THE NATURE OF INFANTS' EARLY OBJECT WORD COMPREHENSION

by

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Abstract

A longstanding question in the literature on language development concerns the nature of infants' first object word representations: Do these terms have scope over individual objects or entire object categories? Answering this question is important for accounts of the origin of lexical knowledge. Through seven experiments, this dissertation explored the nature of infants' early object word comprehension.

Experiments 1 to 4 assessed six-month-olds' comprehension of the names for their caregivers. The findings support the claim that these words have scope over individual objects and are consistent with the possibility that infants can represent names for individual objects from the outset of word learning.

Experiments 5 and 6 explored whether six- and nine-month-olds comprehend both labels with scope over individual objects (the name for their mother, e.g., "Mommy") *and* labels with scope over object categories (the word "hand" at six months; the word "ball" at nine months). The results were consistent with these predictions. These discoveries suggest that infants can represent both words for individual objects and words for object categories from the beginning of lexical development.

Experiment 7 went a step further than the previous experiments by exploring whether 12- to 15-month-olds comprehend two object labels with differing scope for *the same object* (i.e., their own pet dog or cat): both a name for the individual object (e.g., "Fido") and a name for the object category (e.g., "dog"). The results indicate that by about their first birthday, infants have the cognitive flexibility to learn multiple words differing in extension (individual object, object category) for the same object.

Together, the findings suggest that the capacity to learn both words with individual object scope and words with object category scope is present from the outset of lexical development. Additionally, the demonstration that by one year, infants can learn two words – one with individual scope and one with categorical scope – for the same object, indicates previously undocumented flexibility in their capacity to represent the same physical object both as an individual object and as an instance of an object category. The findings significantly enrich our understanding of the origins of lexical development.

Lay Summary

Among infants' earliest-produced words are labels for individual people (e.g., proper names like "Mommy") and labels for object categories (e.g., count nouns like "ball"). There is a longstanding debate in the literature about whether infants initially understand these words as having scope over individual objects and object categories. The experiments in this dissertation tested the hypothesis that infants in the earliest stages of lexical development comprehend both words that are restricted to individual objects and words that extend across object category members. The findings from Experiments 1 to 6 provide support for this hypothesis from six- and nine-month-olds. The results from Experiment 7 further indicate that, by 12 months, infants have the cognitive flexibility to learn two labels – one with individual scope and one with categorical scope – for the same object (i.e., their pet dog or cat). The findings significantly enrich our understanding of the origins of human word learning.

Preface

The research presented in this dissertation is the work of the author and was developed through discussion and collaboration with her advisor, Dr. D. Geoffrey Hall. The author had primary responsibility for all aspects of all the research. The author had the responsibility of conducting the experiments and overseeing all data collection. Data analysis was also the responsibility of the author.

The research in this dissertation was approved by the UBC Behavioural Research Ethics Board: certificate number H17-00006-A001 (Early lexical comprehension) and H07-01582 (Origins of word learning).

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1 Chapter 1: Introduction

1.1 General Introduction

Acquiring a mature understanding of an object word involves more than simply establishing a link between an auditory signal and an entity in the environment. Full object word knowledge also consists of representing the appropriate mental concept to which the label refers. For instance, a word applied to an object could refer to the object as an individual (i.e., a proper name), as a member of a category (i.e., a count noun), or as an exemplar of a particular property (i.e., an adjective). Although the connections between object words and concepts in the adult lexicon are generally clear, it is unknown whether infants begin lexical development with object words that are linked to the same concepts. Research to date has not addressed the nature of infants' earliest object-word-to-concept connections. For example, although many of infants' first object words would be classified as proper names and count nouns in the adult lexicon, it is not known whether infants link these labels specifically to individual objects and object categories, respectively. Thus, it is unclear whether infants have proper names (i.e., labels for individuals) or count nouns (i.e., labels for categories) early in development. This dissertation focuses on examining infants' earliest representations of words of these two types, exploring the extent to which their understanding is consistent with that of adults. This dissertation presents a series of experiments which explore (1) the nature of infants' earliest comprehension of proper names, (2) infants' early representation of multiple lexical types (proper names, count nouns) for different objects (people and artifacts), and (3) infants' early representation of multiple lexical types (proper names, count nouns) for the same object (family pets). These experiments help to elucidate the nature of infants' earliest lexical-conceptual capacities, their ability to acquire

words of multiple lexical types, and their flexibility to represent the same physical object as falling under words from different lexical types.

1.1.1 Foundations of Early Word Learning

Although infants do not produce their first words until around their first birthday, they develop skills in speech perception and word comprehension during their first year of life. From birth, infants have a preference to listen to human speech (i.e., a nonsense word) over complex non-speech sounds (i.e., sinusoidal waves speech-like properties) (Vouloumanos & Werker, 2007) as well as a preference for the language(s) heard in utero over unfamiliar languages (Moon, Cooper, & Fifer, 1993). Moreover, from birth, infants have an ability to discriminate languages of different rhythmic classes (Mehler et al., 1988); and by four months of age, they can discriminate between their own language and a different one belonging to the same rhythmic class (Nazzi, Juscxyk, & Johnson, 2000). Previous work reveals that over their first year of life, infants also become attuned to the specific properties of their native language. Infants at around six to eight months of age can discriminate vowel and consonant contrasts used in non-native languages (and in their own native language), but by 10 to 12 months of age they show a decrease in their ability to discriminate non-native sound contrasts (Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992; Polka & Werker, 1994; Werker & Tees, 1984). This development provides infants with an ability to interpret the speech stream in terms of native-language categories and creates a foundation for further language acquisition.

Along with the preceding perceptual change, beginning around 7.5 months of age, infants become able to segment words from continuous speech streams (Jusczyk & Aslin, 1995; Jusczyk & Hohne, 1997). Specifically, at this age, infants show a preference to listen to words from a previously heard short story over phonetically similar words that were not in the story.

Moreover, by eight months of age infants can listen to a speech stream of nonsense tokens and track the probabilities of tokens co-occurring and use this information to segment appropriately the frequently paired sounds (Saffran, Aslin, & Newport, 1996). Being able to track the distributional patterns in the speech stream may enable infants to pull out words that may subsequently be mapped to objects in their environment. A major step towards successful word learning occurs near the end of the first year of life when infants show understanding of the social referential nature of language (Carpenter, Nagell, Tomasello, Butterworth, Moore, 1998; Tomasello, 2001) – a development that some have argued is a prerequisite for the learning of words (Carpenter et al., 1998).

The preceding evidence suggests that linguistic development during the first year proceeds incrementally along several fronts: Infants acquire language-specific perceptual abilities by honing in on the sound properties of their native language(s); they develop the ability to segment language-specific tokens in the speech stream, and they come to recognize the referential nature of language. Under this view of language development, infants may not learn their first words until close to their first birthday precisely because they need these foundational linguistic-processing abilities to anchor their word learning. If this were true, infants could use their knowledge of native phonetic categories, statistical speech segmentation abilities and their recognition of referential intention to guide their lexical acquisition. Yet recent experimental evidence presents a challenge to this type of account of early word learning: Infants appear to have some object words in their receptive lexicons by six months of age (Bergelson & Swingley, 2012, 2015, 2017; Tincoff & Jusczyk, 2012). This recent research on six-month-olds' lexical comprehension suggests that infants can learn object words from very early in development and possibly even before acquiring many of the speech perception, statistical speech segmentation,

and social-cognitive abilities just described. Moreover, this recent work suggests that infants do not require detailed native-language phonetic category knowledge, statistical speech segmentation abilities or an ability to engage in joint attentional events to learn words and may even indicate that the learning of early words instead influences the acquisition of these other capacities. This new work on infants' earliest word understanding thus challenges previous notions about the nature of early language acquisition, making it important to understand the nature of this precocious lexical comprehension.

1.1.2 Nature of Early Word Comprehension

If infants can learn object words by the middle of the first year of life, then what is the nature of these early lexical representations? Object labels in the in the adult language have one of two referential properties: they can be either extended to multiple objects (e.g., they are category labels, namely count nouns) or restricted to the object that was labelled (e.g., they are individual labels, namely proper names). Two opposing theoretical accounts of lexical development posit that word learning progresses from the ability to acquire one of these lexical types to the ability to acquire the other. The *narrow-to-broad* account proposes that infants progress from learning individual words to learning category words, whereas the *broad-to-narrow* account postulates the opposite order of learning (see Hall, 2009; Hirsh-Pasek, Golinkoff, Hennon, & Maguire, 2004; Macnamara, 1982).

The *narrow-to-broad* account of lexical development proposes that infants' earliest object words are terms for individual objects. This account proposes that infants have an initial bias to interpret object labels as words for individuals. Many researchers have argued that infants begin as conservative word learners who do not initially extend object-directed words from the labelled object to other objects (Hirsh-Pasek et al., 2004; Nelson, 1973; Smith, 2000). Under this account,

infants learn their first object words as restricted to individual objects and only after further experience with language do they gain the ability to learn words with categorical scope (Hennon et al., 2000; see also Locke, 1689). One of the proposed ways by which infants may overcome the initial bias to assume that object words are labels for individuals is through attending to speakers' pattern of labeling multiple objects from the same category with the same label (Hennon et al., 2000). Additionally, infants may learn that some object labels are labels for categories by learning to attend to the shared perceptual features between objects that share the same label (Golinkoff, Mervis, & Hirsh-Pasek, 1994). On the *narrow-to-broad* account, the presence of proper names in the early lexicon has a simple explanation, but the presence of count nouns is harder to understand. The account would thus face a challenge in explaining the presence of labels for both individuals and categories in infants' earliest receptive lexicons.

In contrast, the *broad-to-narrow* account of lexical development posits that words initially serve as invitations to form categories (Waxman & Markow, 1995; see also Waxman, 2004). Under this account, infants first interpret object words as labels for categories (Markman, 1989). Many studies have found support for this account by demonstrating that children as young as 12 months will assume that novel object labels extend to other objects of the same category (e.g., Booth & Waxman, 2003a; Markman & Jaswal, 2004; Woodward, Markman, & Fitzsimmons, 1994). Although there have been some studies reporting cases of young children's incorrectly failing to generalize count nouns (e.g., interpreting "dog" as referring to only their own pet and not to all dogs), such instances appear to be rare in comparison to the frequency of their incorrectly over-generalizing labels (e.g., interpreting "dog" as extending to both cats and dogs) (e.g., Dromi, 1987; Nelson, 1973). If infants first interpret object words as labels for categories, then how do they move beyond this assumption to learn object words that label individuals?

Booth and Waxman (2003) have suggested that infants begin with the expectation that object words label categories and that subsequent experience with the co-occurrences between particular grammatical forms and their referents allows infants to learn that some other object words that apply to only one object (e.g., proper names). Markman and Jaswal (2004) have made a similar proposal whereby infants begin lexical development with an initial assumption that words for objects are labels for categories; by observing the tendency of speakers not to extend certain object words to other members of the category, infants learn that some words do not apply to categories and instead label individuals. Although there is evidence that 3- to 4-year-olds can use pragmatic information like this to learn novel proper names (Hall & Bélanger, 2009; Hall & Rhemtulla, 2014), it is unclear whether infants have this ability. By positing that infants have an initial bias to assume that object words are labels for categories, the *broad-to-narrow* account sheds light on the presence of count nouns in early vocabularies; however, it makes the presence of proper names harder to explain. The account is thus inconsistent with the possibility that the receptive vocabularies of infants as young as six months contain words that refer to object categories *and* words that refer to individual objects.

Both the *narrow-to-broad* and the *broad-to-narrow* accounts have received support from a number of experimental studies which have demonstrated that there are conditions under which infants do not extend words to other category members and conditions under which they extend words to other category members. Moreover, the *narrow-to-broad* correctly predicts infants' early production of labels for individual objects (e.g., "Mommy"), and the *broad-to-narrow* account accurately predicts the early appearance of labels for object categories (e.g., "hand") in infants' early productive vocabularies. Yet in recent studies of infants' earliest-understood words, both labels for individuals and labels for categories seem to be understood in some

manner at around six months of age (Bergelson & Swingley, 2012, 2015, 2017; Tincoff & Jusczyk, 1999). Neither of the preceding accounts can easily explain why the earliest lexicon appears to contain both words that for adults are count nouns *and* words that for adults are proper names, providing the motivation for a third account of lexical development. According to this alternative *narrow-and-broad* account, infants have the capacity to learn both lexical types – words for object categories (i.e., count nouns) and words for individual objects (i.e., proper names) – from the outset of development (Hall, 2009; Macnamara, 1982). This account predicts a pattern of vocabulary development that has been observed in previous studies, namely that at the earliest stages of word acquisition, infants appear to know some words that are proper names in the adult lexicon and some that are count nouns (Nelson, 1973; Fenson, Dale, Reznick, Bates, Thal & Pethick, 1994). The literature on lexical development has not yet, however, reported controlled tests of the account (i.e., tests of whether infants' earliest lexicons contain *both* words that pick out individual objects *and* words that extend across members of object categories).

1.1.3 Children's Comprehension of Proper Names and Count Nouns

Many of infants' first words would be classified in the adult lexicon as proper names (i.e., labels for individuals) and count nouns (i.e., labels for category members). Among the earliest words learned by infants at six months of age are proper names for caregivers, but it is unclear whether infants understand these labels as words with individual scope (Tincoff & Jusczyk, 1999). For instance, to date studies have not examined whether infants interpret labels for their mother and father (e.g., "Mommy", "Daddy") as labels for any familiar woman or man, respectively. It is similarly unclear whether young infants understand any count nouns (e.g., "hand", "ball") as labels for categories. Prior research has not examined whether infants interpret these labels as extendable to other members of the same category (Bergelson & Swingley, 2012,

2015, 2017). Although infants thus appear to have words that are individual labels and categorical labels in their earliest vocabulary, it is not clear to what extent these early words have the same interpretation as the words in the adult lexicon.

Once children are able to learn labels with different referential scope, then a next question is whether they can learn multiple labels differing in scope for the same object. Prior work has found evidence that two-year-olds can learn both a label with restricted scope (i.e., a sub-category label that is not extended to all within-category members) and a label with categorical scope for the same object (i.e., a basic-level category label that can be extended to within-category members) (e.g., Gelman and Taylor, 1989; Waxman & Senghas, 1992). Yet if young infants' early lexicon contains both labels with individual scope and categorical scope for different objects, then they may also possess the ability to learn labels of these two lexical types for a single object. Although prior work has not examined this question in young infants, parental reports from young toddlers suggest that children may be able to learn a label with individual scope and a label with categorical scope for the same object. Specifically, some parents of toddlers who live with pets have indicated that the name and category label for that animal appear in the early productive vocabulary (Macnamara, 1982). Although the referential scope of these words is not clear from parental reports, the reports raise the possibility that young infants have the ability to acquire both a label with individual scope and a label with categorical scope for the same object (animal).

Although it is unclear whether young infants comprehend both labels for individuals and labels for category members, a number of studies have shown that by around 17 months of age infants appropriately interpret novel proper names (i.e., labels for individuals) and novel count nouns (i.e., labels for category members). In a seminal study, Katz, Baker, and Macnamara

(1974) presented infants with a doll labelled either with a novel proper name (e.g., "This is ZAV") or a novel count noun (e.g., "This is a ZAV"). They then presented a second distinct-looking doll which had a different hair color and different dress. With the two dolls side-by-side, they then asked infants to either "Give me ZAV" in the proper name condition or "Give me a ZAV" in the count noun condition. Katz et al. found that by 17 months of age, girls preferentially selected the named doll in the proper name condition and picked both dolls equally often in the count noun condition. Thus, by 17 months old, girls showed an understanding of the linguistic markers of proper names and count nouns by appropriately restricting the proper name to the named individual but extending the count noun to both dolls. Boys did not show this same pattern of response until 28 months of age. In Katz et al. (1974), however, it was unclear whether the lack of preference for either doll in the count noun naming condition was due to children's category interpretation of the label or confusion of the task. Gelman and Taylor (1984) addressed this concern by amending the original task to include out-of-category foils. They found that 2-year-old children generalized the label modeled as a count noun to objects within the named object's category but not to objects belonging to a different category than that of the named object. Thus, children appeared to be making an object category interpretation of the count noun.

In the studies conducted by Katz et al. (1974) and Gelman and Taylor (1984), the dolls presented were all visually distinctive (e.g., different hair, different clothing). This feature of their experimental designs leaves open the possibility that infants were mapping the proper name not to an individual doll but to a unique visual property of the named doll. Several studies have sought to address this possibility by amending the original procedure to involve identical-looking dolls (e.g., Bélanger & Hall, 2006; Hall & Bélanger, 2010; Hall, Lee & Bélanger, 2001;

Liittschwager & Markman, 1993; Sorrentino, 2001). The findings from this research indicate that by 24 months of age, both boys and girls will restrict a label presented as a proper name to the named doll but extend a label presented as a count noun to a second object belonging to the same category as the labelled object (Hall et al., 2001).

A comprehensive study was carried out by Hall and Bélanger (2010) to clarify the discrepancy between the findings from previous work involving either perceptually contrasting or identical-looking objects (Katz et al.,1974; Gelman & Taylor, 1984; Hall et al., 2001). In this study, researchers examined infants between the ages of 14 months to 23 months and observed their extension of a proper name and count noun applied to either two identical-looking objects or two different-looking objects. They found that it was not until 17 months of age that infants of both genders extended novel words modeled as proper names and count nouns appropriately when presented with two different-looking dolls. However, infants did not appropriately extend the proper names as labels for individual objects and count nouns as labels for object categories when presented with identical-looking dolls until 23 months of age. This work suggests that infants' ability to demonstrate an understanding of the linguistic distinction between proper names and count nouns is dependent on the perceptual properties of the objects labelled. In another study that used looking time rather than object selection as the dependent measure, infants showed an appropriate interpretation of novel proper names and count nouns in a task involving identical-looking objects at 20 months of age (Bélanger & Hall, 2006). Together, this work suggests that between 17 and 23 months, infants master the grammatical distinction between proper names (words for individual objects) and count nouns (words for object categories).

The preceding findings demonstrate that by around 17 months, English-exposed infants have learned the distinction between words marked linguistically as proper names and those marked linguistically as count nouns, expecting the former to have individual scope and the latter to have categorical scope. By whatever method infants accomplish this impressive feat of learning, their ability to interpret novel proper names as referring to individual objects and novel count nouns as referring to object categories must emerge from a prior ability to learn labels for individuals and labels for categories in their language. Yet it is unclear from the literature at what age infants first appreciate the different referential nature of words with individual scope and words with categorical scope.

1.2 Thesis Rationale

Prior evidence indicates that early in the second year, infants produce some proper names that they appear to restrict to individual objects and some count nouns that they appear to generalize across objects from the same category (e.g., Fenson et al., 1994). As early as the middle of the second year, infants' novel word interpretations reveal that they have learned the grammatical distinction between proper names (words for individual objects) and count nouns (words for object categories) (e.g., Katz et al.,1974; Gelman & Taylor, 1984; Hall & Bélanger, 2010). But when do infants first show comprehension of words for individual objects and words for object categories? Several studies have demonstrated that infants' first object-word comprehension emerges at around six months of age, yet the nature of this comprehension is unclear (Bergelson & Swingley, 2012, 2015, 2017; Tincoff & Jusczyk, 1999, 2012). For instance, prior work has shown that infants look more to a video of their own mother than to a video of their own father upon hearing the word "Mommy" (Tincoff & Jusczyk, 1999), and that they look more to a picture of a banana than to a picture of a foot upon hearing the word

"banana" (Bergelson & Swingley, 2012). Although these results are consistent with infants' interpreting the word "Mommy" as a label for their own mother and "banana" as a categorical label, they are also consistent with the possibility that infants extend the word "Mommy" to other familiar women and that they do not extend the word "banana" to other bananas. Thus, although infants' earliest lexicon contains words that would be classified in the adult lexicon as proper names (i.e., labels for individuals) and count nouns (i.e., labels for category members), prior research has not closely examined the specific interpretations infants assign to these early words – and whether they are consistent with the adult interpretations.

If infants can learn both words with individual scope and word with categorical scope from the outset of lexical development, then a further question is whether they can learn both label types for the same object. Although any object could potentially receive both an individual label (proper name) and a category label (count noun), it is common in practice to use both types of words in conjunction with objects of only certain kinds – in particular, kinds of animals that are pets. Some parental reports indicate that infants have learned both their pet's proper name and their pet's count noun label by early in the second year (Macnamara, 1982). Additionally, there is experimental evidence suggesting that toddlers can learn multiple labels with different referential scope for a single object (e.g., Gelman and Taylor, 1989; Kandhadai et al., 2016; Waxman & Senghas, 1992). Yet there is no experimental evidence addressing the question of whether infants' comprehension of labels for their pets reflects the capacity to learn both an individual label and a category label for the same object.

This dissertation seeks to determine the nature of infants' earliest representations of object words. Specifically, through a series of seven experiments, this dissertation will examine whether infants understand both words that label individuals (i.e., proper names) and words that

label category members (i.e., count nouns) from the outset of word learning. The dissertation will explore three specific issues about the nature of infants' understanding of their earliest proper names and count nouns. First, Chapter 2 (Experiments 1 through 4) will examine whether six-month-olds understand that names for familiar people (e.g., "Mommy") are restricted to individual people. Chapter 3 (Experiments 5 and 6) will assess whether six-month-olds (Experiment 5) and nine-month-olds (Experiment 6) understand that names for familiar people ("Mommy") are restricted to individual people, whereas words for other familiar objects ("hand"; "ball") extend across category members. Finally, in Chapter 4 (Experiment 7) we will further assess whether slightly older infants (i.e., 12- to 15-month-olds) comprehend both a name for an individual object (e.g., "Rover") and a word for an object category (e.g., "dog") for the *same* familiar object (i.e., the family pet dog or cat).

