

INFANTS' USE OF OBJECT CATEGORY DISTINCTIONS
IN WORD LEARNING

by

Dilys Hay Lok Leung

B.A., University of British Columbia, 2003

M.Sc., Dalhousie University, 2006

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENT FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in

The Faculty of Graduate Studies

(Psychology)

THE UNIVERSITY OF BRITISH COLUMBIA

(Vancouver)

April 2011

© Dilys Hay Lok Leung, 2011

ABSTRACT

How do infants initially determine whether a novel object word labels a specific individual (e.g. Madonna) or an instance of a category (e.g., a person)? The research in this dissertation tested the hypothesis that infants assume words for objects from some categories (e.g., people) label individuals (are proper names) but words for objects from other categories (e.g., artifacts) label instances of the category (are count nouns). This assumption could help infants to identify proper names and count nouns in their language, and thereby facilitate the learning of the linguistic proper name/count noun distinction.

In a preferential looking task, 16- and 17-month-olds heard a novel word for a target person (a face) or artifact, and their willingness to generalize the word to a non-target object was assessed. In Experiment 1, infants restricted the word to the target object when it was paired with a non-target object from a different category, providing evidence that infants can learn a novel word for the target object in this task. In Experiment 2, infants restricted the word to the target object when both the target and non-target objects were people, but not when they were artifacts from the same category. This finding is consistent with the hypothesis that infants interpret words for people as proper names and words for artifacts as count nouns. In Experiment 3, infants were asked to find the referent of a *second* novel label in a task identical to Experiment 2. Here, infants restricted their looking to the *non-target* object when the objects were people, but not when they were artifacts. In Experiment 4, infants did not restrict the novel label to a person (a face) when it was inverted. This result provides evidence that infants' tendency in Experiment 2 to restrict a label to a particular person was not simply due to the greater perceptual complexity of faces.

Together, the findings reveal that infants interpret words for people and words for artifacts differently, raising the possibility that object category distinctions help infants to identify proper names and count nouns in their language and to learn how they are expressed linguistically.

PREFACE

The author had primary responsibility for conducting the research presented in this dissertation. The theoretical and methodological ideas were initially developed by her advisor, Dr. Geoffrey Hall (see Hall, 2009), and the experiments were developed in a collaboration between the author and him.

The research presented in this dissertation was approved by the UBC Behavioral Research Ethics Board, under certificate number H07-01582, and it was supported by a Standard Research Grant from the Social Sciences and Humanities Research Council to D. Geoffrey Hall.

TABLE OF CONTENTS

ABSTRACT.....	ii
PREFACE.....	iv
TABLE OF CONTENTS.....	v
LIST OF TABLES.....	viii
LIST OF FIGURES.....	ix
INTRODUCTION.....	1
Linguistic Cues to Object Word Meaning.....	3
Theoretical Accounts of the Acquisition of the Proper Name/Count Noun Distinction	6
Narrow-to-Broad Accounts.....	7
Broad-to-Narrow Accounts.....	11
Challenges for the Narrow-to-Broad and Broad-to-Narrow Accounts.....	14
Alternative Hypothesis: Narrow-and-Broad Accounts.....	17
Summary of Experiments.....	20
EXPERIMENT 1.....	35
Method.....	35
Participants.....	35
Materials.....	35
Procedure.....	40
Coding.....	41
Results.....	42
Familiarization Trials.....	43

Test Trials	45
Discussion	47
EXPERIMENT 2	49
Method	49
Participants.....	49
Materials	49
Procedure	52
Coding.....	52
Results.....	52
Familiarization Trials.....	54
Test Trials	55
Discussion	59
EXPERIMENT 3	63
Method	63
Participants.....	63
Materials	63
Procedure	64
Coding.....	64
Results.....	64
Familiarization Trials.....	67
Test Trials	71
Post Hoc Analysis	58
Discussion	74

EXPERIMENT 4	79
Method	79
Participants.....	79
Materials	79
Procedure	79
Coding.....	81
Results.....	81
Familiarization Trials.....	82
Test Trials	84
Post Hoc Analysis	85
Discussion.....	86
GENERAL DISCUSSION	89
Linguistic Cues to Object Word Meaning	90
Theoretical Accounts of the Proper Name/Count Noun Distinction	94
Interpretive Issues and Future Directions	95
REFERENCES	101
APPENDIX A.....	110
APPENDIX B.....	111

LIST OF TABLES

Table 1. Experiment 1 Predictions for Test Trials	43
Table 2. Experiment 2 Predictions for Test Trials	54
Table 3. Experiment 3 Predictions for Test Trials	69
Table 4. Experiment 4 Predictions for Test Trials	82

LIST OF FIGURES

Figure 1. Objects Used in Experiment 1	30
Figure 2. Enlarged Images of the Objects Used in Experiment 1	31
Figure 3. Enlarged Images of the Objects Used in Experiment 2	32
Figure 4. Enlarged Images of the Objects Used in Experiment 3	33
Figure 5. Enlarged Image of the Objects Used in Experiment 4	34
Figure 6. Schematic Example of Video Stimuli for Experiment 1	38
Figure 7. Experiment 1 Results in Familiarization Trials	45
Figure 8. Experiment 1 Results in Test Trials	47
Figure 9. Schematic Example of Video Stimuli for Experiment 2	50
Figure 10. Experiment 2 Results in Familiarization Trials	56
Figure 11. Experiment 2 Results in Test Trials	59
Figure 12. Schematic Example of Video Stimuli for Experiment 3	65
Figure 13. Experiment 3 Results On Familiarization Trials	71
Figure 14. Experiment 3 Results on Test Trials	74
Figure 15. Schematic Example of Video Stimuli for Experiment 4	80
Figure 16. Experiment 3 Results on Familiarization Trials	83
Figure 17. Experiment 4 Results on Test Trials	85

INTRODUCTION

When they acquire their native language, infants face a fundamental challenge in learning how to identify words in the input and link them with their appropriate meanings. This task is complicated by the presence of virtually an infinite number of possible referents in any situation in which infants hear a novel word (e.g., Quine, 1960). For example, consider a mother playing in a park with her infant. Suppose she points to a nearby event (e.g., a dog running by) and says, “ZAVY!” What is the meaning of “ZAVY”? There are countless interpretations. For example, “ZAVY” could refer to the event itself (e.g., the dog running in the park), to the kind of participant in the event (e.g., dog), to the individual participant in the event (e.g., Fido), to a part of the participant (e.g., nose), or to a property of the participant (e.g., furry), among many other possible referents. Infants regularly encounter such word-learning situations. How do infants correctly identify the intended meaning of the word?

Related to the question of how infants learn the meanings of novel words is the question of how they learn words’ lexical classes. Words fall into different lexical classes (e.g., noun, adjective, verb), and these different lexical classes appear to have distinctive types of meanings (Bloom, 2000; Macnamara, 1986). For example, consider the difference between words from the lexical class count noun (e.g., “dog”) and the lexical class proper name (e.g., “Fido”). There is a basic semantic difference between words from the two lexical classes. A count noun refers to an object (e.g., a dog) as an interchangeable exemplar of a category (e.g., as a dog), whereas a proper name (e.g., “Fido”) refers to an object as a distinctive individual in its own right (e.g., as Fido). When infants hear a novel label (e.g., “FEPPY”) for an object, they need to have a way to determine the lexical class to which it belongs. How do they make this determination?

Adults are generally able to determine the lexical class of a word by noticing the linguistic context in which it appears, and they are able to use previously acquired linguistic knowledge to distinguish words from the two lexical classes if their language distinguishes linguistically between the two classes, as English does. For example, when English-speaking adults hear “This is a DAXY” for an object, they can infer that the novel label is a count noun. On the other hand, when they hear “This is DAXY” for the object, they can interpret the word as a proper name, a mass noun (which refers to a category whose members are not individuals; e.g., water), or an adjective (which refers to an object property; e.g., warm). However, infants cannot use such linguistic knowledge to guide their interpretation of novel object words at the outset of lexical development, because this is information that they still need to learn.

It should also be noted that some languages lack linguistic cues that distinguish proper names from count nouns. For example, in Japanese, there appear to be no linguistic cues that mark this distinction (Imai & Haryu, 2001). Imai and Haryu examined Japanese 2- and 4-year-olds’ interpretation of novel words for objects from various categories. Their interest was in whether children interpreted these words in the manner of proper names (restricted to the labeled object) or in the manner of count nouns (generalized to other objects of the same category). They discovered that children made a proper name interpretation under some conditions (when the referent was a familiar animal), but a count noun interpretation under others (when the referent was an unfamiliar animal or artifact). Japanese children thus seemed able to learn both proper names and count nouns, despite the fact that their language lacks linguistic cues marking the distinction between the two lexical classes. These considerations raise the possibility that infants have some non-linguistic way (or ways) to identify which object labels in their language are proper names and which ones are count nouns. The present research aimed to explore this

possibility by investigating whether the particular category of object being labeled guides infants to think a certain word for an object is a count noun or a proper name for the object.

Linguistic Cues to Object Word Meaning

There is a body of empirical evidence suggesting that young children learning English acquire the linguistic distinction between proper names and count nouns at an early age. In a seminal study by Katz, Baker, and Macnamara (1974; see also Macnamara, 1982), young children's understanding of the semantic distinction between the two lexical classes was assessed after the infants learned a novel proper name or a novel count noun for a doll. Children heard an experimenter label a doll with a word marked linguistically as either a proper name (e.g., "This is ZAV") or a count noun (e.g., "This is a ZAV"). The experimenter then presented a second doll that differed in hair and dress color, and children were asked to choose the referent of the word from the pair. For example, the experimenter said, "Give me ZAV" in the proper name condition and "Give me a ZAV" in the count noun condition. Katz et al. predicted that if the children are able to use linguistic cues to distinguish between proper names and count nouns, they should have selected the labeled doll at above-chance levels if they heard a proper name, and they should have selected either doll at chance if they heard a count noun. The researchers found this pattern of results in girls as young as 17 months of age and in boys as young as 28 months of age.

Several subsequent studies have attempted to clarify the results from the Katz et al. (1974) study. For example, Gelman and Taylor (1984) investigated whether children's lack of preference for either doll in the count noun condition of Katz et al.'s study was truly due to a count noun interpretation of the novel word (i.e., they thought the word labeled a category, such

as doll) or due to simple guessing (i.e., they selected randomly because they did not know which object to choose). The researchers replicated the study by Katz et al. with a slight modification to the method. They presented 2-year-old children with two out-of-category distractors from the same category (e.g., two blocks), along with the two objects from the same category (e.g., two dolls), so children were asked to choose among four possible objects. If children were interpreting the novel proper name as referring to the individual object, they should have restricted their choice to the labeled object. On the other hand, if children were interpreting the label as a count noun, they should have restricted their selection to either object from the category of the labeled object. The results were consistent with the hypothesis that young children understand that proper names label objects as individuals, and that count nouns label objects as instances of a category.

It is important to note that there is an alternative interpretation of the preceding findings. In both the Katz et al. (1974) and Gelman and Taylor (1984) studies, the dolls used in the tasks were always perceptually different from each other (e.g., their dresses and hair differed in color). These differences make the results difficult to interpret because when children restricted a novel word to the labeled object, it is possible that they thought the word was a label for an individual object (i.e., a proper name), a label for one of the visible properties of the object (i.e., an adjective), or a label for a specific category (subcategory) to which the labeled doll belongs (i.e., a count noun). Several researchers have attempted to address whether infants who restricted the novel proper name to the labeled object actually interpreted the word as referring to an individual object (i.e., a proper name) (e.g., Bélanger & Hall, 2006; Hall & Bélanger, 2010; Hall, Lee & Bélanger, 2001; Liittschwager & Markman, 1993; Sorrentino, 2001). For example, Hall et al. designed a task that was similar to the one used by Katz et al., but instead of using pairs of

different-looking dolls, they used pairs of identical-looking dolls (i.e., dolls that differed in no visible properties). This modification ruled out the possibility that infants who restricted the word to the labeled object interpreted the word as a property term (for a visible property) or a specific category (subcategory) term. Infants aged 23 months were found to restrict the novel word to the labeled doll in the proper name condition, but they generalized the novel word to the second object in the count noun condition. These results suggest that infants in the proper name condition interpreted the word as a proper name (i.e., a word for an object as an individual) and not as an adjective for a visible property or as a count noun for a specific object category (subcategory).

Although the results from the preceding experiments address ambiguities in children's performance on prior tasks, they suggest that it is not until children are close to two years of age that they can use linguistic cues to distinguish correctly between novel words presented as proper names and count nouns. More specifically, when the "identical dolls" task is used, the youngest age at which children showed some knowledge of the distinction was 23 months when the dependent measure was pointing or reaching (Hall et al., 2001) or 20 months when the dependent measure was looking time (Bélanger & Hall, 2006). These findings are in contrast to the results from the original Katz et al. (1974) study involving the "contrasting dolls" task, where 17-month-old girls showed some understanding of the semantic difference between words modeled linguistically as proper names and count nouns.

In an attempt to reconcile the results from the identical dolls task with earlier findings (e.g., Gelman & Taylor, 1984; Katz et al., 1974; Macnamara, 1982), Hall and Bélanger (2010) conducted a comprehensive study that combined the methods from previous experiments. In this study, the same infants (aged 14, 17, 20, and 23 months) were presented with a task involving

different-looking objects (as in the original Katz et al., 1974, task) and a task involving identical looking objects (as in the revised Hall et al., 2001, task). For each task, infants participated in either a proper name condition (where the novel word was presented as a proper name) or a count noun condition (where the novel word was presented as a count noun). Infants were asked to find a referent of the novel word by choosing one of the two objects. Overall, the researchers found that 14- and 17-month-olds failed to distinguish between proper names and count nouns, while 20- and 23-month-olds succeeded, replicating previous findings based on the identical dolls task. Further analysis of the data revealed a striking additional finding. The researchers analyzed infants' performance on the contrasting dolls and identical dolls tasks separately for the proper name condition and found an age difference in infants' understanding between the two tasks. They found that infants as young as 17 months of age appeared to interpret the novel label as a proper name by choosing the labeled doll systematically in the contrasting dolls task. However, infants did not show the same behavior in the identical dolls task until 23 months of age. The reason for this age difference in infants' understanding is unclear. One possibility is that infants have a different understanding of the semantics of proper names at 17 and at 23 months of age. That is, perhaps younger infants interpret proper names as referring to properties or specific object categories, rather than to individual objects. A second possibility is that both 17- and 23-month-olds interpret proper names as referring to individual objects; however, younger infants expect individual objects to be perceptually distinct. A third possibility is that 17-month-old infants find objects more difficult to track in the identical objects version of the task.

Theoretical Accounts of the Acquisition of the Proper Name/Count Noun Distinction

In the word-learning literature, several researchers have developed proposals about how infants first identify proper names and count nouns and learn the linguistic properties of these

two types of words in their native language, as they appear to do between 17 and 23 months of age when they are learning English. There are two general types of account of infants' early object word learning. Hirsh-Pasek, Golinkoff, Hennon, and Maguire (2004) termed them the "narrow-to-broad" and the "broad-to-narrow" accounts.

Narrow-to-Broad Accounts

Narrow-to-broad accounts propose that infants initially interpret all new object words as labels for individual objects (i.e. as proper names). To learn count nouns under this type of account, infants must overcome the tendency to interpret all object words as labels for individual objects in order to acquire more general terms for object categories. Several developmental researchers have defended a version of this type of account (e.g., Hennon et al., 1999, 2000; Hirsh-Pasek et al., 2004; Nelson, 1973; Smith, 2000). For example, both Hennon et al. and Hirsh-Pasek et al. argued that young word learners are biased to interpret new object words as labels for individuals (i.e., proper names), and only through experience do they extend words across objects of a particular category. According to this view, infants' earliest object word vocabularies should consist mostly of proper names.

There is a small amount of experimental evidence on early word learning that supports the narrow-to-broad hypothesis. Hirsh-Pasek et al. (2004) described an experiment first reported by Hennon et al. (1999, 2000) examining infants' interpretation of a novel word for an individual object. In their task, the researchers taught infants a novel label for a novel object (a red lemon reamer). They first assessed whether infants learned the novel word by asking them to look at a referent for the label, after pairing the labeled object with an out-of-category distractor (a green razor holder). The researchers then administered two more trials. One was a proper name trial,

which was designed to test whether infants interpreted the word as a label for an individual object. Infants were asked to find the referent of the novel label, after seeing the labeled object (the red lemon reamer) paired with another object from the same category (a purple lemon reamer). The other was a generalization trial, which was designed to test whether infants interpreted the word as a count noun that can be extended to other instances from the same category as the labeled object. On this trial, infants were asked to find the referent of the novel label, after seeing the unlabelled exemplar (the purple lemon reamer) paired with the out-of-category distractor (the green razor holder).

The results for the initial trial showed that infants in all three age groups (10- and 12-month-old, 14-month-olds, and 19- and 24-month-olds) learned the word-object pairing, as they preferred to look at the labeled object (Hirsh-Pasek et al., 2004). For the subsequent trials, Hirsh-Pasek et al. reported three different patterns of interpretation of the novel word depending on the age group. The 10- and 12-month-olds appeared to interpret the label to refer to an individual object (i.e. a proper name). They preferred to look at the labeled object on the proper name trial, while they showed no preference to look at either object on the generalization trial. The 14-month-olds appeared to interpret the label as a proper name under one learning circumstance and as a count noun under another. If infants saw the proper name trial before the generalization trial, they restricted their looking to the labeled object on the proper name trial, but showed no signs of extending the label on the generalization trial. On the other hand, if they saw the generalization trial before the proper name trial, they preferred to look at the object from the same category as the labeled object on the generalization trial, but they looked equally at either object on the proper name trial. The 19- and 24-month olds appeared to interpret the label as a count noun that could be extended across instances of the object category. They showed no preference to look at

the labeled object on the proper name trial, while they preferred to look at the object from the same category as the labeled object on the generalization trial. Based on these findings, Hirsh-Pasek et al. proposed that infants at the beginning of word learning interpret novel object words as proper names, and they learn to extend words across objects from the same category through experience.

The claim made by Hirsh-Pasek et al. (2004) appears, however, to be at odds with the full details of the study as reported in Hennon et al. (1999, 2000). First, Hirsh-Pasek et al. did not report that almost half the 10- and 12-month-olds reported in Hennon et al. failed to learn the word-object pairing (on the initial trial). This raises concerns about how to interpret 10- and 12-month-olds' performance on the proper name and generalization trials. Furthermore, for many of the younger children who did appear to learn the word-object pairing, there were possible trial order effects. The infants who received the proper name trial first appeared to have a tendency to interpret the novel label as a proper name, but those who received the generalization trial first seemed to have a tendency to interpret the novel label as a count noun. This finding suggests that infants have the capacity to restrict novel words to specific individuals only under certain learning circumstances. Another concern surrounds the design of the generalization trial. Infants were asked to choose the referent of the novel label, given an unlabelled category member and an out-of-category distractor. This pairing could have confused infants who thought the word was a proper name, because the originally labeled object was absent. As a result of the confusion, infants may have abandoned their proper name interpretation and looked equally at both objects.

Markman and Jaswal (2004) reported the results of an experiment by Markman, which was modeled after Hennon et al. (1999, 2000), but without the potentially misleading

generalization trial. In Markman's task, 13-, 15-, and 18-month-old infants were given two types of trials. One involved pairing a labeled object with an out-of-category distractor, in order to examine whether infants learned the word-object pairing (akin to Hennon et al.'s initial trial). The other involved pairing the labeled object with another object from the same category (akin to Hennon et al.'s proper name trial). The results showed that 13-month-olds failed to show clear evidence that they learned the word-object pairing, which made their performance on the proper name trial difficult to interpret. On the other hand, Markman found that 15- and 18-month-olds learned the word and generalized it to another object from the same category as the labeled object on the proper name trial. These results, along with the findings from Hennon et al., suggest that infants younger than 14 months of age have (at best) only a weak tendency to interpret novel words as referring to specific individuals.

The phenomenon of underextension provides further support for the narrow-to-broad hypothesis. There is some evidence that when infants begin to produce words for objects, they have a tendency to restrict the labels to only a small subset of the entire category membership (e.g., Bloom, 1973; Clark, 1973; Dromi, 1987; Reich, 1976). For example, Bloom reported that her daughter used the word "car" only for the moving cars that were visible from her living room window. Reich noted that his son initially used the word "shoe" only when referring to his mother's shoes. These reports on infants' productive vocabularies offer some additional evidence of an initially narrow interpretation of novel object labels.

In summary, according to the narrow-to-broad hypothesis, infants' first object words are labels for individual objects (i.e., proper names). However, the experimental evidence on early word learning does not clearly support this account. Specifically, the research suggesting that infants have an early capacity to learn novel proper names is methodologically problematic. As

well, there is other experimental evidence to indicate that infants appear to interpret object words as count nouns early in lexical acquisition. These issues raise concerns about the validity of this type of account.

Broad-to-Narrow Accounts

In contrast to narrow-to-broad accounts, broad-to-narrow accounts propose that infants initially interpret new object words more widely in scope. To learn proper names under this type of account, infants must overcome the tendency to interpret all object words as labels for object categories in order to acquire terms for individual objects. A number of developmental researchers have defended for a version of this account (e.g., Booth & Waxman, 2003; Markman, 1989; Waxman, 2004; Waxman & Booth, 2003; Waxman & Leddon, 2011; Waxman & Markow, 1995; Woodward & Markman, 1998). For example, Waxman and her colleagues proposed that infants are initially under a broad assumption that novel words apply to any of a range of different types of commonalities among named objects. That is, at the outset of word learning, infants are biased to interpret novel words as labels for categories that are formed based on any of a number of different properties. When they hear a novel word, infants draw on a mechanism that leads them to extract any of a number of perceptual properties, including object-category-based properties, such as shape, and other properties, such as color. This initial bias is subsequently refined as infants gain experience with correlations between words from different lexical classes and their referents, which first guides them to learn count nouns for object category-related commonalities (e.g., shape). After a period of initial learning, infants further refine their initial bias and use a similar correlation-detection mechanism to identify object labels for specific individuals. Success at this task is dependent on their ability to keep track of when their parents use labels that are restricted to individual objects, provided that parents use proper

names in those situations. According to this proposal, infants are biased to learn the link between count nouns and object categories before they learn the link between proper names and individual objects.

