, they did not need to establish a firm object-to-word correspondence. Perhaps by providing labels for the objects in the study, the commonality between objects in a category was emphasized. As Waxman and Markow (1995) suggested, children in the study may have used the labels as an indicator of the category relationship between the objects, inferring from the label that the objects were the same "kind" of thing.

Research by Landau, Smith, and Jones (1998) looked at the factors children consider when determining relationships between objects. Specifically, they found that children generalized novel names to novel objects on the basis of shape. In the present study, the objects within a category were the same shape, although not identical. Following Landau and colleague's finding, it may be that children in the present study generalized the novel name given to an exemplar of each category to the other objects within that category on the basis of their common shape. Children's formation of categories may have been encouraged by their generalization of the name to related objects, as Waxman and Markow (1995) suggested.

Additionally, consistent with the initial hypothesis, trends in the data also suggest that novice word learners benefited more from hearing the object names than more experienced word learners. Perhaps because these word learners are just beginning to categorize more frequently, the labels provide them with an additional indicator of the

relationship between the objects and of category membership, as Waxman and Markow (1995) suggested. It may be that more experienced word learners with more practice categorizing may not rely on these labels as much to infer category membership.

Single and dual categorization was also examined in children. Dual categorization is considered to be a more sophisticated category behavior than single categorization (Sugarman, 1981), as it implies that children not only recognize the commonality between objects in one category, but can also perceive differences between two distinct categories of objects. This analysis indicated that few children were dual categorizers in this study. The majority of the dual categorizers were children in the High Vocabulary group. In fact, when the data were examined more closely, the three children who were dual categorizers in the High Vocabulary group had productive vocabularies of greater than 300 words. Their large productive vocabularies indicate that these children may have been more advanced categorizers coming into the study, regardless of whether they received names for the experimental objects in the study. Only one child was a dual categorizer in the Low Vocabulary group in the Name condition. Although her productive vocabulary was extremely low (13 words,) she was in the older age group. Research by Goldin-Meadow, Seligman and Gelman (1976) suggest that children of her age with low productive vocabularies typically have larger receptive vocabularies. Perhaps her categorization in this study was more related to her receptive vocabulary than productive vocabulary, as Gershkoff-Stowe and colleagues (1997) suggest.

Because children in the Name condition did not demonstrate comprehension of the object labels, we cannot make claims about the relationship between their comprehension of individual object words and their categorization abilities. Children's low performance in

the comprehension task was unexpected based on previous research indicating that even younger children are able to learn new words with similar amounts of exposure (Hahn, 2000). Children's poor comprehension may in part reflect their interest in the complexity of the stimuli. Children engaged in extended periods of exploratory behavior with the objects during the familiarization phase. It may be that children were so engaged in exploring the individual objects that they were unable to map a label onto the objects because they were distracted by the objects themselves. Also, when we trained the children on the object names, we performed small actions with the objects while naming them with the aim of keeping the children's attention focused. However, perhaps these actions distracted the children and reduced their ability to learn the object names. The children's attention did not appear to be focused on the experimenters labeling. Research has shown that joint attention is essential for children to learn object names (Baldwin, 1995). Because children were distracted by the objects, they may not have attended to the experimenters' focus on the objects during naming. The literature suggests that without this joint attention, children may fail to associate the object label with the appropriate object. Thus, these factors, which were originally intended to capture and maintain the children's interest in the stimuli, may have instead distracted children from the labeling of the objects.

Children's unexpected performance in the comprehension task raises the question, what does it mean to comprehend a word? Children who received names for the objects did not demonstrate that they mapped the labels to the objects in the comprehension task. However, they still noted differences between object labels, as evidenced by their increased category performance. It may be that the definition of comprehension does not adequately explain children's understanding of the object words.

That is, they did not need to establish an object-to-word correspondence to understand the differences between the object labels.

In summary, this study suggests that hearing individual names for the objects may facilitate children's category behavior, especially for novice word learners. This lends tentative support to Waxman and Markow's (1995) findings that giving objects labels "invite" children to see the category relationship between the objects. This finding adds to our understanding about how children's category performance is related to their word knowledge, and ultimately our understanding about the relationship of language and cognition in the young child.