1.2.1 What is the nature of infants' early understanding of names for people?

Recent advances in the study of language development have led to the discovery that infants as young as six months have a number of words in their receptive lexicons. Among these earliest words are labels for familiar people, body parts, food, and artifacts. Although a few studies have established that six-month-olds comprehend words for familiar objects and body parts (Bergelson & Swingley, 2012, 2015, 2017), only one study has uncovered comprehension of labels for people (Tincoff & Jusczyk, 1999). That study uncovered support for the claim that infants understand the words "Mommy" and "Daddy" as labels for their individual caregivers. In the study, Tincoff and Juscyzk (1999) found that when infants viewed videos of their mother and father next to each other, they looked more to their mother than to their father when hearing the word "Mommy" but looked more to their father than to their mother when hearing "Daddy". Moreover, when infants viewed videos of an unfamiliar woman paired with an unfamiliar man,

they looked equally to either person when hearing the words "Mommy" or "Daddy". Thus, infants appeared to interpret "Mommy" and "Daddy" as referring to their own mother and father and not as referring to an unfamiliar woman and man, respectively. The results offer evidence of comprehension of "Mommy" and "Daddy" by six-month-olds, but they do not clearly establish whether infants interpret these labels for their caregivers as labels for individual people or as labels for categories. An alternative interpretation is that infants interpreted these labels as terms that are extendible to categories of familiar people (e.g., grandparents, aunts, uncles). Infants' response to look equally at videos of unfamiliar men and women upon hearing the names for their caregivers was interpreted as indicating that infants do not understand the labels "Mommy" and "Daddy" as being extendible to an *unfamiliar* woman and man, respectively; however, it is possible that infants interpret these words as extendable to *familiar* people. These results do not address whether infants would extend the words to other *familiar* people of the same gender (e.g., extend "Mommy" to a grandmother, aunt or a familiar female). If infants extend labels for caregivers to other *familiar* people of the same gender, this would indicate that infants have learned these labels as category terms (i.e., as count nouns).

Experiments 1 through 4 will attempt to clarify whether six-month-olds interpret one of their earliest proper names (i.e., "Mommy") as a name for their mother *as an individual*. These experiments will also investigate six-month-olds' understanding of names for other familiar people in their environment (i.e., grandmother, aunt, family friend). Although previous work has established that infants have some comprehension of a name for their mother at six months of age, it remains unclear whether infants of this age understand the word as a label for an individual (Tincoff & Jusczyk, 1999). The results of these studies will serve to illuminate infants' understanding of their first names for people – in particular, to help determine whether

infants from the earliest stages of language development have names for individual people. In this way, this work will shed light on one lexical type that may be present in infants' earliest vocabulary.

1.2.2 Do young infants represent multiple lexical types?

The *narrow-and-broad* account of language development predicts that infants have the capacity from the outset of word acquisition to learn both words for individual objects and words for object categories. This prediction stands in contrast to those made by both the *narrow-to-broad* and the *broad-to-narrow* accounts, which predict that infants begin language development with the assumption that all object words are labels for individuals (*narrow-to-broad*) or labels for categories (*broad-to-narrow*). Neither of these accounts can easily explain the apparent presence in the infant's first lexicon of labels with scope over individuals *and* labels with scope over categories. Although recent research suggests that the early receptive lexicon of infants contains labels for individual caregivers (e.g., "Mommy", "Daddy") as well as labels for object categories (e.g., "banana", "bottle", "hand") (Tincoff & Jusczyk, 1999, 2012; Swingley & Bergelson, 2012), this work has not established that these words are, in fact, interpreted by infants as labels for individual objects and labels for categories, respectively.

Experiments 5 and 6 will further examine whether six- and nine-month-olds understand the proper name for their mother (e.g., "Mommy") as an individual label, one that does not extend from their own mother to an *unfamiliar* woman. A limitation of Tincoff & Jusczyk's (1999) study not addressed by Experiments 1 to 4 concerns the fact that their evidence that infants did not extend the word for the mother to any unfamiliar woman came from a task in which infants heard that label in the presence of two unfamiliar people (a man and a woman). In other words, the infant's mother was not visible when the name was uttered. This leaves open the possibility

that the finding that infants did not prefer to look at the unfamiliar woman in that task (i.e., they did not appear to extend the word for their mother to another woman) reflected confusion brought about by being presented with two unfamiliar people (i.e., the mother was not present). In Experiment 5 and 6, we will address this issue by examining infants' willingness to extend the label for mother in the presence of both the mother and an unfamiliar woman. In addition, Experiment 5 will assess whether six-month-olds understand the count noun for an early-learned body-part category (e.g., "hand") as a category label that extends from their own hand to an *unfamiliar* hand. Experiment 6 will examine whether nine-month-olds understand the count noun for slightly later-learned artifact category (e.g., "ball") as a category label that extends from their own ball to an *unfamiliar* ball (e.g., "ball"). Previous related work (e.g., Jusczyk & Tincoff, 1999; Swingley & Bergelson, 2012) has established that infants comprehend these words but has not documented whether infants at this young age have learned them as differing in their referential scope from proper name for their caregivers (i.e., as words for individual objects and words for categories rather than words for individuals). Experiments 5 and 6 will thus establish whether infants understand words with different scopes as young as six months, in an effort to shed light on whether they can learn words of the two lexical types at the outset of lexical development.

1.2.3 Do young infants have words with distinct meanings for the same individual object?

The *narrow-and-broad* account of language development posits that infants have the capacity to learn both labels for individual objects and labels for object categories from the outset of language development. Experiments 5 and 6 will explore whether infants at this point in lexical learning know both labels for individuals and labels for categories for *different* objects (i.e., mother versus hand or ball). Experiment 7 will go a significant step beyond those

experiments by seeking to establish whether infants are capable of learning both an individual label and a category label for the *same* object. As adults, we have the capacity to label the same object with either a proper name or a count noun, reflecting a capacity to represent an object either as an individual in its own right or as a member of a category. Do infants have this same conceptual flexibility?

Previous work addressing children's ability to acquire multiple words for objects has focused on older toddlers and preschoolers, and so cannot shed light on infants' earliest capabilities. The research on the abilities of these older children, however, suggests that by 24 months of age, children are able to learn two words – one with individual scope and one with categorical scope – for a single object (Taylor & Gelman, 1989). Prior work has found that young children may find it particularly easy to acquire both a proper name and a count noun for a pet (e.g., a dog or a cat; Hall, 1991; 1994). Additionally, some parents have indicated that among the words that toddlers first produce are names for pets and count nouns for pets (Macnamara, 1982). Yet it is not clear from these prior parental reports whether young children understand the name for their pet as a label with individual scope and understand the count noun for their pet as a label with categorical scope.

Experiment 7 will explore whether infants understand both an individual name and a category name for their family pet (i.e., a dog or a cat). Specifically, this experiment will assess whether 12- to 15-month-olds' understand the proper name for their pet (e.g., "Fido") as being restricted to the individual object and a count noun for it (e.g., "dog") as extending across category members. By establishing whether young infants can represent two words with different scope (individual, category) for the same object, the results of this experiment will shed light on

whether infants at this young age understand hierarchically related lexical terms and thus have the cognitive flexibility to acquire two words (with different extensions) for the same object.

2 Chapter 2: The Nature of Infants' Early Understanding of Names for People

2.1 Introduction

Several recent studies have revealed that infants show very early comprehension of several object category labels for foods, body parts, and artifacts (e.g.,"milk", "hand", "car") (Bergelson & Swingley, 2012, 2015, 2017), but only one previous study has documented infants' comprehension of words for individual objects, focusing on names for their caregivers (i.e., "Mommy" and "Daddy"; Tincoff & Jusczyk, 1999). The results of that study established that infants have an understanding of both these words, but the findings fail to rule out the possibility that infants interpret these words as labels for categories. As discussed earlier, Tincoff and Jusczyk found that when infants viewed their own mother and father on screen, there was a significant main effect to look more to the named parent than the unnamed parent. In a second study, they showed that infants looked equally to an unfamiliar woman and an unfamiliar man when they heard the words "Mommy" and "Daddy". These results are consistent with the possibility that infants understand the words "Mommy" and "Daddy" as referring to their individual mother and their individual father, respectively; but they are also consistent with the possibility that they comprehend these words as labels for categories of *familiar* women and *familiar* men, respectively. If infants extend the labels for their caregivers to other *familiar* people of the same gender, this would indicate that infants have learned these labels as category terms (i.e., as count nouns). The nature of infants' earliest representations of names for people is thus not well understood. The first set of experiments in this dissertation will examine six-

month-olds' comprehension of names for caregivers and will attempt to rule out the possibility that these words pick out certain categories.

A review of prior work on infants' early production of words for individual objects (i.e., proper names) suggests that these labels are present in the lexicon before the middle of the second year of life. By 15 months of age, parental reports indicate that English-learning infants already produce on average ten words, and among these words are some that in the adult lexicon are classified as proper names (i.e., terms for one particular object) and others that are classified as count nouns (i.e., terms for an object category) (Nelson, 1973). Words from these two grammatical classes make up a large portion of the early vocabulary, accounting for 24% (proper names) and 41% (count nouns) of an English-learning child's first ten-word lexicon (Nelson, 1973). Analyses of parental reports for children learning Cantonese and Mandarin have revealed similar findings – proper names for caregivers and common nouns are predominant among the first ten words produced (Tardif et al., 2008).

Parents report that the words "Mommy" and "Daddy" are among children's first words produced (Nelson, 1973). Since the time of this initial finding, many researchers have replicated the finding that proper names are among the first words to appear in children's productive vocabularies (Dromi, 1987; Fenson et al., 1994; Nelson, 1973; Tardif et al., 2008). The prominent presence of the words "Mommy" and "Daddy" in infants' early productive vocabularies (i.e., in their first ten words) has been found across multiple languages suggesting a more general pattern whereby infants learn labels for caregivers as some of their first words (Tardif et al., 2008). The research on infants' first ten spoken words conducted by Nelson (1973) and Tardif et al. (2008) focused on infants who were on average between 11 and 15 months, and the findings are consistent with other parental reports of the age at which infants first produce

these words. Specifically, data from parents who completed the MacArthur Communicative Development Inventory (MCDI) indicate that by 12 months of age, 50% of infants produce the names for their caregivers; and by 16 months of age, 76% of infants do so (Fenson et al., 1994).

Prior evidence indicates that infants comprehend certain proper names for a number of months prior to producing them. Data collected from parental administrations of the MCDI indicate that by eight months of age, at least 85% of infants understand the words "Mommy" and "Daddy" (Fenson et al., 1994). Yet parental report information provided by MCDI data is limited in several ways. For instance, parental reports can be unreliable and present an inaccurate depiction of early infant word comprehension since there can be high variability among the criteria parents use to evaluate their infant's comprehension (Stiles, 1994; Tomasello & Mervis, 1994). Moreover, the words "Mommy" and "Daddy" are inherently ambiguous since these terms can function as proper names (e.g., "Mommy is drinking coffee") and count nouns (e.g., "she is a mommy") in the adult lexicon. The formatting of the MCDI further conflates these two meanings since there are no clear instructions about what interpretation is intended. Given this ambiguity in the nature of parental self-reports, we are limited in our conclusions about the infants' earliest understanding of proper names. An additional limitation is that we do not have detailed parental report data for infants younger than eight months of age, and so it is unclear at what age infants first understand these names.

More recent experimental work examining infants' understanding of proper names has helped to address the preceding concerns. Tincoff and Jusczyk (1999) experimentally tested six-month-olds' comprehension of the words "Mommy" and "Daddy". In this experiment, infants viewed side-by-side silent videos of their mother and father during a familiarization phase, a silent baseline phase, and a test phase. For each infant, the videos of each adult were randomly

assigned to a fixed side of the screen. There were four familiarization trials intended to acquaint infants with the location of each person. On the familiarization trials, infants viewed one of their caregivers on half of the trials and the other caregiver the other half of the trials. These trials were followed by a silent baseline phase in which infants viewed both caregivers on the screen simultaneously while infants' eye gaze fixations to each person's video were recorded. Finally, in the test phase, infants viewed both caregivers while hearing the label "Mommy" on four trials and "Daddy" on four trials. During the test phase, Tincoff and Jusczyk found that infants looked proportionally longer to their named parent than to their unnamed parent in comparison to the baseline phase. In a second experiment, Tincoff and Jusczyk (1999) had a new sample of infants view the same video presentations that the first sample of infants had seen. Infants in this second experiment thus saw videos of adults who were unfamiliar to them. These infants did not look proportionally longer to either the woman or man when hearing "Mommy" and "Daddy". Together these experiments suggest that six-month-olds understand that the words "Mommy" and "Daddy" apply to their particular mother and father and that they do not believe that the words extend to an unfamiliar woman or man. These findings are consistent with the possibility that, for six-month-olds, these words function as labels for individuals—not for gender categories encompassing all people.

Although Tincoff and Jusczyk's (1999) findings are consistent with the possibility that six-month-olds comprehend the names for their caregivers (e.g., "Mommy" and "Daddy") as being restricted to particular individuals (i.e., as proper names), the nature of this understanding is unclear. Infants' tendency to match the names for their caregivers to videos of their caregivers and not to those of an unfamiliar woman and man may also arise from infants' understanding of these labels as gender category terms for familiar people. Infants' response to look equally at

videos of unfamiliar men and women upon hearing the names for their caregivers was interpreted as indicating that infants do not understand the labels "Mommy" and "Daddy" as being extendible to an *unfamiliar* woman and man, respectively; however, it is difficult to interpret non-significant behavioural differences. Infants' lack of preference for either person in Tincoff and Jusczyk's (1999) second experiment could have been due to infant confusion brought about by the fact that neither infants' mother nor their father was visible. Moreover, the results of the first and second experiment do not address whether infants would extend the words to other *familiar* people of the same gender (e.g., extend "Mommy" to a familiar grandmother, a familiar aunt or another familiar female). If infants extend labels for caregivers to other *familiar* people of the same gender, this would indicate that infants have learned these labels as category terms.

A couple of previous studies have reported young children's occasional extension of labels for caregivers to other familiar people of the same gender, though these instances appear to be rare (e.g., Macnamara, 1982; Nelson, 1973). In one of these studies, one child out of 18 overextended the label "Mom" to the child's two older sisters (Nelson, 1973). In this case, the child's extension was consistent with the possibility that the word was understood as a kinship term (i.e., a category term). Some of the other cases of overextension appeared to be the result of mistaken identities, such as the case of Macnamara's (1982) son, who only very rarely extended proper names to people of high perceptual similarity to the named person. Although previous studies have thus found that the overextension of names for caregivers is rare in children, such extensions in production may reflect earlier tendencies to overextend the labels to highly perceptually similar individuals when infants first learn these words at around six months of age.

Previous work thus leaves the nature of six-month-olds' understanding of names for their caregivers unclear. The prior findings are consistent with (at least) two possibilities: (1) infants

understand "Mommy" and "Daddy" as labels for their own individual mother and their own individual father (i.e., as individual terms), or (2) infants understand these words as labeling *any* familiar woman and *any* familiar man (i.e., as category terms). This second possibility is consistent with the previously described cases of overextension, in which labels for caregivers were incorrectly applied to other familiar people of the same gender (e.g., Macnamara, 1982; Nelson, 1973). Experiments 1 to 4 of this dissertation will examine whether six-month-old infants restrict the labels for caregivers to individual people or extend the labels for caregivers to other familiar people of the same gender category (i.e., extend "Mommy" to their grandmother, maternal aunt, or female family friend). If infants understand the labels for caregivers as having scope over individuals, then they should not extend these terms to any other familiar people of the same gender category. If instead infants interpret the labels for caregivers as having scope over categories of familiar people of the same gender, then infants should generalize the labels for their caregivers to any familiar people of the same gender as the labelled caregiver. By concentrating on six-month-olds, these experiments will be able to explore the nature of infants' comprehension of their earliest-learned proper names. If infants restrict the labels for caregivers to individuals, this finding would be consistent with the claim that infants understand labels for caregivers as individual terms from the outset of development. As an additional contribution, these experiments will provide new evidence about infants' earliest interpretation of names for familiar people other than their primary caregivers (e.g., "Grandma", "Aunty").

In sum, Experiments 1 to 4 will advance our understanding of early lexical development by clarifying the nature of infants' earliest comprehension of the name for one of their caregivers (their mother)– specifically, by helping to determine whether this word has scope over an individual or over a gender category of familiar women (Tincoff & Jusczyk, 1999). Experiment 1

is an attempt to replicate Tincoff and Jusczyk's (1999) experiment, examining infants' comprehension of names for their mother and their father. Experiments 2 and 3 then move beyond the findings of Experiment 1, examining infants' understanding of names for their mother and maternal grandmother (Experiment 2) and their understanding of names for their mother and maternal aunt or female family friend (Experiment 3). Experiment 4 reports analyses examining whether infants' comprehension of their mother's name is related to her perceptual distinctiveness from the second familiar female.

2.2 Experiment 1

This initial experiment was an attempt to replicate a previous experiment conducted by Tincoff and Jusczyk (1999). In addition to seeking to replicate the original finding with a new sample of six-month-olds in a different lab environment, we sought to set the stage for Experiments 2 and 3 in which we more precisely probed six-month-olds' comprehension of the name for their mother (e.g., "Mommy"). This experiment thus tested the hypothesis that infants show comprehension of the names for their mother and their father (e.g., "Mommy" and "Daddy") by restricting each name to the appropriate individual parent when shown video clips of the two individuals side by side. As in Tincoff's and Jusczyk's study, the experiment here also tested the hypothesis that infants do *not* restrict these names to either an unfamiliar woman or an unfamiliar man when shown side-by-side video clips of those people.

2.2.1 Methods

2.2.1.1 Participants

Participants were 40 English-learning infants between 6 months 0 days old and 6 months 30 days old. Twenty infants participated in the Experimental group (*M* = 6 months 12 days, *SD* = 10 days). A power analysis revealed that the sample size needed to detect the effect reported by

Tincoff and Jusczyk (1999; Experiment 1) for infants' preference to look at the named parent over the unnamed parent in response to hearing the name (*d* = .94) at alpha = .05 and a power of 80% was 19 participants. Due to counterbalancing constraints we, therefore, recruited a sample of 20 infants. A further nine children participated in the Experimental group but were excluded from the analyses due to fussiness (n = 5) and equipment error (n = 4). We additionally excluded the data from a child who showed an extreme preference to look at one parent's video during the baseline trials described below (i.e., proportional looking above .80). We followed this exclusion criterion because our dependent variable measured the change in proportional looking time from baseline trials to test trials (also described below), making extreme scores problematic.[1] Following this criterion, we excluded the data from one child who showed extreme looking towards the mother on the baseline trials. An additional 20 infants participated in our Control group (*M* = 6 months 12 days, *SD* = 7 days). A further seven children participated in the Control group but were excluded from the analyses due to fussiness (n = 3) and equipment error (n = 4). Following the same criterion as in the Experimental group, we also excluded the data from two children who showed extreme looking towards the female during the baseline trials. Children in both groups were primarily from middle- and upper-middle-class socioeconomic backgrounds. All children received a certificate and a small book for participating in the study.

[1] For instance, consider an infant whose mean baseline proportional looking time to their mother was .80 and to their father was .20. To demonstrate knowledge of the name for their mother using our measures, an infant would need to increase their mean proportional looking to their mother above .80 during the test trials (i.e., when the mother was labeled). Conversely, to demonstrate knowledge of the label for their father they would need to increase their mean proportional looking to their father only above .20 during the test trials (i.e., when the father was labeled). In other words, to show evidence of comprehension of the word for mother, the infant would need to look almost exclusively to the mother when she was labelled, but to show comprehension of the word for father, the infant would need to look much less to the father. As a result, it would be difficult for the infant to demonstrate knowledge of the name for their mother, but relatively easy to show knowledge of the name for their father.

2.2.1.2 Stimuli

For the Experimental group, a researcher recorded separate video clips of the infant's own mother and the infant's own father, to be used as stimuli in the experiment. Each recording showed only the person's face and shoulders. To control for the perceptual effects of clothing differences, we asked all adults to wear a white smock during filming. Each video clip was ten seconds long and was recorded in silence. Adults were instructed and look directly into the camera for the entire recording while maintaining a neutral facial expression. Women with long hair were also asked to push their hair behind their shoulders. Infants in the Control group viewed the pairs of video clips used in the Experimental group.

We made a modification to the design of Tincoff and Jusczyk's (1999) experiment in terms of the production of the familiar names for the caregivers. In the experiment by Tincoff and Jusczyk (1999), a speech synthesizer presented the labels to the infants, and the words were always "Mommy" and "Daddy". In the current experiment, the labels were spoken live by a trained experimenter (e.g., Bergelson & Swingley, 2012; 2014), and infants heard the labels most often used for their own particular caregivers. For example, if parents reported that their infant heard the labels "Mama" and "Papa", rather than "Mommy" and "Daddy", we used those labels throughout the experiment. We believe that this was an important modification since our pilot data indicated that across infants there was a variety of names used for caregivers. Since we wanted to assess the comprehension of names that infants actually heard, we felt it was vital to use the labels that they were familiar with. Since there was variability across infants in the names that we assessed, a female native English speaker located in an adjacent room spoke the names (and other auditory stimuli) live during the experiment. The experimenter spoke into a

microphone that was connected to the speakers in front of the infant's television, as described in the next section. The researcher who spoke the labels could see the experimental presentation on a screen that mirrored the television viewed by the infant but could not see the infant. The experimenter used a stopwatch to time three repetitions of the auditory stimuli appropriately on each 10-second-long trial (baseline and test). The experimenter timed the first utterance to begin at the start of the trial with the second and third repetitions beginning at four and seven seconds into the trial. Across the 20 participants in the Experimental group, the names used for mothers were "Mommy" (n = 10), "Mama" (n = 6), and "Mom" (n = 4), and the names for fathers were "Daddy" (n = 13), "Dada" (n = 4), "Dad" (n = 2), and "Pop" (n = 1). For the 20 participants in the Control group, the names for mothers were "Mommy" (n = 7), "Mama" (n = 10), and "Mom" (n = 3) and the names for fathers were "Daddy" (n = 9), "Dada" (n = 6), and "Papa" (n = 5).

2.2.1.3 Procedure and Analyses

A trained research assistant first verbally administered a questionnaire to the parents. By administering the questionnaire verbally, we were able to ensure that it was completed as accurately as possible. We asked parents to report what percentage of their infant's language exposure was to English and, if applicable, what other languages the child was heard. To be included in the sample, we required that at least 80% of the infant's language exposure be to English. We also asked how many waking hours, in an average week, the infant's mother and father spent with the infant. To see the complete questionnaire, see Appendix A.