Markman proposed a different but related version of the broad-to-narrow account, which posits that infants' early lexical acquisition is guided by a set of word-learning assumptions (e.g., Markman, 1989; Markman & Hutchinson, 1984; Markman & Wachtel, 1988; Woodward & Markman, 1998). According to Markman's taxonomic constraint, infants are initially biased to interpret novel labels given to unfamiliar objects as referring to the categories to which the whole objects belong. This constraint can easily account for infants' early count noun acquisition, but it presents a challenge for the acquisition of words from other lexical categories, including proper names. In order to learn proper names, infants must override their tendency to interpret novel object words as category labels. Markman has proposed that infants may overcome this assumption by resorting to another word-learning bias called the mutual exclusivity constraint. This constraint posits that infants expect a single object to have only one category label. Therefore, when infants hear a term given to an object that is already named, they will be motivated to find an alternative interpretation of the word in order to avoid giving two object category labels to the same object. This constraint would thereby allow infants to interpret the label as a proper name for the individual object (e.g., Hall, 1991). Mutual exclusivity does not, however, specifically lead infants to interpret the word as a proper name. For example, instead of interpreting the novel term as a proper name labeling an individual, infants may use mutual exclusivity to interpret the word as an adjective labeling a property of the object, such as its colour or texture (e.g., Markman & Wachtel, 1988).

Markman and Jaswal (2004) also proposed a learning strategy that infants may use to

identify proper names in their language and learn their linguistic properties – without using the mutual exclusivity assumption. According to this proposal, infants use pragmatic and statistical information to overcome the taxonomic constraint to learn a proper name. That is, infants attend to the fact that a speaker does *not* extend a novel word given to one object to other objects from the same category, even though the speaker has the opportunity to do so, as a strong cue to interpreting the word as a label for an individual object (i.e., a proper name). For example, when infants hear a label (e.g., “Sophie”) for an object (e.g., a giraffe), they initially assume that the term should be generalized to other objects of the same category (e.g., other giraffes). At the same time, however, they are sensitive to when a speaker does not give the same label to other objects from the same object category also present in the scene (e.g., other giraffes). Markman and Jaswal proposed that infants keep track of the multiple instances of usage and non-usage of object labels by a speaker, and they use this information to override the taxonomic constraint to learn proper names for individual objects.

Several experimental studies have provided evidence that infants interpret novel object words in the manner of count nouns, extendible across members of an object category, soon after their first birthday (e.g., Booth & Waxman, 2003; Markman & Jaswal, 2004; Woodward, Markman & Fitzsimmons, 1994). For example, Woodward et al. (1994) taught 13- and 18-month-old infants a novel label (e.g., “TOMA”) for a novel artifact (e.g., a large plastic paper clip). The authors first assessed whether infants learned the word by asking them to choose a referent for the novel word after pairing the labeled object with an out-of-category distractor (e.g., a small plastic strainer). The authors also tested whether infants interpreted the novel word as a count noun that generalized across category members by asking them to choose a referent after pairing another instance of the labeled object category (e.g., a different-colored paper clip)

with the out-of-category distractor. In both tasks, infants in both age groups tended to choose the object from the same category as the labeled object, indicating that they learned the word and thought the word was extendible across instances of the category. In sum, broad-to-narrow accounts state that infants are biased to interpret novel object labels as category terms, and there is some evidence to support this claim.

Challenges for the Narrow-to-Broad and Broad-to-Narrow Accounts

The narrow-to-broad and the broad-to-narrow accounts make clear predictions about how infants acquire proper names and count nouns at the start of lexical acquisition. As previously discussed, there is empirical evidence to support both accounts. There is, however, also evidence from the word learning literature that poses challenges for both of them. First, there is extensive evidence from parental report, naturalistic studies, and experimental studies that suggests infants' earliest vocabularies contain *both* proper names *and* count nouns (e.g., Dromi, 1987; Fenson, Dale, Reznick, Bates, Thal, & Pethink, 1994; Macnamara, 1982; Nelson, 1973). Fenson and his colleagues provided an analysis of parental report data, which they collected during the development of the English version of the MacArthur Communicative Development Inventory. They found that parents reported proper names and count nouns to be part of infants' earliest receptive and productive vocabularies. For example, parents reported that by eight months of age, at least 85% of infants understood proper names like "Mommy" and "Daddy", and by twelve months of age, at least 50% of infants were able to produce these words. Parents also observed that by 10 months of age, at least 60% of infants understood count nouns like "dog" and "ball", and by 14 to 15 months of age, at least 50% of infants were able to produce these terms. In addition, Nelson conducted a longitudinal naturalistic study and found that both proper

names (including “Mommy” and “Daddy”) and count nouns (such as “dog” and “ball”) were among the first ten words produced by 13- to 16-month-old English-learning infants.

Furthermore, Tincoff and Jusczyk (1999, 2000) provided experimental evidence that 6-month-old infants have an emerging understanding of words for specific individuals and words for object categories. Tincoff and Jusczyk (1999) tested infants’ early understanding of an association between the words “mommy” and “daddy” and video displays of their parents. In one experiment, infants were shown videos of their own mother and father and presented with the words “Mommy” or “Daddy.” Results indicated that infants looked more at the named than the unnamed parent. In a second experiment, the researchers investigated whether infants generalize “Mommy” to all women, and “Daddy” to all men. Another group of 6-month-old infants were shown videos of an unfamiliar woman and man, and presented with the labels “Mommy” or “Daddy.” Findings showed that the infants displayed no preference to look at either person in either case. The researchers concluded that infants understood the terms “Mommy” and “Daddy” to refer to their own mother and father, respectively. In a subsequent study, Tincoff and Jusczyk (2000) used a similar method to that of the previous study and found that 6-month-old infants are able to generalize some count nouns, like “hands” and “feet” to unfamiliar exemplars of hands and feet. Taken together, the findings by Tincoff and Jusczyk provide evidence that infants as young as 6 months of age have some understanding that proper names like “Mommy” and “Daddy” refer to distinct individuals, and that count nouns like “hands” and “feet” can be extended to other instances of the object categories. The findings from these studies provide some evidence that infants can learn both terms for individual objects and terms for object categories from the outset of lexical development, in contrast to the predictions of the narrow-to-broad and the broad-to-narrow accounts.

It is important to note, however, that the evidence supporting the early appearance of proper names in children's vocabularies is limited and ambiguous. There are anecdotal reports that suggest infants over-extend some of their first-learned proper names (e.g., "Mommy" and "Daddy") to other category members (e.g., other women and men) in the manner of object category terms (i.e., count nouns); however, other reports assert that infant's first proper names label individual objects (e.g., Macnamara, 1982). It should also be noted that the terms "Mommy" and "Daddy" are atypical proper names because they are both proper names and kinship terms which adults use as both labels for individual (e.g., "Mommy is cooking") and as labels that extend to different members of an object category (e.g., "My mommy is cooking").

A second notable characteristic of infant's earliest words is that their first proper names and count nouns appear to refer to objects from distinctive categories. That is, parents have reported that infants' first proper names are usually words for people, and their first count nouns are commonly words for objects from other categories, notably artifacts (such as balls, cups, and dogs) (e.g., Dromi, 1987; Fenson et al., 1994; Macnamara, 1982; Nelson, 1973; Tardif et al., 2008). As well, experimental examinations of infants' understanding of proper names and count nouns have typically focused on different categories of objects. Namely, experimental evidence on proper name learning has focused on labels for people (Tincoff & Jusczyk, 1999), whereas count noun learning has focused on labels for artifacts (e.g., Woodward et al., 1994) or body parts (Tincoff & Jusczyk, 2000). This feature of previous experimental research raises further questions about accounts (i.e., narrow-to-broad and broad-to-narrow) in which infants are initially held to interpret words for objects from *all* categories, as either proper names or count nouns.

Alternative Hypothesis: Narrow-and-Broad Account

There is an alternative hypothesis about early object word learning that may address the preceding challenges to the narrow-to-broad and broad-to-narrow accounts. This account, which I will refer to as “narrow-and-broad”, proposes that infants learn words from both lexical categories from the outset of language acquisition. Furthermore, infants’ tendency to interpret an object word as a proper name or a count noun depends on the category of object being labeled. Several developmental researchers have argued for a version of this account (e.g., Bloom, 1994, 2000; Hall, 2009; Macnamara, 1982), but little direct evidence for it has been presented in the literature.

Macnamara (1982) proposed a straightforward version of the narrow-and-broad account of how infants may approach object word learning. He suggested that infants identify and learn the linguistic properties of proper names by relying on a conceptual bias to construe some objects (in particular, people) as distinct individuals, which leads them to interpret labels for these objects as proper names. At the same time, infants identify and learn the linguistic properties of count nouns by relying on a conceptual bias to construe objects from most other categories as instances of the categories, which leads them to interpret labels for these objects as count nouns.

Recently, Hall (2009) proposed a version of the account, hypothesizing that infants interpret words for people as proper names that label individual objects, while they interpret words for other kinds of objects (in particular, artifacts) as count nouns that extend across objects of the same category. Hall noted that this account has independent motivation from extensive research in cognitive development, indicating that infants construe people in fundamentally

different ways from objects in most other categories (e.g., Bonatti, Frot, Zangl, & Mehler, 2002; Kuhlmeier, Bloom, & Wynn, 2004; Quinn & Eimas, 1998; for a review, see Rakison & Poulin-Dubois, 2001).

From an early age, infants appear to represent people differently from other animate and inanimate objects (e.g., Mandler, 2000; Mandler & McDonough, 1993, Quinn & Eimas, 1998). For example, Quinn and Eimas found that infants as young as three and four months of age appear to have different categorical representations of humans compared to non-human animals (e.g., cats). More specifically, three- and four-month-olds had a tendency to represent humans but not cats as individual exemplars. At around six months of age, infants begin to discriminate between characteristics that differentiate animate (namely people), and inanimate objects (namely artifacts; e.g., Leslie, 1984; Spelke, Philips, & Woodward, 1995; Woodward, 1998, 1999). For example, Spelke and colleagues found that by seven months, infants assume that people but not other objects are capable of self-propulsion. Furthermore, there is evidence that infants as young as six months construe people as goal-directed agents whose individuality is important in its own right (e.g., Bloom, 2004; Carey, 2009). This manner of interpreting people is quite different from infants' construal of objects from most other categories, which they may interpret as mere instances of their categories.

Hall hypothesized that this difference in conceptualization of people and artifacts leads infants to interpret words for people as labeling individual objects, but to interpret words for many other categories of objects, like artifacts, as extendible across objects of a category. He also proposed that this difference plays a fundamental role in infants' learning of the distinction between proper names and count nouns in their language.

There is some evidence in the literature that bears on this hypothesis, but it comes from children past the point of having learned the linguistic distinction between proper names and count nouns. Katz et al. (1974) found that 22-month-old girls interpreted a novel proper name for a doll as a word for the labeled doll, as they had shown was true of 17-month-old girls. Katz et al. also found, however, that 22-month-old girls generalized a proper name for a toy block to another toy block treating it in the manner of a count noun. Similarly, Gelman and Taylor (1984) found that 2-year-olds interpreted a new word differently when it was applied to a stuffed animal than when it was applied to a toy artifact. They interpreted the word for the animal as a proper name and the word for the artifact as a count noun. Although the results of these studies are consistent with the narrow-and-broad hypothesis, the advanced age (and linguistic sophistication) of the children means that the data do not address it directly.

The present research attempted to explore directly Hall's (2009) version of the narrow-and broad-account. Four experiments were conducted to investigate how infants interpret novel words given to people and artifacts. Infants 16- and 17-months of age were assessed. Although these infants have been learning words for several months, they are just beginning to learn how proper names and count nouns are expressed in their language. They also straddle the earliest age at which linguistic knowledge of the proper name/count noun distinction has been reported in the literature (e.g., Katz et al., 1974; Bélanger & Hall, 2006; Hall & Bélanger, 2010). The goal of the research was to determine whether infants at this point in development interpret words for people as labels for individual objects, but interpret the same words when applied to artifacts as labels for the object categories. In this way, our aim was to shed light on how infants identify and learn the linguistic distinction between these two lexical classes.

Summary of Experiments

The general design of the experiments reported in this dissertation was based on a design developed by Bélanger and Hall (2006). Using a video preferential looking paradigm, four experiments examined infants' learning of words for either people or artifacts. In each experiment, infants learned a novel word for an object, and their willingness to generalize the word to a second object was assessed. The experiments included a people condition, in which infants learned a label for a human face, and an artifacts condition, in which infants learned a label under identical circumstances for an artifact.

There were different versions of the people and artifacts conditions to allow for a comparison between people and artifacts along two dimensions of similarity. The first dimension was whether infants were familiar with the objects; the second was whether infants knew category terms for the objects. Infants are highly familiar with people, but they commonly do not know a count noun for the category people (e.g., a word like “person,” “people,” “lady,” or “woman”; Fenson et al., 1994). Conversely, infants usually readily acquire count nouns for highly familiar artifacts at a very young age (e.g., the word “ball” for the category ball). By using different versions of the people and artifacts conditions, we were able to match artifacts to people along each of these dimensions of similarity separately. Matching the conditions in terms of these two dimensions helped clarify whether any observed differences in infants' looking behavior in the people and artifacts conditions were due to their familiarity with the objects or to their knowledge of category terms for the objects.

Gender was another factor that was incorporated into the design to address potential differences in interpretation of novel words between girls and boys. Some of the earlier work

examining infants' early understanding of the linguistic distinction between proper names and count nouns (e.g., Hall et al., 2001; Katz et al., 1974; Macnamara, 1982) revealed significant gender differences, with girls showing an ability to differentiate proper names from count nouns approximately one year earlier than boys. For example, as previously mentioned, Hall and colleagues taught infants a novel proper name or a novel count noun for one of two identical-looking objects. They found that 20-month-old boys and girls demonstrated no understanding of the proper name/count noun distinction when they were asked to find a referent for the novel label. By 24 months of age, girls (but not boys) selected the labeled object significantly more often when it was labeled with a proper name than when it was labeled with a count noun. It was not until 37 months of age that boys displayed success on the same task. The researchers, however, were able to detect an understanding of the linguistic distinction in boys at 23 months of age after they modified the task to increase the level of exposure to the novel label. Macnamara and colleagues reported a gender difference in a task that taught infants novel proper names or count nouns for one member of a pair of non-identical looking objects. They found that girls as young as 17 months of age showed an understanding of the linguistic distinction between proper names and count nouns, but there was no evidence of such an understanding in boys before 28 months of age. More recent studies, moreover, have reported no gender differences in the early appearance of knowledge of the linguistic proper name/count noun distinction (Bélanger & Hall, 2006; Hall & Bélanger, 2010). The current experiments included an equal number of boys and girls in each condition to examine possible gender differences in performance on the task.

In all four experiments, infants received two familiarization trials, followed by two test trials. The purpose of the familiarization trials was to generate a baseline measure of infants'

looking at each test object, as well as to reduce novelty preference effects (i.e., infants' tendency to pay more attention to new objects than to those they have seen before) on the test trials.

However, as will be discussed later, infants could still have shown a novelty preference for the non-target object during the test trials of the experiments because it was on screen for a shorter period of time than the target object. During the familiarization trials, infants were shown two objects (e.g., two different colored balls) that appeared simultaneously on a projection screen with no accompanying labels. The purpose of the test trials was to teach infants a novel word for one of the two objects and to evaluate their interpretation of the word. During these trials, infants first heard a novel word for one of the objects that they had seen during the familiarization trials (e.g., "Look! DAXY!"). No linguistic cues were provided to make the word appear as either a proper name or a count noun (although the bare sentence frame was more felicitous for a proper name interpretation in English). This object will be referred to as the "target object". The other object that they saw during the familiarization trials then appeared on the screen, and infants were asked to find the referent of the novel label (e.g., "Where's DAXY?"). This object will be referred to as the "non-target object". Infants' looking behavior was recorded and analyzed.

Experiment 1 provided a basic control to establish the validity of the method as a way to assess the learning of words for people and artifacts in 16- and 17-month-old infants. We designed two versions of the people condition and two versions of the artifacts condition. We conducted two versions of the people and artifacts conditions because people typically match artifacts in one of two ways for young infants: either in terms of familiarity (e.g., infants are familiar with both people and many artifacts, like balls and cups) or in terms of knowledge of a category term (e.g., infants lack knowledge of a category term for both people and many novel artifacts). People do not typically match artifacts along both dimensions simultaneously, because

infants usually know a category word for highly familiar artifacts, but they do not know a category label for people (e.g., a word like “person” or “people” or “man” or “lady”), even though they are highly familiar. These considerations led us to conduct two versions of our people and artifacts conditions in order to allow us to assess the generality of our results across the dimensions of familiarity and knowledge of a category term for the objects.

In the first version of the people condition, the target object was an image of a female face and the non-target object was an image of an animal from an unfamiliar category. This version matched infants’ lack of knowledge of category terms for the objects (i.e., infants did not have a category term for either the person or for the novel animal). In the second version of the people condition, the target object was also an image of a female face and the non-target object was a familiar animal (e.g., a dog). This version matched for infants’ familiarity with the objects (i.e., infants were highly familiar with both categories of objects). In the first version of the artifacts condition (i.e., the familiar artifacts version), the target object was an image of a colorful ball and the non-target object was an artifact from another familiar category (e.g., a cup). As in the case with people, balls and cups are highly familiar to infants, but unlike the case with people, most infants at the age under examination in this work know a count noun for the category ball and the category cup (e.g., “ball” and “cup”; Fenson et al., 1994). This version matched the objects in terms of infants’ familiarity with the objects, as well as their knowledge of category terms for the objects (i.e., infants were very familiar with the objects and they understood category terms for the objects). In the second version of the artifacts condition (i.e., the unfamiliar artifacts version), the target object was an image of a novel artifact that shared perceptual features with the familiar artifact and the non-target object was an object from another unfamiliar category of artifact. Unlike the case with people, these objects were unfamiliar to

infants; however, as in the case with people, infants did not know count nouns for the object categories. This condition again matched for infants' familiarity with the objects and their knowledge of category terms for the objects (i.e., infants were unfamiliar with both objects and did not have category terms for either object). In both the people and the artifacts conditions in Experiment 1, we hypothesized that infants would successfully map a novel word onto the target object, regardless of whether the object was a human face or an artifact. Furthermore, when infants were asked to find the referent of the word, we expected that they would look longer to the target object in all conditions. The reason for this prediction is that regardless of whether they interpreted the word as a proper name, as a count noun, or even as an adjective, infants should have restricted their looking to the target object because the non-target object was a different individual, from a different object category, with visibly contrasting (and most likely non-visibly contrasting) properties. As will be seen, the results supported our hypothesis and provided evidence of the validity of our method.

Experiment 2 tested our main hypothesis that the category of object that is labeled influences 16- and 17-month-old infants' interpretation of a novel word and affects their tendency to extend a novel word from one object to another object from the *same* category. In order to assess clearly infants' interpretation of the novel word across the dimensions of familiarity and knowledge of a category label for the objects, the experiment consisted of one version of the people condition and two versions of the artifacts conditions (i.e., familiar and unfamiliar artifacts). As previously mentioned, the purpose of having the different versions was to match familiarity and knowledge of category terms between people and artifacts. Infants are highly familiar with people; therefore, a highly familiar artifact was chosen to match people on the dimension of familiarity. On the other hand, infants should be unfamiliar with a category

term for the category people; therefore, an unfamiliar artifact was chosen to match people on the dimension of lack of knowledge of a category term. The objects were the same as the target objects used in the Experiment 1.

We hypothesized that infants would interpret words for people as proper names. Therefore, when they were asked to find the referent of the novel word, we expected that they would look longer at the target object in the people condition. In contrast, we hypothesized that infants would not interpret words for artifacts as proper names. In the unfamiliar artifacts condition, where infants did not know a count noun for the target object, we predicted that they would interpret the novel word as a count noun that is extendible across instances of the object category. Therefore, when they were asked to find the referent of the label, we expected that they would look equivalently at either object. In the familiar artifacts condition, we expected that infants would interpret the word in one of two ways. One possibility was that because infants in this condition already knew a category term for the object (such as “ball”), they would use an assumption such as mutual exclusivity or contrast to interpret the label as a count noun for a visibly contrastive subcategory (e.g. a subcategory of ball, such as balls of a certain color), or as an adjective for a visibly contrastive property (e.g., a property of the ball, such as a certain color). Therefore, they would look longer at the target object when they were asked to find the referent of the label (as in the people condition). It was also possible that infants would use mutual exclusivity or contrast to interpret the label as a count noun for a non-visibly contrastive subcategory (e.g., a subcategory of ball, such as balls of a certain inferred specialized function) or as an adjective for a non-visibly contrastive property (e.g., a property of the ball, such as round). Therefore, when they were asked to find the referent of the label, they would generalize the label and look equally at both objects because there was no basis for favoring either object on

this type of interpretation. The results from Experiment 2 provided the first evidence in the literature that at 16 and 17 months, infants make different interpretations of novel labels based on the category of object being labeled (person, artifact), in line with our predictions.

Experiment 3 was very similar to Experiment 2, but it presented a more stringent exploration of the role of object category differences in early word learning. Experiment 3 examined how infants' different interpretation of novel words for people and objects influenced their interpretation of a *second* novel word. In this experiment, infants were taught a novel word for one object (i.e., "Look! DAXY!") exactly as in Experiment 2. Instead of asking them to find the referent for the word that they just learned, however, we asked them to find the referent of a second novel word that they had never heard before (i.e., "Where's BLICKY?").

As in Experiment 2, we predicted that infants in Experiment 3 would interpret the first word for a person as a proper name. When they were asked to find the referent of the second novel word, we expected that infants in the people condition would look longer at the *non-target* object. This expectation was based on the prediction that infants would assume that one object should only have one proper name (cf. Hall & Graham, 1999). On the other hand, we expected that infants in the two artifacts conditions would not interpret the first word for an artifact as a proper name. In the unfamiliar artifacts condition, where infants did not know a count noun for the target object, we predicted that they would interpret the first novel label as a count noun that is extendible across instances of the object category (as in Experiment 2). Therefore, when infants heard a second novel label, we expected they would interpret the word in one of two ways. One possibility was that infants would use mutual exclusivity or contrast to interpret the second word as a count noun for a visibly contrastive subcategory (e.g., a subcategory of ball such as balls of a certain color), or as an adjective for a visibly contrastive property (e.g., a

property of the ball such as its color). A second possibility was that infants would use mutual exclusivity or contrast to interpret the second label as a count noun for a non-visibly contrastive subcategory (e.g., a subcategory such as balls of a certain inferred specialized function), or as an adjective for a non-visibly contrastive property (e.g., a property such as round). In either case, infants would look equally at both objects when they were asked to find the referent for the second novel label because there was no basis for favoring either object on either type of interpretation.