References

Baldwin, D.A. (1995). Understanding the Link Between Joint Attention and Language. In Moore, C. & Dunham, P.J, Joint Attention: Its Origins and Role In Development (pp 131-158). New Jersey: Lawrence Erlbaum Associates, Inc.

Benedict, H. (1979). Early Lexical development: comprehension and production. Journal of Child Language, 6(2), 183-200.

Dixon, W.E., Woodard, T., Merry, M.S. (1998). Touch Stat: A Monte Carlo Program for calculating sequential touching probabilities. Behavior Research Methods, Instruments, and Computers, 30(4). 592-604.

Gershkoff-Stowe, L. & Smith, L.B. (1997). A curvilinear trend in naming errors as a function of early vocabulary growth. Cognitive Psychology, 34, 37-71.

Gershkoff-Stowe, L., Thal, D., Smith, L., & Namy, L. (1997). Categorization and Its Developmental Relation to Early Language. Child Development, 68 (5), 843-859.

Goldin-Meadow, S., Seligman, M., & Gelman, R. (1976). Language in the two-year-old. Cognition, 4, 189-202.

Gopnik, A., & Meltzoff, A. (1987). The Development of Categorization in the Second Year and Its Relation to Other Cognitive and Linguistic Developments. Child Development, 58, 1523-1531.

Hahn, E.R. (2000). Asymmetries in Comprehension and Production: The Developmental Relation Between Understanding and Saying Words. Unpublished Manuscript, Carnegie Mellon University, Pittsburgh.

Landau, B., Smith, L., Jones, S. (1998). Object shape, object function, and object name. Journal of Memory & Language, 38(1), 1-27.

Mandler, J.M., Fivush, R., & Reznick, J.S. (1987). The development of contextual categories. Cognitive Development, 2, 339-354.

Poulin, Dubois, D., Graham, S., & Sippola, L. (1995). Early lexical development: the contribution of parental labelling and infants' categorization abilities. Journal of Child Language, 22, 325-343.

Riccuiti, H. (1965). Object grouping and selective ordering in infants 12 to 24 months. Merrill-Palmer Quarterly, 11, 129-148.

Riccuiti, H., Thomas, M., & Ricciuti, A.E. (1999). Availability and Use of Verbal Labels as Predictors of Sorting Categorization in 16- to 23-Month-Olds. Presented at the SCRD Symposium, Albuquerque, NM.

Starkey, D. (1981). The origins of concept formation: object sorting and object preference in early infancy. Child Development, 52, 489-497.

Sugarman, S. (1981). The Cognitive Basis of Classification in Very Young Children: An Analysis of Object-Ordering Trends. Child Development, 52, 1172-1178.

Sugarman, S. (1983). Children's Early Thought: Developments in Classification. Cambridge University Press: New York.

Waxman, S., & Markow, D. (1995). Words as Invitations to Form Categories: Evidence from 12- to 13-Month-Old Infants. Cognitive Psychology, 29, 257-302.

Appendix A

Stimuli Used in the Study

Object Set 1

Object Set 2

Appendix A (Continued)

Object Set 3

Appendix B

Novel Names Used in the Study.

1. Pibby

2. Toma

3. Coba

4. Dax

5. Wug

6. Rif

Author's Note

This research study was supported in part by Carnegie Mellon's Student Undergraduate Research Initiative. The author would like to thank Dr. Lisa Gershkoff-Stowe, Dr. David Rakison, Dr. Sharon Carver, and Dr. Marsha Poster for their assistance in this project.

Table 1. Percentage of Single and Dual Categorizers and Mean Run Lengths in the Name and No Name Condition

	Condition			
	Name		No Name	
Classification	%	M	%	M
	Object Set 1 (Knobs v. Caps)			
Single	60	9.8	60	6.7
Dual	10	6.0	20	5.0
Total	70		80	
	Object Set 2 (Rings v. Handles)			
Single	60	10.3	60	9.7
Dual	0		10	9.0
Total	60		70	
	Object Set 3 (Cookie Cutters v. Clips)			
Single	70	8.7	50	5.4
Dual	0		0	
Total	70		50	

Table 2. Percentage of Single and Dual Categorizers and Mean Run Lengths in the High and Low Vocabulary Groups