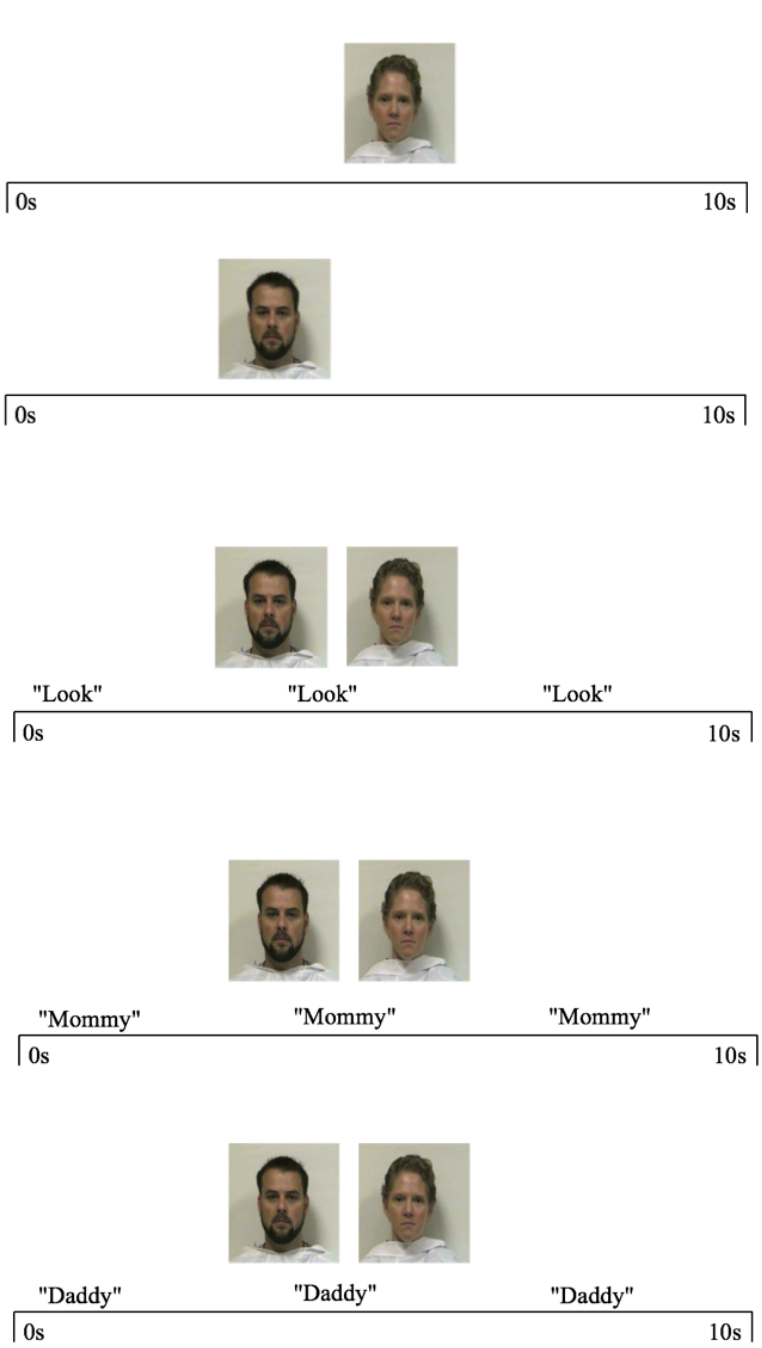
To assess infants' understanding of the names for their caregivers, we modeled the experiment directly on Tincoff and Jusczyk's (1999) experiment that used the intermodal preferential-looking paradigm (Golinkoff et al., 1987). Six-month-old infants were assigned to one of two groups, Experimental or Control. During the experiment, infants in the Experimental

group viewed brief video clips of their own caregivers (mother and father) on a television screen. Infants in the Control group viewed the same video clips that were shown to infants in the Experimental group, meaning that for these participants, the adults in the clips were unfamiliar.

During the experiment, infants sat on their mother's lap while viewing a television screen on which they could see the side-by-side videos of the two caregivers. Infants' eye gaze was measured throughout the experiment via a camera below the television screen. Each trial was separated by a video of a colourful spinning wheel which served to maintain infant attention throughout the study. Once an infant fixated on the colourful wheel, an experimenter pressed a designated button which began the next trial. Each child's experimental session began with a familiarization phase to acquaint the infants with the location of each of the adults. The side on which each video was presented was fixed within a child but counterbalanced across infants. The familiarization phase consisted of four 10-second-long silent trials, each of which showed only one of the adults on the screen. Two of the familiarization trials showed one person (e.g., the child's mother) and two showed the other person (e.g., the child's father). After familiarization, infants completed four 10-second-long baseline trials in which both of the adults' faces were shown simultaneously on the screen while the word "Look" was heard via speakers located beneath the television, repeated three times per trial. The baseline trials served to allow us to measure for any preferences infants had for looking at either of the people. Finally, the child completed eight 10-second-long test trials, on which they saw both caregivers simultaneously on screen (i.e., the mother and the father, side by side), while they heard the child's own name for *one* of the adults (e.g., "Mommy") on four trials and the child's own name for the *other* adult (e.g. "Daddy") on four trials. On each of the test trials, the label was repeated three times. The order of the presentation of the labels across the eight test trials was randomized. In both the

Experimental group and Control group, infants heard the labels for their own mother and father; however, infants in the Experimental group viewed the videos of their own parents, but infants in the Control group viewed an unfamiliar man and woman. See Figure 1.1 for an example of trial structure.

Figure 1.1 Example of Trial Structure for Experiment 1



We assessed infant label comprehension using a method of eye gaze calculation different from the method used by Tincoff and Jusczyk (1999). Tincoff and Jusczyk calculated infants' proportional looking times to the named and unnamed parents' videos on both the baseline trials

and the test trials (creating four scores). Recall that for the Experimental group, these parents were the child's own mother and father, but for the Control group, these parents were unfamiliar to the infant. Tincoff and Jusczyk then divided the proportional looking times during the test trials by the proportional looking times during the baseline trials to create looking-to-target scores which were used in their analysis. We believe that this scoring method is problematic because it can result in inflated scores for those infants who have low proportional looking times during the baseline trials (i.e., a small denominator). For this reason, we decided to assess label comprehension by calculating a different eye-gaze measure which has been used in recent studies with infants (cf. Bergelson & Aslin, 2017a; Ferguson, Graf & Waxman, 2017; Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987). This method involves *subtracting* the proportional looking time during the baseline trials from the proportional looking times during the test trials. Additionally, we analyzed our data differently from Tincoff and Jusczyk. Tincoff and Jusczyk examined infants' comprehension of the words "Mommy" and "Daddy" when shown their own caregivers (Experiment 1) and when shown an unfamiliar woman and unfamiliar man (Experiment 2). Tincoff and Jusczyk thus did not include in their planned analysis a comparison of infants' interpretation of the labels "Mommy" and "Daddy" when they viewed their own caregivers and when they viewed unfamiliar people. In contrast, our experimental design included one group of infants who viewed their own caregivers (i.e., the Experimental group) and one group of infants who viewed an unfamiliar woman and man (i.e., the Control group) as conditions within a single experiment. Our planned analysis thus allowed us to examine whether infants' looking behaviour in response to hearing the name for their mother and name for their father differed when they viewed their own caregivers and when they viewed an unfamiliar woman and an unfamiliar man.

To analyze our results, we calculated two baseline-corrected target looking scores: one for the name for the mother (e.g., "Mommy") and one for the name for the father (e.g., "Daddy"). The first step in calculating an infant's baseline-corrected target looking score for the name for the mother was to calculate the mean proportion of time the infant spent looking to the mother both during the baseline trials and during the test trials. These proportions were calculated by dividing the total looking time to the mother by the total looking time to both people combined (Bergelson & Aslin, 2017a; Ferguson, Graf & Waxman, 2017; Smith & Yu, 2013). The second step in calculating an infant's baseline-corrected target looking score for the name for the mother accounted for infants' baseline preferences to look at the mother. Here we subtracted the mean proportional looking score to the mother during the four baseline trials from the mean proportional looking score to the mother during the four test trials that involved the presentation of the child's name for the mother. The difference in proportional looking between the baseline trials and test trials created a baseline-corrected target looking score for the name for the mother. We interpreted a resulting positive baseline-corrected target looking score for the name for the mother (i.e., a greater proportion of looking to the mother on test trials than on baseline trials) to indicate comprehension of the name for their mother as an individual label (e.g., Bion, Borovsky, Fernald, 2013; Ferguson & Waxman, 2016; McMillan & Saffran, 2016).

We used a similar method to calculate an infant's baseline-corrected target looking score for the name for the father (e.g., "Daddy"). First, we calculated a proportional looking time score for both the baseline trials and the test trials by dividing the total looking time to the father by the total looking time to both people combined. Second, we subtracted the mean proportional looking score to the father during the four baseline trials from the mean proportional looking score to the father during the four test trials that involved the presentation of the child's name for

the father. We considered a positive baseline-corrected target looking score for the name for the father (i.e., a greater proportion of looking to the father on the test trials than on the baseline trials) to indicate comprehension of the word for their father as an individual label. See Figure 2 for the formulae for calculating baseline-corrected target looking scores for both the name for the mother (e.g., "Mommy") and the name for the father (e.g., "Daddy").

Figure 1.2 Baseline-Corrected Target Looking Score Formulae for Experiment 1

Baseline-Corrected Target Looking Score for "Mommy"

$$\left(\frac{\text{Looking time to video of mother in test trials}}{\text{Total looking time to both videos in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to video of mother in baseline trials}}{\text{Total looking time to both videos in baseline trials}}\right)$$

Baseline-Corrected Target Looking Score for "Daddy"

$$\left(\frac{\text{Looking time to video of father in test trials}}{\text{Total looking time to both videos in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to video of father in baseline trials}}{\text{Total looking time to both videos in baseline trials}}\right)$$

2.2.2 Results

We first conducted a repeated-measures analysis of variance (ANOVA) of the baseline-corrected target looking scores, with the video type (mother and father) as a within-subjects factor and group (Experimental and Control) as a between-subjects factor. We did not find a significant main effect of video type, $F(1, 38) = 1.01$, $p = .321$, $\eta_p^2 = .03$, but did find a significant main effect of group, $F(1, 38) = 22.37$, $p < .001$, $\eta_p^2 = .37$, with higher scores in the

Experimental than in the Control group. There was no significant interaction between video type and group, $F(1, 38) = .43$, $p = .520$, $\eta_p^2 = .01$.[2]

We followed up the results of the ANOVA by examining whether infants in the Experimental group and Control groups had baseline-corrected target looking scores that differed from chance (i.e., a baseline-corrected target looking score of 0). The Experimental group (M =.08, SD = .06) showed greater-than-chance baseline-corrected target looking scores, $t(19) = 5.46$, $p < .001$, 95% CI [.08, .11]; but those in the Control group (M = -.01, SD = .05) did not, $t(19) = .57$, $p = .574$, 95% CI [-.03, .02]. These findings in the Experimental group indicate that infants showed systematic comprehension of the labels in the presence of their own mother and their own father, while the results in the Control group reveal that infants did not appear to interpret the names for their mother and father as referring to any unfamiliar woman or man. The findings do not, however, indicate whether infants in the Experimental group understood either label individually.

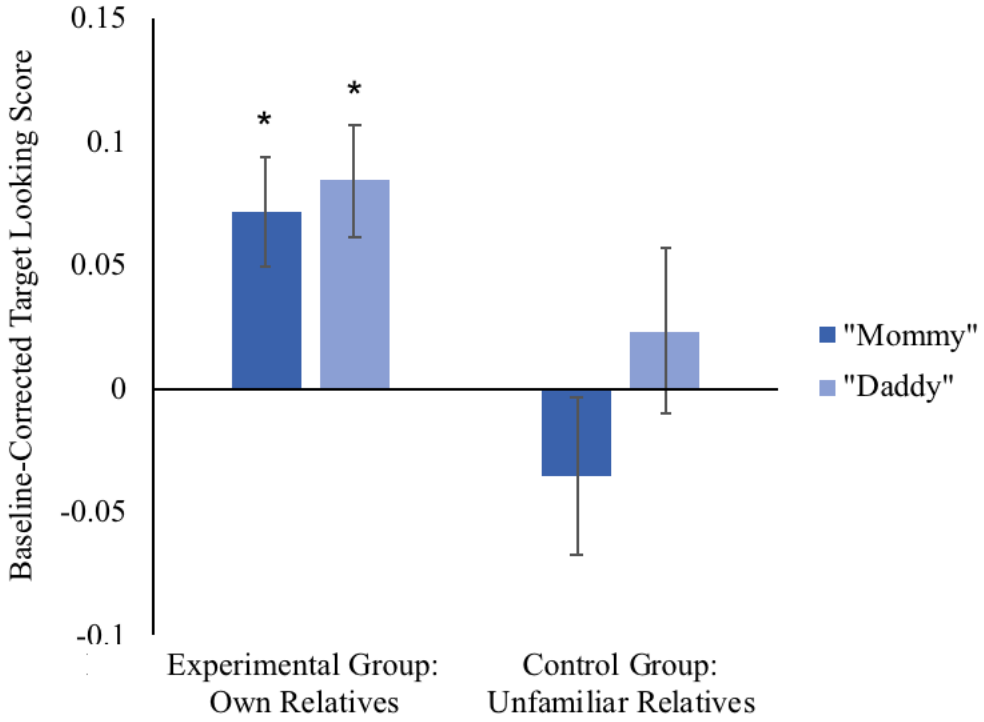
Because we were specifically interested in whether infants understood both the name for their mother and the label for their father, we further broke down the data from the Experimental group to consider comprehension of each label separately. For the name for their mother, infants' baseline-corrected target looking score was significantly greater than chance (M =.07, SD = .10), $t(19) = 3.21$, $p = .005$, 95% CI [.02, .12]. Similarly, for the name for their father, infants' baseline-corrected target looking score was significantly greater than chance (M =.08, SD = .10), $t(19) = 3.68$, $p = .002$, 95% CI [.04, .13]. These findings indicate systematic comprehension of both words. To check whether infants in the Control group showed any understanding of the labels when the people in the videos were strangers, we examined baseline-corrected target

[2] We observed a comparable set of results when using the scoring and analysis method used by Tincoff and Jusczyk (1999).

looking scores for each label in that condition. For the name for their mother, infants' baseline-corrected target looking score was not significantly above chance (M = -.04, SD = .14), $t(19)$ = -1.10, p = .284, 95% CI [-.10, .03]. Similarly, for the label for their father, infants' baseline-corrected target looking score was not significantly above chance (M = .02, SD = .14), $t(19)$ = .71 , p = .490, 95% CI [-.05, .09]. These findings indicate that infants did not interpret the name for their mother or father as referring to an unfamiliar woman or man, respectively. See Figure 1.3.

Figure 1.3 Infants' Baseline-Corrected Target Looking Scores in Experiment 1

Infants' baseline-corrected target looking scores in response to hearing the proper names for their mother and father while viewing videos of their mother and father (Experimental group) or videos of an unfamiliar woman and an unfamiliar man (Control group). Asterisks indicate a significant difference from chance, p < .05.



Our second analysis examined whether parental report of the time each infant spent with each caregiver per week correlated infants' baseline-corrected target looking score for the label for that caregiver. Parental report of the mean number of hours a week that a child saw their mother was not significantly correlated with the baseline-corrected target looking score for the name for their mother, $r = .32$, $p = .178$. Similarly, parental report of the mean number of hours a week that a child saw their father was not significantly correlated with the baseline-corrected target looking score for the name for their father, $r = -.13$, $p = .606$. See Table 1.1 for further details of the weekly hours of reported exposure to the mother and father.

Table 1.1 Descriptive Statistics for Infants' Weekly Hours of Adult-Reported Exposure to Relatives or Friend

Descriptive statistics for infants' weekly hours of adult-reported exposure to the mother, father, grandmother, aunt or friend for infants who participated in the experimental conditions of Experiments 1 to 3.

Experiment 1	Mother	Father
Mean	68.39	28.61
Standard Deviation	7.38	12.11
Minimum	49	12
Maximum	84	65

Experiment 2	Mother	Grandmother
Mean	70.45	10.07
Standard Deviation	15.57	7.12
Minimum	25	2.5
Maximum	98	28

Experiment 3	Mother	Aunt or Friend
Mean	63.95	7.38
Standard Deviation	9.33	9.74
Minimum	42	1
Maximum	84	35

2.2.3 Discussion

In a seminal study, Tincoff and Jusczyk (1999) presented evidence that six-month-olds understand the labels for their caregivers (e.g., "Mommy", "Daddy") as terms for those individuals. Moreover, they showed that infants did not interpret these labels as referring to any unfamiliar woman or any unfamiliar man. In Experiment 1, we were able to replicate these findings for six-month-old infants. Additionally, the results appear to be robust since our experiment differed methodologically in two primary ways from that of Tincoff and Jusczyk. First, Tincoff and Jusczyk (1999) assessed infants' understanding of the specific labels "Mommy" and "Daddy", even though there were infants in their sample who did not hear these particular labels for their caregivers. In the current study, we assessed infants' comprehension of the actual names caregivers reported that their infants heard (e.g., "Mommy", "Mama", or "Mom"). The second difference between our experiment and Tincoff and Jusczyk's (1999) study was in how the data were coded and analyzed. Despite making these changes, we replicated the findings from Tincoff and Jusczyk (1999), uncovering clear additional support for the hypotheses that six-month-olds understand the labels for their mother and father as names that apply to their own caregivers and do not extend these labels to either an unfamiliar woman or an unfamiliar man.

2.3 Experiment 2

The results of Experiment 1 are consistent with the possibility that infants comprehend the names for their caregivers as extending only to those particular individuals. Yet the results leave open the possibility that infants understand these names for their caregivers as category terms that extend to any familiar woman or any familiar man. In other words, the findings are consistent with the possibility that infants understand the words for their caregivers as category

terms for familiar people of a particular gender. For instance, infants may interpret "Mommy" as naming any familiar woman. Experiment 2 attempted to rule out this possibility by examining whether six-month-olds extend the name for their mother to their familiar maternal grandmother. This experiment was similar in design to Experiment 1, except that instead of viewing video clips of their mother and father, infants in the Experimental group viewed video clips of their mother and their familiar maternal grandmother. If infants show evidence (in their looking behaviour) of comprehension of the name for their mother in this context, then this result would support the claim that infants do not understand this name as a category label for any familiar woman. Additionally, Experiment 2 allowed an assessment of whether infants show comprehension of the label for their maternal grandmother, shedding light on whether six-month-olds understand names for any individuals other than those for their mother and father.

2.3.1 Methods

2.3.1.1 Participants

To participate in this experiment, each infant had to be familiar with his/her maternal grandmother, such that to participate the mother and grandmother had to report that the infant saw the grandmother for at least one hour a week and had done so since birth. We used this minimum inclusion criterion to ensure that each infant had at least some familiarity with the grandmother. We recruited maternal rather than paternal grandmothers to pair with the mothers, in an effort to have a greater degree of perceptual similarity between the two women, thus presenting infants with a more challenging discrimination task.

As in Experiment 1, twenty infants participated in the Experimental group (*M* = 6 months 15 days, *SD* = 9 days). An additional seven children participated in this group but were excluded from the analysis due to fussiness (n = 3), equipment error (n = 2), distraction by a toy (n = 1),

and parental interference (n = 1). We excluded six further children from the analysis for showing a strong preference to look at their mother's video during the baseline trials, following the same exclusion criterion as in Experiment 1 (i.e., proportional looking to either person in baseline trials above .80). Twenty other infants participated in our Control group (*M* = 6 months 18 days, *SD* = 8 days). An additional six children participated in this group but were excluded from the analysis due to fussiness (n = 4) and parental interference (n = 2). We excluded one child's data from this group for showing a strong preference to look at the mother's video during the baseline trials (i.e., proportional looking above .80).

2.3.1.2 Stimuli

The stimuli for Experiment 2 were prepared in the same manner as those in Experiment 1, but instead of presenting infants in the Experimental group with videos of, and labels for, their mother and father, we presented infants with videos of, and labels for, their mother and maternal grandmother. Infants in the Control group viewed the pairs of video clips used in the Experimental group. Across the 20 participants in the Experimental group, the names used for mothers were "Mommy" (n = 5), "Mama" (n = 12), and "Mom" (n = 3), and the names for grandmother were "Grandma" (n = 8), "Grammy" (n = 1), "Gram" (n = 1), "Nanny" (n = 1), "Nana" (n = 3), "Oma" (n = 3), "Baba" (n = 1), "Mimi" (n = 1), and "Lola" (n = 1). For the 20 participants in the Control group, the names for mothers were "Mommy" (n = 6), "Mama" (n = 8), and "Mom" (n = 6), and the names for grandmother were "Grandma" (n = 11), "Granny" (n = 1), "Nana" (n = 2), "Oma" (n = 1), "Baba" (n = 2), "Bibi" (n = 1), "Babi" (n = 1), and "Bama" (n = 1).

2.3.1.3 Procedure and Analyses

A trained research assistant first verbally administered a questionnaire to the mother and the grandmother. It was similar to the questionnaire from Experiment 1 but included additional questions pertaining to the grandmother. The complete questionnaire is provided in Appendix B.

Prior to beginning the experiment, an experimenter took videos of the infants' mother and grandmother. These videos were taken in the same manner as in Experiment 1. The videos of the mothers and grandmothers used in the experimental video presentations shown to infants. The same experimental procedure was used in Experiment 2 as in Experiment 1 with one change: instead of viewing videos of a mother and father, infants viewed videos of a mother and grandmother.

We calculated infants' baseline-corrected target looking score for the name for the mother analogously to the way we calculated it in Experiment 1. To calculate the baseline-corrected target looking score for the name for the grandmother, we first calculated a proportional looking time score for both the baseline trials and test trials by dividing the total looking time to the grandmother by the total looking time to both people combined. Second, we subtracted the mean proportional looking score to the grandmother during the four baseline trials from the mean proportional looking score to the grandmother during the four test trials that involved the presentation of the child's name for the grandmother. We interpreted a resulting positive baseline-corrected target looking score for the name for the grandmother (i.e., a greater proportion of looking to the grandmother on the test trials than on the baseline trials) to indicate an infant's comprehension of the word for their grandmother as an individual label. See Figure 1.4 for the formulae for calculating baseline-corrected target looking scores for the name for the mother (e.g., "Mommy") and the name for the grandmother (e.g., "Grandma") in Experiment 2.