In the familiar artifacts condition, we expected that infants would interpret the first novel word in one of two ways (as in Experiment 2). One possibility was that because infants in this condition already knew a category term for the object (such as “ball”), they would use mutual exclusivity or contrast to interpret the first novel word as a count noun for a visibly contrastive subcategory, or as an adjective for a visibly contrastive property of the target object. Another possibility was that infants would use mutual exclusivity or contrast to interpret the first novel word as a count noun for a non-visibly contrastive subcategory, or as an adjective for a non-visibly contrastive property of the target object. On either possibility, when they were asked to find the referent of a second novel label at test, we expected that infants would take the word to label a different subcategory or a different property, using the contrast assumption. We did not predict that they would favor either object, given that there is no evidence to suggest that learners avoid mapping a second subcategory term or a second property term to one object (e.g., Hall & Graham, 1999; Hall et al., 2008). The results from Experiment 3 provided additional support for our hypothesis that infants interpret words for people and artifacts in fundamentally different ways, again in line with our predictions.

Experiment 4 addressed an interpretive question arising from the results of Experiments 2 and 3. One possible reason why infants interpreted the labels for people differently from the labels for artifacts in those experiments is not that there were conceptual differences between the labeled object categories, but that there were differences in perceptual complexity between them. In particular, the faces may have been seen as more complex perceptually (with many more inherent surface features, such as a nose, a mouth, eyes and hair) than the artifacts (which, in our case, have a uniform surface and are distinguishable only by their colors). As a result, it is possible that the findings in Experiments 2 and 3 were due to the differences in perceptual complexity between the objects. Experiment 4 was designed to test this alternative interpretation of the findings for Experiments 2 and 3. In this experiment, we assessed infants' interpretation of a novel label given to an inverted face in the task from Experiment 2. There is evidence from the infant facial perception literature to suggest that by 7 months of age, infants analyze an upright face in a different manner from the manner in which they analyze an inverted face (e.g., Cohen & Cashon, 2001; Kestenbaum & Nelson, 1990; Younger & Cohen, 1986). That is, they process an upright face as a configuration of all features, but an inverted face as a set of independent features. The objects used in Experiment 4 shared perceptual features with the faces used in Experiments 2 and 3 (because they were the same faces). The only difference is that the objects no longer appeared person-like or face-like, because they were inverted. We predicted that infants would no longer see the inverted heads as person-like or face-like. Therefore, we expected infants to interpret a first novel word for the inverted faces in the same manner as one given to an unfamiliar artifact and look equally at both objects at test when asked to find the referent of the novel word. The results provided support for our hypothesis.

See Figure 1 for images of the objects used in the four experiments. See Figures 2 to 5 for enlarged versions of the images.

Figure 1. Objects Used in Experiment 1

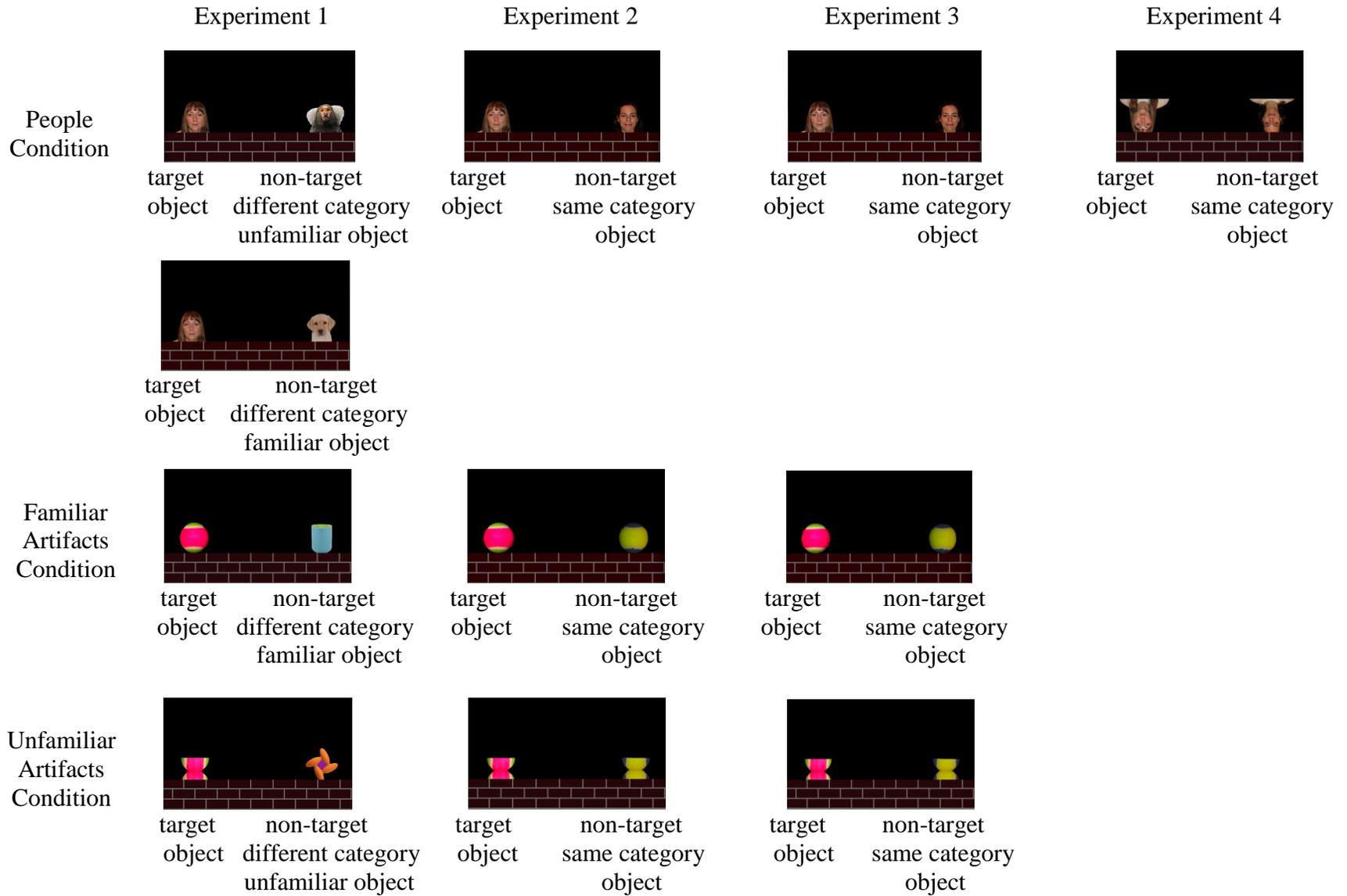
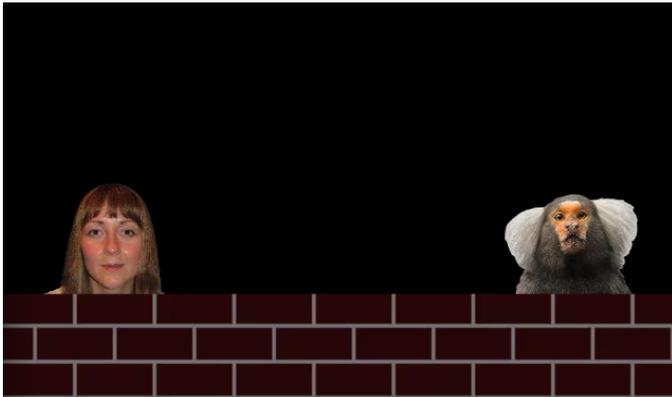


Figure 2. Enlarged Images of the Objects Used in Experiment 1

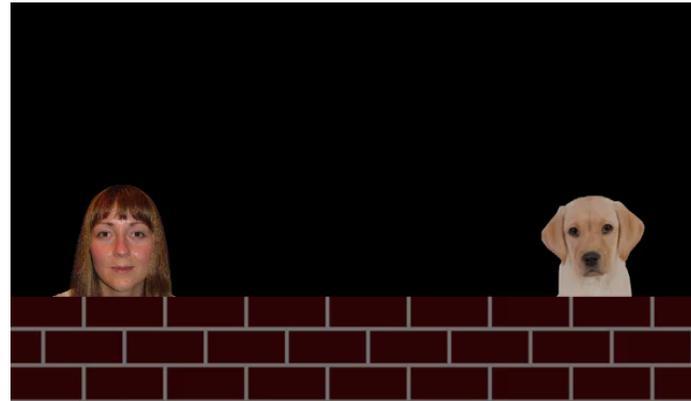
People Condition



target object

non-target different category
unfamiliar object

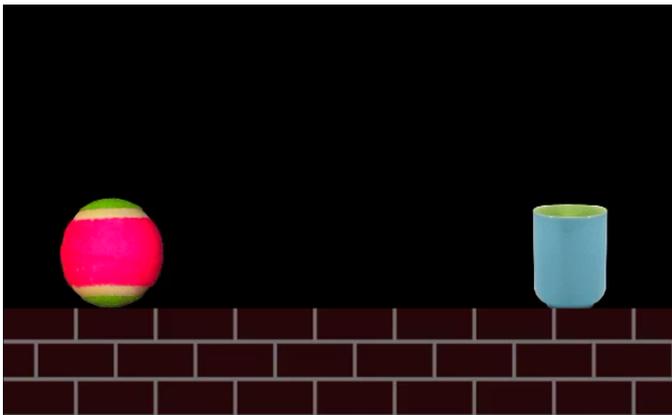
People Condition



target object

non-target different category
familiar object

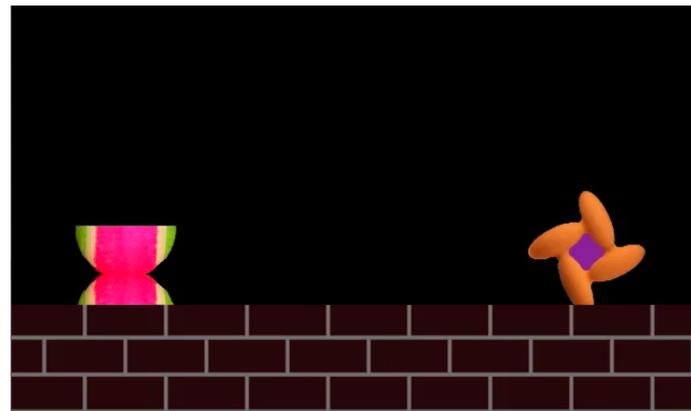
31 Familiar Artifacts Condition



target object

non-target different category
familiar object

Unfamiliar Artifacts Condition

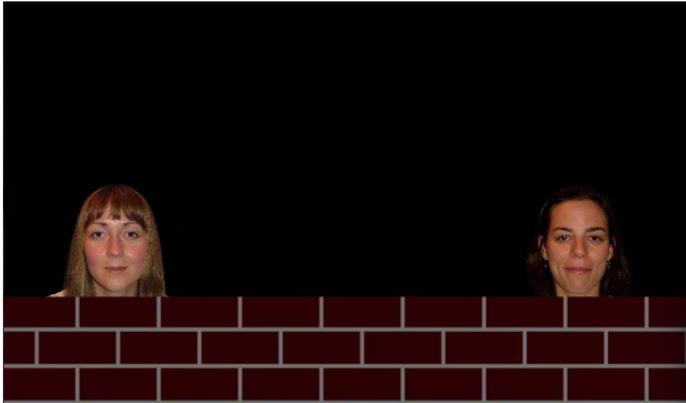


target object

non-target different category
unfamiliar object

Figure 3. Enlarged Images of the Objects Used in Experiment 2

People Condition

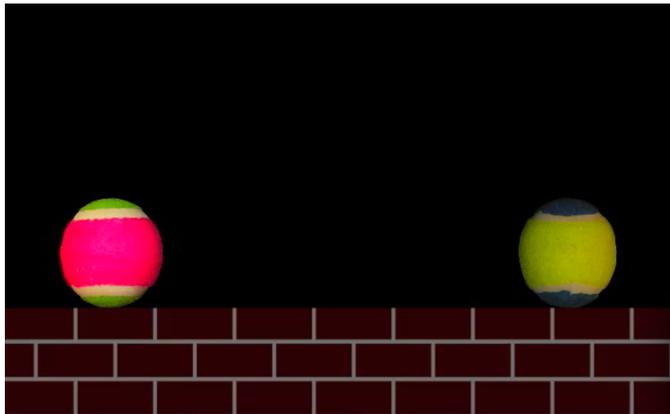


target object

non-target same category
object

32

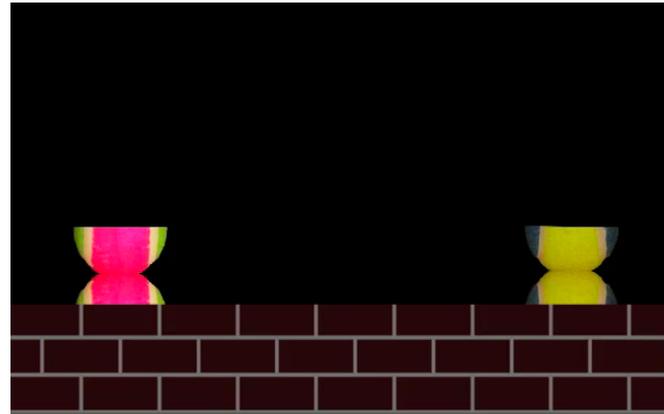
Familiar Artifacts Condition



target object

non-target same category
object

Unfamiliar Artifacts Condition

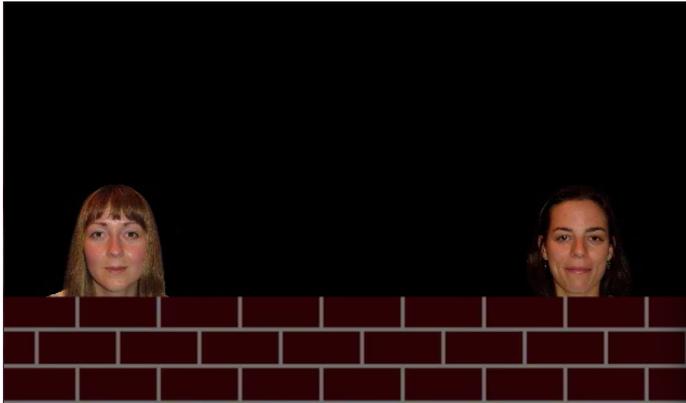


target object

non-target same category
object

Figure 4. Enlarged Images of the Objects Used in Experiment 3

People Condition

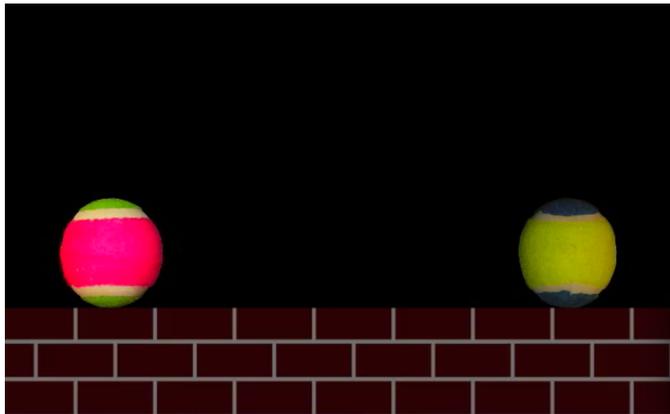


target object

non-target same category object

33

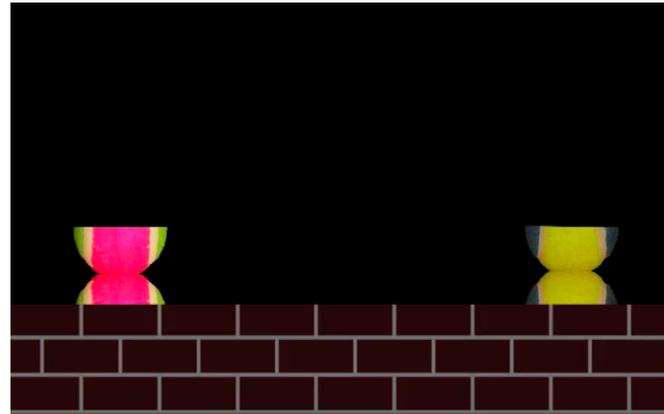
Familiar Artifacts Condition



target object

non-target same category object

Unfamiliar Artifacts Condition

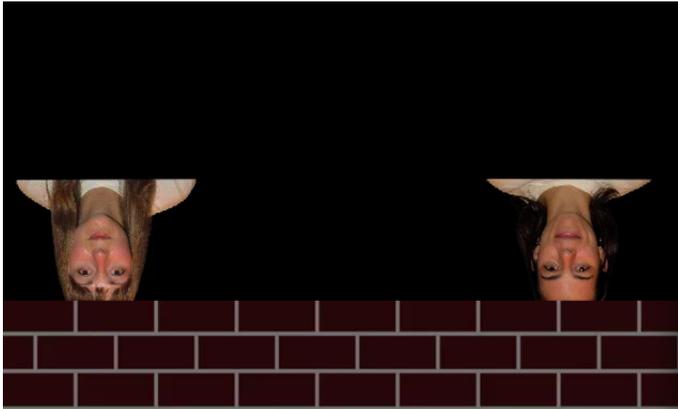


target object

non-target same category object

Figure 5. Enlarged Image of the Objects Used in Experiment 4

People Condition



target object

non-target same category
object

EXPERIMENT 1

Method

Participants

Forty-eight 16- and 17-month-old infants participated (24 boys and 24 girls; range = 16 months, 0 days – 17 months, 30 days; mean age = 17 months, 2 days). The infants were recruited through the University of British Columbia Early Development Research Group database. All infants were monolingual English learners (exposed to at least 80% from all sources). Equal numbers of infants were randomly assigned to one of two conditions: people and artifacts. There were two versions of the people condition and two versions of the artifacts condition, each containing an equal number of boys and girls. An additional 27 infants participated but were not included in the analyses because they were too fussy to complete the task ($n = 21$), because their parents interfered in some way ($n = 1$), or because of equipment failure ($n = 5$). Infants participated in only one video task during their visit to our centre.

Materials

There were eight familiarization trial videos and eight test trial videos for the people condition, and eight familiarization trial videos and eight test trial videos for the artifacts condition. The videos were created by animating images of test objects using Final Cut Express HD. For the first version of the people condition, two female faces were each paired with a dog face. For the second version, two female faces were each paired with the face of a monkey-like animal. For the first version of the artifacts condition (familiar), two balls were each paired with a cup. For the second version (unfamiliar), two hourglass-like objects were each paired with a squeaky artifact toy.

The images of the female faces were photographed heads of two young, Caucasian women who were asked to display a pleasant facial expression: one had long blond hair, and one had shoulder-length brown hair. The images of the balls were photos of two tennis balls: one that was pink and green, and one that was yellow and blue. The images of the hourglass-like objects were created using Adobe Photoshop by cutting the images of the two tennis balls, just described, in half and then inverting the halves so that the rounded edges were touching. The image of the dog face was a photographed head of a golden Labrador Retriever. The image of the monkey-like animal face was a photographed head of an animal with black and white fur. The image of the cup was a photo of a ceramic cup that was blue on the outside and green on the inside. The image of the squeaky artifact toy was a photo of an object that resembled a ninja star with rounded edges and was orange with a purple center. See Figure 1 for a schematic example of the video stimuli.

The accompanying audio track was of a female voice reading a script in infant-directed speech. See Appendix A for the entire script presented on used for both the familiarization and the test trials.

Familiarization Trial Videos. For each condition, familiarization videos showed two objects (e.g., a pink-and-green ball and a blue-and-green cup) appearing on the screen simultaneously. The objects rotated back and forth by 30 degrees while a pre-recorded voice said, “Look! Wow! See! Look!” in infant-directed speech. Each familiarization trial video lasted 10 seconds, and the left-right positioning of these objects was counterbalanced across videos. There were 16 familiarization videos in total (four per condition).

Test Trial Videos. In each video in each condition, the target object entered the scene from one side (left or right, counterbalanced), stopping in full view on that side. The object rotated back and forth by 30 degrees while a pre-recorded voice presented a label in a bare sentence context (e.g., “Look! DAXY!”). This sentence was repeated seven times, over a period of 15 seconds (cf. Hollich et al., 2000). Then the object moved slowly to the opposite side of the scene, stopping there in full view. The object rotated back and forth by 30 degrees while the pre-recorded voice simply told infants to look (e.g., “Look!”) three times over a period of three seconds. Then the non-target object from the familiarization trials entered the scene from the side where the target object initially appeared, stopping in full view where the target object first stopped. The non-target object rotated back and forth by 30 degrees while the pre-recorded voice again simply told infants to look (e.g., “Look!”) six times over a period of eight seconds. Then both objects dimmed to 50% brightness and an attention-getter (an image of a blue flower that grew and shrank while spinning) appeared at the top-centre of the scene for five seconds. The purpose of the attention-getter was to draw infants’ attention to the centre of the scene and away from the two objects. After the attention-getter disappeared, the two objects returned to full brightness and rotated back and forth by 30 degrees. The voice then asked a test question (e.g., “Where’s DAXY?”) three times at five-second intervals over a period of 15 seconds. There were 16 test trial videos in total (four per condition). See Figure 6 for a schematic example of the video stimuli.

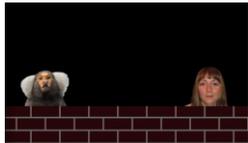
Attention-getter Video. An attention-getter video was also used, consisting of an image of a blue and white spiral that grew and shrank while spinning.

Figure 6. Schematic Example of Video Stimuli for Experiment 1

People condition with unfamiliar animal

Familiarization trial

“Look!”



Both objects appear simultaneously on the screen

“Look! DAXY!”



Target object enters the scene from one side

“Look!”



Target object moves to the opposite side

Test trial

“Look!”



Non-target object enters the scene

“Where’s DAXY!”



Attention getter appears at the top centre of the scene



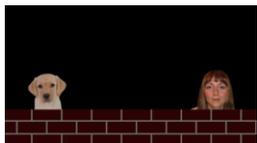
Infants asked to find the referent for the novel label

38

People condition with familiar animal

Familiarization trial

“Look!”



Both objects appear simultaneously on the screen

“Look! DAXY!”



Target object enters the scene from one side

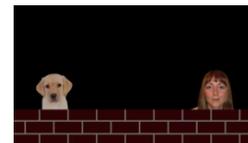
“Look!”