	Vocabulary			
	Low		High	
Classification	%	M	%	M
Object Set 1 (Knobs v. Caps)				
Single	66	8.6	55	7.83
Dual	11	6	18	5
Total	77		73	
Object Set 2 (Rings v. Handles)				
Single	55	9.2	63	10.57
Dual	0		9	9
Total	55		72	
Object Set 3 (Cookie Cutters v. Clips)				
Single	66	8.71	45	7
Dual	0		0	
Total	66		45	

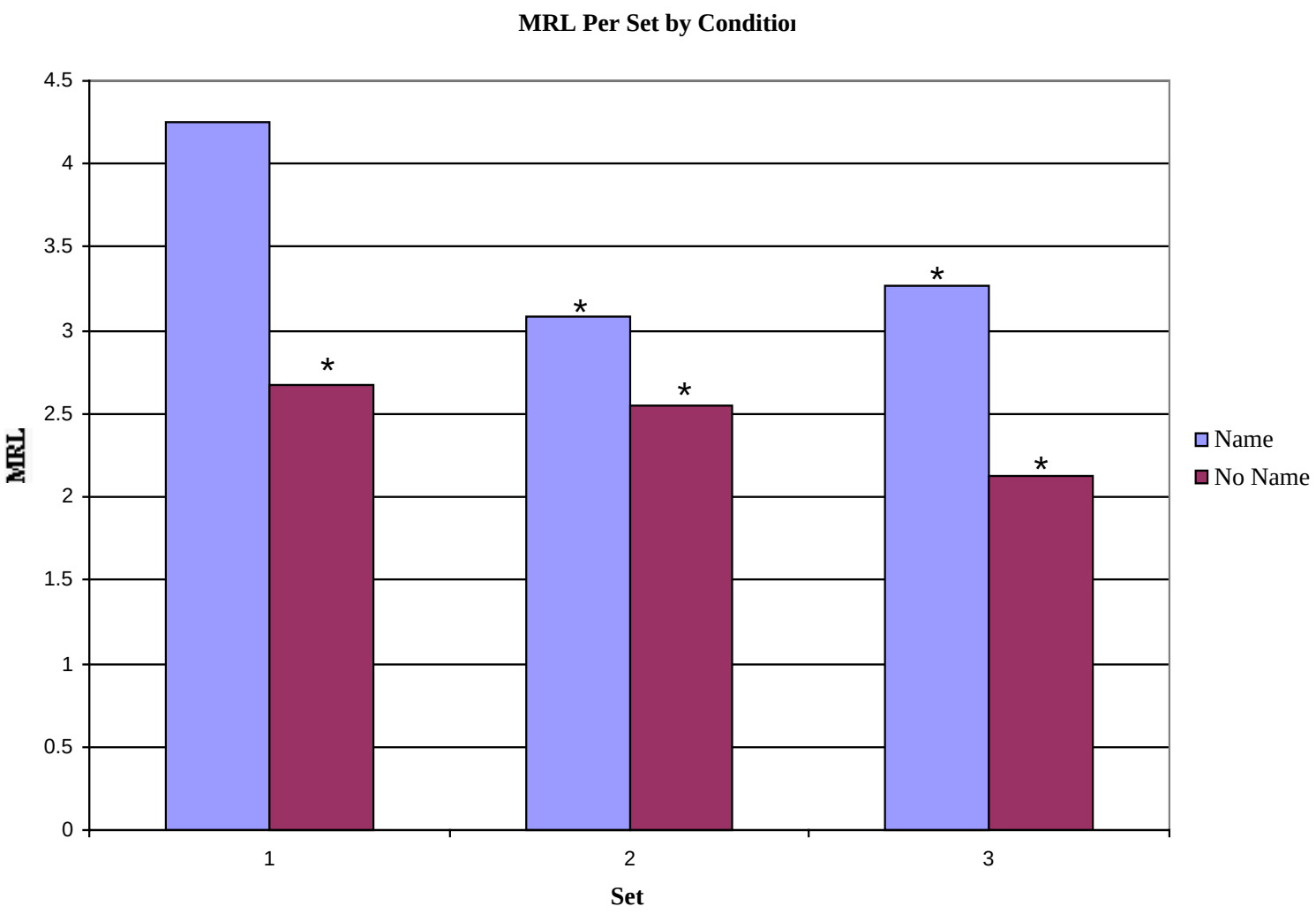
Figure Captions