Figure 1.4 Baseline-Corrected Target Looking Score Formulae for Experiment 2

Baseline-Corrected Target Looking Score for "Mommy"

$$\left(\frac{\text{Looking time to video of mother in test trials}}{\text{Total looking time to both videos in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to video of mother in baseline trials}}{\text{Total looking time to both videos in baseline trials}}\right)$$

Baseline-Corrected Target Looking Score for "Grandma"

$$\left(\frac{\text{Looking time to video of grandmother in test trials}}{\text{Total looking time to both videos in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to video of grandmother in baseline trials}}{\text{Total looking time to both videos in baseline trials}}\right)$$

2.3.2 Results

We conducted a repeated-measures analysis of variance (ANOVA) of the baseline-corrected target looking scores, with video type (mother and grandmother) as a within-subjects factor and group (Experimental and Control) as a between-subjects factor. We found a significant main effect of group, $F(1, 38) = 4.92$, $p = .033$, $\eta_p^2 = .15$, but no significant main effect of video type, $F(1, 38) = 1.70$, $p = .200$, $\eta_p^2 = .043$. Moreover, there was no significant interaction between group and video type $F(1, 38) = 0.38$, $p = .539$, $\eta_p^2 = .01$. The significant main effect indicated that the Experimental group had higher baseline-corrected target looking scores than the Control group.

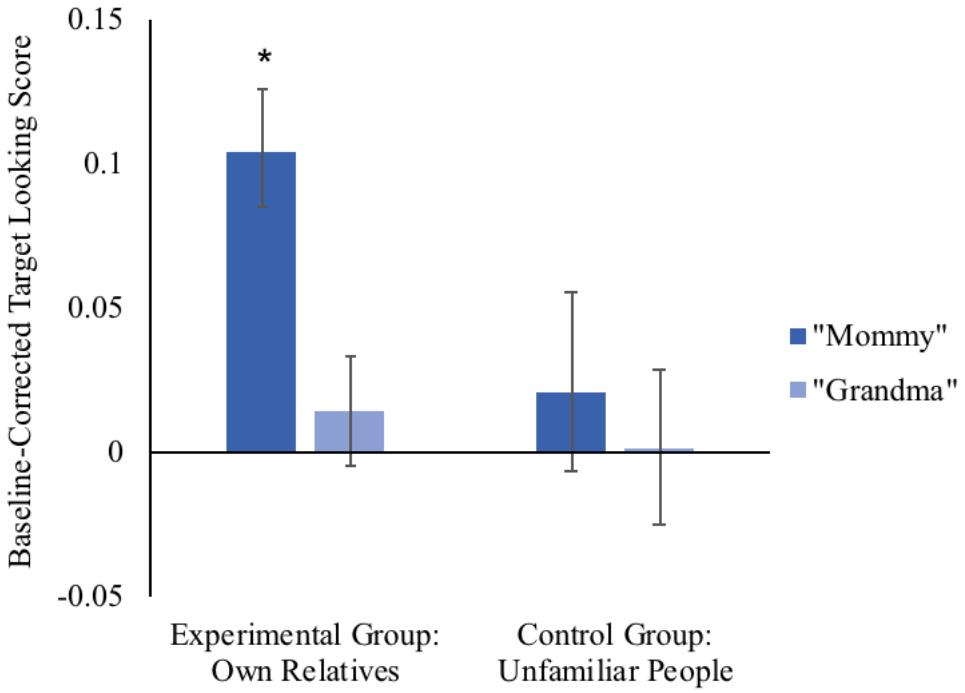
We followed up the significant main effect of group by examining whether infants in the Experimental group and those in the Control group showed systematic comprehension of the labels. We did so by comparing the baseline-corrected target looking scores in each group to chance (i.e., a score of 0, which would be expected if hearing the label had no effect on the tendency to look at the appropriate individual). Infants in the Experimental group (M =.06, SD =

.05) had significantly positive baseline-corrected target looking scores, $t(19) = 5.23$, $p < .001$, 95% CI [.04, .08]), but those in the Control group did not (M =.01, SD = .08), $t(19) = 0.85$, p = .405, 95% CI [-.02, .05]). These findings indicate that infants in the Experimental group showed systematic comprehension of the labels for both mother and grandmother when considered together, while those in the Control group did not interpret these labels as referring to the unfamiliar younger woman or unfamiliar older woman, respectively. The findings do not, however, indicate whether infants understood either label individually.

We further analyzed the baseline-corrected target looking scores in the Experimental group to assess whether infants understood both the name for their mother and the label for their grandmother. For the name for their mother, infants showed a significant positive mean baseline-corrected target looking score (M =.10, SD = .10), $t(19) = 4.78$, p <.001, 95% CI [.06, .15]). Yet for the label for their grandmother, infants' baseline-corrected target looking score (M =.01, SD = .09) did not differ from zero, $t(19)$ =.75 , p = .464, 95% CI [-.03, .06]). These findings indicate that infants understood the name for their mother, but they reveal no significant comprehension of the label for their grandmother. As a check on whether infants in the Control group systematically extended the label in the presence of an unfamiliar mother and an unfamiliar grandmother, we also examined baseline-corrected target looking scores for each label in that group. For the name for their mother, infants' baseline-corrected target looking score did not differ from zero (M =.03, SD = .23), $t(19) = .60$, p =.556, 95% CI [-.08, .14]). Similarly, for the label for the grandmother, infants' baseline-corrected target looking score did not differ from zero (M =-.002, SD = .19), $t(19)$ =-.04, p = .969, 95% CI [-.09, .09]). Thus, infants do not appear to interpret the name for their mother or name for their grandmother as referring to any unfamiliar younger woman (mother) or unfamiliar older woman (grandmother). See Figure 1.5.

Figure 1.5 Infants' Baseline-Corrected Target Looking Scores in Experiment 2

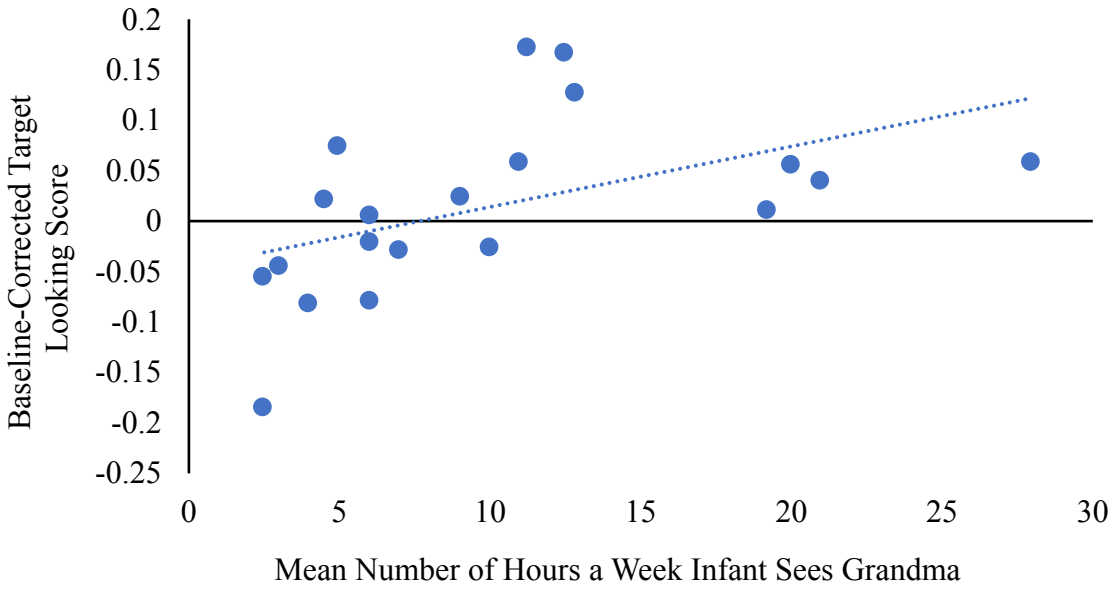
Infants' baseline-corrected target looking scores in response to hearing the proper names for their mother and grandmother while viewing videos of their mother and grandmother (Experimental group) or videos of unfamiliar women (Control group). Asterisks indicate a significant difference from chance, $p < .05$.



In our second analyses, we explored whether adults' report of the mean number of hours a week that infants saw their mother or grandmother was related to infants' baseline-corrected target looking score for the label for mother or grandmother in the Experimental group. The mother's report of the mean number of hours a week that the infant saw her (the mother) was not significantly correlated with the baseline-corrected target looking score for the name for the mother, $r = -.04$, $p = .869$. However, the adult-reported of the mean number of hours a week that a child saw the grandmother was significantly correlated with the baseline-corrected target looking score for the name for the grandmother, $r = .49$, $p = .028$. See Figure 1.6. The specific

range of weekly hours of reported exposure to the grandmother (i.e., 2.5 hours to 28 hours) may have contributed to the observed effect; this range was skewed towards a higher mean number of hours per week for the mother (i.e., 25 hours to 98 hours). See Table 1.1 for further details of the weekly hours of reported exposure to the mother and grandmother.

Figure 1.6 Correlation Between Infants' Baseline-Corrected Target Looking Scores and Grandmother-Reported Mean Number Hours of Weekly Exposure to Grandmother in Experiment 2



2.3.3 Discussion

The results from Experiment 2 provide evidence that infants restrict the name for their mother to her when she is paired with another familiar woman – their maternal grandmother. These results clarify the nature of six-month-olds' comprehension of the name for their mother, ruling out the possibility that they understand the name as a category word for *any* familiar woman. The findings lend further support to the claim that infants interpret the name for their mother as a label for an individual person rather than a category. Additionally, we found

evidence that infants as a group did not show comprehension of the name for their maternal grandmother. We found, however, that comprehension of the name for their maternal grandmother was related to the grandmother-reported mean weekly number of hours of exposure to her. Additionally, we found evidence that infants do not appear to interpret the name for their mother and name for their grandmother as referring to any unfamiliar younger (mother) or unfamiliar older (grandmother) woman.

Although the results indicate that infants do not interpret their mother's name as a category term extendible to any familiar woman, they do not definitively demonstrate that infants understand this label as a proper name for their individual mother. Although the mothers and grandmothers who participated in Experiment 2 were of the same gender and closely genetically related, their age difference made them perceptually dissimilar. The results of Experiment 2 thus leave open the possibility that infants comprehend the name for their mother as a category term for perceptually (more) similar familiar women. We addressed this possibility in Experiment 3.

2.4 Experiment 3

Experiment 3 was designed to extend the findings of Experiment 1 and Experiment 2. The results of the earlier experiments provided evidence that infants understand the name for their mother as a proper name for her as an individual, by ruling out the possibility that the name picks out a category comprising any familiar person (Experiment 1) or any familiar woman (Experiment 2). However, in both Experiment 1 and 2, the mother was presented next to an individual (a father, a grandmother) who was perceptually quite dissimilar to the mother. It is thus possible that infants comprehend the name for their mother as extending to any familiar woman who is perceptually (more) similar to her. Although infants' maternal grandmothers may be more similar to infants' mothers than are their fathers (see Experiment 4), their grandmothers

are still very visually distinctive from their mothers by virtue of the age difference between the two women. In Experiment 3, we aimed to reduce the perceptual dissimilarity between the mother and the second familiar woman presented, examining whether infants will extend the name for their mother to the mother's (roughly same-aged) sister or (roughly same-aged and same-ethnicity) female friend. The mother's sister and same-ethnicity female friend may be more perceptually similar to the child's mother than either the father or the grandmother, given their comparability in both age and gender (and ethnicity) (see Experiment 4). This experiment will, therefore, help to establish with further precision the nature of six-month-olds' comprehension of the name for their mother.

2.4.1 Methods

2.4.1.1 Participants

To participate in this experiment, each infant had to be familiar with her/his maternal aunt or with his/her mother's (same-ethnicity) female friend, such that the aunt or friend reported that the infant saw her for at least one hour per week from birth. We used this minimum criterion to ensure that the women paired with the mother were familiar to the infant.

As in Experiments 1 and 2, we assigned 20 six-month-old infants to the Experimental group in which we showed a video of their mother paired with a video of either their maternal aunt (n = 10; *M* = 6 months 15 days, *SD* = 7 days) or their mother's same-ethnicity female friend (n = 10; *M* = 6 months 16 days, *SD* = 9 days). No additional infants participated in the aunt sub-group; an additional two infants participated in the friend sub-group but were excluded from the analysis because of equipment error (n = 2). Two further infants in the friend sub-group were excluded from the analysis for failing to satisfy the baseline trials inclusion criterion used in Experiments 1 and 2: They showed a strong preference for their mother's video during the

baseline trials (i.e., proportional looking above .80). Twenty other infants participated in our Control group, with ten infants in the aunt sub-group (*M* = 6 months 17 days, *SD* = 8 days) and ten in the friend subgroup (*M* = 6 months 18 days, *SD* = 9 days). An additional two infants participated in the aunt sub-group but were excluded from the analyses because of fussiness (n = 1) and experimental equipment error (n = 1); one additional infant participated in the friend sub-group and was excluded because of distraction by a toy. One further infant in the aunt sub-group failed to meet our baseline trials inclusion criterion, showing a strong preference to look at the aunt's video during the baseline trials (i.e., proportional looking above .80).

2.4.1.2 Stimuli

The stimuli for Experiment 3 were created in the same way as those in Experiment 1, but instead of presenting infants in the Experimental group with videos of, and labels for, their mother and father, we presented infants with videos of, and labels for, their mother and either (1) a maternal aunt (aunt sub-group) or (2) a same-ethnicity, similar-age female friend (friend sub-group). Across the 20 participants in the Experimental group, the names used for mothers were "Mommy" (n = 5), "Mama" (n = 12), and "Mom" (n = 3). The names for aunts were "Aunty" (n = 5), "Aunty Ashley" (n = 1), "Aunty Bebe" (n = 1), "Aunty Leah" (n = 1), "Diay" (n = 1) and "Tita" (n = 1), and the names for friends were "Aunty" (n = 2), "Aunty Katie" (n = 1), "Aunty Amy" (n = 1), "Jen" (n = 1), "Angela" (n = 1), "Nicole" (n = 1), "Liz" (n = 1), "Asley" (n = 1), and "Christie" (n = 1). For the 20 participants in the Control group, the names used for mothers were "Mommy" (n = 6), "Mama" (n = 11), and "Mom" (n = 3). The names for aunts were "Aunty" (n = 2), "Aunty Jacquiline" (n = 1), "Aunty Lala" (n = 1), "Aunty Andrea" (n = 1), "Aunty Sidney" (n = 1), "Aunty Dedie" (n = 1), "Aunty Lindsay" (n = 1), "Yee Yee" (n = 1), and "Yee" (n = 1), and the names for friends were "Aunty Mel" (n = 1), "Jenn" (n = 1), "Hannah" (n

= 1), "Thalia" (n = 1), "Rachel" (n = 1), "Leslie" (n = 1), "Max" (n = 1), "Ann" (n = 1), "Les" (n = 1), and "Tara" (n = 1).

2.4.1.3 Procedure and Analyses

A trained research assistant first verbally administered a questionnaire to the mother and the aunt/friend. It was similar to the questionnaire from Experiment 1 but included additional questions pertaining to the aunt/friend. See Appendix C for the complete questionnaire.

Prior to beginning the experiment, an experimenter took videos of the infants' mother and aunt or friend. These videos were taken in the same manner as in Experiment 1. The videos of the mothers and aunts/friends were used in the experimental video presentations and shown to infants. The same experimental procedure was used in Experiment 3 as in Experiment 2 with one change: instead of viewing videos of a mother and father, infants viewed videos of a mother and aunt or friend.

We calculated infants' baseline-corrected target looking score for the name for the mother analogously to the way we calculated it in Experiment 1. To calculate infants' baseline-corrected target looking score for the other woman's name (i.e., the name of the aunt or friend), we first computed a proportional looking time score for both the baseline trials and the test trials, obtained by dividing the total looking time to the other woman by the total looking time to both the mother and the other woman combined. Second, we subtracted the mean proportional looking score to the other woman during the four baseline trials from the mean proportional looking score to the other woman during the four test trials that involved the presentation of the child's name for the other woman. We interpreted a resulting positive baseline-corrected target looking score for the name for the other woman (i.e., a greater proportion of looking to the other woman on the test trials than on the baseline trials) as indicating comprehension of the word for

the other woman as a label for the individual. See Figure 1.7 for the formulae for calculating baseline-corrected target looking scores for the name for the mother and the name for the other woman.

Figure 1.7 Baseline-Corrected Target Looking Score Formulae for Experiment 3

Baseline-Corrected Target Looking Score for "Mommy"

$$\left(\frac{\text{Looking time to video of mother in test trials}}{\text{Total looking time to both videos in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to video of mother in baseline trials}}{\text{Total looking time to both videos in baseline trials}}\right)$$

Baseline-Corrected Target Looking Score for "Other Woman"

$$\left(\frac{\text{Looking time to video of other woman in test trials}}{\text{Total looking time to both videos in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to video of other woman in baseline trials}}{\text{Total looking time to both videos in baseline trials}}\right)$$

2.4.2 Results

First, we conducted a repeated-measures analysis of variance (ANOVA) of the baseline-corrected target looking scores, with video type (mother and other woman) as a within-subjects factor and group (Experimental and Control) as a between-subjects factor. We found a significant main effect of group, $F(1, 38) = 4.54$, $p = .040$, $\eta_p^2 = .11$, but no significant main effect of video type, $F(1, 38) = 0.66$, $p = .420$, $\eta_p^2 = .02$. Moreover, there was no significant interaction between group and video type $F(1, 38) = 2.41$, $p = .129$, $\eta_p^2 = .06$. The significant group main effect indicated that the Experimental group had higher baseline-corrected target looking scores than the Control group.

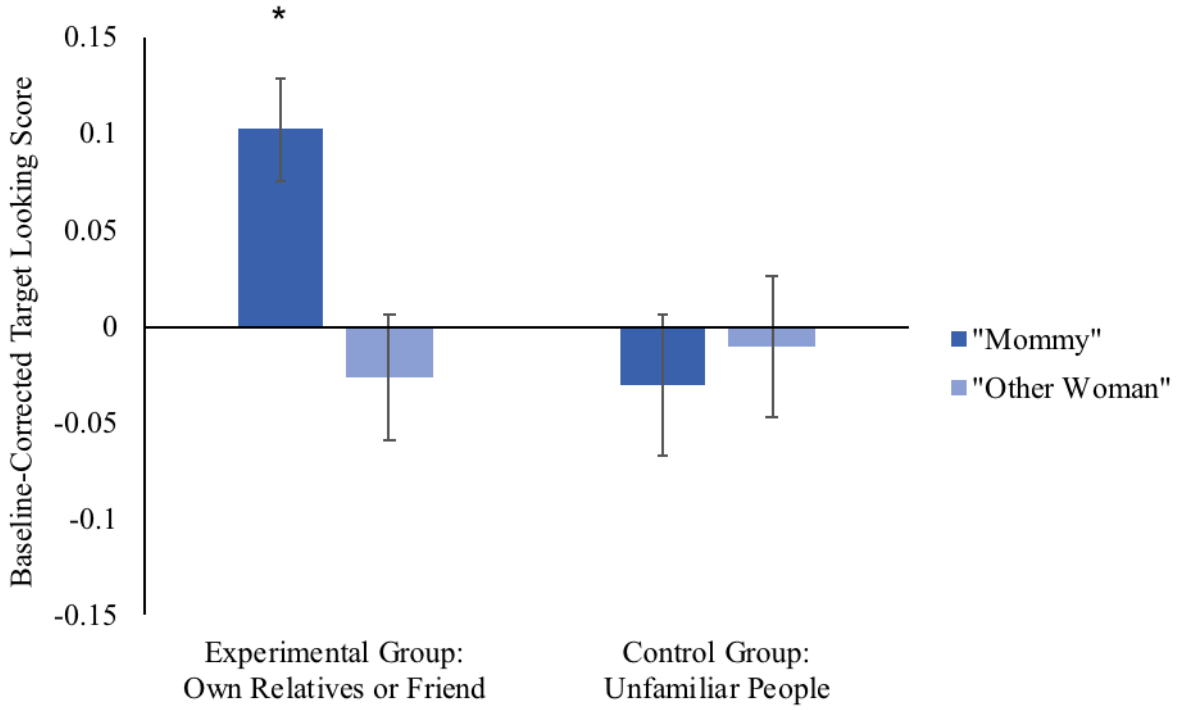
We followed up the significant main effect by examining whether infants in the Experimental group and those in the Control group had baseline-corrected target looking scores

that were different from chance (i.e., a proportional score of 0). The Experimental group (*M* = .03, *SD* = .06) showed a significant positive baseline-corrected target looking score, $t(19) = 2.61$, $p = .017$, 95% CI [.01, .07], but the Control group (*M* = -.04, *SD* = .15) did not have a score differing from zero, $t(19) = -1.24$, $p = .229$, 95% CI [-.11, .03]. The results indicate that infants in the Experimental group showed overall comprehension of the two names (for mother and for the other woman), but they do not indicate that they understood each label individually. Infants in the Control group, in contrast, did not show evidence of comprehension of either of these labels as referring to one of the two unfamiliar women.

We further analyzed the baseline-corrected target looking scores in the Experimental group to assess whether infants understood both the name for their mother and the label for the other woman. For the name for their mother, infants showed a baseline-corrected target looking score significantly different from chance: (*M* =.10, *SD* = .12), $t(19) = 3.74$, $p < .001$, 95% CI [.05, .16]. For the label for the other woman, however, infants' score did not differ from zero: (*M* = -.03, *SD* = .17), $t(19) = -.71$, $p = .485$, 95% CI [-.11, .05]. To check that infants in the Control group did not understand either person's label as referring to a particular unfamiliar person, we also examined their baseline-corrected target looking scores. Infants did not show a baseline-corrected target looking score different from chance for either the name for the mother (*M* = -.06, *SD* = .30), $t(19) = -0.93$, $p = .365$, 95% CI [-.20, .08] or the name for the other woman (*M* = -.02, *SD* = .23), $t(19) = -.40$, $p = .700$, 95% CI [-.13, .09]. See Figure 1.8.