Target object moves to the opposite side

Test trial

“Look!”

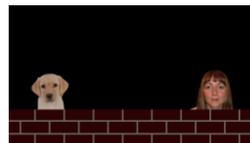


Non-target object enters the scene

“Where’s DAXY!”



Attention getter appears at the top centre of the scene

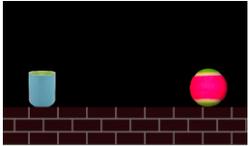


Infants asked to find the referent for the novel label

Familiar artifacts condition

Familiarization trial

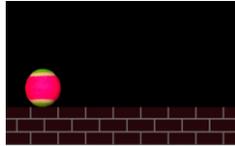
“Look!”



Both objects appear simultaneously on the screen

Test trial

“Look! DAXY!”



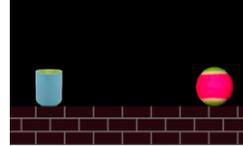
Target object enters the scene from one side

“Look!”

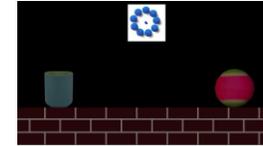


Target object moves to the opposite side

“Look!”

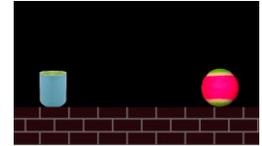


Non-target object enters the scene



Attention getter appears at the top centre of the scene

“Where’s DAXY!”



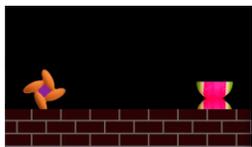
Infants asked to find the referent for the novel label

39

Unfamiliar artifacts condition

Familiarization trial

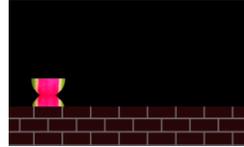
“Look!”



Both objects appear simultaneously on the screen

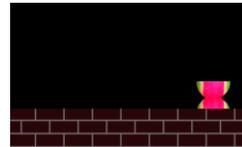
Test trial

“Look! DAXY!”



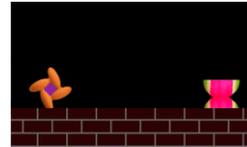
Target object enters the scene from one side

“Look!”



Target object moves to the opposite side

“Look!”



Non-target object enters the scene



Attention getter appears at the top centre of the scene

“Where’s DAXY!”



Infants asked to find the referent for the novel label

Procedure

After the procedure was explained to the parent or parents and they signed a consent form, the infant and one of the parents were taken into the testing room. Infants were seated on their parent's lap approximately 1.5 m away and directly faced a large projection screen in a dimly lit room. Parents were asked to refrain from pointing at the screen, to remain silent during the experiment, to keep their eyes closed, and to keep their infant on their lap as best as possible. The experimenter returned to the observing area to start the videos.

The experiment was controlled by Habit X 1.0 software (Cohen, Atkinson, & Chaput, 2004) and run on a Macbook Pro. The video stimuli were presented on a large projection screen. The audio stimuli were presented using Bose speakers linked to the Macbook Pro. A video camera partially hidden under the screen captured infants' looking behavior. The experimenter manually began each video when the infant was attending to the screen. The attention-getter video was played at the start of the experiment to attract infants' gaze and in between subsequent videos to recapture their attention.

Infants first saw two familiarization trial videos, with the target object appearing once on the left and once on the right. The left/right placement of the target object for the first and second familiarization trial videos matched the left/right placement of the target object for the first and second test trial videos. After the familiarization trial videos, infants saw two test trial videos. Infants saw one of four orders, crossing left/right entrance of the target object (L-R or R-L) with the object being target (e.g., pink-and-green ball or yellow-and-blue ball) serving as the target.

Upon completion of the task, we asked parents to provide information about their infants' knowledge of a word for the stimuli. Parents were asked whether their infant comprehended or

produced a word for the objects used in the videos. Their answers were recorded on the infants' files. In all experiments, all the infants in the familiar artifacts condition either comprehended or produced a word for the category ball (e.g., "ball"). In contrast, none of the infants in the unfamiliar artifacts condition comprehended or produced a word for the unfamiliar object category. Similarly, none of the infants in the people condition comprehended or produced a word for the category people (e.g., "people," "person," "lady," "woman").

Coding

Trained coders blind to which object was labeled coded infants' looking behavior during the videos. Infants' looking behavior during the familiarization and test trials was coded frame-by-frame according to whether each infant was looking at the target object, the non-target object, or elsewhere. Our dependent measure was extracted from this coding process: infants' *proportion of looking to the target object* (i.e., total time spent looking at the target object / total time spent looking at either object; Bélanger & Hall, 2006; Reznick, 1990). Some form of looking time is the most common behavioral measure used to study infant perception, cognition and language development (Aslin, 2007). Previous research on word learning has used total looking time as a reliable measure infants' knowledge (e.g., Bélanger & Hall, 2006; Halberda, 2003, Hollich et al., 2000).

To assess inter-rater reliability, a second independent researcher, also blind to condition, coded the data from 25% of the participants in each condition. The same dependent measure as in the original coding process (proportion of looking to the target object) was extracted for the familiarization and test trials, and the relation between the numbers from the two coders was

evaluated through a correlation. The results showed that the inter-rater reliability was very high for the familiarization trials, $r = .99$, and the test trials, $r = .99$.

Results

On the familiarization trials, if infants had no preference for the target objects, we predicted that (1) they would show no difference in their tendency to look at the target object across conditions, and (2) they would show no difference from chance in their looking at the target within each condition.

On the test trials, if infants were able to learn a novel word for a person or an artifact in our task, we predicted that (1) infants would show no difference in their tendency to look at the target object across conditions, and (2) they would show a significant tendency to look at the target object in all conditions. Our reasoning was that regardless of whether infants interpreted the novel word as labeling the individual object, the object category (or subcategory), or a visible (or even non-visible) property, they should not generalize their looking to the non-target object because it was both a different individual and a member of a different object category with contrasting visible (and non-visible) properties. See Table 1.

The analyses performed in this experiment and in subsequent experiments are reported as two-tailed tests unless otherwise noted. A two-tailed, non-directional approach was taken, except for when the hypothesis motivated a one-tailed, directional prediction.

Table 1. Experiment 1 Predictions for Test Trials

Condition	Interpretation of Novel Label	Looking Behavior When Asked to Find Referent for Novel Label
People with Familiar Animal	Proper Name	Target Object
People with Unfamiliar Animal	Proper Name	Target Object
Unfamiliar Artifacts	Category Count Noun	Target Object
Familiar Artifacts	Subcategory Count Noun or Adjective	Target Object

Familiarization Trials

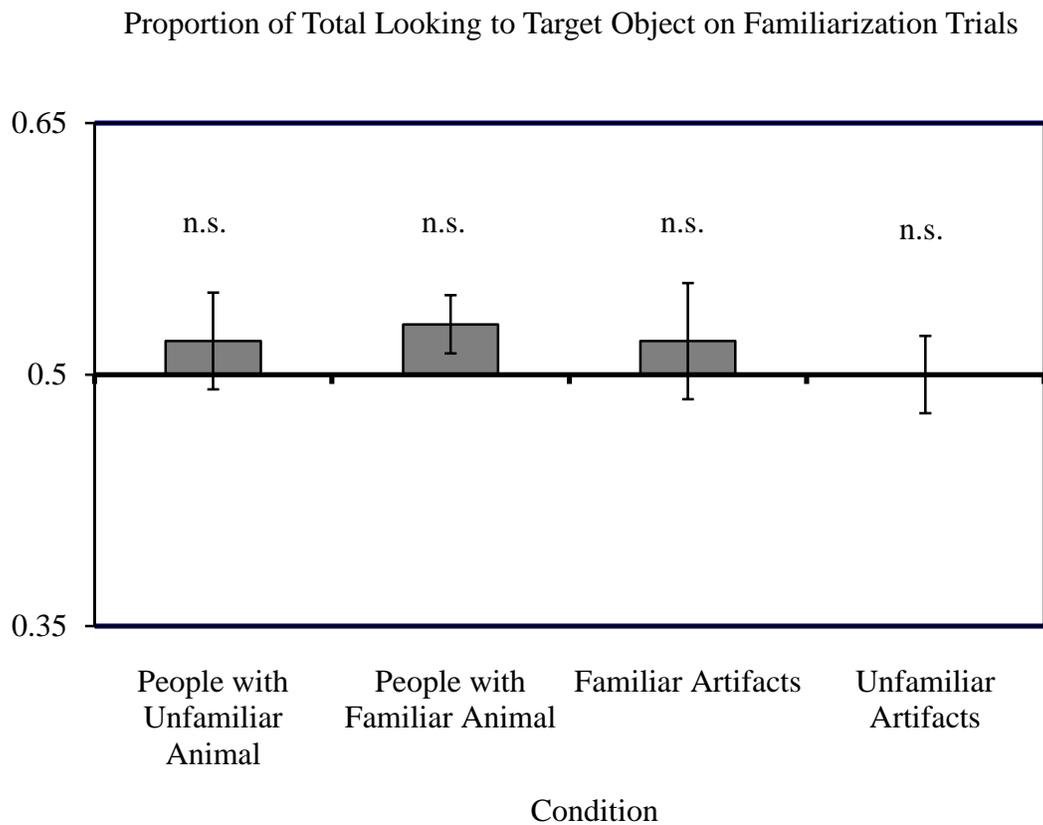
Differences Between Conditions. To examine the effect of our manipulation as well as the effect of gender on infants' proportion of looking to the target object, we conducted a 2 (gender: male, female) by 4 (condition: people with unfamiliar animal, people with familiar animal, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded no significant main effect of condition, $F(3, 40) = .15, p = .93, \eta_p^2 = .011$, no main effect of gender, $F(1, 40) = .015, p = .90, \eta_p^2 = .000$, and no interaction, $F(3, 40) = .14, p = .93, \eta_p^2 = .011$.

Previous research has provided evidence that infants begin to understand linguistic cues marking the proper name/count noun distinction by 17 months of age (e.g., Hall & Bélanger, 2010; Macnamara, 1982). Therefore, we decided to perform a follow-up analysis to examine differences in performance between 16- and 17-month-olds. We divided the sample into two groups based on the median age. The median age was 17 months, 3 days. The mean age for the younger group (“16-month-olds”) was 16 months, 19 days and the mean age for the older group (“17-month-olds”) was 17 month, 17 days. We then conducted a 2 (age: “16 months”, “17 months”) by 4 (condition: people with unfamiliar animal, people with unfamiliar animal, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded no significant main effect of condition, $F(3, 40) = .18, p = .91, \eta_p^2 = .013$, main effect of age, $F(1, 40) = .30, p = .59, \eta_p^2 = .007$, or interaction, $F(3, 40) = 1.35, p = .27, \eta_p^2 = .092$, indicating that the proportion of looking to the target object was comparable across conditions and ages.

Differences Within Conditions. Four planned single-sample t-tests were conducted to compare the means of each condition to chance: the people condition with unfamiliar animal ($M = .52, SD = .097$), the people condition with familiar animal ($M = .53, SD = .06$), the familiar artifacts condition ($M = .52, SD = .12$), and the unfamiliar artifacts condition ($M = .50, SD = .08$). We defined chance as .50 because the task was a two-object forced-choice task. We predicted that there would be no preference for the target object over the other object in any condition during the familiarization trials. Therefore, we predicted that the proportion of looking to the target object would not differ from chance in any condition. This prediction was supported in all four conditions. Infants looked equally at both objects in the people condition with the unfamiliar animal, $t(11) = .87, p = .40, d = .21$, in the people condition with the familiar animal,

$t(11) = 1.45, p = .18, d = .50$, in the familiar artifacts condition, $t(11) = .52, p = .68, d = .17$, and in the unfamiliar artifacts condition, $t(11) = .10, p = .93, d = .000$. See Figure 7.

Figure 7. Experiment 1 Results in Familiarization Trials



Test Trials

Differences Between Conditions. To examine the effect of our manipulation as well as the effect of gender on infants' proportion of looking to the target object on the test trials, we conducted a 2 (gender: male, female) by 4 (condition: people with unfamiliar animal, people with unfamiliar animal, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This

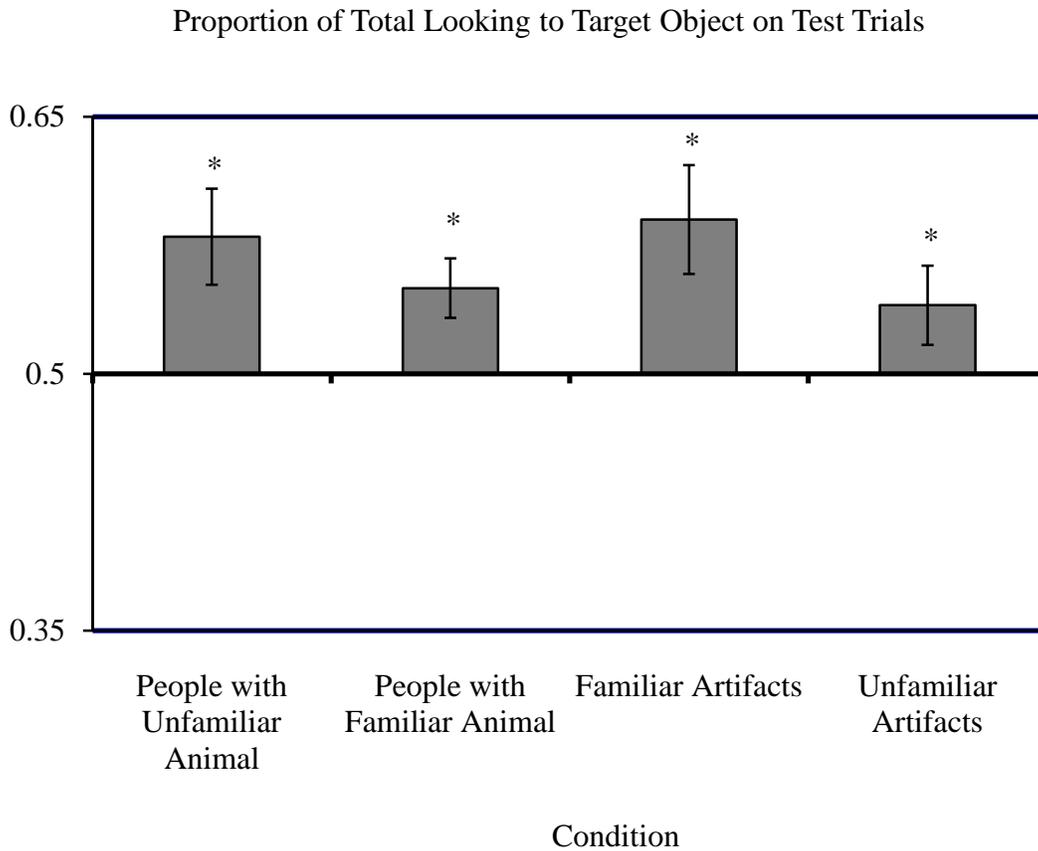
analysis yielded no significant main effect of condition, $F(3, 40) = 1.27, p = .30, \eta_p^2 = .087$, no main effect of gender, $F(1, 40) = .40, p = .53, \eta_p^2 = .01$, and no interaction, $F(3, 40) = .49, p = .69, \eta_p^2 = .035$.

To examine age differences in infants' performance, we performed a follow-up analysis to investigate differences in performance between infants in our "16 months" and "17 months" groups. We conducted a 2 (age: "16 months", "17 months") by 4 (condition: people with unfamiliar animal, people with unfamiliar animal, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded no significant main effect of condition, $F(3, 40) = 1.65, p = .19, \eta_p^2 = .11$, no main effect of age, $F(1, 40) = 3.46, p = .070, \eta_p^2 = .08$, and no interaction, $F(3, 40) = .60, p = .62, \eta_p^2 = .043$, indicating that the proportion of looking to the target object was comparable across conditions and ages.

Differences Within Conditions. Four planned single-sample t-tests were conducted to compare the means of each condition to chance: people condition with unfamiliar animal ($M = .58, SD = .093$), people condition with familiar animal ($M = .55, SD = .06$), familiar artifacts condition ($M = .60, SD = .11$), and unfamiliar artifacts condition ($M = .54, SD = .045$). If infants learned the word-object pairings, they should have looked significantly longer at the target object than the non-target object. Therefore, we predicted that the means in all four conditions would be significantly higher than .50. The proportion of looking to the target object was significantly higher than chance in the people condition with the unfamiliar animal, $t(11) = 2.89, p = .015, d = .86$; the people condition with the familiar animal, $t(11) = 2.75, p = .019, d = .83$; the familiar artifacts condition, $t(11) = 2.93, p = .014, d = .90$; and the unfamiliar artifacts condition, $t(11) = 2.76, p = .019, d = .89$. These results matched our predictions, providing evidence that infants

learned the term for the target object in all conditions and that the task is appropriate for assessing the learning of words for these stimuli in 16- and 17-month-olds. See Figure 8.

Figure 8. Experiment 1 Results in Test Trials



* = significantly different from chance, $p < .05$ (2-tailed)

Discussion

In Experiment 1, 16- and 17-month-old infants demonstrated that they were able to learn a novel word for the target object on the test trials in all conditions. The findings indicate that our task provides a suitable method for assessing 16- and 17-month-old infants' interpretation of

words for both our people and artifacts. In all the conditions, infants looked proportionally more often than chance at the target object than at the non-target object when they were asked to find the referent of the novel label. This finding is consistent with the results from previous word-learning studies involving infants in the same age range using similar methods (e.g., Bélanger & Hall, 2006; Hall & Bélanger, 2010). Also, a notable finding of this experiment is that we found no difference in performance between boys and girls. Gender effects have been evident in some of the previous experiments examining infants' use of linguistic cues to learn proper names and count nouns, with girls showing earlier knowledge than boys (e.g. Hall et al., 2001; Katz et al., 1974). However, more recent research has found no evidence of a gender difference in infant's performance (e.g., Bélanger & Hall, 2006; Hall & Bélanger, 2010). Our finding suggests that both boys and girls make similar interpretations of the novel words for people and artifacts in our task. Furthermore, when we split the group into two according to the median age and compared the performance of 16-month-olds to 17-month-olds, we found no difference between the two age groups. As previously mentioned, 17 months is the youngest age in the literature at which infants have shown knowledge of the linguistic distinction between proper names and count nouns. Our finding that there was no difference between the performance of 16- and 17-month-olds provides evidence that 16-month-olds are as adept as 17-month-olds at learning a novel word for either a person or an artifact in our task. In sum, Experiment 1 established the validity of the methodology for our experiments, setting the stage for the following experiments.

EXPERIMENT 2

Method

Participants

Thirty-six 16- and 17-month-old infants participated (18 boys and 18 girls; range = 16 months, 0 days – 18 months, 1 day; mean age = 16 months, 29 days). The infants were recruited through the University of British Columbia Early Development Research Group database. All infants were monolingual English learners (exposed to at least 80% from all sources). Equal numbers of infants were randomly assigned to one of three conditions: people, familiar artifacts, and unfamiliar artifacts. There was one version of the people condition and two versions of the artifacts condition, each containing an equal number of boys and girls. An additional 11 infants participated but were not included in the analyses because they were too fussy to complete the task. Infants participated in only one video task during their visit to our centre.

Materials

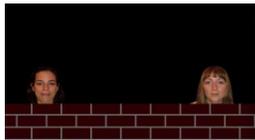
The videos were identical to those used in Experiment 1 with one difference: the object pairs used in each condition were from the *same* category (i.e., a pink-and-green ball and a yellow-and-blue ball). In other words, whereas the non-target object was from a different category in Experiment 1, the non-target object in Experiment 2 was from the same category. There were two familiarization trial videos and four test trial videos for the people condition, and four familiarization trial videos and eight test trial videos for the artifacts condition. See Figure 9 for a schematic example of the video stimuli. See Appendix A for the entire script used for both the familiarization and the test trials.

Figure 9. Schematic Example of Video Stimuli for Experiment 2

People condition

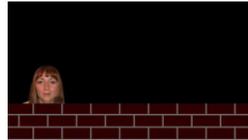
Familiarization trial

“Look!”



Both objects appear simultaneously on the screen

“Look! DAXY!”



Target object enters the scene from one side

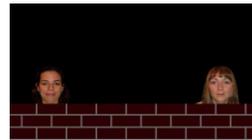
“Look!”



Target object moves to the opposite side

Test trial

“Look!”



Non-target object enters the scene



Attention getter appears at the top centre of the scene

“Where’s DAXY!”



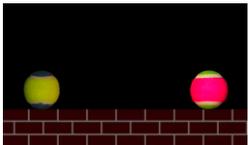
Infants asked to find the referent for the novel label

50

Familiar artifacts condition

Familiarization trial

“Look!”



Both objects appear simultaneously on the screen

“Look! DAXY!”



Target object enters the scene from one side

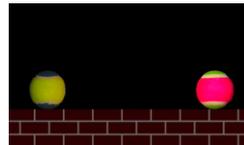
“Look!”



Target object moves to the opposite side

Test trial

“Look!”

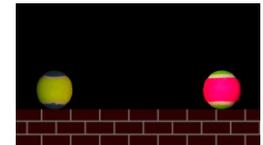


Non-target object enters the scene



Attention getter appears at the top centre of the scene

“Where’s DAXY!”

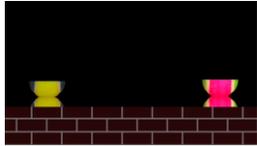


Infants asked to find the referent for the novel label

Unfamiliar artifacts condition

Familiarization trial

“Look!”



Both objects appear simultaneously on the screen

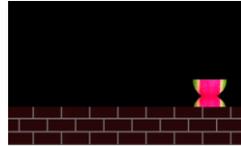
Test trial

“Look! DAXY!”



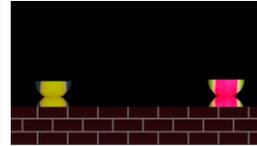
Target object enters the scene from one side

“Look!”

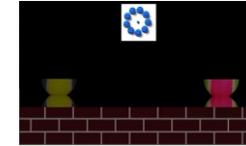


Target object moves to the opposite side

“Look!”

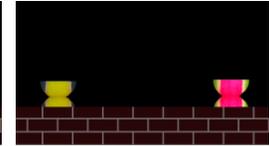


Non-target object enters the scene



Attention getter appears at the top centre of the scene

“Where’s DAXY!”