Figure 1. Mean Run Length for Name and No Name Conditions for Each Object Set

Figure 2. Mean Run Length By Condition

Figure 3. Mean Run Length By Condition and Vocabulary

Figure 1. Mean Run Length for Name and No Name Conditions for Each Object Set



* $p < 0.05$

Figure 2. Mean Run Length By Condition

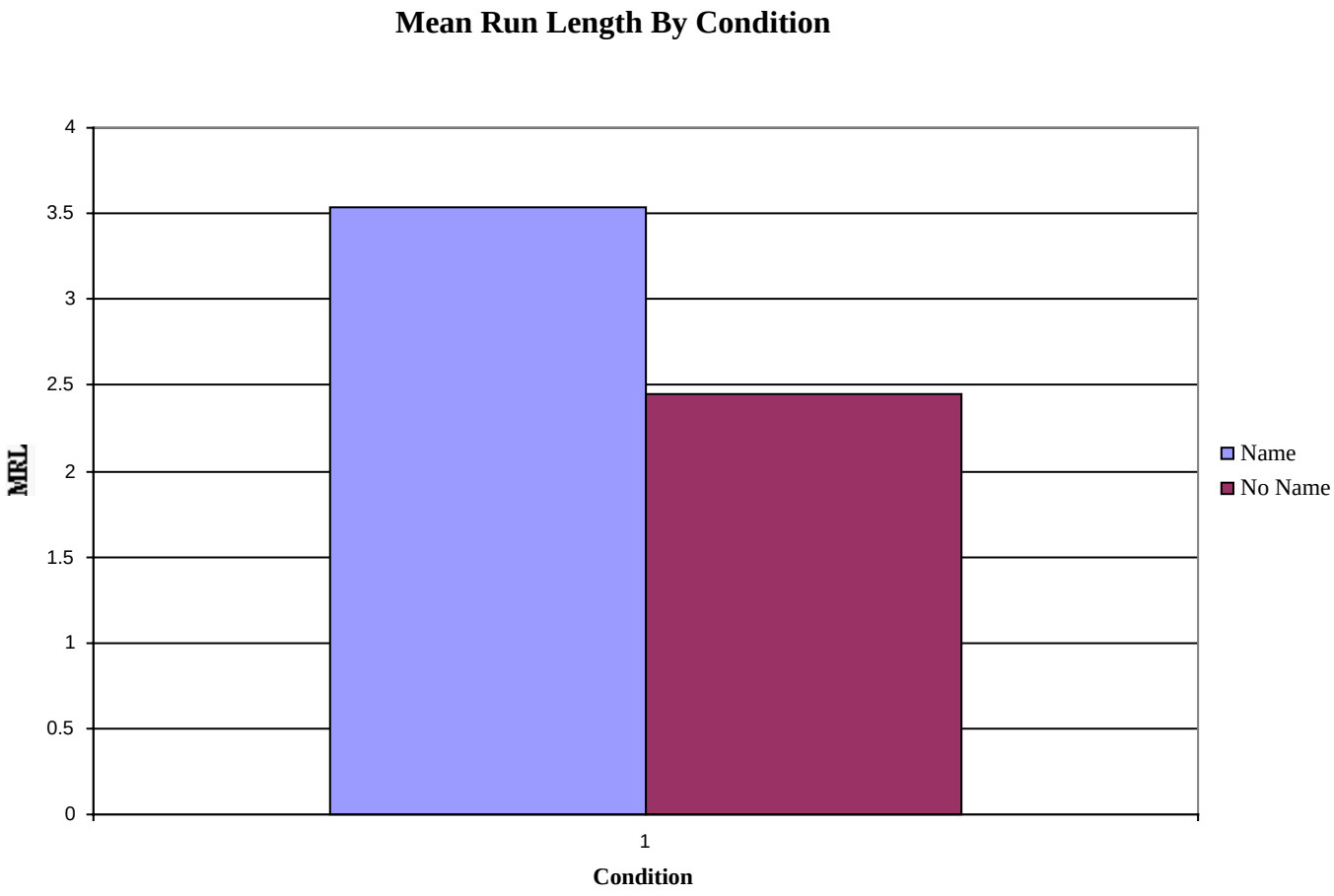


Figure 3. Mean Run Length by Condition and Vocabulary