Figure 1.8 Infants' Baseline-Corrected Target Looking Scores in Experiment 3

Infants' baseline-corrected target looking scores in response to hearing the proper names for their mother and aunt/friend while viewing videos of their mother and their aunt or friend (Experimental group) or videos of unfamiliar women (Control group). Asterisks indicate a significant difference from chance, p < .05.

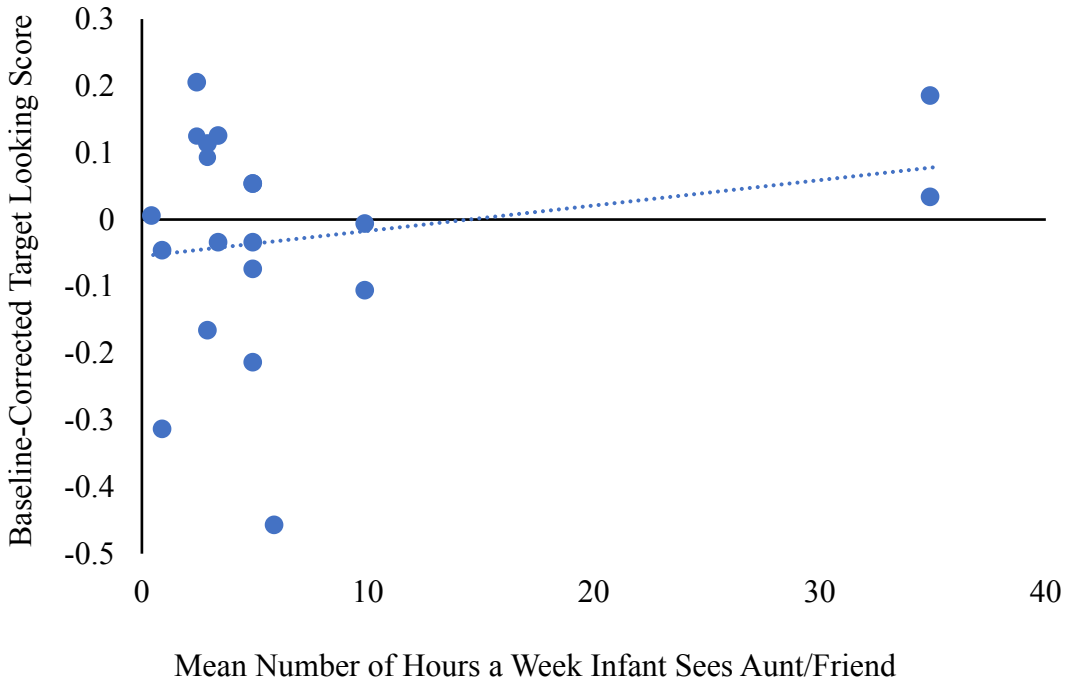


To explore whether infants in the two Experimental sub-groups (aunt, friend) differed in their comprehension of the labels, we compared each sub-group's baseline-corrected target looking scores to chance. In the aunt sub-group, infants showed a significantly positive baseline-corrected target looking score for the name for their mother (M = .11, SD = .11), $t(9) = 3.18$, p = .011, 95% CI [.03, .19), but not for the label for their aunt (M = -.03, SD = .30), $t(19) = -0.93$, p = .365, 95% CI [-.20, .08). In the friend sub-group, infants' baseline-corrected target looking score for the label for mother did not reach significance (M = .09, SD = .14), $t(19) = 2.12$, p = .064,

95% CI [-.01, .18), and it also failed to reach significance for the friend's label (M = -.02, SD = .18), $t(19)$ = -.27 , p = .797, 95% CI [-.15, .12). The sample sizes for these results were very small, however, limiting the power of these tests, and making it difficult to interpret the non-significant results. It is notable that there is a trend indicating comprehension of the name for their mother in both sub-groups, but no such trend indicating comprehension of either the label for the aunt or the label for the friend.

In our next set of analyses, we explored whether the adult-reported mean number of hours per week that infants in the Experimental group saw their mother or aunt/friend was related to the baseline-corrected target looking score of the label for the mother or the aunt/friend. The mother's report of the mean number of hours a week that a child saw her was not significantly correlated with the baseline-corrected target looking score for her name, r = -18, p =.464. Moreover, the adult-reported of the mean number of hours a week that a child saw their aunt or friend was not significantly correlated with the baseline-corrected target looking score for her name, r = .23, p =.332. See Figure 1.9. As was the case with the grandmothers in Experiment 2, there was a wide range of weekly hours of reported exposure to the other female (aunt or friend) in Experiment 3 (i.e., 1 hours to 35 hours). The distribution of scores was, however, heavily skewed, such that only four infants were reported to see the aunt or friend more than six hours per week – perhaps helping to explain the lack of an observed relationship. As in Experiment 2, the range of weekly hours of reported exposure to the mother was skewed towards a higher mean number of hours per week for the mother (i.e., 42 hours to 84 hours). See Table 1.1 for further details of the weekly hours of reported exposure to the mother and aunt.

Figure 1.9 Correlation Between Infants' Baseline-Corrected Target Looking Scores and Adult-reported Mean Number of Hours of Weekly Exposure to Aunt or Friend in Experiment 3



2.4.3 Discussion

The results from the Experimental group of Experiment 3 provide further evidence that six-month-old infants show comprehension of the name for their mother as a label for her as an individual – here, in a context in which she was paired with another woman of roughly the same age and ethnicity (either the mother's sister or same-ethnicity female friend). The results rule out the possibility that infants understand the name for their mother as a category term that encompasses all similar-age and same-ethnicity, familiar women. Infants did not, however, show any comprehension of the name for the maternal aunt or the family friend. Furthermore, as in Experiments 1 and 2, infants in the Control group showed no comprehension of either name as a term for any unfamiliar woman.

2.5 Experiment 4

In Experiments 1 to 3, infants in the Experimental group viewed their mother paired with a second person who varied in relation to them (i.e., father, maternal grandmother, maternal aunt/female family friend). We found that infants showed clear evidence of understanding their name for the mother in all three experiments as a label for her, helping to clarify the precise nature of infants' understanding of this name. In Experiment 4, we sought to understand whether, in addition to systematic (conceptual) relationship differences between the pairs in each experiment, there were also systematic perceptual differences. Our hypothesis was that the perceptual similarity of the mother to the second person increased from the father (Experiment 1), to the grandmother (Experiment 2), to the aunt/friend (Experiment 3).

Our investigation of the degree of perceptual similarity between the mother and the second person shown to infants in each experiment also aimed to determine whether this similarity was correlated with infants' comprehension of the name for their mother as a label for her. Some previous reports of young children's overextension of proper names have been based on cases in which the label was incorrectly extended to people of high perceptual similarity to the target person (e.g., Macnamara, 1982). Although infants showed evidence as a group of comprehending the name for the father as a label for him in Experiment 1, recall that they did not show comprehension of the name for the second person as a label for that person in Experiment 2 (for the name for the grandmother) or Experiment 3 (for the name for the aunt/friend). In Experiment 4, we thus also examined whether infants' comprehension of the name for the second person in each experiment as a label for that person was correlated with the perceptual similarity between the two people.

2.5.1 Methods

2.5.1.1 Participants

Twelve English-speaking undergraduates (M_{age} = 19.92, SD = 2.02, 91% female) received course credit for participating.

2.5.1.2 Stimuli

The stimuli were still images of the 60 pairs of people (20 per experiment) viewed by infants in Experiments 1 through 3, along with additional still images of ten pairs of people (three mother-father, three mother-grandmother, two mother-aunt, and two mother-friend pairs) used in the practice trials. The additional still images used in the practice trials were collected from the adults who came into the lab with infants whose data could not be used.

2.5.1.3 Procedure

The task was presented using PsyScope software.

i. Practice trials. The purpose of the ten practice trials was to familiarize raters with the procedure and to expose them to the range of similarities among the pairs of adults in the main trials.

Raters sat in front of a computer. They read instructions indicating that they would see photos of image pairs presented above a rating scale with numbers from 1 to 9, with 1 labelled 'highly dissimilar' and 9 labelled 'highly similar' (Markman & Gentner, 1993). Raters were instructed to provide a similarity rating by selecting a number key on the keyboard. Raters were instructed to think about the degree to which the two faces resemble each other and to focus only on the faces of the people. On each practice trial, raters saw a photo on the screen in which a mother was paired with another person. The other person in the photo varied across trials (i.e.,

three showed a mother-father pair, three showed a mother-grandmother pair, two showed a mother-aunt pair, and two showed a mother-friend pair).

ii. Main trials. Raters saw photos of the 60 pairs of people used as stimuli in Experiments 1, 2, and 3 (20 mother-father pairs; 20 mother-grandmother pairs; and 20 mother-aunt/friend pairs). The order of presentation was constrained such that raters were not presented with more than three pairs in a row from the same experiment part (1, 2, or 3). Raters provided similarity ratings for the people in each of the 60 photos.

2.5.2 Results

In our first analysis, we sought to establish whether the mean similarity ratings for the adult pairs increased from Experiment 1 (mother-father), to Experiment 2 (mother-grandmother), to Experiment 3 (mother-aunt/friend). The adult similarity ratings revealed a significant linear trend consistent with our prediction, F (1,57) = 8.98, p = .004. There was a significant increase in similarity from mother-father pairs (M = 3.85, SD = 1.00) to mother-grandmother pairs (M = 4.14, SD = .95) to mother-aunt/friend pairs (M = 5.00, SD = 1.60).

After establishing differences in perceptual similarity between adults used in Experiments 1 to 3, we next analyzed whether perceptual similarity was related to infants' baseline-corrected target looking scores for the two labels in each experiment. The first model examined whether infants' baseline-corrected target looking score for the name for the mother was predicted by the similarity between the mother and the other person. This model did not explain a significantly proportion of the variance in baseline-corrected target looking scores ($R^2_{adjusted}$ = .02, F(1, 58) = .06, p = .815 , SEE = .12.) The similarity between the two people on screen did not significantly predict infants' baseline-corrected target looking score for the name for their mother, β = .03, t(58) = .24, p = .815. In our second model, we examined whether infants' baseline-corrected

target looking score for the label for the other person (i.e., father, grandmother, aunt or friend) was predicted by the similarity between the mother and the other person. This model also did not explain a significant proportion of the variance in infants' baseline-corrected target looking scores ($R^2_{adjusted} = .03$, $F(1, 58) = 2.53$, $p = .117$, SEE = .15.) The similarity between the other person (i.e., father, grandmother, aunt or friend) and the mother did not significantly predict infants' baseline-corrected target looking score for the name for the other person, $\beta = -.20$, $t(58) = -1.59$, $p = .117$.

2.5.3 Discussion

In Experiment 4, we asked adults to the rate the degree of perceptual similarity between the pairs of adults shown to infants in Experiments 1 to 3, and we examined whether this degree of similarity was related to infants' baseline-corrected target looking scores in the experiments. Our first goal was to establish whether there was an overall increase in perceptual similarity between the adult pairs from Experiment 1 to 2 to 3, and our results indicate that this was the case. Although there was only a relatively small increase in the mean similarity rating from Experiment 1 (mother-father) to Experiment 2 (mother-grandmother), there was a more substantial increase in the mean similarity rating from Experiment 2 to Experiment 3. Thus, we achieved our aim in Experiment 3 of increasing the mean similarity of the pairs of women from that in Experiment 2. Our second goal was to examine whether adults' rated similarity predicted infants' baseline-corrected target looking scores for the labels in Experiments 1 to 3. We did not find any relation between adults' rated similarities and infants' baseline-corrected target looking scores either for the name for their mother or the label for the other person.

In Experiments 1 to 3, infants showed comprehension of the label of their mother regardless of whether she was paired with the infant's father, grandmother, aunt or family friend.

Moreover, infants' ability to restrict the name for their mother to her was not related to adults' ratings of her similarity to other people. Previous studies have reported that the rare occasions on which infants have overgeneralized the name for their mother label have involved a second person who looked highly similar to the mother (Macnamara, 1982). Our results here do not reveal any relation between comprehension of the label for an infant's mother, and the mother's judged perceptual similarity to other people.

The results here support the claim that infants comprehend the name for their mother as a term for an individual. Specifically, infants do not appear to interpret this label as a category term for people who are judged to be similar to her. A limitation of the design of Experiments 2 and 3 is that they leave open the possibility that infants understand the name for their mother as a term for a category of *highly similar* familiar women – a possibility that is hard to rule out definitively without pairing the mother with her identical twin (cf. Hall, Lee, & Bélanger, 2001; Hall & Bélanger, 2010). Yet the absence of a relation between infants' baseline-corrected target looking score on the *Mommy* trials and their mother's similarity to other people across a wide range of similarity in our experiments offers no evidence to support the claim that infants comprehend the name for their mother as a category term for similar people. Furthermore, it is worth noting that the rarely reported overextension of the labels for mothers to other similar women could involve mistaken identity rather than an intentional generalization of a label (Macnamara, 1982).

2.6 General Discussion

The results from Experiments 1 through 4 help to clarify the nature of infants' earliest comprehension of names for familiar people—in particular, the name for their mother. In this set of experiments, infants were able to correctly match their mother's label to her whether she was

paired with their father (Experiment 1), grandmother (Experiment 2), or maternal aunt or adult female friend (Experiment 3). Moreover, infants' ability to restrict the name for their mother to her alone in these pairings was not related to her perceptual similarity to any of the other adults. Our findings here are consistent with the claim that infants interpret the name for their mother as a label for her as an individual.

In this set of experiments, we also found evidence of infants' comprehension of the name for their father, along with some evidence of comprehension of the label for their grandmother. The more hours per week infants were reported to see their grandmother, the more likely they were to interpret the label for her grandmother as applying specifically to her. This result supports the suggestion that infants' comprehension of a name for a person is related to their amount of exposure with that person. It is possible that this relationship was not observed in infants' comprehension of the labels for aunts or friends in Experiment 3 because most of the infants in our sample were not sufficiently exposed to these females. The mean number of hours per week that infants saw their grandmother (approximately 10 hours) was higher than the mean number of hours per week that infants spent with aunts and friends (approximately 7.5 hours). It is possible that infants require a minimum amount of exposure to a person before showing their comprehension of the name for that person. Moreover, it is possible that we did not observe a similar relationship in infants' comprehension of the name for their mother and father because all of our infants were highly familiar with these individuals. Although we found evidence that infants' comprehension of the label for their grandmother was related to time spent with her, it is also possible that infants' comprehension is related to other factors which are related to infants' time spent with their grandmother. For instance, infants who spend more time with their grandmother may also hear her name more often and may hear her name more often in her

presence. Prior research has found a relation between infants' comprehension of object labels and the degree to which infants hear the words in the presence of the corresponding objects (Bergelson & Aslin, 2017a). Further research is needed to establish the nature of the relationship between infants' comprehension of names for people and their experience with the people.

Although several prior studies have explored the nature of infants' understanding of words for familiar body parts, artifacts, and foods, few studies have examined infants' comprehension of labels for people (Bergelson & Swingley, 2012, 2015, 2017; Tincoff & Jusczyk, 1999). The previous work by Tincoff and Jusczyk (1999) on six-month-olds' understanding of names for their mother and father provided evidence that children of this age understand these words as picking out particular individuals but left open the possibility that they understand the words as category terms for familiar people of a particular gender. The results from Experiment 1 to 3 replicate and significantly extend these previous findings by establishing that young infants do not extend the name for their mother to their grandmother or a maternal aunt or a same-ethnicity female family friend. These findings thus offer stronger evidence for the claim that infants understand the name for their mother as a label for that individual, by ruling out the possibility that the name picks out all more-or-less similar familiar women.

This set of experiments confirms not only that infants comprehend (at least) several words at six months of age but also that their comprehension of the label for their mother appears to be as a term that is specific to her. The finding that infants comprehend words well before their first birthday challenges the view that infants must first acquire other foundational linguistic (perceptual, segmentational, referential) capacities prior to word learning. Work in the last 25 years has described infant language development as beginning at birth with a preference for speech (Vouloumanos & Werker, 2007) and an ability to discriminate languages of different

rhythmic classes (Mehler et al., 1988); to the ability to discriminate between one's own language and another from the same rhythmic class at four months of age (Nazzi, Juscxyk, & Johnson, 2000); to the attunement to the native phonetic categories of their language from six to 10 months of age (Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992; Polka & Werker, 1994; Werker & Tees, 1984); to the ability to segment frequently paired sounds from a speech stream at eight months of age (Saffran, Aslin, & Newport, 1996); and finally to the understanding of the social referential nature of word learning close to their first birthday (Carpenter, Nagell, Tomasello, Butterworth, Moore, 1998; Tomasello, 2001).

Although the preceding list of milestones oversimplifies an account of early infant language development, it serves to illustrate key results from the past 25 years suggesting that word acquisition does not begin until after various fundamental perceptual and statistical speech segmentational abilities are in place. Until recently, very little work had demonstrated word learning in infants until close to their first birthday. Specifically, the parental report data presented by Fenson and colleagues (1994) suggested that infants do not acquire words until around 8 to 10 months of age and indicated that many parents report that their children do not know any words in this age range. Although there were a few experimental findings published around this time period documenting word comprehension in younger infants, these findings were rare in the literature. For instance, discoveries by Jusczyk and his colleagues that six-month-olds comprehend labels for caregivers (Tincoff & Jusczyk, 1999) and that four-month-olds recognize their own name (Mandel, Jusczyk, & Pisoni, 1995) had been viewed as special cases of infant word comprehension, due in part to these words' being high-frequency terms. The experimental work in Experiments 1 to 4, along with the more recent experimental work (e.g., Tincoff & Juzczyk, 2012; Bergelson & Swingley, 2012, 2015, 2017) establishes that at the same

age at which infants are acquiring various fundamental perceptual and statistical speech segmentational abilities, they are also acquiring comprehension not only of some words for people but also of some object words.

Experiments 1 to 4 establish not only that infants have acquired some words at six months of age also provide evidence that these words have scope over individual objects (people). To the extent that infants first begin to acquire object words at six months of age (e.g., Bergelson & Swingley, 2012; Tincoff & Jusczyk, 1999), six-month-olds' comprehension of labels for individuals is consistent with both the *narrow-to-broad* and the *narrow-and-broad* accounts of language development. Recall that the *narrow-to-broad* account of language development suggests that infants begin word learning with an assumption that object words label individuals. This account posits the early acquisition of words for individual objects. In contrast, the *narrow-and-broad* account suggests that infants begin word learning with the capacity to learn both words for individuals and words for members of categories. Both accounts predict that, at the outset of word learning, infants are able to acquire labels for individual objects. Importantly, however, our results are not consistent with the predictions of the *broad-to-narrow* account of language development. The *broad-to-narrow* account of language development posits that infants begin object-word learning with the assumption that words extend across category members. If this account were correct, we would have expected infants in our experiments to show some tendency to extend the name for their mother to at least some of the other people we showed them. In Experiments 1 to 3, infants appeared to restrict the name for their mother to her alone, consistent with the claim that they understand this label as a label for her as an individual, not as a category member.

It is important to note that the results of Experiments 1 through 4 do not definitively rule out the possibility that infants understand the name for their mother as a category term. The design of the experiments leaves open the possibility that infants interpret this name as extending to a category of highly similar familiar women. Ruling out such a possibility would be difficult to do experimentally, since most pairs of people look different from each other, except in special cases like some pairs of identical twins. As a result, this possibility remains open. Nonetheless, the findings from Experiments 1 through 4 establish that infants do not extend the name for their primary caregiver (mother) to other familiar within-gender people even when these people are relatively perceptually similar to their caregiver (as in Experiment 3). Furthermore, the results of Experiment 4 suggest that infants' comprehension of the name for their mother is not related to the perceptual similarity between her and a second familiar person (father, grandmother, or aunt/friend). If infants interpreted the name for their mother as referring to another familiar person of high perceptual similarity to their mother, then we would expect to have observed this relation in Experiment 4.

The results of Experiment 2 also suggest that six-month-olds' early repertoire of understood names is more extensive than previously documented. Infants' early lexicon may include labels not only for mother and father but also for grandmother – comprehension of which was found to be related to infants' exposure to her. With our small sample, it is difficult to determine how much exposure is required before infants show comprehension of a name for a person. Yet our results support the claim that the amount of exposure is related to this comprehension. More exposure to a person presumably gives infants more opportunities to hear that person's name and to establish a link between name and a concept (i.e., that individual person). Although the effect of exposure frequency on name comprehension was not observed in

either Experiment 1 or Experiment 3, we noted earlier that this could have been an effect of the shape of the distribution of the range of hours of weekly exposure reported in those experiments. In Experiment 1, our sample of fathers had a distribution of weekly exposure that was negatively skewed (i.e., mostly large amounts of exposure) but our sample of aunts and female friends was positively skewed (i.e., mostly small amounts of exposure). Further work will be needed to establish more precisely how the amount of exposure to a person is related to early comprehension of a name for that individual; however, there is no reason to believe that this relationship is unique to learning a label for a grandmother.

In conclusion, these four experiments contribute to the growing literature on infants' early lexical comprehension by providing new evidence that young infants understand the word for their primary caregiver (mother) as having scope over her as an individual. The findings from Experiments 1 to 4, in conjunction with previous findings, suggest that at the earliest stages of lexical development infants can learn labels for people and understand these words in a manner that is consistent with their being terms for individuals (i.e., proper names). In particular, we demonstrated that six-month-olds do not extend the name for their mother to their father, grandmother, aunt or a familiar woman of the same-ethnicity and similar age as their mother. We also replicated prior evidence that six-month-olds understand the name for their father, and we found new evidence that infants' comprehension of the name for their grandmother is related to the hours of weekly exposure they have to her. By six months, infants thus appear to have the capacity to acquire words with scope over individual people.

3 Chapter 3: Do Young Infants Represent Multiple Lexical Types?

3.1 Introduction

Any successful account of word learning must accurately predict the nature of infants' early lexical comprehension. Recall that the *narrow-and-broad* account of language development posits that infants have the capacity to learn both labels with individual scope and labels with categorical scope from the outset of lexical development. Under this account, infants have words with different referential scope from the outset of word learning. This account posits that not all words have individual scope (as opposed to the prediction of the *narrow*-to-*broad* account) and not all words have categorical scope (as opposed to the prediction of the *broad-to-narrow* account); infants instead have some words with individual scope *and* some words with categorical scope. No single experiment to date has explored whether young infants understand both words for individuals and words for categories at the same early point in development. Experiments 5 and 6 of this dissertation address this question with a focus on six- and nine-month-olds. What follows is a review of the prior literature on young children's knowledge of words from multiple lexical categories, with a focus on proper names and count nouns. Following this review will be a review of relevant recent findings from studies examining infants' earliest word comprehension abilities.