Infants asked to find the referent for the novel label

Procedure

The procedure was identical to that of Experiment 1.

Coding

The coding process was also identical to that of Experiment 1.

The inter-rater reliability was again very high for the familiarization trials, $r = .99$, and for the test trials, $r = .99$.

Results

On the familiarization trials, if infants had no preference for the target objects, we predicted that (1) they would show no difference in their tendency to look at the target object across conditions, and (2) they would show no difference from chance in their looking at the target object within each condition.

On the test trials, our predictions differed for the different conditions. These predictions were based on the hypothesis that infants interpret novel labels paired with people differently from novel labels paired with artifacts. More specifically, we predicted that infants in the people condition would interpret the novel label as a proper name for the target object. Therefore, when they were asked to find the referent of the label, we expected that they would look longer at the target object than the non-target object.

On the other hand, we predicted that infants in the two artifacts conditions would not interpret the novel label as a proper name. In the unfamiliar artifacts condition, where infants did not know a count noun for the target object, we predicted that they would interpret the novel label as a count noun that is extendible across instances of the object category. Therefore, we

expected that they would look equivalently at either object when asked to find the referent of the label.

In the familiar artifacts condition, we expected that infants would interpret the word in one of two ways. One possibility was that, because infants in this condition already knew a category term for the object (such as “ball”), they would use an assumption such as mutual exclusivity or contrast to interpret the label as a count noun for a visibly contrastive subcategory (such as “pink-and-green ball”), or as an adjective for a visibly contrastive property (such as “pink-and-green”). Therefore, they would look longer at the target object when they were asked to find the referent of the label (as in the people condition). It was also possible that infants would use mutual exclusivity or contrast to interpret the label as a count noun for a non-visibly contrastive subcategory (such as “tennis ball”) or as an adjective for a non-visibly contrastive property (such as “round”). Therefore, when they were asked to find the referent of the label, they would generalize the label and look equally at both objects. See Table 2.

Given the preceding considerations, we predicted that on the test trials (1) infants would show a difference in their tendency to look at the target object across conditions, such that the proportion would be higher in the people condition than in the unfamiliar artifacts condition, and the proportion in the familiar artifacts condition would be equal to that in either the people or the unfamiliar artifacts condition, and (2) they would show a significant tendency to look at the target object in the people condition, show no difference from chance in the unfamiliar artifacts condition, and show either a tendency to look at the target object or no difference from chance in the familiar artifacts condition.

Table 2. Experiment 2 Predictions for Test Trials

Condition	Interpretation of Novel Label	Looking Behavior When Asked to Find Referent for Novel Label
People	Proper Name	Target Object
Unfamiliar Artifacts	Category Count Noun	No Preference
Familiar Artifacts	Subcategory Count Noun or Adjective for Visibly Contrastive Property	Target Object
	Subcategory Count Noun or Adjective for Non-visibly Contrastive Property	No Preference

Familiarization Trials

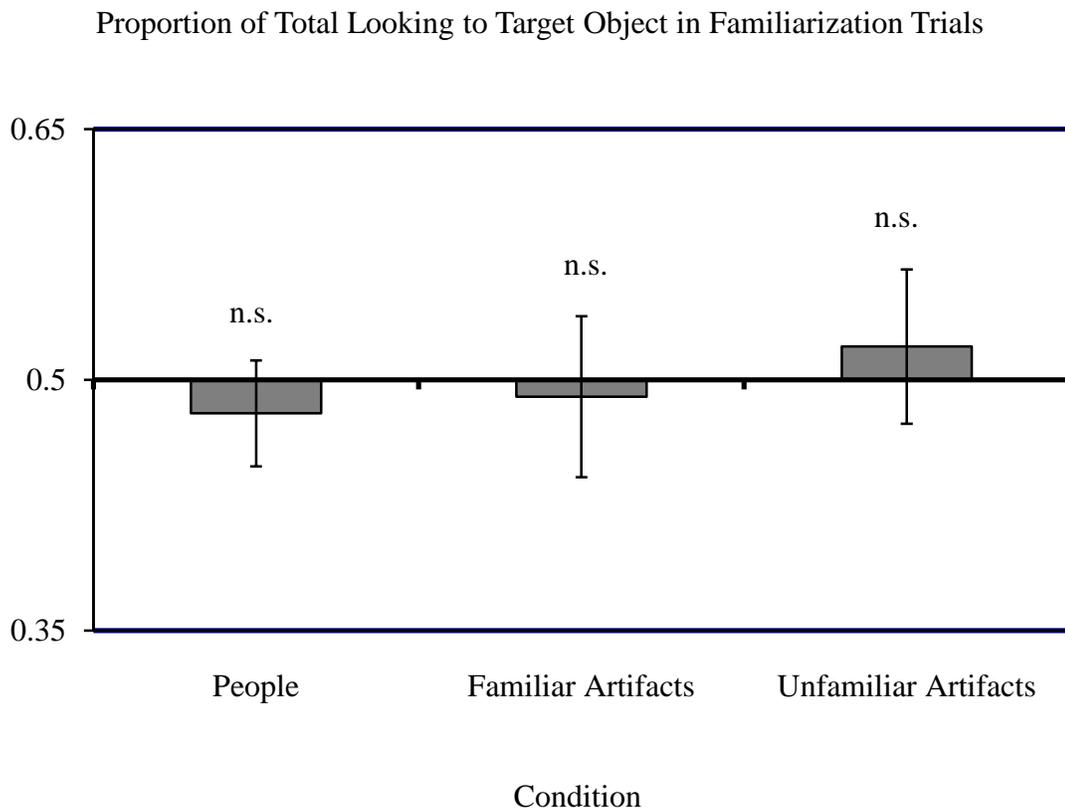
Differences Between Conditions. To examine the effect of our manipulation as well as the effect of gender on infants' proportion of looking to the target object, we conducted a 2 (gender: male, female) by 3 (condition: people, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded no significant main effect of condition, $F(2, 30) = .23$, $p = .79$, $\eta_p^2 = .015$, no main effect of gender, $F(1, 30) = .50$, $p = .48$, $\eta_p^2 = .016$, and no interaction, $F(2, 30) = .91$, $p = .41$, $\eta_p^2 = .057$.

Given that the 16- and 17-month-old infants in our experiment straddle the age at which they first show knowledge of the linguistic proper name/count noun distinction based on prior results (e.g., Hall & Bélanger, 2010; Macnamara, 1982), we performed a follow-up analysis to

examine possible differences in performance between 16- and 17-month-olds. We divided the sample into two groups based on the median age, which was 16 months, 23 days. The mean age for the younger group (“16-month-olds”) was 16 months, 11 days and the mean age for the older group (“17-month-olds”) was 17 month, 15 days. We conducted a 2 (age: “16 months”, “17 months”) by 3 (condition: people, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded no significant main effect of condition, $F(2, 30) = .25, p = .78, \eta_p^2 = .016$, no main effect of age, $F(1, 30) = 1.70, p = .20, \eta_p^2 = .054$, and no interaction, $F(2, 30) = 3.24, p = .053, \eta_p^2 = .18$, indicating that the proportion of looking to the target object was comparable across conditions and ages.

Differences Within Conditions. Three planned single-sample t-tests were conducted to compare the means of each condition to chance, as defined in Experiment 1: people condition ($M = .48, SD = .11$), familiar artifacts condition ($M = .49, SD = .16$), and unfamiliar artifacts condition ($M = .52, SD = .16$). We predicted that there would be no preference during the familiarization trials for one object over the other. Therefore, we expected that the proportion of looking to the target object would not differ from chance. This prediction was supported in all three conditions. Infants looked equally at both objects in the people condition, $t(11) = -.51, p = .62, d = .18$, the familiar artifacts condition, $t(11) = -.15, p = .89, d = .063$, and the unfamiliar artifacts condition, $t(11) = .49, p = .63, d = .13$. See Figure 10.

Figure 10. Experiment 2 Results in Familiarization Trials



Test Trials

Differences Between Conditions. To examine the effect of our manipulation as well as the effect of gender on infants' looking behavior on the test trials, we conducted a 2 (gender: male, female) by 3 (condition: people, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded a significant main effect of condition, $F(2, 30) = 4.60, p = .018, \eta_p^2 = .24$, indicating that infants showed a different looking pattern across the conditions. There was no significant main effect of gender, $F(1, 30) = .66, p = .42, \eta_p^2 = .022$, and no interaction, $F(2, 30) = 2.31, p = .11, \eta_p^2 = .13$. We followed up the significant main effect of condition with three planned pairwise comparisons (i.e., people vs. familiar artifacts, people vs. unfamiliar

artifacts, familiar artifacts vs. unfamiliar artifacts). As predicted, infants looked significantly longer to the target object in the people condition than in the unfamiliar artifacts condition, $p = .003$ (one-tailed). However, infants did not look significantly longer at the target object in the people condition than in the familiar artifacts condition, $p = .057$ (one-tailed). Also, there was no significant difference in infants' looking to the target in the familiar artifacts and the unfamiliar artifacts conditions, $p = .086$ (one-tailed).

To examine age differences in infants' interpretation on test trials, we again divided the group into two using the median age. We conducted a 2 (age: "16 months", "17 months") by 3 (condition: people, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded the previously observed significant main effect of condition, $F(2, 30) = 4.60$, $p = .018$, $\eta_p^2 = .24$, but no main effect of age, $F(1, 30) = .45$, $p = .45$, $\eta_p^2 = .019$, and no interaction, $F(2, 30) = .82$, $p = .44$, $\eta_p^2 = .052$.

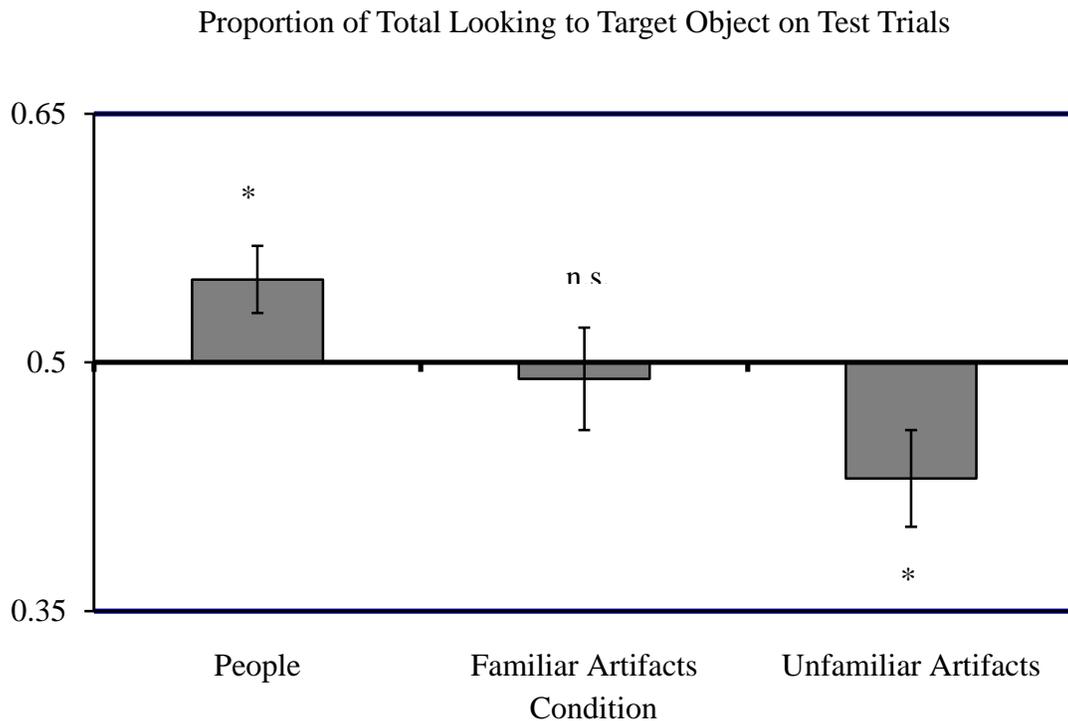
Differences Within Conditions. Three planned single-sample t-tests were conducted to compare the means of each condition to chance: the people condition ($M = .55$, $SD = .07$), the familiar artifacts condition ($M = .49$, $SD = .11$), and the unfamiliar artifacts condition ($M = .43$, $SD = .10$). If infants interpreted the first novel label as a proper name in the people condition, they should have looked significantly longer at the target object than at the non-target object when asked to find the referent of the novel label. Therefore, we predicted that the mean would be significantly higher than chance. As predicted, infants in this condition looked significantly longer at the target object, $t(11) = 2.34$, $p = .04$, $d = .71$.

We predicted that infants in the unfamiliar artifacts condition would interpret the novel word as a term for the object category. Therefore, when they were asked to find the referent of

the novel label, we predicted that they would look equally at both objects. Infants in this condition actually had a significant preference to look at the *non-target object*, $t(11) = -2.24$, $p = .047$, $d = .70$.

We predicted that infants in the familiar artifacts condition would interpret the novel word in one of two ways. One possibility was that infants would use mutual exclusivity or contrast to interpret the word as a count noun for a visibly contrastive subcategory or as an adjective for a visibly contrastive property. Therefore, when they were asked to find the referent of a novel label, they would look longer at the target object. A second possibility was that infants would use mutual exclusivity or contrast to interpret the word as a count noun for a non-visibly contrastive subcategory, or as an adjective for a non-visibly contrastive property. Therefore, when they were asked to find the referent of a novel label, they would look equally at both objects. Consistent with the second possibility, infants in this condition looked equally at both objects, $t(11) = -.43$, $p = .68$, $d = .091$. See Figure 11.

Figure 11. Experiment 2 Results in Test Trials



* = significantly different from chance, $p < .05$ (two-tailed)

Discussion

In Experiment 2, 16- and 17-month-old infants interpreted a novel word for a face in a different manner from the way they interpreted a novel word for an artifact. More specifically, infants who learned a novel word for a face tended to restrict the word to the labeled face and looked longer at it than at the non-target object. In contrast, infants in the two versions of the artifacts condition did not show the same restrictive behavior. Infants in the familiar artifacts condition looked equally at both objects, while infants in the unfamiliar artifacts condition showed evidence of a greater tendency to generalize the term and looked longer at the non-target object.

The results from the people condition are consistent with the possibility that infants in this condition interpreted the word as a proper name. In the unfamiliar artifacts condition, in contrast, the evidence clearly suggested that infants did not interpret the novel word as a proper name (or as a count noun for a subcategory of object, or as an adjective for a visibly property), because they did not restrict the label to the target object. Indeed, they significantly preferred to look at the non-target object. These findings, although not in line with our predictions for this condition, are nonetheless consistent with the possibility that infants interpreted the novel word as a category term extendible across category members. In the familiar artifacts condition, finally, infants' generalization of the term to both objects is consistent with our second prediction for this condition, namely that they interpreted the novel label as a count noun for a non-visibly contrastive subcategory or as an adjective for a non-visibly contrastive property. If they made either of these interpretations, recall that we predicted they would look equally at both objects when asked to find the referent of the novel label. The design constraints of our experiment (i.e., the use of perceptually distinct objects) prevented a more specific conclusion about how infants interpreted the novel label for the familiar artifact. However, our findings do clearly indicate that infants did not interpret the novel label for the familiar artifact as a proper name, as they appeared to do when the label was given to a human face. This difference speaks against accounts of early word learning that propose that infants have an initial bias to interpret novel object words for all categories of objects as either proper names or count nouns.

Our discovery that infants interpreted labels for people, but not artifacts, as proper names supports our hypothesis that infants' interpretation of an object word depends on the category of object being labeled, and that their interpretation of words for people is fundamentally different from their interpretation of words for artifacts. It is striking, moreover, that infants' interpretation

of a word for an unfamiliar artifact appears to be different from their interpretation of a word for a familiar artifact. Specifically, they appeared to make a category count noun interpretation of a word for an unfamiliar artifact and a subcategory count noun or adjective interpretation of a word for a familiar artifact. This difference is consistent with infants' use of mutual exclusivity or contrast to guide their interpretation.

One unpredicted finding was that infants in the unfamiliar artifacts condition showed a preference for the non-target object. Recall that we predicted equal looking to the two objects in this condition. What can explain this result? We speculate that it reflects a novelty preference effect, namely infants' preference to look at the somewhat more novel non-target object on the test trials (i.e., the object that had appeared on the screen for a shorter time than the target object). It is possible that infants showed a novelty preference effect in all conditions of this experiment, but this preference resulted in an actual bias to look at the non-target object only in the unfamiliar artifacts condition, the sole condition in which we had a singular clear prediction that infants would look at either object.

We also found no difference in performance between boys and girls, which is consistent with recent studies examining infants' understanding of the linguistic distinction between proper names and count nouns (e.g., Bélanger & Hall, 2006; Hall & Bélanger, 2010). Furthermore, when we divided the group into two by the median age, "16-month-olds" did not perform differently from "17-month-olds". Recall that Hall and Bélanger (2010) and Katz et al. (1974) found that 17 months is the youngest age at which infants are able to use linguistic cues to learn the proper name/count noun distinction. The current finding that there was no difference between the performance of 16- and 17-month-olds provides evidence that infants as young as 16 months interpret words for people in the manner of proper names, but words for artifacts in the manner

of count nouns. This is significant because prior to learning the linguistic distinction between proper names and count nouns, they appear to use object category distinctions.

Our finding that infants use object category distinctions to guide their interpretation of novel object words at an age just before there is evidence that infants know the linguistic cues is important because it suggests that they could be using object category differences *to learn* the linguistic distinction between proper names and count nouns. It is important to note, of course, that in order for this proposal to be true, caregivers must be making the same object category distinctions when labeling objects with proper names and count nouns. To further explore the role of object category differences in word learning, we conducted another experiment using a more challenging task.

EXPERIMENT 3

Method

Participants

Forty-eight 16- and 17-month-old infants participated (24 boys and 24 girls; range = 16 months, 5 days – 18 months 1 day; mean age = 17 months, 2 days). The infants were recruited through the University of British Columbia Early Development Research Group database. All infants were monolingual English learners (exposed to at least 80% from all sources). Equal numbers of infants were randomly assigned to one of three conditions: people, familiar artifacts, and unfamiliar artifacts. There was one version of the people condition and two versions of the artifacts condition, each containing an equal number of boys and girls. An additional 28 infants participated but were not included in the analyses because they were too fussy to complete the task ($n = 24$), their parents interfered in some way ($n = 3$), or because of equipment failure ($n = 1$). Infants participated in only one video task during their visit to our centre.

We decided, a priori, to increase the sample size of each condition from 12 infants (as in Experiments 1 and 2) to 16 infants for this experiment. The reason was that we expected a smaller effect because infants were given a harder task in which they had to interpret two novel words. Therefore, we sought a more powerful experiment to detect possible differences in infants' interpretation of novel words for objects from different categories.

Materials

The videos were identical to those used in Experiment 2. The only difference was that the audio track was modified so that infants were now asked to find the referent of a second novel label during the test trials (i.e., the voice on the audio stimulus asked, “Where’s BLICKY?”

instead of “Where’s DAXY?” as in Experiment 2). There were two familiarization trial videos and four test trial videos for the people condition, and four familiarization trial videos and eight test trial videos for the artifacts condition. See Figure 12 for a schematic example of the video stimuli. See Appendix B for the entire script used for both the familiarization and the test trials.

Procedure

The procedure was identical to that of Experiment 1.

Coding

The coding process was also identical to that of Experiment 1.

The inter-rater reliability was again very high for the familiarization trials, $r = 1.00$, and for the test trials, $r = 1.00$.

Results

On the familiarization trials, if infants had no preference for the target objects, we predicted that (1) they would show no difference in their tendency to look at the target object across conditions, and (2) they would show no difference from chance in their looking at the target object within each condition.

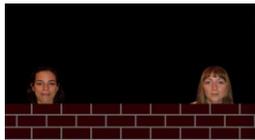
On the test trials, we had different predictions for each condition. These predictions were based on the hypothesis that infants interpret words for people differently from words for artifacts. More specifically, we predicted that infants in the people condition would interpret the first novel label as a proper name for the target object. When they were asked to find the referent of the second novel label, we expected that they would look longer at the non-target object than at the target object. This expectation was based on the assumption that infants have

Figure 12. Schematic Example of Video Stimuli for Experiment 3

People condition

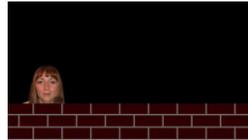
Familiarization trial

“Look!”



Both objects appear simultaneously on the screen

“Look! DAXY!”



Target object enters the scene from one side

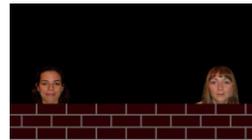
“Look!”



Target object moves to the opposite side

Test trial

“Look!”



Non-target object enters the scene

“Where’s BLICKY!”



Attention getter appears at the top centre of the scene



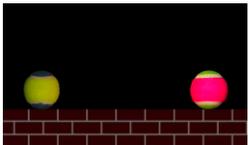
Infants asked to find the referent for the novel label

95

Familiar artifacts condition

Familiarization trial

“Look!”



Both objects appear simultaneously on the screen

“Look! DAXY!”



Target object enters the scene from one side

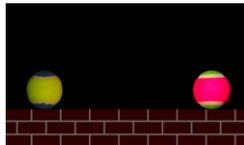
“Look!”



Target object moves to the opposite side

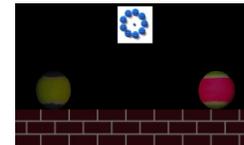
Test trial

“Look!”

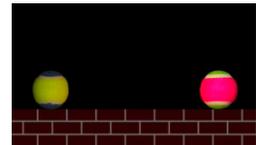


Non-target object enters the scene

“Where’s BLICKY!”



Attention getter appears at the top centre of the scene

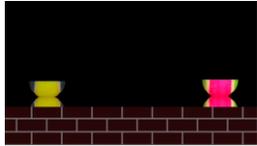


Infants asked to find the referent for the novel label

Unfamiliar artifacts condition

Familiarization trial

“Look!”



Both objects appear simultaneously on the screen

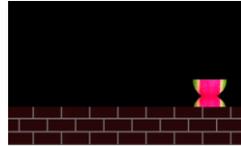
Test trial

“Look! DAXY!”



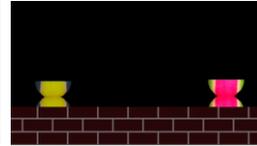
Target object enters the scene from one side

“Look!”