By 17 months of age, English-learning infants begin to show an appreciation of the grammatical distinction between proper names (i.e., words for individuals) and count nouns (i.e., words for categories) (Hall & Bélanger, 2010; Katz, Baker, & Macnamara, 1974). Recall that these studies observed children's extension of either a novel proper name or a novel count noun applied to one of two either identical-looking or different-looking objects (dolls or stuffed animals). It was not until 17 months of age that children interpreted the novel word modeled

syntactically as a proper name (i.e., "She's called X") as picking out the labeled individual object when it was paired with a different-looking object, but interpreted the word modelled syntactically as a count noun (i.e., "She's called an X") as extending to the other object. Moreover, it was not until 23 months of age that children showed these distinct extension patterns in the presence of identical-looking objects. Thus, this prior research demonstrates that beginning around 17 months, toddlers are sensitive to syntactic markers distinguishing proper names from count nouns and indicates that by this age toddlers are able to learn words for individual objects and words for object categories. Yet it remains unclear from this previous evidence whether children can learn words of these types prior to 17 months. One possibility is that infants cannot learn words that are restricted to the named individual objects and words that extend across object category members until they are sensitive to the syntactic markers for proper names and count nouns. But another possibility is that infants are able to learn words for individuals and words for categories prior to learning how syntactic markers can distinguish these two types of words.

At the slightly younger age of 16 - 17 months, infants appear to have the capacity to learn novel words from multiple lexical categories–both words for individuals and words for categories. In a set of studies, Leung (2011) provided evidence that when 16- and 17-month-olds are taught a novel label for a person (a human face), they do not extend this label to a second face, and rather restrict it to the named face. Furthermore, when infants are taught a novel label for a face, shown both the named face and a second face, and then asked to find the referent of a *second* novel label, infants restrict the second label to the second face. These findings suggest that 16- and 17-month-olds are able to learn words for people and that they interpret these words as having scope over individuals. In contrast, Leung found evidence that a different group of

infants of the same age readily extend a novel label for a toy ball from the named ball to a second ball; and when taught a novel label for a ball, shown the named ball along with a second ball, and asked to find the referent of a second novel label, infants do not restrict the second label to the second ball. Thus, 16- and 17-month-olds also appear able to learn words that extend across category members, and they interpret a word for a ball as a category term. This work thus supports the claim that by this age, infants are able to learn words of two different lexical types.

The previous studies support the claim that by 16 to 17 months, infants can learn words from two different lexical types—words for individuals and words for categories. Past work has not, however, provided evidence that the very same infant understands both words with individual scope and words with categorical scope. Moreover, the prior work does not address whether infants have the ability to learn words from these two lexical types before this age and before they master the grammatical distinction between proper names and count nouns. As discussed in the last chapter, previous work has revealed that infants as young as six months old appear to understand labels (for people) that in the adult lexicon are proper names and labels (for body parts, artifacts, and foods) that in the adult lexicon are count nouns; however, whether infants understand the words for people as labels for individual objects and understand the words for body parts, artifacts, and/or foods as labels for object categories has not been clearly established (Bergelson & Swingley, 2012; Tincoff & Jusczyk, 1999; see also Experiment 1 to 3 of this dissertation).

First, consider the prior evidence that young infants understand words for individuals as found in both Tincoff and Jusczyk's (1999) experiment and Experiment 1 of this dissertation. Those studies demonstrated that infants understand the labels for their mother and father and do not extend them to each other or to an unfamiliar person (either an unfamiliar man or an

unfamiliar woman). Although infants did not appear to interpret the label for either their mother or their father as referring to an unfamiliar person (woman or man) the results are limited in that they leave open the possibility that infants interpreted labels for their parents as extendible to any familiar woman or a familiar man. Experiment 2 and 3 of this dissertation addressed this limitation by establishing that infants successfully restrict their mother's proper name to their mother and do not extend this label to another familiar person of the same gender (grandmother or aunt/female friend). These results offer support the claim that infants interpret the name for their mother as a label for a particular individual, though they do not definitively establish that this is the case. Because the individuals presented in the task always looked different from each other (e.g., the mother looked different from the aunt), it is possible that infants interpreted the word as a category term for woman who looked *highly* similar to the mother, and restricted the name to her for that reason, not because they thought the word labelled her as an individual. Despite this difficult-to-rule-out alternative interpretation, the evidence from the first three experiments of this dissertation is consistent with the possibility that infants restrict their earliest names – at least the label for their mother – to an individual person.

Unlike the evidence that young infants understand some words as labels for individual people (caregivers), the evidence that infants also understand some words that generalize across category members is unclear. Recent experimental research has revealed that infants as young as six months understand, at least in some capacity, a number of common nouns (e.g., "hand", "eyes", "mouth", "bottle", "banana") (Bergelson & Swingley, 2012, 2015, 2017). One method for establishing whether infants understand a word as a label for an object category as opposed to an individual object (commonly used in research with older children) is to present them with a novel object word while they view the labelled object paired with either an across-category

object or a within-category object (for a review, Hirsh-Pasek et al., 2004). For instance, to assess children's understanding of the count nouns "hand", a researcher might present infants with the word "hand" on two different types of trials. On the across-category trial, the researcher might present infants with a picture of a target hand alongside a picture of a foot; on the within-category trial, the researcher might present infants with a picture of the same target hand alongside a picture of another hand. If infants understand the label "hand" as a category term, then they should look preferentially towards the hand on the across-category trial (showing that they have knowledge of the meaning) but look equally to both hands on the within-category object trial (showing that they believe the word should be extended across category members). A similar method could be used to determine whether infants understand words with individual scope. For example, infants' understanding of the name for their mother could be assessed by presenting her image paired with a picture of a dog on an across-category trial and paired with a picture of another woman on a within-category trial. If infants understand the name for their mother as a word with individual scope, then they should look preferentially towards the picture of their mother on both trial types. Although our work in Experiments 1 to 4 addresses whether infants' earliest proper names have individual scope, many prior studies examining infants' understanding of the first count nouns (or proper names) in their lexicon have not used a method that makes it clear whether these words have categorical (as opposed to individual) scope.

Much of the work examining word learning in infants has not examined the referential scope of these early-learned words. For instance, some studies of infants' early object word learning have focused on exploring infants' sensitivity to the auditory signal during word learning but have not examined the scope of the word's extension (e.g., whether it can be extended across category members). Through a series of studies, Werker and colleagues have

demonstrated object-word learning in infants as young as 14 months old (e.g., Werker, Cohen, Lloyd, Casasola & Stager, 1998; Werker, Fennell, Corcoran & Stager, 2002; Werker, Ladhar & Corcoran, 2005). In this line of work, the researchers habituated infants to either one or two word-object pair(s) (e.g., Object A paired with "lif", Object B paired with "neem"). After habituation, they assessed infants' comprehension of the word(s) by using a violation-of-expectation procedure, where they presented infants with a mismatch between the word-and-object pair they had learned earlier (e.g., Object A paired with "neem"). Much of this work has found successful word learning in young infants, such that infants show evidence of learning to map the labels to the objects. Yet none of these studies established whether the infants learned these labels as having categorical scope (i.e., extending across category members).

Similarly, work which has focused on infants' early ability to form word-to-category linkages has not examined the nature of infants' interpretations of novel count nouns. Across several papers, Waxman and colleagues explored whether a novel count noun consistently applied to a set of objects led infants – as young as three months – to interpret the word as referring to an object category (e.g., Balaban & Waxman, 1997; Ferguson & Waxman, 2016; Ferry, Hespos, & Waxman, 2010; Waxman & Braun, 2005; Waxman & Booth, 2003b). In these studies, a researcher familiarized infants to a set of objects from a single category (e.g., a set of animals), each of which was presented with the same novel label. In a subsequent test trial, the researcher showed infants a novel within-category object (e.g., another animal) and a novel across-category object (e.g., a tool). Infants' preference to look at the novel across-category object during this trial provided evidence that infants learned the word as a label for the category. Yet none of these studies involved administering a test trial in which infants showed their willingness to extend a novel label across category members.

To our knowledge, only one previous experiment has examined young infants' understanding that a novel object word extends across from a target object to another category member. In that experiment, Waxman and Booth (2001) demonstrated that 14-month-olds interpreted a novel count noun for an object (e.g., a purple horse) as extending to a within-category member (e.g., from a purple horse to a blue horse) but not to an across-category member (e.g., form a purple horse to a plate). In that experiment, infants first received a number of training trials to familiarize them with the object category they were later tested on. Those training trials involved exposing infants to a novel category label for several exemplars (e.g., several horses) (e.g., "These are blickets. This one is a blicket, and this one is a blicket.") and then showing them an across-category member (e.g., a carrot) which was described as not belonging to the target category (e.g., "Uh-oh, this one is not a blicket!"). Since infants participated in a training phase in this experiment, it is unclear whether they would have interpreted the novel count noun as having categorical scope without explicit feedback. Moreover, in this experiment, infants were shown the target object paired *either* with another within-category member *or* with an across-category member (i.e., as a between-subjects manipulation). Thus, this work does not speak to the possibility that the *same* infant understands both that a novel count noun can extend across members of the same category and that it does not extend to a member of another category.

Similarly, recent work examining six-month-olds' comprehension of familiar object labels has not directly demonstrated whether infants have learned these words as having categorical scope. In a series of experiments, Bergelson and Swingley (2012, 2015, 2017) assessed six- to nine-month-olds' comprehension of familiar count nouns by presenting the words while showing infants a novel exemplar from the familiar category alongside an object from a different

category. In their looking-time task, Bergelson and Swingley found evidence that infants looked more to the matching familiar artifacts (e.g. "bottle"), food items ("banana"), and body parts (e.g., "hand") than to the items from different categories, indicating that they have an early understanding of these count nouns. Yet because the design of these studies did not include a within-category trial, the research was unable to establish whether infants understand the label as extending to multiple exemplars of the same category (i.e., as true category terms). In many cases, infants likely learn their first count nouns for unique objects in their own home (e.g., their own ball, their own cup), and whether infants assume that these labels are equally extendable to other objects of the same category has not yet been examined.

Recall that the *narrow-and-broad* account of language development proposes that infants have the capacity to learn both count nouns and proper names from the outset of development. The preceding review indicates that it is not clear that infants' earliest lexicon includes words from multiple lexical types – both words for individuals and words for categories. Experiment 5 sought to address this issue by examining whether six-month-old infants understand both a word with scope over an individual person and a word with scope over an object category. Importantly, this experiment probed infants' understanding of familiar words from *both* these lexical types.

First, Experiment 5 assessed whether infants interpret the name for their mother (e.g., "Mommy") as an individual label using two test trials–one in which her photo was paired with a photo of an unfamiliar female adult (within-category trial), and one in which her photo was paired with a photo of a dog (across-category trial). If infants interpret the name for their mother as a name for her as an individual, then they should give evidence in their looking of restricting the name to the mother on both trials. If, however, infants interpret the name for their mother as a

category term, then they should extend the label to both women on the within-category trial but restrict it to her on the across-category trials. Prior evidence (including the results of Experiments 1-3) suggests that infants will make an individual interpretation of this word. Note that by examining infants' interpretation of the name for the mother in the presence of both the mother and an unfamiliar woman, Experiment 5 also addressed another limitation of Tincoff and Jusczyk's (1999) study, which was not addressed by Experiments 1 to 3. Tincoff and Jusczyk's evidence that infants did not extend the word for the mother to any unfamiliar woman came from a task in which infants heard that label in the presence of two unfamiliar people (a man and a woman). This result is consistent with the claim that infants do not extend the label for their mother to any unfamiliar woman, but it leaves open the possibility that infants were simply confused by being presented with two unfamiliar people (i.e., the mother was not present). In Experiment 5, the mother was visible on all trials.

Second, Experiment 5 assessed whether infants interpret the word for their hand (i.e., "hand") as a category label, through the use of the same two types of test trial–one in which the infant's hand was paired with a photo of another infant's hand (within-category trial), and one in which their hand photo is paired with a photo of a foot (across-category trial). If infants interpret the word for their hand as a name for it as an individual, then they should give evidence in their looking behaviour of restricting the word to their own hand on both trials. If, however, infants interpret the word for their hand as a category term, then they should extend the label to both hands on the within-category trial but restrict it to their hand on the across-category trials.

In sum, Experiment 5 tested six-month-olds' interpretation of *both* a familiar proper name *and* a familiar count noun. By using a within-subjects design, this experiment aimed to shed new light on whether the *same* infant has the ability to learn words from two lexical types–in other

words, to learn that a name (for a person) is a label for an individual and a count noun (for a body part) extends across category members. This experiment will thus elucidate whether infants have the capacity to learn multiple lexical types (both individual and category terms) very early in lexical development, as predicted by the *narrow-and-broad* account, but not the *narrow-to-broad* or *broad-to-narrow* accounts of lexical development.

3.2 Experiment 5

Experiment 5 assessed six-month-old infants' understanding of a proper name for a familiar person (e.g., "Mommy") and a count noun for a familiar body part (i.e., "hand"), in an effort to explore whether young infants comprehend both words with individual scope and words with categorical scope. The results of Experiments 1 to 3 in this dissertation and prior work (Tincoff & Jusczyk, 1999) provide support for the claim that six-month-olds understand the name for their mother as a label with individual scope. Although these previous studies indicate that infants will not extend the name for their mother to an unfamiliar person, it is possible that this result reflected infant confusion due to their mother not being present when they heard her name. The current study will address this concern by examining whether infants restrict the name for their mother to her in the presence of her and an unfamiliar woman. A few studies have found evidence that six-month-olds also understand the word "hand" in some manner (Bergelson & Swingley, 2012; Tincoff & Jusczyk, 2012), but the claim that they understand it as having categorical scope has not been tested, because prior work has not assessed young infants' tendency to restrict a count noun to an exemplar of a particular category along with their tendency to extend it across members of the same category (e.g., Bergelson & Swingley, 2012, 2015, 2017; Tincoff & Jusczyk, 2012; Waxman & Braun, 2005; Waxman & Booth, 2003b; Werker et al., 1998; Werker et al., 2002; Werker et al., 2005). The current study will thus

elucidate whether infants' earliest lexicons contain *both* words for individuals *and* words for categories. By employing a within-subjects design, this work will establish whether young infants have the capacity to learn words with distinct referential properties (individual scope, category scope) from the outset of lexical development.

3.2.1 Methods

3.2.1.1 Participants

Participants were 20 English-learning infants between 6 months 0 days old and 7 months 0 days old. As in previous experiments, we recruited twenty infants to participate in this experiment (*M* = 6 months 13 days, *SD* = 12 days). For this experiment, we recruited only Caucasian mothers and infants, because the unfamiliar stimuli in the within-category trials (the unfamiliar woman and the unfamiliar hand) were also Caucasian, and we did not want variability in ethnicity to complicate our interpretation of the word extension patterns. A further three infants participated in the study but were excluded from the analysis due to equipment error (n = 2) and fussiness (n = 1). Unlike in Experiments 1 to 3, none of the children showed an extreme preference (above 80%) to look at one of the objects during the baseline trials.

3.2.1.2 Stimuli

For each participant, an experimenter first took a photo of the infant's own mother and own left hand to be used as stimuli in the experiment. The photo of the mother was taken in a manner similar to the way in which videos were recorded in Experiment 1. Mothers were seated in front of a white background and were asked to wear a white smock. Furthermore, they were instructed to keep a neutral expression and look directly into the camera. As in Experiment 1, we asked all women with long hair to push it behind their shoulders. During the experiment, each infant viewed an image of their own mother and an image of an unfamiliar woman. The

unfamiliar woman's photo was taken in the same manner as the mother's photo. The unfamiliar woman was a Caucasian mother of a six-month-old infant who had participated in a pilot version of this experiment. All infants viewed the same unfamiliar woman. During the experiment infants also viewed the image of their mother paired with an image of a dog. A picture of a beagle was cropped to show the dog's head and shoulders on the same background as that used for the mothers' images. Like the mothers, the dog was looking directly into the camera.

We also took a picture of each infant's left hand. To take this photo, the infant sat on their mother's lap at a table. Secured to the top of the table was a white poster board which served as the photo's background. The mother was asked to hold her child's arm at the elbow and to position her child's hand on the board, palm down. With the mother's assistance, we positioned the infant's fingers to lay straight and splayed out. When applicable, we asked the mother to roll up her child's sleeve to ensure that no clothing was visible in the hand photo. In the experiment, each infant viewed the image of their own hand and an image of an unfamiliar infant's hand (i.e., another infant's hand). All infants viewed the same unfamiliar infant's hand. The unfamiliar infant's hand photo was taken in the same manner described above and belonged to a child who participated in a pilot version of this study. In this study, infants also viewed the photo of their own hand paired with a photo of an adult foot. A Caucasian woman's foot was photographed on top of the same table and poster board used for the hand photos. The foot did not have any distinctive markers or features. As with the hand photos, no clothing was visible in the foot photo. The foot photo showed a profile view with the sole on the surface of the poster board.

As in Experiments 1 to 3, auditory stimuli for the study were produced live via a microphone by a female experimenter located in an adjacent room. The experimenter could not see the infant but watched a screen which mirrored the display that the infants were viewing so

that she could provide the appropriate words for a given trial. The experimenter used a stopwatch to space the auditory stimuli evenly across the 10-second-long trials. The auditory stimuli were produced live rather than via a recording because across infants there was variety in the name used for the mother and we wanted to assess infants' understanding of the particular (possibly idiosyncratic) name for their own caregiver. The names used for mothers were "Mommy" (n = 7), "Mammy" (n = 1), "Mama" (n = 11), and "Mom" (n = 3). All infants heard the word "hand" for the hand picture.

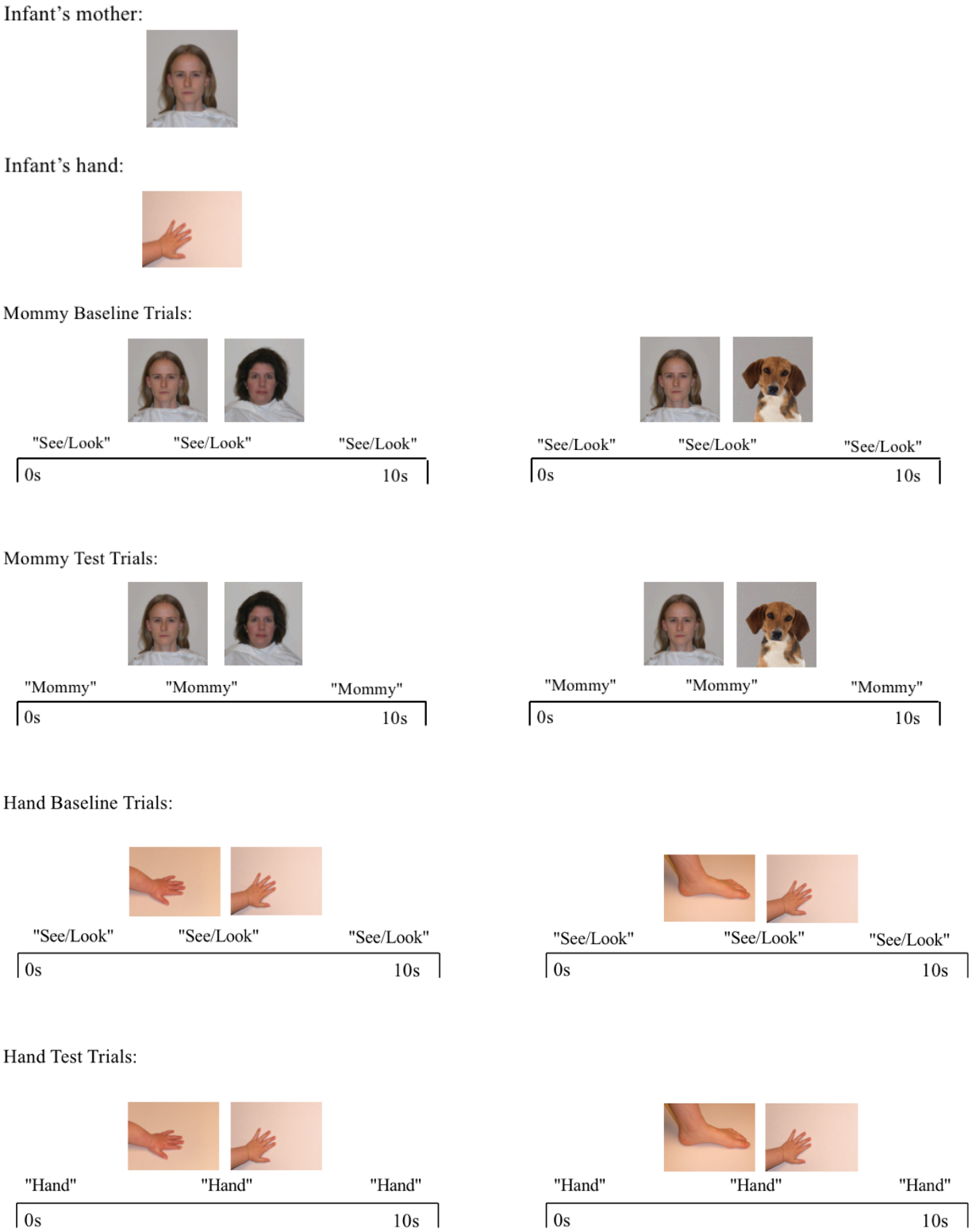
3.2.1.3 Procedure and Analyses

At the beginning of the study, we asked parents to answer a series of questions presented by a trained research assistant. As with the previous experiments, we required that 80% of the infant's language exposure be to English. See Appendix D for the complete set of questions.

During the experiment, infants sat on their caregiver's lap while viewing a television screen on which they could see the side-by-side images of objects. Infants' eye gaze was measured throughout the experiment. Separating each trial was a video of a colourful spinning wheel which served to maintain infant attention throughout the study. Once an infant fixated on the colourful wheel, an experimenter began the next trial. The experiment consisted of two blocks: A *Mommy* block and a *Hand* block. Unlike Experiments 1-3, there was not a familiarization block. Recall that the purpose of the familiarization block in Experiments 1-3 was to familiarize infants with the position of each person on the screen (e.g., their mother on the right side of the screen and their father on the right side of the screen). In Experiment 5, each image appeared on both sides of the screen over the course of the experiment and so a familiarization block was not required.

The order of the *Mommy* and *Hand* blocks was randomized. Within each block, the first four trials were baseline trials; these were followed by four test trials. Trials within each block were semi-randomized with the constraint that the baseline trials always preceded the test trails. In the baseline trials, infants viewed two images on the screen side-by-side while hearing the words "Look" and "See". Two of these trials showed the target object (i.e., the child's mother or the child's hand) paired with a within-category object (i.e., an unfamiliar woman or an unfamiliar infant's hand, respectively), and two trials showed the target object paired with an across-category object (i.e., a dog or a foot, respectively). After taking part in the four baseline trials, infants participated in four test trials which showed the same image pairs as infants saw in the baseline trials. In the *Mommy* block, infants heard the name for their mother (e.g., "Mommy" or whatever word parents reported using as the mother's name) and in the *Hand* block, infants heard the word "hand". Each block was made up of eight trials, each trial being ten seconds long. All test words were presented in isolation, without any accompanying carrier phrase. See Figure 1.10 for the trial structures.

Figure 1.10 Example of Trial Structure for Experiment 5



We assessed the nature of infants' comprehension of the two labels by analyzing infants' looking patterns on the two trial types in each block. We interpreted the looking behaviour to indicate an *individual* interpretation of a word if infants' looking revealed restriction of the label to the target familiar object on both the within-category trial and the across-category trial. In contrast, we interpreted the looking behaviour to indicate a *category* interpretation of a word if infants' looking revealed extension of the label to both objects on the within-category trial but a restriction to the target object on the across-category trial.

In the current experiment, we calculated baseline-corrected target looking scores for "Mommy" in the same manner as in Experiment 1, but now two scores were calculated for each word - one for the within-category trials and one for the across-category trials. The first step in calculating an infant's baseline-corrected target looking score for "Mommy" was to calculate the mean proportion of time the infant spent looking to their mother both during the baseline trials and during the test trials. These proportions were calculated by dividing the total looking time to the mother by the total looking time to both objects on screen (i.e., looking time to own mother plus looking time to the other woman; or looking time to own mother plus looking time to the dog). The second step in calculating an infant's baseline-corrected target looking score for "Mommy" accounted for any baseline preferences to look at either object. Here we subtracted the mean proportional looking score to the mother during the baseline trials from the mean proportional looking score to the mother during the test trials (when infants heard the name for the mother). The difference in proportional looking between the baseline trials and test trials created a baseline-corrected target looking score for the name for their mother (i.e., a "Mommy" baseline-corrected target looking score). A resulting positive baseline-corrected target looking score on both within-category and across-category trials (i.e., a greater proportion of looking to

the mother on test trials than on baseline trials) indicated that infants interpreted the word as having scope over an individual (i.e., over the mother). A null (i.e., not different from 0) baseline-corrected target looking score on the within-category trials but a positive baseline-corrected target looking score on the across-category trials indicated that infants interpreted the word as having scope over an object category (e.g., young Caucasian women).

We calculated baseline-corrected target looking scores for the word "hand" in a similar manner. First, we calculated a proportional looking time score for both the baseline trials and the test trials by dividing the total looking time to an infant's own hand by the total looking time to both paired objects (i.e., looking time to own hand plus looking time to the unfamiliar infant's hand; or looking time to own hand plus looking time to the foot). Second, we subtracted the mean proportional looking score to an infant's hand during the baseline trials from the mean proportional looking score to their own hand during the test trials (where they heard the word "hand"). A positive baseline-corrected target looking score on both within-category and across-category trials (i.e., a greater proportion of looking to the own hand on test trials than on baseline trials) indicated that infants interpreted the word as having scope over an individual (i.e., over their own hand). A null baseline-corrected target looking score during the within-category trials and a positive baseline-corrected target looking score during the across-category trials indicated that infants interpreted the word as having categorical scope. See Figure 1.11 for the formulae for calculating baseline-corrected target looking scores for "Mommy" and "hand".

Figure 1.11 Baseline-Corrected Target Looking Score Formulae for Experiment 5

Within-Category Trials: Baseline-Corrected Target Looking Score for "Mommy"

$$\left(\frac{\text{Looking time to picture of mother in test trials}}{\text{Total looking time to both women's pictures in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to picture of mother in baseline trials}}{\text{Total looking time to both women's pictures in baseline trials}}\right)$$

Across-Category Trials: Baseline-Corrected Target Looking Score for "Mommy"

$$\left(\frac{\text{Looking time to picture of mother in test trials}}{\text{Total looking time to both mother and dog pictures in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to picture of mother in baseline trials}}{\text{Total looking time to both mother and dog pictures in baseline trials}}\right)$$

Within-Category Trials: Baseline-Corrected Target Looking Score for "Hand"

$$\left(\frac{\text{Looking time to picture of own hand in test trials}}{\text{Total looking time to both hand pictures in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to picture of own hand in baseline trials}}{\text{Total looking time to both hand pictures in baseline trials}}\right)$$

Across-Category Trials: Baseline-Corrected Target Looking Score for "Hand"

$$\left(\frac{\text{Looking time to picture of own hand in test trials}}{\text{Total looking time to both hand and foot pictures on test trials}}\right)$$

$$-\left(\frac{\text{Looking time to picture of own hand in baseline trials}}{\text{Total looking time to both hand and foot pictures in baseline trials}}\right)$$

Recall our predictions. We expected that infants would interpret the name for their mother (used in the *Mommy* block) as an individual term, showing a positive baseline-corrected target looking score on both the within-category trial and the across-category trial. This finding would be consistent with the previous findings (using a different experimental design) from Tincoff and Jusczyk (1999) and with the results from Experiments 1 to 3. In contrast, we expected that

infants would interpret the count noun "hand" (used in the *Hand* block) as a category term, showing a null baseline-corrected target looking score on the within-category trial but a positive baseline-corrected target looking score on the across-category trial.

3.2.2 Results

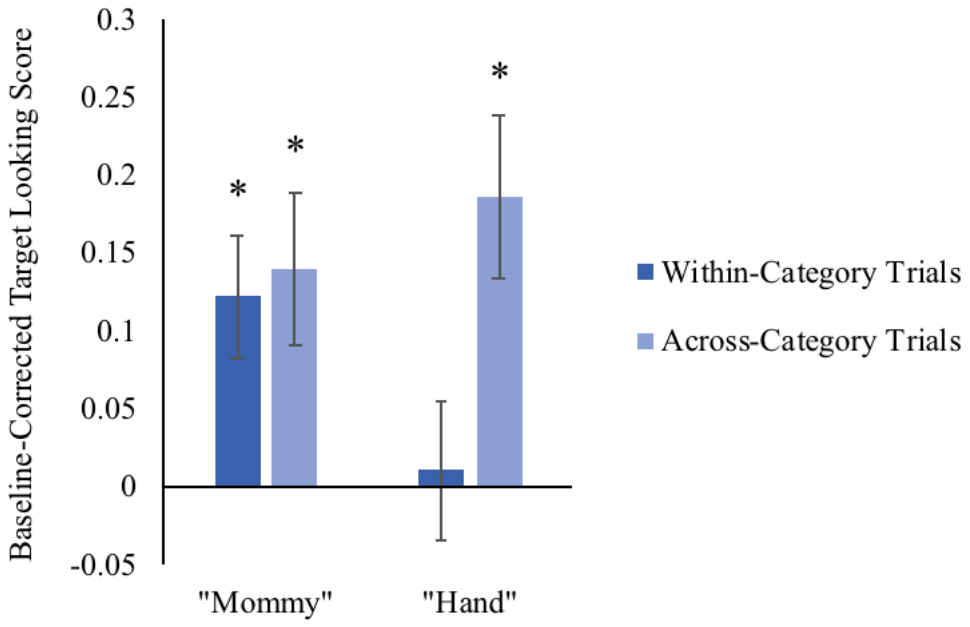
We conducted a preliminary analysis of the baseline scores to determine whether infants could discriminate their both own mother from the unfamiliar woman and their own hand from the unfamiliar hand. Since we intended our within-category trials to provide evidence about infants' tendency to generalize the label for their mother to another woman and to generalize the word "hand" to another hand, it was important to establish that infants saw their own mother and their own hand as distinct from the unfamiliar woman and unfamiliar hand. To probe whether infants recognized the familiar object (mother or hand), we examined their looking behaviour on the within-category baseline trials. On the *Mommy* baseline trials, infants showed a novelty preference on the within-category trials, looking proportionally longer at the unfamiliar woman ($M = .58$, $SD = .13$), $t(19) = 2.82$, $p < .05$, 95% CI[.36, .47]]. On the *Hand* baseline trials, infants showed an analogous effect. On the within-category trials, they looked proportionally longer at the unfamiliar infant's hand ($M = .60$, $SD = .09$), $t(19) = 5.23$, $p < .001$, 95% CI [.36, .44). Thus, on both within-category baseline trials, infants appeared to show a preference to look at the unfamiliar object rather than the familiar object (i.e., a novelty preference). The presence of a novelty preference on our baseline trials provides evidence that the novel objects stood out as different from the familiar objects (Houston-Price & Nakai, 2004). As will be further discussed in the following section, these novelty preferences are consistent with the claim that infants recognized their own mother and their own hand as distinct from an unfamiliar woman and an unfamiliar hand.

We next conducted a repeated-measures analysis of variance (ANOVA) of baseline-corrected target looking scores, with word (*Mommy* and *Hand*) and trial type (within-category and across-category) as within-subjects factors. We did not find a significant main effect of word, $F(1, 19) = .78$, $p = .388$, $\eta_p^2 = .04$, but did find a significant main effect of trial type, $F(1, 19) = 5.07$, $p = .036$, $\eta_p^2 = .21$. Moreover, there was a significant interaction between word and trial type, $F(1, 19) = 5.23$, $p = .034$, $\eta_p^2 = .22$. To follow up the interaction effect, we examined how infants performed on the *Mommy* and *Hand* trials separately. On the *Mommy* trials, infants' baseline-corrected target looking score was comparable on the within-category trials ($M = .12$, $SD = .17$) and the across-category trials ($M = .14$, $SD = .20$), $t(19) = -.46$, $p = .649$, 95% CI [-.10, .06). On the *Hand* trials, however, infants' baseline-corrected target looking score was significantly lower on the within-category trials ($M = .01$, $SD = .22$) than on the across-category trials ($M = .19$, $SD = .23$), $t(19) = -2.60$, $p = .018$, 95% CI [-.32, -.03).

To clarify the preceding results, we further analyzed the baseline-corrected target looking scores for each word on both the within-category and the across-category trials. On the *Mommy* trials, infants' baseline-corrected target looking score was significantly above chance on the both the within-category trials, $t(19) = 3.12$, $p < .001$, 95% CI [.04, .20), and the across-category trials, $t(19) = 3.12$, $p < .001$, 95% CI [.04, .23). On the *Hand* trials, infants' baseline-corrected target looking score did not differ from chance on the within-category trials, $t(19) = .21$, $p = .836$, 95% CI [-.09, .11), but was significantly above chance on the across-category trials, $t(19) = 3.56$, $p = .002$, 95% CI [.08, .30). See Figure 1.12. Taken together, the results indicate that infants interpreted the name for their mother as having individual scope but the word "hand" as having categorical scope.

Figure 1.12 Infants' Baseline-Corrected Target Looking Scores in Experiment 5

Infants' baseline-corrected target looking scores in response to hearing the name for their mother (e.g., "Mommy") and the word "hand" on within-category trials and across-category trials. Asterisks indicate a significant difference from chance, $p < .05$.



3.2.3 Discussion

The results of this study provide the first evidence in the literature that at six months of age infants understand *both* a word with scope over an individual object *and* a word with scope over an object category. First, we found further support for the claim that infants as young as six months understand the name for their mother as a label for an individual. Our finding extends the results from Experiments 1 through 3 by demonstrating that infants restrict the name for their mother to her alone not only when she appears in the presence of another familiar woman (grandmother in Experiment 2, aunt/friend in Experiment 3) but also when she appears in the presence of an unfamiliar woman of the same ethnicity and same rough age. The findings thus

rule out the possibility that infants extend the label for their mother from her to another similar-looking unfamiliar woman. This finding is consistent with the result of the control conditions of previous studies (Tincoff & Jusczyk, 1999, and Experiments 1 to 3 of this dissertation) but goes beyond the previous findings. Specifically, the prior studies left open the possibility that infants' tendency not to look systematically at an unfamiliar person when hearing the name for their mother reflected confusion because the mother was not visible (i.e., the display presented two unfamiliar people). The findings from Experiment 5 rule out this possibility and demonstrate that infants will not extend the label for their mother to another unfamiliar woman when the mother is visible.

Second, we found evidence that *the same* six-month-olds understand a word for their hand ("hand") as a label that extends across category members. Our findings are consistent with prior evidence that infants of this age comprehend the word "hand" (Bergelson & Aslin, 2017a; Tincoff & Jusczyk, 2012), but previous studies have included only versions of our across-category trials, leaving the scope of infants' extensions unclear. Our results significantly extend those previous findings by including a within-category trial, offering the first evidence to support the claim that infants interpret the word "hand" as having scope across category members.

The results from the *Mommy* trials are consistent with the possibility that infants made an individual interpretation of the name for their mother since infants did *not* extend it to another within-category member (i.e., from their own mother to another unfamiliar woman). The results from the *Hand* trials, in contrast, are consistent with the possibility that infants interpreted this label as having categorical scope since infants did extend it to another within-category member (i.e., from their own hand to another unfamiliar hand). These results thus support the main claim of the *narrow-and-broad* account of word learning–namely that infants have the ability from

early in lexical development to acquire words from different lexical types—both words for individual objects and words for object categories. As noted earlier, prior work has reported that infants comprehend both labels for caregivers (proper names) and labels for body parts, foods, and artifacts (count nouns) by six months of age (e.g., Bergelson & Swingley, 2012, Tincoff & Jusczyk, 1999), but it has been unclear whether infants assign these words different referential meanings at this early age. Our work here indicates that at least one of these early words is understood as having individual scope and that at least one is comprehended as having categorical scope.

One striking finding from this experiment is that infants showed a novelty preference on baseline trials involving *both* their own mother *and* trials involving their own hand: At baseline, they looked systematically at the unfamiliar woman on *Mommy* trials and at the unfamiliar hand on *Hand* trials. Previous research has found that as exposure to a stimulus (e.g., an image, a sound) increases, infants will shift their preference towards a novel stimulus (for review see Houston-Price & Nakai, 2004). For instance, if an infant is repeatedly shown one image and then sees the now-familiar image paired with a novel image, they will prefer to look at the novel image. Whether an infant shows a novelty preference or a familiarity preference (i.e., preference to look at the old image) depends on the extent to which infants are exposed to the familiarized stimulus (Houston-Price & Nakai, 2004). Yet the presence of a novelty or familiarity effect is only possible if one of the images stands out to an infant as different from the other.

Infants' novelty preference observed on the *Mommy* baseline trials, coupled with the evidence that they tended to restrict the name for her to her, supports the claim that infants interpreted the word as a term for the individual mother. Infants' behaviour on the *Hand* baseline trials (i.e., a preference for the novel hand), coupled with the evidence that they tended to extend

the word "hand" across the two hands, supports the claim that infants generalized the word across the two objects. The observed novelty preferences offer support for the claim that infants recognized *both* their mother *and* their hand as familiar. While it is perhaps not surprising that six-month-olds appeared to recognize their own mothers, it is striking that they also appeared to recognize their own hand as familiar – particularly when it was presented alongside the similar-looking hand of another infant. Nonetheless, these baseline data help to support the claim that the tendency to extend the label "hand" on within-category trials in this experiment – revealed in a null baseline-corrected target looking score – reflects a categorical interpretation of the word, rather than confusion brought about by an inability to distinguish between the hands.

While the existence of novelty preference effects on the baseline *Hand* trials in Experiment 5 provides support for the argument that infants have a categorical understanding of the word "hand", it remains clear that the two hands presented to infants on within-category *Hand* trials were very similar to each other – and more similar to each than the two women were to each other on within-category *Mommy* trials. Stronger support for the claim that infants comprehend the word "hand" as having categorical scope would come from a study in which infants showed a tendency to extend the word to a more dissimilar exemplar of the category. One way to obtain such support would be to replicate the findings Experiment 5 using a more perceptually dissimilar hand pair (e.g., pairing the child's own hand with an adult's hand or with the hand of someone from a different ethnicity). If infants showed the same pattern of novelty preference in the baseline within-category trials but a null baseline-corrected target looking score on those trials, then this would enhance support for the claim that infants comprehend the word "hand" as a word with categorical scope.

Another way to address this issue would be to examine comprehension of a word for another object category also familiar to young infants – a category whose members have a wide range of perceptual variability. At six months, there is little evidence that infants generally comprehend any such words, but by nine months, many know the word "ball" (Bergelson & Swingley, 2015; Frank, Braginsky, Yurovsky & Marchman, 2016). In addition to being familiar to young infants – such that many have one or more that they play with regularly as a toy – balls come in a wide range of salient colours and textures, making it easy to create highly discriminable pairs. If we could replicate the results of Experiment 5, replacing *Hand* trials with *Ball* trials (and using highly distinctive balls on the within-category trials), then we would obtain even stronger support for the claim that young infants have the ability to learn words with categorical scope. Experiment 6 was thus a replication of Experiment 5 with those modifications, involving nine-month-olds as participants.

3.3 Experiment 6

In Experiment 6, we sought to replicate and extend the results from Experiment 5 by examining whether nine-month-old infants interpret the name for their mother as a label with individual scope but interpret the word "ball" as a label with categorical scope. We tested nine-month-olds instead of six-month-olds because previous evidence suggests that six-month-olds' vocabularies vary widely in terms of the specific lexical items that they contain (Tardiff et al., 2008), and previous work indicates that there are few count nouns (category terms) – aside from "hand" – that are widely understood at this age (Bergelson & Swingley, 2012; Tincoff & Juscyzk, 2012). By nine months of age, however, experimental work indicates that there are several common nouns (category terms), including "ball", that most English-learning infants appear to comprehend in some way (Bergelson & Swingley, 2012). Additionally, approximately

50% of parents of nine-month-old infants report that their child understands the word "ball" (Frank et al., 2016). Moreover, because instances of the category "ball" differ widely in their perceptual features, an examination of infants' extension of this word offered a way to assess more stringently whether young infants comprehend any words with categorical scope.

Although previous work indicates that nine-month-olds understand a number of words (including "ball") that are count nouns (category terms) in the adult lexicon, there has been no prior exploration of whether infants understand these labels as category terms. Specifically, prior work is limited in that it did not assess young infants' tendency to extend a count noun to within-category members (e.g., Bergelson & Swingley, 2012, 2015, 2017; Waxman & Braun, 2005; Waxman & Booth, 2003b; Werker et al., 1998; Werker et al., 2002; Werker et al., 2005).

Experiment 6 was a modified replication of Experiment 5, in which we sought further evidence that infants' early lexicons contain both words with individual scope and words with categorical scope. By again employing a within-subjects design, the work aimed to establish whether nine-month-olds have the capacity to learn object labels with distinct referential properties (individual scope, category scope) at this age. Because the infants in Experiment 6 were three months older than those in Experiment 5, the results do not speak to the nature of the infants' earliest object-word lexicons, but the paucity of count nouns (category words) in six-month-olds' receptive vocabularies indicates that data from nine-month-olds are informative about the nature of infants' very early-learned words.

3.3.1 Methods

3.3.1.1 Participants

Participants were 20 English-learning infants between 8 months 16 days old to 9 months 13 days old (*M* = 9 months 2 days, *SD* = 8 days). As in Experiment 5, we recruited infants of

Caucasian mothers, because the unfamiliar woman shown on within-category *Mommy* trials was Caucasian, and we did not want variability in ethnicity to complicate our interpretation of the word extension patterns. Also, we recruited parents who reported that their infants had a toy ball at home, and who agreed to bring the ball to the lab with them. (If parents reported that their infant had more than one toy ball, then they were asked to bring in the one their child played with most often.) The infants' toy ball was used to create the stimuli used in the *Ball* trials of the experiment. A further three children participated in this study but were excluded from analyses due to fussiness (n = 2) and experimenter error (n = 1).

3.3.1.2 Stimuli

We assessed infants' comprehension of the child's name for their mother (using a photo of the child's own mother) and the word "ball" (using a photo of the child's own toy ball). We expected that these words would be familiar to most nine-month-olds. We have previously investigated comprehension of the name for their mother in six-month-olds; and parental reports indicate that by nine months, 85% of infants understand this word (Frank et al., 2016). Additionally, as noted, approximately 50% of parents report that their child knows the word "ball" at nine months of age (Frank et al., 2016).

The auditory stimuli were produced live into a microphone during the experiment by an experimenter located in an adjacent room in the same manner as Experiment 1. The auditory stimuli were produced live rather than via a recording because pilot data indicated that across infants there was a variety in the name used for the caregiver and we wanted to assess infants' understanding of the particular (possibly idiosyncratic) name for their own caregiver. The names for the mothers in this experiment were "Mommy" (n=7), "Mama" (n=10), and "Mom" (n=3). All infants heard the word "ball" for the ball picture.