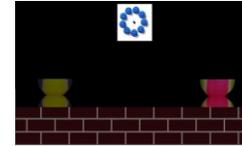
Target object moves to the opposite side

“Look!”

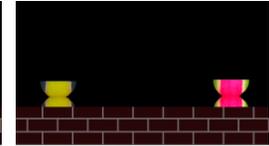


Non-target object enters the scene

“Where’s BLICKY!”



Attention getter appears at the top centre of the scene



Infants asked to find the referent for the novel label

an analogue of the mutual exclusivity assumption for proper names. According to this assumption, one object should only have one proper name. There is evidence that young children make this assumption (cf. Hall & Graham, 1999; Hall et al., 2008). For example, Hall and Graham (1999) found that young children expect familiar stuffed animals to have only one proper name. In their task, 3- and 4-year-olds heard a novel word, presented linguistically as either a proper name or an adjective, for a stuffed animal (e.g., a stuffed white rabbit). Children were then presented with a second object from the same category (e.g., another stuffed white rabbit) and they were asked to choose one of the objects as the referent for a second novel label that was also presented linguistically as either a proper name or an adjective. The results suggested that young children were unlikely to accept two words for one object if both words were proper names, but they were more likely to do so if both words were adjectives or if one word was a proper name and the other was an adjective.

On the other hand, we predicted that infants in the two versions of the artifacts conditions would not interpret the first novel label as a proper name for the target object. In the unfamiliar artifacts condition, where infants did not know a count noun for the target object, we predicted that they would interpret the first novel label as a count noun that is extendible across instances of the object category (as in Experiment 2). When infants were asked to find the referent of a second novel word, we expected that they would use mutual exclusivity or contrast to interpret the word as a count noun for a subcategory or as an adjective for a property. Therefore, we expected that infants would look equally at both objects when they were asked to find the referent for the second novel label, because they would have had no reason to expect either of the objects to be the appropriate referent.

In the familiar artifacts condition, we expected that infants would interpret the first novel word in one of two ways (as in Experiment 2). One possibility was that because infants in this condition already knew a category term for the object, they would use mutual exclusivity or contrast to interpret the first novel label as a count noun for a visibly contrastive subcategory or as an adjective for a visibly contrastive property. The second possibility was that infants would use mutual exclusivity or contrast to interpret the first novel label as a count noun for a non-visibly contrastive subcategory or as an adjective for a non-visibly contrastive property. On either possibility, when infants were asked to find the referent of a second novel label, we expected that they would use contrast to interpret the word as a different subcategory term or as a different property term. As a result, we expected that infants would look equally at both objects at test, because they would have no reason to prefer one over the other as the appropriate referent of the second subcategory or property term (see also Hall & Graham, 1999). See Table 3.

Given the preceding considerations, we predicted that (1) infants would show a difference in their looking patterns between conditions on the test trials, such that the proportion would be lower in the people condition than either the unfamiliar or familiar artifacts condition, and (2) they would show a significant tendency to look at the non-target object in the people condition, but show no difference from chance in either the unfamiliar or familiar artifacts condition.

Table 3. Experiment 3 Predictions on Test Trials

Condition	Interpretation of First Novel Label	Interpretation of Second Novel Label	Looking Behavior When Asked to Find Referent for Second Novel Label
People	Proper Name	(Different) Proper Name	Non-target Object
Unfamiliar Artifacts	Category Count Noun	Subcategory Count Noun or Adjective	No Preference
Familiar Artifacts	Subcategory Count Noun or Adjective for Visibly Contrastive Property	(Different) Subcategory Count Noun or Adjective	No Preference
	Subcategory Count Noun or Adjective for Non-visibly Contrastive Property	(Different) Subcategory Count Noun or Adjective	No Preference

Familiarization Trials

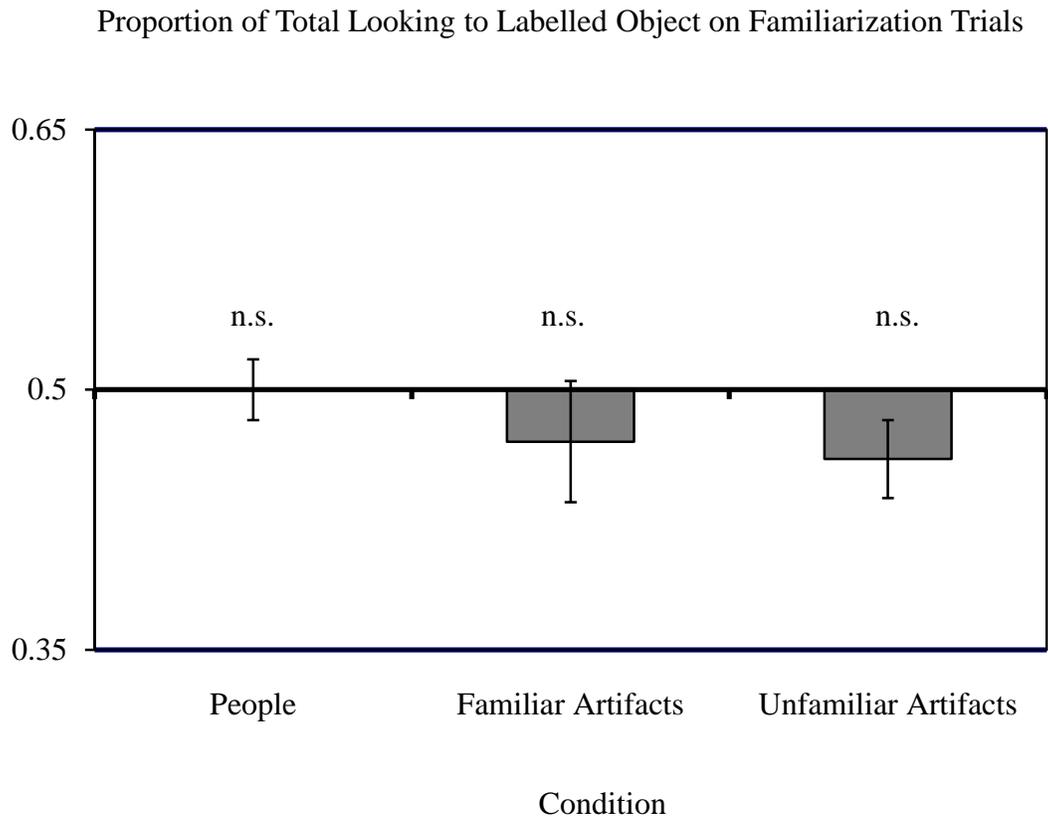
Differences Between Conditions. To examine the effect of our manipulation as well as the effect of gender on infants' proportion of looking to the labeled object, we conducted a 2 (gender: male, female) by 3 (condition: people, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded no significant main effect of condition, $F(2, 42) = .54$, $p = .59$, $\eta_p^2 = .025$, no main effect of gender, $F(1, 42) = .87$, $p = .36$, $\eta_p^2 = .02$, and no interaction,

$F(2, 42) = .21, p = .81, \eta_p^2 = .01$, indicating that the proportion of looking to the target object was comparable over conditions and gender.

Previous research has shown that by 17 months of age, infants begin to understand linguistic cues to the proper name/count noun distinction (e.g., Hall & Bélanger, 2010; Macnamara, 1982). Therefore, we performed a follow-up analysis to examine differences in performance between 16- and 17-month-olds. We divided the sample into two groups based on the median age, which was 17 months, 2 days. The mean age for the younger group (“16-month-olds”) was 16 months, 20 days and the mean age for the older group (“17-month-olds”) was 17 months, 15 days. We conducted a 2 (age: “16 months”, “17 months”) by 3 (condition: people, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded no significant main effect of condition, $F(2, 42) = .66, p = .52, \eta_p^2 = .03$, no main effect of age, $F(1, 42) = .063, p = .80, \eta_p^2 = .001$, and no interaction, $F(2, 42) = 1.94, p = .16, \eta_p^2 = .084$, indicating that the proportion of looking to the target object was comparable across conditions and ages.

Differences Within Conditions. Three planned single-sample t-tests were conducted to compare the means of each condition to chance, as defined in Experiment 1: people condition ($M = .50, SD = .07$), familiar artifacts condition ($M = .47, SD = .14$), and unfamiliar artifacts condition ($M = .46, SD = .09$). We predicted that there would be no preference for one object over the other in any condition. Therefore, we predicted that the proportion of looking to the target object would not differ from chance in any condition. This prediction was supported in all three conditions. Infants looked equally at both objects in the people condition, $t(15) = -.16, p = .88, d = .000$, the familiar artifacts, $t(15) = -.87, p = .40, d = .21$, and the unfamiliar artifacts condition, $t(15) = -1.91, p = .08, d = .44$. See Figure 13.

Figure 13. Experiment 3 Results On Familiarization Trials



Test Trials

Differences Between Conditions. To examine the effect of our manipulation as well as the effect of gender on infants' proportion of looking to the target object on the test trials, we conducted a 2 (gender: male, female) by 3 (condition: people, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded no significant main effect of condition, $F(2, 42) = 1.75, p = .19, \eta_p^2 = .077$, no main effect of gender, $F(1, 42) = .64, p = .43, \eta_p^2 = .015$, and no interaction, $F(2, 42) = .74, p = .49, \eta_p^2 = .034$.

We performed a follow-up analysis to examine differences in interpretation between 16- and 17-month-olds. We again divided the sample into two groups based on the median age. We

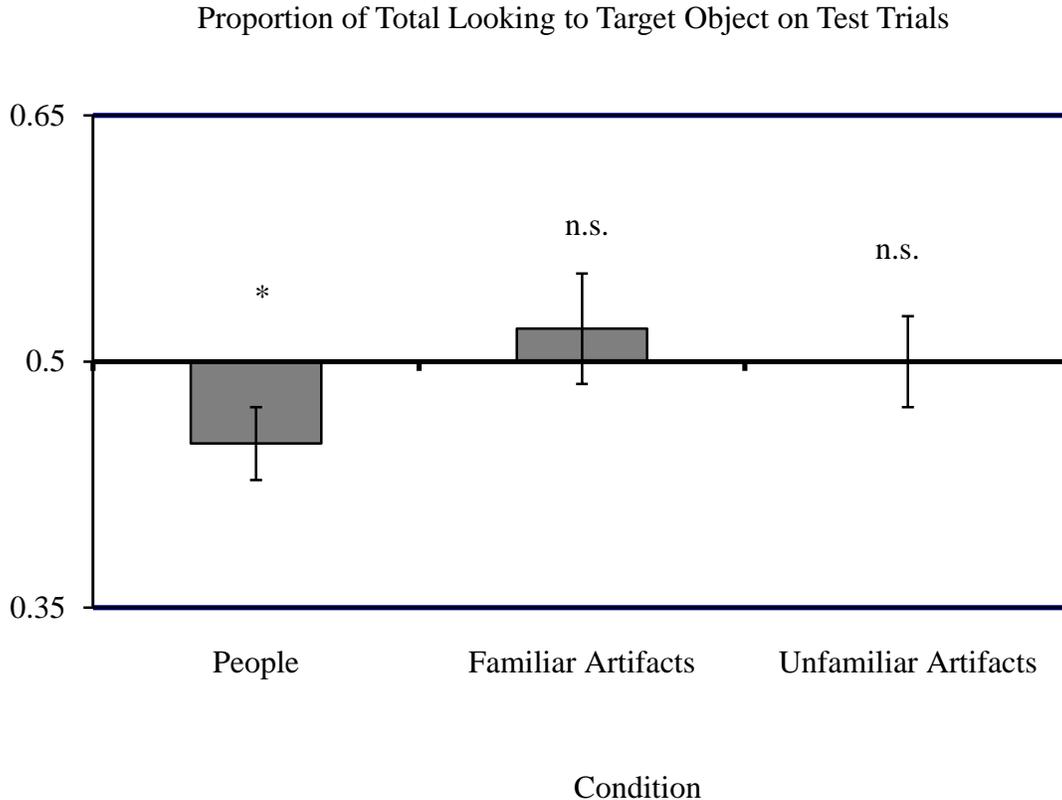
conducted a 2 (age: “16 months”, “17 months”) by 3 (condition: people, familiar artifacts, unfamiliar artifacts) fully between-subjects ANOVA. This analysis yielded no significant main effect of condition, $F(2, 42) = 1.99, p = .15, \eta_p^2 = .086$, no main effect of age, $F(1, 42) = .97, p = .33, \eta_p^2 = .023$, and no interaction, $F(2, 42) = .43, p = .65, \eta_p^2 = .02$, indicating that the proportions of looking to the target object was comparable across conditions and ages.

Differences Within Conditions. Three planned single-sample t-tests were conducted to compare the means of each condition to chance: people condition ($M = .45, SD = .089$), familiar artifacts condition ($M = .52, SD = .14$), and unfamiliar artifacts condition ($M = .50, SD = .11$). If infants interpreted the first novel label as a proper name in the people condition (as in Experiment 2) and if they expected one object should have only one proper name (Hall & Graham, 1999), they would have looked significantly longer at the non-target object when asked to find the referent of the second novel label. Therefore, we predicted that the mean would be significantly lower than chance. In support of this prediction, infants in this condition looked significantly longer at the non-target object, $t(15) = -2.33, p = .03, d = .56$.

In the unfamiliar artifacts condition, we predicted that infants would interpret the first novel label as a count noun that is extendible across instances of the object category (as in Experiment 2). Therefore, when infants heard the second novel label, we expected they would use mutual exclusivity or contrast to interpret the word as a count noun for a subcategory, or as an adjective for a property. As a result, we expected that infants would look equally at both objects when they were asked to find the referent of the second novel label, because they would have had no reason to expect either of the objects to be the appropriate referent. Infants in this condition looked equally at both objects, $t(15) = .001, p = .99, d = .000$, which is consistent with both predictions.

In the familiar artifacts condition, we predicted that infants would interpret the word in one of two ways (as in Experiment 2). One possibility was that because infants in this condition already knew a category term for the object, they would use mutual exclusivity or contrast to interpret the first novel label as count noun for a visibly contrastive subcategory or as an adjective for a visibly contrastive property. A second possibility was that infants would use mutual exclusivity or contrast to interpret the first novel label as a count noun for a non-visibly contrastive subcategory or as an adjective for a non-visibly contrastive property. On either possibility, when infants were asked to find the referent of a second novel label, we expected that they would use contrast to interpret the word as a different subcategory term or as a different property term. As a result, infants would look equally at both objects at test because they would have no reason to prefer one over the other as the appropriate referent of the second subcategory or property term (see Hall & Graham, 1999; Hall et al., 2008). Infants in this condition looked equally at both objects, $t(15) = .64, p = .53, d = .14$. See Figure 14.

Figure 14. Experiment 3 Results on Test Trials



* = significantly different from chance, $p < .05$ (two-tailed)

Post Hoc Analysis

We performed several analyses to compare infants' looking behavior for each condition across Experiments 2 and 3 because we wanted to examine differences in first and second label interpretation. We conducted a 2 (experiment: 2, 3) by 2 (age: 16 months, 17 months) by 3 (condition: people, familiar artifacts, unfamiliar artifacts) between-subjects ANOVA. This analysis yielded a significant experiment by condition interaction, $F(1, 72) = 4.93, p = .01, \eta_p^2 = .12$, but no main effect of experiment, $F(1, 72) = .016, p = .90, \eta_p^2 = .000$, no main effect of age, $F(1, 72) = 1.45, p = .23, \eta_p^2 = .02$, no main effect of condition, $F(1, 72) = 1.18, p = .31, \eta_p^2 = .032$, no experiment by age interaction, $F(1, 72) = .032, p = .86, \eta_p^2 = .000$, no age by condition

interaction, $F(1, 72) = .082, p = .92, \eta_p^2 = .002$, and no experiment by age by condition interaction, $F(1, 72) = 1.08, p = .34, \eta_p^2 = .029$. The significant experiment by condition interaction was further examined by three tests of simple main effects. The analyses showed that infants' proportion of looking to the target object between Experiments 2 and 3 was significantly different in the people condition, $F(1, 72) = 6.00, p = .017, \eta_p^2 = .077$, but not significantly different in the unfamiliar artifacts condition, $F(1, 72) = 3.02, p = .087, \eta_p^2 = .04$, and not significantly different in the familiar artifacts condition, $F(1, 72) = .87, p = .36, \eta_p^2 = .012$. The dramatic crossover effect in the people condition strongly suggests that infants did not generalize the first or the second label. That is, infants appeared to strongly favor a proper name interpretation of words for people. The non-significant result in either artifacts condition suggests that infants did not restrict the first or the second label to a specific object. That is, infants did not favor proper name interpretation of words for artifacts.

As some previous studies have reported striking gender effects in infants' understanding of the proper name/count noun distinction, it was important to perform an analysis combining the data from Experiments 1, 2, and 3 to provide a more stringent examination of the effect of gender on infants' proportion of looking to the target object on the test trials. We conducted a 3 (experiment: 1, 2, 3) by 3 (condition: people, familiar artifacts, unfamiliar artifacts) by 2 (gender: male, female) between-subjects ANOVA. This analysis yielded a main effect of experiment, $F(2, 114) = 8.34, p = .000, \eta_p^2 = .13$, and a significant experiment by condition interaction, $F(4, 114) = 2.82, p = .028, \eta_p^2 = .090$, but no main effect of condition, $F(2, 114) = 2.11, p = .13, \eta_p^2 = .036$, no main effect of gender, $F(1, 114) = .031, p = .86, \eta_p^2 = .000$, no experiment by gender interaction, $F(2, 114) = .79, p = .46, \eta_p^2 = .014$, no condition by gender interaction, $F(2, 114) = .49, p = .61, \eta_p^2 = .009$, and no experiment by condition by gender interaction, $F(4, 114) = 1.52,$

$p = .20$, $\eta_p^2 = .051$. The absence of a condition by gender interaction provided strong evidence that both male and female infants interpreted novel objects words in the same manner in each of the conditions.

Discussion

Experiment 3 provided additional support for the hypothesis that 16- and 17-month-old infants interpret novel words for people and artifacts differently. The results from this experiment were weaker than those in Experiment 2 in that there was no significant condition effect in the ANOVA. Nevertheless, we found that infants showed a significant tendency to look at the non-target object in the people condition, but they showed no significant difference in their looking from chance in either version of the artifacts conditions. Infants appeared to have a powerful assumption that words for people label distinct individuals and additionally that one person should only have one proper name. When infants were asked to locate the referent of a second novel label that they had never heard before, they attended more to the person that did not already have a label. In contrast, infants did not appear to make the same interpretation for a second word given to either unfamiliar or familiar artifacts. In both artifacts conditions, infants' behavior was consistent with the possibility that they took the second word to label a subcategory or property, in that neither object was favored as the appropriate referent. Due to the constraints of our design (i.e., the use of perceptually distinct objects), we were unable to reach a clear conclusion about how infants interpreted the second novel label in either of our artifacts conditions. Nonetheless, the data indicate that infants did not interpret the second novel label for the artifacts as a proper name. The finding is an important discovery because it stands in contrast to the result in the people condition. This difference provides further evidence against accounts

of early word learning that propose infants have an initial bias to interpret novel object words for all categories of objects as either proper names or count nouns.

Another notable finding from Experiment 3 is that there was no difference in performance between boys and girls. This discovery is different from previous studies that found girls show an earlier sensitivity to the linguistic distinction between proper names and count nouns than boys (e.g. Hall et al., 2001; Katz et al., 1974). Further, when we divided the group using the median age, we found no difference between 16- and 17-month old infants' interpretation of the second novel word. Since 17 months is the youngest age in the literature at which infants have shown knowledge of the linguistic distinction between proper names and count nouns (Hall & Bélanger, 2010; Katz et al., 1974), the current finding suggests that infants as young as 16 months may be using the object category distinction between people and artifacts to learn the linguistic distinction between proper names and count nouns.

Infants' performance is quite remarkable given the taxing requirements of this experiment. The findings indicate not only that infants interpret words for people as labels for individuals, but that they also assume that a second label is a label for a different individual. This pattern of behavior is consistent with the hypothesis that infants have an analogue of the mutual exclusivity assumption for proper names, consistent with previous findings from Hall and his colleagues (cf. Hall & Graham, 1999; Hall et al., 2008). Experiment 3 extended those findings and provided new evidence that 16- and 17-month-old word-learners have knowledge of and apply a version of the mutual exclusivity assumption relating to proper names.

There is, however, an interpretative question that arises from the findings of Experiments 2 and 3. Our hypothesis is that the results reflect a conceptual distinction between different

categories of objects. However, another reason why infants may have interpreted labels for people differently from labels for artifacts is that there were differences in perceptual complexity between the categories of objects. The faces used in the current experiments were possibly more complex perceptually than the artifacts. Therefore, it is possible that it is the difference in perceptual complexity that drove the difference in interpretation of the novel words. Experiment 4 was designed to test this alternative interpretation of the results. We created a condition of comparable complexity to the people condition of Experiment 2 by inverting the faces used in that experiment, so that they no longer appeared face-like or people-like.

EXPERIMENT 4

Method

Participants

Twelve 16- and 17-month-old infants participated (6 boys and 6 girls; range = 16 months, 15 days – 17 months 29 days; mean age = 16 months, 29 days). The infants were recruited through the University of British Columbia Early Development Research Group database. All infants were monolingual English learners (exposed to at least 80% from all sources). Equal numbers of boys and girls were randomly assigned to one condition: inverted faces. Infants participated in only one video task during their visit to our centre.

Materials

The videos were identical to those used in the people condition of Experiment 2, except that the faces shown in the videos were inverted. There were two familiarization trial videos and four test trial videos. See Figure 15 for a schematic example of the video stimuli. See Appendix A for the entire script used for both the familiarization and the test trials.

Procedure

The procedure was identical to that of Experiment 1.

Figure 15. Schematic Example of Video Stimuli for Experiment 4

People condition

Familiarization trial

Test trial

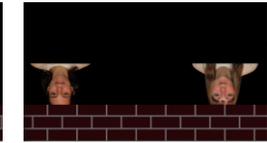
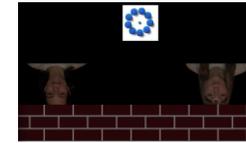
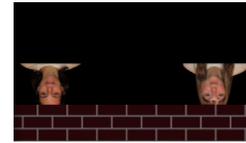
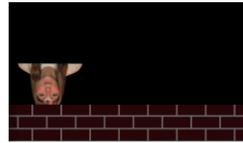
“Look!”

“Look! DAXY!”

“Look!”

“Look!”

“Where’s DAXY!”



Both objects appear simultaneously on the screen

Labeled object enters the scene from one side

Labeled object moves to the opposite side

Unlabeled object enters the scene

Attention getter appears at the top centre of the scene

Infants asked to find the referent for the novel label

Coding

The coding process was identical to that of Experiment 1.

The inter-rater reliability was again very high for the familiarization trials, $r = 1.00$, and the test trials, $r = 1.00$.

Results

On the familiarization trials, we expected that infants would show no difference from chance in their looking at the target object. Therefore, we predicted that infants would look equally at both objects.

On the test trials, we also expected that infants would show no difference in their looking at the target object from chance. More specifically, the predictions for the test trials in this experiment were the same as those for the test trials of the unfamiliar artifacts condition in Experiment 2 because the objects used in this experiment were unfamiliar and non-people-like. In other words, we expected infants would interpret the novel label as a count noun extendible across instances of the object category. Therefore, when they were asked to find the referent of the label, we expected that they would look equivalently at either object (or possibly look longer at the non-target object, as in the unfamiliar artifacts condition of Experiment 2). See Table 4.

Table 4. Experiment 4 Predictions for Test Trials

Condition	Interpretation of Novel Label	Looking Behavior When Asked to Find Referent for Novel Label
People (Inverted Faces)	Category Count Noun	No Preference

Familiarization Trials

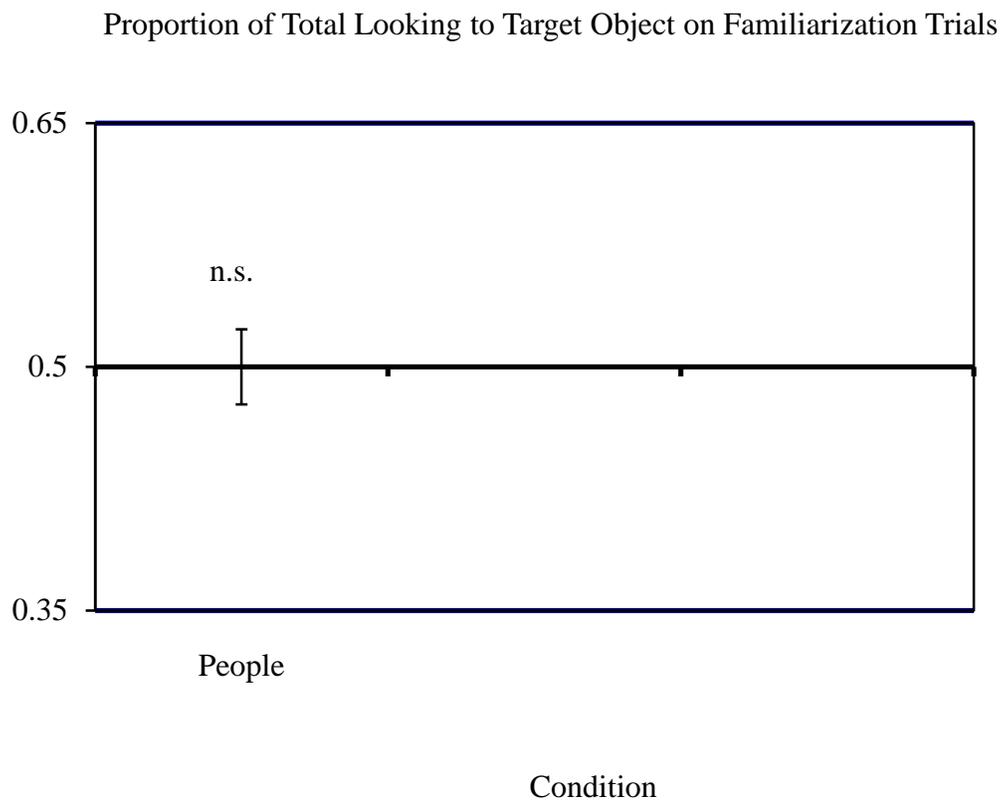
Differences Within Condition. To examine the effect of gender on infants’ proportion of looking to the target object on the test trials, we conducted a one-way ANOVA using infants’ proportion of looking to the target object ($M = .50, SD = .08$), with gender (male and female) as the between-subjects factor. This analysis yielded no significant difference between boys and girls in their tendency to look at the target object, $F(1, 10) = 1.36, p = .27, \eta_p^2 = .12$.

In addition, given that our experiment consists of 16-month-olds who do not yet understand the linguistic distinction between proper names and count nouns, and 17-month-olds who are just beginning to understand this distinction, we decided to perform a follow-up analysis by dividing the group using the median age to examine differences in interpretation between the two age groups. The median age was 16 months, 28 days. The mean age for the younger group (“16-month-olds”) was 16 months, 18 days, and the mean age for the older group (“17-month-olds”) was 17 month, 10 days. To examine the effect of age on infants’ performance, we performed a one-way ANOVA on their proportion of looking to the target object. This analysis

did not yield a significant difference in the proportion of looking to the target object between the two age groups, $F(1, 10) = .81, p = .39, \eta_p^2 = .007$.

One planned single-sample t-test was conducted to compare the mean of the condition to chance, as defined in previous experiments. We predicted that there would be no preference for one object over the other. Therefore, we expected the proportion of looking to the target object would not differ from chance. This prediction was supported. Infants looked equally at both objects, $t(11) = .15, p = .88, d = .000$. See Figure 16.

Figure 16. Experiment 3 Results on Familiarization Trials



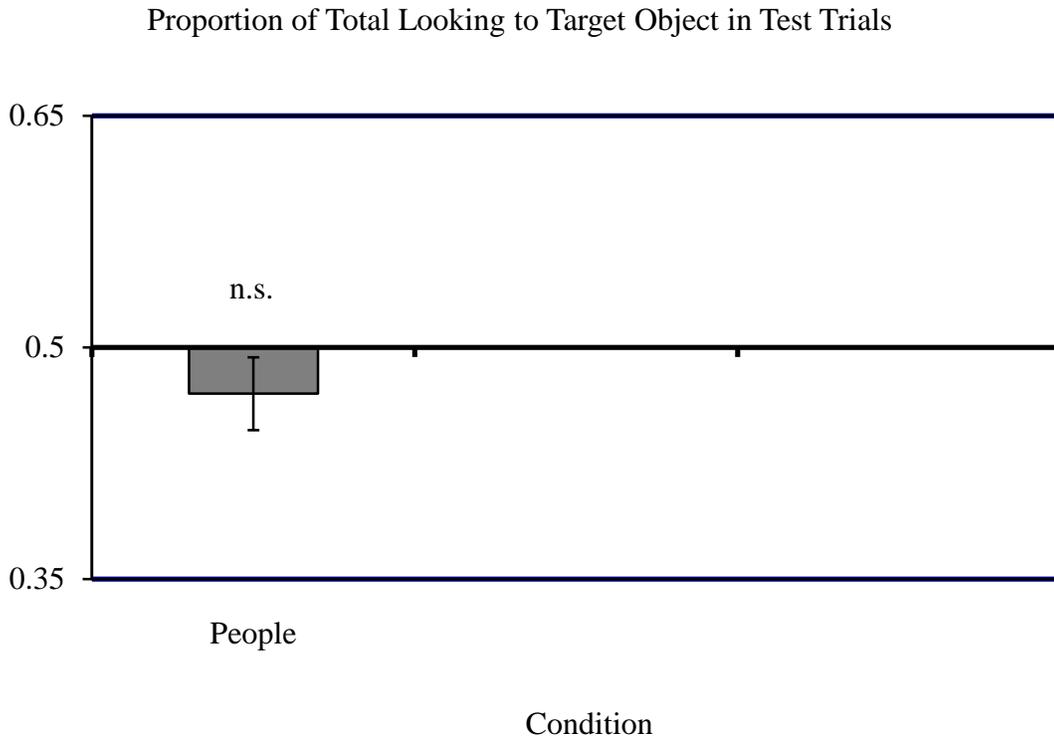
Test Trials

Differences Within Condition. To examine the effect of gender on infants' looking behavior on the test trials, we conducted a one-way ANOVA using infants' proportion of looking to the target object ($M = .47$, $SD = .08$), with gender (male and female) as the between-subject factor. This analysis yielded no significant difference between boys and girls in their tendency to look at the target object, $F(1, 10) = .03$, $p = .87$, $\eta_p^2 = .003$.

We again divided the group using the median age to perform a follow-up analysis to investigate possible differences in performance between 16- and 17-month-olds. This analysis did not yield a significant difference in the proportion of looking to the target object between the two age groups, $F(1, 10) = .81$, $p = .39$, $\eta_p^2 = .075$.

One planned single-sample t-test was conducted to compare the mean of the condition to chance. If infants do not construe the inverted faces as people, we expected that they would interpret the novel as a term for the object category. Therefore, when they were asked to find the referent of the second novel label, they would look equally at both objects. Infants in this experiment did just that, $t(11) = -1.29$, $p = .22$. $d = .38$. See Figure 17.

Figure 17. Experiment 4 Results on Test Trials



Post Hoc Analysis

To examine the test trials results from the current experiment in relation to the findings of Experiment 2, we conducted a 2 (age: 16 months, 17 months) by 4 (condition: people, familiar artifacts, unfamiliar artifacts, inverted faces) between-subjects ANOVA. This analysis yielded a significant main effect of condition, $F(3, 40) = 3.38, p = .027, \eta_p^2 = .20$, but no main effect of age, $F(1, 40) = 1.17, p = .29, \eta_p^2 = .028$, and no interaction $F(3, 42) = .61, p = .61, \eta_p^2 = .044$. The significant main effect of condition was followed by three planned pairwise comparisons between the groups (i.e., inverted faces vs. people, inverted faces vs. unfamiliar artifacts, inverted faces vs. familiar artifacts). In line with the predictions for Experiment 2, we predicted that infants' proportion of looking to the target object would be higher in the people condition than in

the inverted faces condition, that the proportion would be equal between the unfamiliar artifacts and the inverted faces condition, and between the familiar artifact condition and the inverted faces condition. As predicted, there was a significant difference in infants' looking to the target object between the inverted faces condition and the people condition, $p = .046$ (one-tailed), but there was no significant difference in infants' looking to the target object between the inverted faces condition and either the familiar artifacts condition, $p = .63$ (two-tailed) or the unfamiliar artifacts conditions, $p = .28$ (two-tailed). The last finding indicates that although infants did not display the same looking pattern between the inverted faces condition and the unfamiliar artifacts condition when the two conditions were examined on their own (i.e., the mean proportion of looking to the target object was at chance in the inverted faces condition, but below chance in the unfamiliar artifacts condition of Experiment 2), there was no difference between them when they were directly compared (with both means being below 50%).

It is not clear why infants had a preference to look at the non-target object in the unfamiliar artifacts condition of Experiment 2, but not in the inverted faces condition of this experiment. We speculate that this difference reflects an object familiarity effect, namely that infants' interpretation of a novel word is influenced by their level of familiarity with the object. Infants may be more inclined to interpret words as count nouns for artifacts that are completely novel. As many 16- and 17-month-old infants may have seen inverted faces before (e.g., their mother's face peering into their crib) they may not have readily interpreted words for inverted faces as count nouns. At the same time, even though many 16- and 17-month-old infants will have had some exposure to inverted faces, they do not process inverted faces in the same manner as upright faces; therefore, they do not interpret words for inverted faces as proper names as they do for upright faces.

Discussion

In Experiment 4, 16- and 17-month-old infants showed a tendency to generalize a novel word paired with one inverted face to another inverted face. This finding provided evidence against an alternative explanation for the results of Experiments 2 and 3. That is, the finding suggests that infants did not interpret of labels for faces as proper names simply because the objects were more perceptually complex. The inverted faces used in this experiment were similar in perceptual complexity to the faces used in Experiment 2, yet infants did not interpret a novel word for one of them as a proper name. Also, post-hoc pairwise comparisons showed that infants' looking behavior in the inverted faces condition in Experiment 4 differed significantly from that in the people condition in Experiment 2, but did not differ significantly from the looking behavior in the two artifacts conditions in Experiment 2. More specifically, infants in the inverted faces condition showed a slight preference for the non-target object, which is similar to infants' significant preference for the non-target object in the unfamiliar artifacts condition.

In addition, we found no difference between genders and no difference between 16- and 17-month-old infants, suggesting that females and males in both age groups interpreted the novel word for the inverted faces in the same way. As previously noted, 17 months is the youngest age in the literature at which infants have shown knowledge of the linguistic distinction between proper names and count nouns (e.g., Hall & Bélanger, 2010; Katz et al., 1974). Our finding that there is no difference between the performance of 16- and 17-month-olds provides additional support for the proposal that infants as young as 16 months of age use object category distinctions to guide their interpretation of novel words.

Our evidence that 16- and 17-month-old infant did not construe inverted faces in Experiment 4 in the same manner as the upright faces in Experiments 2 and 3 is consistent with the infant face perception evidence provided by Cohen and his colleagues (e.g., Cohen & Cashon, 2001; Younger & Cohen, 1986). In a series of studies, they tested whether 7-month-old infants process faces featurally or holistically depending on whether the face is upright or inverted. They habituated infants to two female faces and then tested them on a familiar face, a switched face (which consisted of a new combination of familiar features), and a novel face. The authors reasoned that if infants processed only independent features of the face, the switched face should not appear more novel than the familiar face, and they should not look longer at the switched face. On the other hand, if infants are sensitive to the relations among features and process the faces holistically, the switched face should appear novel and infants should look longer at it. The results showed that infants who saw upright faces looked longer at the switched faces than at the familiar face, suggesting that they processed the upright faces configurally. Conversely, infants who saw inverted faces looked equally at both the familiar face and the switched face, suggesting that they processed the inverted faces featurally. In sum, they concluded that 7-month-old infants do not process an inverted face in the same manner as an upright face.

The literature on infant face perception reveals no research that has examined how 16- and 17-month olds construe inverted faces. Experiment 4 provides new evidence that, like 7-month-old infants, 17-month-old also do not appear to view upside down faces as being face-like or people-like. Furthermore, they may actually be conceptualizing inverted faces in the manner of artifacts since their looking behavior in this experiment was comparable to the looking behavior in the artifacts conditions in the previous two experiments.

GENERAL DISCUSSION

The results of these four experiments addressed the questions of how 16- and 17-month-old infants, who are on the brink of learning the linguistic distinction between proper names and count nouns accomplish this feat. Infants heard a novel word for either a person or an artifact, and their interpretation of the label was assessed when the target objects were paired with non-target objects that were either from a different object category or from the same object category.

In Experiment 1, infants successfully learned a novel word for people and artifacts when the target objects were paired with objects from a different category. In addition, this experiment established the validity of the method used to assess the learning of words for people and artifacts in the subsequent experiments. In Experiment 2, infants restricted a novel word to the target object when the object was a person, but they did not demonstrate the same restrictive interpretation when the object was a familiar artifact or an unfamiliar artifact. In Experiment 3, infants demonstrated they have a strong assumption that words for people are labels for individuals (and that people have only one proper name) while labels for artifacts are not labels for individuals, because they mapped a second novel label to the non-target object of the same category when the object was a person, but not when the object was a familiar artifact or an unfamiliar artifact. Finally, in Experiment 4, infants provided evidence that their tendency to interpret labels for people as terms for individuals, and to interpret labels for unfamiliar artifacts as terms for categories, is not simply based on differences in perceptual complexity between the human faces and the artifacts used in this research. The reason is that the inverted faces used in this experiment shared perceptual features with the faces used in Experiments 2 and 3 because they were the same faces, only inverted. Despite this fact, we found that infants did not display the same restrictive looking behavior towards the target object in the inverted faces condition in

Experiment 4 as they did towards the target object in the people condition in Experiment 2. The present findings will be discussed in relation to the existing word-learning literature reviewed in the introduction.

Linguistic Cues to Object Word Meaning

Previous research has revealed that 17-month-olds have an emerging understanding of the linguistic distinction between proper names and count nouns, and that by 23 months, this understanding is well established (Hall & Bélanger, 2010; Katz et al., 1974). Hall and Bélanger (2010) found that when 17-month-old infants were presented with a novel word modeled linguistically as a proper name, they restricted the word to the labeled object when the two objects were perceptually contrasting dolls, but not when the dolls were perceptually identical. Infants aged 23 months demonstrated a more robust understanding of the distinction between proper names and count nouns. When the 23-month-old infants were presented with a novel word modeled linguistically as a proper name, they restricted the word to the labeled object regardless of whether the dolls were perceptually contrasting or perceptually identical. Neither age group displayed the same restrictive behavior when the novel word was modeled linguistically as a count noun. However, it should be noted that the evidence of restrictive behavior from 17-month-olds in the contrasting dolls task is ambiguous. The reason is that when infants were presented with contrasting dolls, it is possible that they interpreted the novel word for the labeled object as a proper name, as a subcategory count noun, or as an adjective. Nevertheless, 17-month-olds interpreted words modeled linguistically as proper names in a different manner from words modeled linguistically as count nouns, providing evidence that they have some understanding of the meaning of linguistic cues. On the other hand, the evidence from 23-month-olds is more unambiguous because they restricted the novel word to the labeled object

even when the dolls were perceptually identical, providing clearer evidence of a proper name interpretation (because there are no visible differences between the object that could enable them to interpret the word as a label for an individual, a subcategory, or an adjective).

Given the prior evidence that infants as young as 17 months have some understanding of the linguistic distinction between proper names and count nouns, the present studies attempted to clarify *how* young infants aged 16 and 17 months learn this distinction. We included 16-month-old infants in our sample because there is no prior experimental evidence that infants at that age have knowledge of the linguistic distinction between the two lexical classes. Therefore, if 16-month-olds display different interpretations of words for people and words for artifacts (as in the current experiments), it raises the possibility that they use non-linguistic information related to the category of objects that is labeled to learn the linguistic distinction.

It should be noted that there is prior evidence to show that caregivers use distinctive strategies to teach young children the meanings of novel words from different lexical categories (Hall, Burns, & Pawluski, 2003). Moreover, their teaching strategies appear to be consistent with children's learning biases. For example, Hall and his colleagues asked caregivers to teach their two- to four-year-old children novel labels for drawings of familiar objects that were animate (e.g., a dog) or inanimate (e.g., a shoe). When children were taught words that were modeled syntactically as proper names (e.g., "This dog is *named* FEPPY"), caregivers were more likely to flag the words as exceptional or odd when they were paired with inanimate objects (artifacts) than when they were paired with animates (animals). Such results suggest that caregivers' strategies for teaching novel proper names dovetail with children's interpretative biases. This congruence between caregivers' teaching strategies and children's learning biases is, of course,

an important part of any successful account of young children's early lexical development. This is an important assumption in assessing the viability of the proposal in this thesis.

As discussed in the introduction, there is some prior evidence to suggest that infants have some sensitivity to object category distinctions in guiding their word learning (e.g., Katz et al., 1974). Katz et al. (1974) investigated 22-month-old girls' interpretation of novel words modeled linguistically as proper names and count nouns for pairs of perceptually distinct dolls or blocks. The researchers found that 22-month-old girls restricted a novel proper name to the labeled object when the object was a doll, but not when the object was a block, suggesting that the infants were making a non-linguistic distinction between the two categories of objects when interpreting the novel labels. However, it should be noted that there are several limitations to these findings. One limitation is that those prior results were based on a very small sample size of five infants per condition. Another limitation is that only girls were examined in this study. A third limitation is that the 22-month-old infants, unlike 17-month-olds, have been learning words for almost a year and have a much more mature understanding of the distinction between proper names and count nouns.

The present studies were designed to address the limitations discussed in the previous paragraph and to examine more clearly which non-linguistic cues infants attend to when interpreting novel object words. More specifically, we investigated whether 16- and 17-month-old infants use their understanding of the conceptual difference between people and artifacts to distinguish between proper names and count nouns. We hypothesized that infants would interpret labels for people in the manner of proper names and labels for (unfamiliar) artifacts in the manner of count nouns.

After establishing the validity of the methodology in Experiment 1, we conducted Experiments 2 and 3 in which we provided two key pieces of evidence about infants' interpretation of novel object words. The first was that infants as young as 16 months base their interpretation of novel object words on the categories of objects being labeled. The second was that infants not only interpret a novel label for a person as a proper name, but also draw on an analogue of the mutual exclusivity constraint in the interpretation of proper names, whereby they assume that one object will only receive one proper name. The latter finding is remarkable because it demonstrates that infants' assumption that words for people are labels for individual objects is so strong they do not think that the second novel label could be a category term for people. The reason is that if infants interpreted the second novel label as a count noun for people, they would have generalized the word and displayed equal looking to both objects in Experiment 3. Previous evidence from Hall and Graham (1999) suggested that 3- and 4-year-olds assume an object (a stuffed animal) can have only one proper name. The findings from Experiment 3 provides new evidence that suggests infants as young as 16- and 17-months of age have a similar assumption when interpreting words for people. These results also speak to the way infants construe members of the category, people. Based on our findings, infants appear to assume that each person should only have one proper name. Therefore, since proper names denote distinct individuals, infants must be construing people as unique individuals.

The findings from Experiments 2 and 3 clearly demonstrated that infants do not interpret novel words for people in the same manner as novel words for artifacts. Infants in the unfamiliar artifacts condition in Experiment 2 showed a strong tendency to generalize the novel word, clearly suggesting that they interpreted the label as a count noun. Furthermore, the findings from both experiments provide converging evidence that suggests infants who were in the familiar

artifacts condition interpreted the novel word for the target object as a term that can be generalized to both the target object and the non-target object.

Theoretical Accounts of the Proper Name/Count Noun Distinction

The current findings suggest that infants aged 16 and 17 months interpret words for people in the manner of proper names and words for unfamiliar artifacts (i.e. objects that they do not already know a count noun for) in the manner of count nouns. Infants appear to be using the type of object category being labeled (person, artifact) to guide their learning of the linguistic distinction between proper names and count nouns.

Our findings bear on both the narrow-to-broad and broad-to-narrow accounts of the learning of the proper name/count noun distinction. According to the narrow-to-broad accounts, infants initially interpret all new object words as proper names, and they must overcome this tendency in order to learn count nouns. For example, both Hennon et al. (1999, 2000) and Hirsh-Pasek et al. (2004) argued that infants are conservative word learners, and they do not freely generalize words across members of an object category. The researchers argued that infants are initially biased to interpret new object words as labels for individuals (in the manner of proper names), and only with experience do they begin to interpret new object words as labels that can be extendible across objects of a particular category (in the manner of count nouns).

On the other hand, the broad-to-narrow accounts propose that infants initially interpret new object words as count nouns, and they must overcome this tendency in order to learn proper names. For example, Waxman and colleagues (e.g., Booth & Waxman, 2003; Waxman & Markow, 1995) proposed that infants have a beginning bias to interpret all object words as referring to common properties among named objects, and this initial assumption is subsequently

refined so that infants learn that some object words (i.e., count nouns) are terms for object categories. In order for infants to learn terms for individual objects, they would need some kind of mechanism to override the broad tendency to interpret object words as terms for certain commonalities among objects.

Neither account proposes that infants have the capacity to learn both proper names and count nouns at the outset of lexical development. However, it should be noted that these word-learning accounts pertain to infants who are at the outset of lexical acquisition. In order to provide stronger evidence against the narrow-to-broad and broad-to-narrow accounts, we will need to use our task (or another task) to examine the knowledge of infants who are younger than 16 and 17 months.

The current findings provide support for Hall's (2009) narrow-and-broad account (see also Macnamara, 1982). According to this proposal, infants are not constrained to learn only proper names or only count nouns early in lexical acquisition. Instead, they have the ability to learn both words for individuals and words for object categories, and their tendency to interpret a novel object word as one or the other depends on conceptual biases that lead them to interpret words for people as proper names and words for artifacts as count nouns.

Interpretive Issues and Future Directions

The present research has shed light on infants' early understanding of proper names and count nouns. The findings raise issues and questions, and indicate several directions for additional study.

It is important in discussing our evidence to note that a number of the findings involved null results. In particular, the results in the familiar artifacts conditions in Experiments 2 and 3,

the unfamiliar artifacts condition in Experiment 3, and the inverted faces condition in Experiment 4 revealed that infants had no preference for either object at test. However, it is important to note that there was one condition in Experiments 2 and 3 (i.e., the people condition), in which we found positive results (i.e., preference for the target object in Experiment 2 and preference for the non-target object in Experiment 3). Furthermore, although some of our evidence involved null results, it seems clear that infants' lack of preference was not due to an inability to learn a novel word for the target object in our task. The reason is that Experiment 1 provided evidence that infants in our age group can successfully map a novel word onto a target object. These considerations speak against the possibility that our null results reflected a simple failure to learn the novel word(s) in our task.

It should be noted that the narrow-and-broad account (as examined in this research) proposes that infants base their interpretation of novel object words on the conceptual differences between people and artifacts. However, it is also possible that infants' determination is not based on the distinction between people and artifacts per se. Instead, infants may base their determination on the broader conceptual distinction between animate objects and their surrogates (such as people, animals, dolls and stuffed animals) and inanimate objects (such as balls and cups). That is, infants may interpret object words for all animate things (and their surrogates) as proper names and object words for all inanimate things as count nouns. Conversely, it may be that the more ambiguous an object is as an individual, the more likely infants will interpret a label for the object as a count noun. For example, infants may show an equal tendency to interpret a novel word for a vegetable peeler or a stuffed monster-like animal with only a pair of eyes as a count noun. To examine infants' construal of objects from different categories and how this subsequently influences their interpretation of novel words for these objects, additional

research will be required. One line of future studies could directly compare how infants interpret words for objects that vary in the degree to which they are considered to be animate or agentive. This research would provide considerable new insight into our understanding of infants' early learning of proper names and count nouns.

A second avenue for future research would be to address the question of whether infants' conceptual biases influence their interpretation of words for different categories of objects at the outset of language acquisition. Although the present experiments have provided new evidence that infants as young as 16 months have an understanding of the distinction between proper names and count nouns, they are no longer beginner word-learners, even though there is no evidence that they have learned the linguistic proper name/count nouns. Previous work has shown that 14-month-old infants can distinguish count nouns from other types of words and map them specifically to object categories (e.g., Booth & Waxman, 2003; Waxman & Booth, 2001), even though they fail to identify proper names and map them specifically onto individual objects (Hall & Bélanger, 2010). However, there is research to suggest that infants as young as 6 months of age have some comprehension of proper names (Tincoff & Jusczyk, 1999). It would be fruitful to try to reconcile these previous findings by investigating whether infants' earliest understanding of words for objects is affected by the categories to which the objects belong. For example, future work could begin by testing 14- and 15-month-old infants because 14 months is the youngest age at which infants begin to show an understanding of the distinction between words from different lexical classes. More specifically, 14-month-olds appear to have a limited capacity to generalize count nouns across object categories, and to generalize adjectives across specific properties (e.g., Booth & Waxman, 2003). If 14- and 15-month-olds provide some evidence that they interpret words for people differently from words for artifacts, additional work

could examine the knowledge of 10- to 12-month-olds, because previous research has shown that infants begin to comprehend their first words at around 10 months of age. To successfully examine infants' lexical understanding at such young ages, the studies would need to use a task that is sensitive enough to detect their knowledge. Previous studies with 12- and 13-month-olds have yielded ambiguous results regarding their knowledge because there was no clear evidence that the infants mapped a novel word onto a target object in the first place (e.g., Hennon et al., 1999, 2000; Markman & Jaswal, 2004). Therefore, if our task is to be used, one possible modification would be to increase the number of times infants heard the novel word for the target object in order to increase the likelihood that they would learn the word-object pairing.

In the current work (Experiments 2, 3, and 4), we assessed infants' interpretation of novel words for pairs of within-category objects that were perceptually distinct. Our results showed that infants as young as 16 months of age interpreted words for people in a different manner from words for artifacts. A potential issue with this type of design is that leaves open multiple interpretations of the data because it is possible that infants mapped the novel words to subcategories or properties given that the non-target objects belonged to different subcategories and had different visual properties. A useful line of future work would examine infants' knowledge using pairs of within-category objects that are perceptually identical. This design would also help to rule out alternative interpretations of the data. Although previous research has shown that it is not until infants are 23 months that they restrict a novel label to the labeled doll when presented with identical-looking dolls, it is possible that 17-month-olds in the current task would show the same pattern of results when asked to identify the referent between a pair of identical-looking faces. Infants can rely on spatiotemporal evidence when visible property cues are unavailable to help them distinguish between the two images. Previous research has

suggested that young infants have the ability to use spatiotemporal information to identify and track individual objects through time and space (e.g., Xu & Carey, 1996). If infants are able to track and identify the identical objects as being distinct individuals, they might be able to successfully restrict the novel word to the labeled object as they do in the current work.

As previously discussed, infants face a challenge in learning how to identify object words from different lexical classes when they begin to acquire their language. We have argued that infants rely on non-linguistic ways to distinguish proper names and count nouns because they have no knowledge of linguistic cues to the proper name/count noun distinction at the outset of language acquisition. Infants appear to make different interpretations of novel words given to objects from different categories, a finding which speaks to the hypothesis infants rely on the conceptual distinction between different categories of objects to guide their interpretations of novel object words. In addition, it is important to recall that findings from cross-linguistic studies have shown that young children are able to learn the distinction between proper names and counts nouns in the absence of linguistic cues in their language.

Languages such as Japanese, Korean, and Chinese do not have linguistic markers that help their speakers distinguish between different classes of object labels (e.g., Erbaugh, 1992; Imai & Haryu, 2001; Kim, McGregor, & Thompson, 2000). Nevertheless, speakers of those languages have an understanding of the distinction between the different lexical classes. For example, as mentioned earlier, Imai and Haryu provided evidence that 2-year-old Japanese children make a semantic distinction between proper names and count nouns. They found that when a novel word was used to label an unfamiliar object, children interpreted the word in the manner of a count noun regardless of whether it was an animal or an artifact. In addition, they discovered that when a novel word was used to label a familiar artifact for which children

already knew a count noun, they interpreted the word as a noun for a subcategory. Lastly, they found that when a novel word was used to label a familiar animal, they interpreted the word as in the manner of a proper name. Although the 2-year-old Japanese children have been learning words for many months, they are similar to English infants at the outset of word learning in terms of having no access to linguistic cues. These findings provide further support for the proposal that that young children attend to non-linguistic cues (such as conceptual distinctions between different categories of objects) to learn proper names and count nouns. The collective evidence from cross-linguistic studies, which suggests that infants are capable of learning the distinction between proper names and count nouns even when linguistic cues are unavailable, speaks to the universality of infants' use of non-linguistic cues in word learning. More specifically, it raises the possibility that all infants, regardless of which language they are learning, attend to the conceptual differences between different categories of objects and they use this information to help them initially learn proper names for objects from some categories of objects and count nouns for objects from other categories of objects.

A large body of research on early word learning has examined older infants' knowledge of the linguistic distinction between proper names and count nouns. However, little research has investigated young infants' initial understanding this distinction. The evidence reported here suggests that infants may base their interpretations of novel words on conceptual biases that they have for different categories of objects, namely a difference between their manner of construing people and artifacts. Infants appear to have a different understanding of words for people and words for artifacts. The results suggest that they interpret words for people as labels for individual objects, but interpret the same words when applied to artifacts as labels for the object categories. These findings provide support for the narrow-and-broad account of word learning,

which proposes that infants are capable of learning both proper names and count nouns early in lexical acquisition. In sum, this research sheds new light on how infants identify and learn the linguistic distinction between these two lexical classes.

REFERENCES

- Aslin, R. (2007). What's in a look? *Developmental Science*, *10*, 48-53.
- Bélanger, J. & Hall, D. G. (2006). Learning proper names and count nouns: Evidence from 16- and 20-month-olds. *Journal of Cognition and Development*, *7*, 45-72.
- Bloom, L. (1973). *One Word at a Time: The Use of a Single Word Utterances before Syntax*. The Hague: Mouton.
- Bloom, P. (1994). Possible names: The role of syntax-semantics mappings in the acquisition of nominals. *Lingua*, *92*, 297-329.
- Bloom, P. (2000). *How children learn the meaning of words*. Cambridge, MA: MIT Press.
- Bloom, P. (2004). *Descartes' baby*. New York: Basic Books.
- Bonatti, L., Frot, E., Zangl, R., & Mehler, J. (2002). The human first hypothesis: Identification of conspecifics and object individuation in the young infant. *Cognitive Psychology*, *44*, 388-426.
- Booth, A. E. & Waxman, S. R. (2003). Mapping words to the world in infancy: Infants' expectations for count nouns and adjectives. *Journal of Cognition and Development*, *4*, 357-381.
- Carey, S. (2009). *The origin of concepts*. New York: Oxford University Press.
- Clark, E. (1973). What's in a word? On the child's acquisition of semantics in his first language. In T. Moore (Ed.), *Cognitive Development and the Acquisition of Meaning* (pp. 65–110). New York: Academic Press.

- Clark, E. (1987). The principle of contrast: A constraint on language acquisition. In B. MacWhinney (Ed.), *Mechanisms of Language Acquisition* (pp. 1-34). Hillsdale, NJ: Erlbaum.
- Cohen, L.B., Atkinson, D.J., & Chaput, H. H. (2004). Habit X: A new program for obtaining and organizing data in infant perception and cognition studies (Version 1.0). Austin: University of Texas.
- Cohen, L.B. & Cashon, C.H. (2001). Do 7-month-old infants process independent features or facial configurations? *Infant and Child Development*, *10*, 83-92.
- Dromi, E. (1987). *Early lexical development*. Cambridge: Cambridge University Press.
- Echols, C. H. & Marti, C. N. (1999). Children's use of syntactic cues in word learning: Successes and failures. Paper presented at the biennial meeting for the Society for Research in Child Development, Albuquerque, NM, April.
- Erbaugh, M. (1992). The acquisition of Mandarin. In D. S. Slobin (Ed.), *The cross-linguistic study of language acquisition*, Vol. 3 (pp. 373-456). Hillsdale, NJ: Lawrence Erlbaum.
- Fenson, L., Dale, P., Reznick, S., Bates, E., Thal, D., & Pethick, S. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development*, *59* (Serial No. 242).
- Gelman, S. & Taylor, M. (1984). How two-year-old children interpret proper and common names for unfamiliar objects. *Child Development*, *55*, 1535-1540.
- Halberda, J. (2003). The development of a word-learning strategy. *Cognition*, *87*, B23-B34.
- Hall, D. G. (2009). Early proper name learning: Implications for a theory of lexical development. *Mind and Language*, *24*, 404-432.

- Hall, D. G. & Bélanger, J. (2010). *Infants' acquisition of lexical-category-to-meaning links: The case of count nouns and proper names*. Manuscript in preparation, Department of Psychology, University of British Columbia.
- Hall, D. G., Burns, T. C., & Pawluski, J. L. (2003). Input and word learning: caregivers' sensitivity to lexical category distinctions. *Journal of Child Language*, *30*, 711-729.
- Hall, D. G., Corrigan, K., Rhemtulla, M., Donegan, E., & Xu, F. (2008). Infants' use of lexical-category-to-meaning links in object individuation. *Child Development*, *79*, 1432-1443.
- Hall, D. G. & Graham, S. (1999). Lexical form class information guides word-to-object mapping in preschoolers. *Child Development*, *70*, 78-91.
- Hall, D. G., Lee, S., & Bélanger, J. (2001). Young children's use of syntactic cues to learn proper names and count nouns. *Developmental Psychology*, *37*, 298-307.
- Hennon, E., Hirsh-Pasek, K., Golinkoff, R., Rocroi, C., Arnold, K., Maguire, M., Baker, S., & Driscoll, K. (2000). *From proper names to categories: infants learn how words work*. Paper presented at the International Conference on Infant Studies, Brighton, UK.
- Hennon, E., Rocroi, C., Chung, H., Hollich, G., Driscoll, K., Hirsh-Pasek, K., & Golinkoff, R. (1999). *Testing the principle of extendibility: Are new words learned as proper names or category labels?* Paper presented at the biennial meetings of the Society for Research in Child Development, Albuquerque, NM.
- Hirsh-Pasek, K., Golinkoff, R., Hennon, E., & Maguire, M. (2004). Hybrid theories at the frontier of developmental psychology: the emergentist coalition model of word learning as a case in point. In D. G. Hall and S. Waxman (Eds.), *Weaving a lexicon* (pp. 173-204). Cambridge, MA: MIT Press.

- Hollich, G. J., Hirsh-Pasek, K., & Golinkoff R. M. (2000). Breaking the language barrier: An emergentist coalition model for the origins of word learning. *Monographs of the Society for Research in Child Development, Vol. 65* (3, Serial No.)
- Imai, M. & Haryu, E. (2001). Learning proper nouns and common nouns without clues from syntax. *Child Development, 72*, 787-802.
- Katz, N., Baker, E., & Macnamara, J. (1974). What's in a name? A study of how children learn common and proper names. *Child Development, 45*, 469-473.
- Kestenbaum, R. & Nelson, C. (1990). The recognition and categorization of upright and inverted emotional expressions by 7-month-old infants. *Infant Behavior and Development, 13*, 473-511.
- Kim, M., McGregor, K. K., & Thompson, C. K. (2000). Early lexical development in English- and Korean-speaking children: Language-general and language-specific patterns. *Journal of Child Language, 27*, 225-254.
- Kuhlmeier, V., Bloom, P., & Wynn, K. (2004). Do 5-month-olds see humans as material objects? *Cognition, 94*, 95-101.
- Leslie, A. M. (1984). Infant perception of a manual pick-up event. *British Journal of Developmental Psychology, 2*, 19-32.
- Liittschwager, J. C. & Markman, E. M. (1993). *Young children's acquisition of proper versus count nouns*. Paper presented at the biennial meetings of the Society for Research in Child Development, New Orleans, LA.
- Macnamara, J. (1982). *Names for things: A study of human learning*. Cambridge, MA: MIT Press.

- Macnamara, J. (1986). *A border dispute*. Cambridge, MA: MIT Press.
- Mandler, J. M. (2000). Perceptual and conceptual processes in infancy. *Journal of Cognition and Development, 1*, 3-36.
- Mandler, J. M. & McDonough, L. (1993). Concept formation in infancy. *Cognitive Development, 8*, 291–318.
- Markman, E. M. (1989). *Categorization and naming in children: Problems of induction*. Cambridge, MA: MIT Press.
- Markman, E. M. & Hutchinson, J. (1984). Children's sensitivity to constraints on word meaning: Taxonomic vs. thematic relations. *Cognitive Psychology, 16*, 1-27.
- Markman, E. M. & Jaswal, V. K. (2004). Acquiring and using a grammatical form class: Lessons from the proper-count distinction. In D. G. Hall and S. Waxman (Eds.), *Weaving a Lexicon* (pp. 317-409). Cambridge, MA: MIT Press.
- Markman, E. M. & Wachtel, G. F. (1988). Children's use of mutual exclusivity to constrain the meaning of words. *Cognitive Psychology, 20*, 121-157.
- Nelson, K. (1973). Structure and strategy in learning to talk. *Monographs of the Society for Research in Child Development, 38* (Serial No. 149).
- Quine, W. V. O., (1960). *Word and Object*. Cambridge, MA: MIT Press.
- Quinn, P. C. & Eimas, P. D. (1998). Evidence for a global categorical representation of humans by young infants. *Journal of Experimental Child Psychology, 69*, 151-174.
- Rakison, D. & Poulin-Dubois, D. (2001). Developmental origin of the animate-inanimate distinction. *Psychological Bulletin, 127*, 209-228.

- Reznick, J. S. (1990). Visual preference as test of infant word comprehension. *Applied Psycholinguistics, 11*, 145-166.
- Smith, L. (2000). Learning how to learn words: An associative crane. In R. Golinkoff, K. Hirsh-Pasek, L. Bloom, L. Smith, A. Woodward, N. Akhtar, M. Tomasello, & G. Hollich (Eds.) *Becoming a word learner: A debate on lexical acquisition* (pp. 51-80). New York: Oxford University Press.
- Sorrentino, C. (2001). Children and adults represent proper names as referring to unique individuals. *Developmental Science, 4*, 399-407.
- Southgate, V., Csibra, G., Kaufman, J., & Johnson, M. H. (2008). Distinct processing of objects and faces in the infant brain. *Journal of Cognitive Neuroscience, 20*, 741-749.
- Spelke, E. S., Philips, A., & Woodward, A. L. (1995). Infants' knowledge of object motion and human action. In D. Sperber, D. Premack, & A. J. Premack (Eds.), *Causal cognition* (pp. 150-184). Oxford, England: Clarendon.
- Tardif, T., Fletcher, P., Liang, W., Zhang, Z., Kaciroti, N., & Marchman, V. (2008). Baby's first ten words. *Developmental Psychology, 44*, 929-938.
- Tincoff, R. & Jusczyk, P. (1999). Some beginnings of word comprehension in 6-month-olds. *Psychological Science, 10*, 172-175.
- Tincoff, R. & Jusczyk, P. (2000). *Do 6-month-olds link sound patterns of common nouns to new exemplars?* Paper presented at the International Conference on Infant Studies, Brighton, UK.
- Waxman, S. R. (2004). Everything had a name, and each name gave birth to a new thought: Links between early word-learning and conceptual organization. In D. G. Hall and S. Waxman (Eds.), *Weaving a Lexicon* (pp. 295-335). Cambridge, MA: MIT Press.

- Waxman, S. R. & Booth, A. E. (2001). Seeing pink elephants: Fourteen-month-olds' interpretations of novel nouns and adjectives. *Cognitive Psychology*, *43*, 217-242.
- Waxman, S. R. & Booth, A. E. (2003). The origins and evolution of links between word learning and conceptual organization: New evidence from 11-month-olds. *Developmental Science*, *6*, 130-137.
- Waxman, S. R. & Leddon, E.M. (2011). Early word learning and conceptual development: Everything had a name, and each name gave birth to a new thought. In U. Goswami (Ed.) *The Wiley-Blackwell Handbook of Childhood Cognitive Development* (pp. 180-208). Malden, MA: Wiley-Blackwell.
- Waxman, S. R. & Markow, D. (1995). Words as invitations to form categories: Evidence from 12- to 13-month-old infants. *Cognitive Psychology*, *29*, 257-302.
- Waxman, S. R. & Markow, C. (1998). Object properties and object kind: Twenty-one-month-old infants' extension of novel adjectives. *Child Development*, *69*, 1313-1329.
- Woodward, A. L. (1998). Infants selectively encode the goal object of an actor's reach. *Cognition*, *69*, 1-34.
- Woodward, A. & Markman, E. (1998). Early word learning. In D. Kuhn and R. Ziegler (Eds.), W. Damon (Series Ed.), *Handbook of Child Psychology: Vol. 2. Cognition Perception, and Language*. New York: Wiley.
- Woodward, A., Markman, E., & Fitzsimmons, C. (1994). Rapid word learning in 13- and 18-month-olds. *Developmental Psychology*, *30*, 553-566.
- Xu, F. & Carey, S. (1996). Infants' metaphysics: The case of numerical identity. *Cognitive Psychology*, *30*, 111-153.

Younger, B.A. & Cohen, L.B. (1986). Developmental change in infants' perception of correlations among attributes. *Child Development*, 57, 803-815.

APPENDIX A

Script for pre-recorded audio stimuli for Experiments 1, 2, and 4.

Familiarization Trials

“Look! Wow! See! Look! Wow! Look! Wow! See! Look!”

Test Trials

Version 1

“Look! DAXY! See! DAXY! Look! DAXY! See! DAXY! Look! DAXY! See! DAXY!
Look! DAXY!”

“Look! See! Look!”

“Look! Wow! Look! Wow! See! Look!”

“Find DAXY! Where’s DAXY? Find DAXY!”

Version 2

“Look! BLICKY! See! BLICKY! Look! BLICKY! See! BLICK! Look! BLICK! See!
BLICKY! Look! BLICKY!”

“Look! See! Look!”

“Look! Wow! Look! Wow! See! Look!”

“Find BLICKY! Where’s BLICKY? Find BLICKY!”

APPENDIX B

Script for pre-recorded audio stimuli for Experiment 3.

Familiarization Trials

“Look! Wow! See! Look! Wow! Look! Wow! See! Look!”

Test Trials

Version 1

“Look! DAXY! See! DAXY! Look! DAXY! See! DAXY! Look! DAXY! See! DAXY!
Look! DAXY!”

“Look! See! Look!”

“Look! Wow! Look! Wow! See! Look!”

“Find BLICKY! Where’s BLICKY? Find BLICKY!”

Version 2

“Look! BLICKY! See! BLICKY! Look! BLICKY! See! BLICK! Look! BLICK! See!
BLICKY! Look! BLICKY!”

“Look! See! Look!”

“Look! Wow! Look! Wow! See! Look!”

“Find DAXY! Where’s DAXY? Find DAXY!”