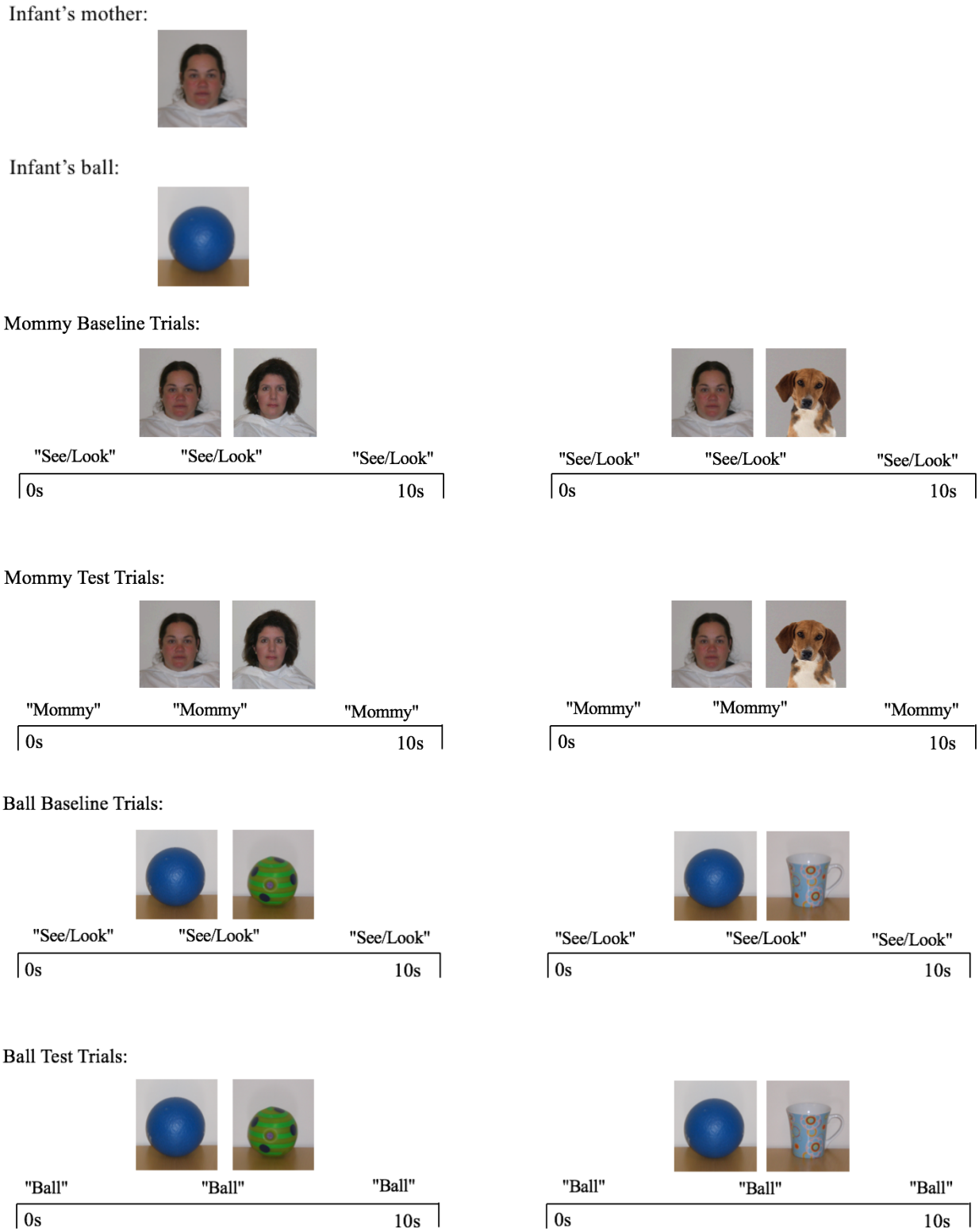
3.3.1.3 Procedure and Analyses

A trained research assistant asked parents to answer a series of questions, analogous to those in Experiment 5. See Appendix E for the full set of questions. To be included in the final sample, at least 80% of the infant's language exposure had to be to English. In addition, parents completed the MacArthur Short Form Vocabulary Checklist: Level I which has been validated for infants as young as 8 months old (Fenson et al., 1993).

Prior to beginning the experiment, an experimenter took pictures of the infant's mother and the infant's toy ball. The photo of the infant's mother was taken in the same manner as in Experiment 5. We also used the unfamiliar woman's photo and the dog photo from Experiment 5. The photo of the child's ball was taken with the ball positioned on a table in front of a white wall. The photo of the unfamiliar toy ball and the photo of the cup were taken in the same manner.

The photos of infants' mothers and the infants' toy balls – as well as the photos of the unfamiliar woman, dog, unfamiliar ball, and cup – were used in the experimental video presentations shown to infants. The same experimental procedure was used in Experiment 6 as in Experiment 5 with one change: instead of viewing a *Hand* block, infants viewed a *Ball* block. See Figure 1.13 for an example of the trial structure.

Figure 1.13 Example of Trial Structure for Experiment 6



Baseline-corrected target looking scores for the names for the mother and for "ball" were calculated in the same manner as these scores were calculated in Experiment 5.

Figure 1.14 Baseline-Corrected Target Looking Score Formulae for Experiment 6

Within-Category Trials: Baseline-Corrected Target Looking Score for "Mommy"

$$\left(\frac{\text{Looking time to picture of mother in test trials}}{\text{Total looking time to both women's pictures in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to picture of mother in baseline trials}}{\text{Total looking time to both women's pictures in baseline trials}}\right)$$

Across-Category Trials: Baseline-Corrected Target Looking Score for "Mommy"

$$\left(\frac{\text{Looking time to picture of mother in test trials}}{\text{Total looking time to both mother's and dog's picture in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to picture of mother in baseline trials}}{\text{Total looking time to both mother and dog pictures in baseline trials}}\right)$$

Within-Category Trials: Baseline-Corrected Target Looking Score for "Ball"

$$\left(\frac{\text{Looking time to picture of own ball in test trials}}{\text{Total looking time to both of the balls' pictures in test trials}}\right)$$

$$-\left(\frac{\text{Looking time to picture of own ball in baseline trials}}{\text{Total looking time to both balls' pictures in baseline trials}}\right)$$

Across-Category Trials: Baseline-Corrected Target Looking Score for "Ball"

$$\left(\frac{\text{Looking time to picture of own ball in test trials}}{\text{Total looking time to both ball and cup pictures on test trials}}\right)$$

$$-\left(\frac{\text{Looking time to own ball in baseline trials}}{\text{Total looking time to both ball and cup pictures in baseline trials}}\right)$$

Recall our predictions. We predicted that infants would interpret the name for their mother as an individual term, restricting it to their own mother on both the within-category trials and the across-category trials. This finding would be consistent with the previous findings (using a different experimental design) from Tincoff and Jusczyk (1999) and Experiments 1- 3 and 5. In

contrast, we expected that infants would interpret the count noun "ball" as a category term, extending the label to both balls on the within-category trials but restricting it to the target ball on the across-category trials.

3.3.2 Results

As in Experiment 5, we first examined the baseline trials to establish whether infants could discriminate both their own mother from the unfamiliar woman and their own ball from the unfamiliar ball. Since we intended our within-category trials to provide evidence about infants' tendency to generalize the label for their mother to another woman and to generalize the word "ball" to another ball, it was important to establish that infants saw their own mother and their own ball as distinct from the unfamiliar woman and unfamiliar ball. To probe whether infants recognized the familiar object (mother or ball), we examined their looking behaviour on the within-category baseline trials. On the *Mommy* baseline trials, infants showed a significant preference to look at the unfamiliar woman on the within-category trials ($M = .55$, $SD = .11$), $t(19) = 2.10$, $p < .05$, 95% CI [.40, .49]. On the *Ball* baseline trials, infants significantly preferred to look at the unfamiliar toy ball on the within-category trials ($M = .59$, $SD = .17$), $t(19) = 4.51$, $p < .001$, 95% CI [.37, .45]. As in Experiment 5, these systematic initial asymmetries (i.e., novelty preferences) in looking behavior offer evidence that infants recognized both their own mother and their own ball as being distinct from the unfamiliar woman and unfamiliar ball.

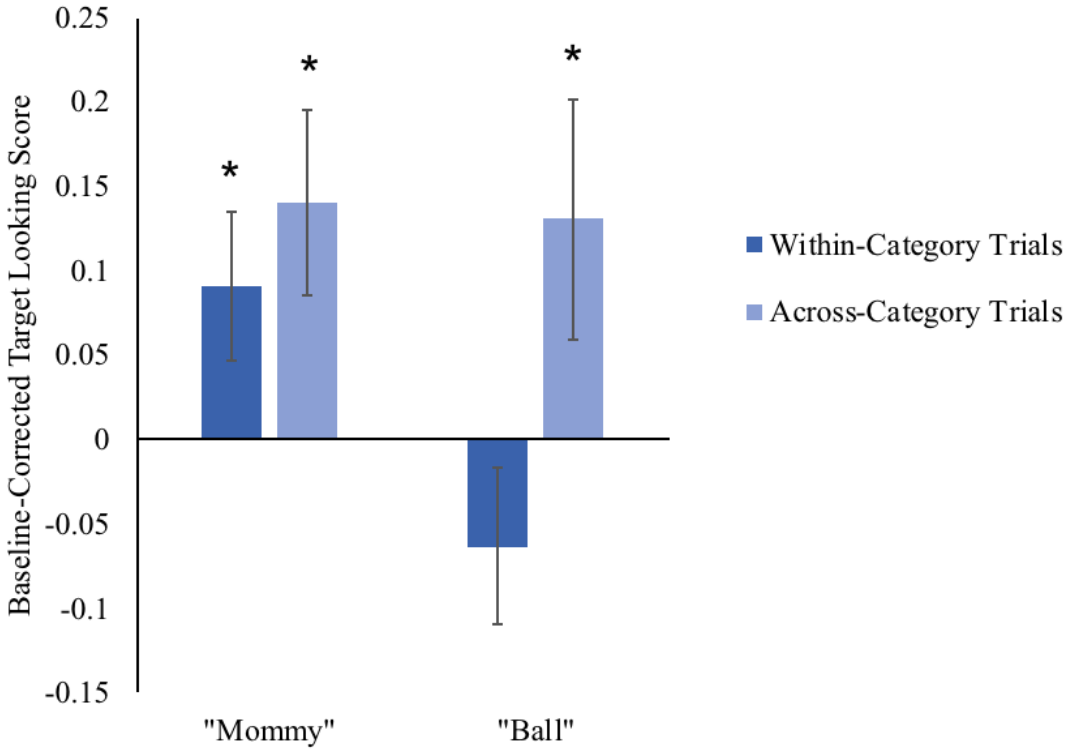
Next, we conducted a repeated-measures analysis of variance (ANOVA) of the baseline-corrected target looking scores, with word (name for mother and ball) and trial type (within-category and across-category) as within-subjects factors. As in Experiment 5, we did not observe a significant main effect of word, $F(1, 19) = 3.32$, $p = .084$, $\eta_p^2 = .15$, but did find a significant main effect of trial type, $F(1, 19) = 11.61$, $p = .003$, $\eta_p^2 = .38$. Moreover, there was a significant

interaction between word and trial type $F(1, 19) = 2.46$, $p = .133$, $\eta_p^2 = .12$. To follow up these analyses, we examined how infants performed on the *Mommy* trials and how they performed on the *Ball* trials separately. As in the *Mommy* trials from Experiment 5, infants' baseline-corrected target looking scores did not significantly differ between the within-category trials ($M = .09$, $SD = .16$) and across-category trials ($M = .14$, $SD = .24$), $t(19) = -.98$, $p = .34$, 95% CI [-.16, .06]. And as in the *Hand* trials from Experiment 5, infants had significantly lower baseline-corrected target looking scores on the within-category *Ball* trials ($M = -.06$, $SD = .17$) than on the across-category *Ball* trials ($M = .13$, $SD = .25$), $t(19) = -3.00$, $p = .007$, 95% CI [-.33, -.06].

As in Experiment 5, we then further analyzed the baseline-corrected target looking scores for each word on both the within-category and the across-category trials. On the *Mommy* trials, infants had significantly positive baseline-corrected target looking scores on both within-category trials, $t(19) = 2.48$, $p = .023$, 95% CI [.01, .17], and across-category trials, $t(19) = 2.62$, $p = .017$, 95% CI [.03, .25]. On the *Ball* trials, the baseline-corrected target looking score did not differ from chance on the within-category trials, $t(19) = -1.65$, $p = .115$, 95% CI [-.14, .02], but it was significantly above chance on the across-category trials, $t(19) = 2.29$, $p = .028$, 95% CI [.02, .25]. See Figure 1.15.

Figure 1.15 Infants' Baseline-Corrected Target Looking Scores in Experiment 6

Infants' baseline-corrected target looking scores in response to hearing the name for their mother (e.g., "Mommy") and the word "ball" on within-category trials and across-category trials. Asterisks indicate a significant difference from chance, $p < .05$.



3.3.3 Discussion

The results of Experiment 6 replicate the discovery from Experiment 5 that young infants understand *both* a word with scope over an individual object *and* a word with scope over an object category. In this experiment, we found evidence that nine-month-old infants comprehend the name for their mother as having scope over her alone but understand the word "ball" as having scope over an object category. The findings concerning infants' understanding of the name for mother replicate the results with six-month-olds from earlier studies (cf. Experiments 1 to 3 and Experiment 5, as well as Jusczyk & Tincoff, 1999), while those pertaining to the word

"ball" are new and indicate that, by nine months, infants understand at least two words with categorical scope (i.e., "hand" and "ball"). The existence of novelty preference at baseline in both the within-category *Hand* trials of Experiment 5 and the within-category *Ball* trials of this experiment provides evidence that infants recognized their own familiar hand and their own familiar ball and thus generalized the words across exemplars of their categories. Yet the Experiment 6 "ball" results offer even more compelling evidence of a categorical understanding of this word because the ball exemplars were more perceptually distinctive than the hand exemplars in Experiment 5.

3.4 General Discussion

In Experiments 5 and 6, we found evidence that both six- and nine-month-old infants comprehend both a word with scope over an individual and a word with scope over a category. In Experiment 5, we found evidence that six-month-old infants restrict the name for their mother to her and do not extend this label to an unfamiliar woman; but they understand that the word "hand" extends to both their own hand and an unfamiliar hand although not to an object of a different category (i.e., a foot). This finding supports the claim that infants understand both a label for an individual and a label for a category at six months of age. To the extent that six months is the earliest age at which infants show any evidence of object word comprehension, the findings here support the claim that infants comprehend both a label for an individual and a label for a category from the outset of lexical development. Experiment 6 was a replication of Experiment 5 involving a different category term understood by nine-month-olds – namely a word for an artifact category, "ball". In Experiment 6, we replicated the finding from Experiment 5 that young infants do not extend the name for their mother to an unfamiliar woman; and we

demonstrated that infants do extend the label "ball" from their own familiar toy ball to a different-looking novel ball, although not to an object of a different category (i.e., a cup).

Together the findings from Experiments 5 and 6 support the predictions of the *narrow-and-broad* account of language development. Recall that the *narrow-and-broad* account of language development posits that from the outset of lexical development infants are capable of learning both labels for individuals and labels for categories. Although previous work has established that infants comprehend both labels for people (Tincoff & Jusczyk, 1999) and labels for body parts, artifacts, and food items (e.g., Swingley & Bergelson, 2012) as early as six months of age, these previous studies did not clearly establish whether infants understand these early words as including both labels for individuals and labels for categories. Importantly, the *narrow-and-broad* account suggests that at the same early stage of lexical development, infants have both words for individuals and words for categories. In both Experiments 5 and 6, we used a within-subjects design to establish whether the very same infant understood words with differing extensions – namely, words for individuals and words for categories. Our work goes beyond previous experiments by using within-category trials (i.e., trials in which infants saw two objects belonging to the same category) to establish that young infants restrict the name for a caregiver to one person but generalize labels for hands and balls to multiple exemplars.

The results of our experiments are consistent with the claim that infants interpret labels for people as labels for individuals and labels for body parts and artifacts as labels for category members. It is possible that infants learn the particular meaning of the specific words used in Experiments 5 and 6 simply by attending to the contingencies of their use in caregiver speech. By six and nine months of age, infants likely have had extensive experience hearing their mother's name used uniquely for her and not for other women, but hearing "hand" and "ball"

used to label multiple members of these categories. The experiments presented here do not speak to whether infants learned the appropriate scope of the words under investigation by using an unconstrained analysis of the contingencies of these specific words' use by caregivers (and other speakers). The findings do, however, raise another possibility – namely, that infants learn the appropriate scope of these words by using a more constrained learning mechanism that operates in conjunction with conceptual biases related to different object types. That possibility will be discussed next.

First, recall that in Experiments 5 and 6, our goal was to examine infants' comprehension of labels that in the adult lexicon are proper names (i.e., "Mommy") and count nouns (i.e., "hand" or "ball"). Our experiments thus examined infants' understanding of a label for a person and a label for either a body part or an artifact. The tendency for *people* to have early-learned individual labels and the tendency for *body parts* and *artifacts* to have early-learned category labels may not be random. In the adult lexicon, there appears to be a relation between the lexical type of a label and the type of object which typically receives it. In particular, only certain types of objects – notably people –typically receive proper names (individual terms), and these objects are usually picked out by these words. In contrast, other types of objects – including body parts and artifacts – ordinarily do not receive proper names, and these objects are generally picked out by count nouns (category terms). The tendency for people to be labeled by proper names and for body parts and artifacts to be labeled by count nouns may reflect a bias to conceptualize objects of these types as individuals and as category members, respectively. If such a bias exists, it raises the possibility that infants' learning of different lexical types (proper names for individual objects; count nouns for object categories) is guided by differences in their conceptualization of objects.

If infants' object word learning is guided by a constrained statistical learning mechanism that operates in conjunction with conceptual biases about object types, they may naturally interpret some object-directed words as proper names (individual terms) and others as count nouns (category terms). For example, Hall (2009; see also Macnamara, 1982) has proposed that infants interpret words for people (and perhaps other agents) as proper names (i.e., terms for individual objects), since they may think of these entities as important as individuals in their own right; in contrast, infants may interpret words for other objects (including body parts and artifacts) as count nouns (i.e., terms for categories), because they may view these entities as being more-or-less interchangeable with other instances of the same category. According to this proposal, proper names in the early lexicon should tend to be words for people (and other agents), whereas count nouns should tend to be words for other types of objects, including body parts and artifacts.

There is evidence from work on older children's comprehension that supports the claim that object type may influence children assumptions about a label's referential scope. As discussed earlier, previous work has found that 16- to 17-month-olds interpret a novel label given to a novel face as a label restricted to an individual but extend the same novel label given to an artifact (e.g., a ball) as extendible across category members (Leung, 2011). Additionally, earlier work indicates that 2-year-olds have a bias to interpret a novel word for a person as having individual scope, whereas they will not make the same interpretation for a novel word for an artifact (Hall & Bélanger, 2009). Specifically, 2-year-olds interpreted a novel word presented as a proper name for a doll (i.e., a human surrogate) as being restricted to that doll but failed to interpret the same novel proper name for a toy airplane as restricted to that individual airplane. Further work has similarly found that toddlers interpret novel proper names for human surrogates

and familiar anthropomorphized stuffed animals as having individual scope but do not do so for the same words given to various types of artifacts (Bélanger and Hall, 2006; Gelman & Taylor, 1984; Hall, 1991; Hall, Lee & Bélanger, 2001; Jaswal & Markman, 2001; Katz, Baker, & Macnamara, 1974; Macnamara, 1982).

The origin of the posited conceptual biases is unclear. It is possible that experience with language leads infants to conceptualize different types of objects differently. Infants may use a statistical mechanism whereby they learn the correlation between types of objects and the tendency for a word to label an individual or label a category. Moreover, this acquired correlation may then lead infants to conceptualize types of objects differently, guiding further word learning. Yet it is also possible that children conceptualize different object types (people, body parts/artifacts) in different ways from the outset of lexical development and that these construal differences drive them to interpret labels for entities of these types differently. For example, a number of researchers have proposed that infants possess a foundational core cognitive system which guides them to conceptualize agents (including people) differently than non-agents (see Carey & Gelman, 1991; Spelke, 2003). Several studies have found evidence which supports the claim that infants conceptualize agents differently than inanimate objects. For instance, infants expect agents to have goal-directed actions (Woodward, 1998), achieve goals through efficient means (Gergely & Csibra, 2003), and interact contingently with other agents (Johnson, Booth, & O'Hearn, 2001). Further work will be needed to determine whether there is a connection between infants' early conceptualization of objects and their early tendency to learn labels as individual or category terms – and how any such connection develops. In particular, further research is needed to examine infants' interpretations of novel labels on the cusp of word

learning and to establish whether infants use object type information to guide their word interpretations from the outset.

The results from our experiments suggest that young infants have words of two different lexical types in their earliest receptive vocabulary. Infants here restricted the name for their mother to her and did not extend it to an unfamiliar woman, but they extended the label for a body part or artifact from a familiar exemplar to another category member. These results are consistent with the possibility that infants understand these words as proper names (terms for individuals) and count nouns (terms for categories); however, the data do not rule out alternative possibilities. As discussed in Chapter 2, it is possible that infants understand the name for their mother as a term for a highly restricted object category, such as women of a highly similar appearance – and would extend it to another *highly similar* woman (e.g., a twin). It is also possible that young infants do not extend the words "hand" or "ball" across all instances of the category, though we included extension tests involving both more (in the case of "hand") and less (in the case of "ball") similar exemplars. Thus, while infants extend their early-understood words in distinct ways, we cannot conclude definitively that they understand the name for their mother as an individual label or that they understand the words "hand" and "ball" as categorical labels.

The preceding concern about infants proposed early comprehension of category terms is especially important to note since work by Bergelson and Aslin suggests that infants do not understand their early words in the same way as adults do (Bergelson & Aslin, 2017a; 2017b). In one recent study, Bergelson and Aslin compared six-month-old infants' ability to correctly match a word to a target object when the target object (e.g., a glass of milk) was paired with either a semantically related object (e.g., a glass of juice) or a semantically unrelated object (e.g., a car)

(Bergelson & Aslin, 2017a). In this study, infants looked more at the correct object when it was shown with a semantically unrelated object. The authors observed similar results in a study with 12- to 20-month-olds, in which they compared infants' looking behavior on trials where they presented a target word (e.g., "nose") or a semantically related word (e.g., "mouth") while showing two objects (e.g., cookie and nose) (Bergelson & Aslin, 2017b). In this study, researchers observed that from 12 to 20 months of age, infants looked increasingly more at the target object when hearing the target word and increasingly less at the target when hearing a semantically related word.

Bergelson and Aslin suggest that their results indicate that infants' first words are semantically underspecified. These findings raise the possibility that infants' early object category labels are not understood in the same way that adults understand these labels and that the scope of the object categories linked to these labels may be broader than those of adults (i.e., count nouns may be understood to extend to wider categories of semantically related objects). For instance, perhaps infants interpret the word "milk" as referring to a category that includes both milk and juice. Importantly, however, Bergelson and Aslin did not observe such semantic interference effects for all the words they examined. For instance, six-month-olds looked longer at the picture of a hand in response to the word "hand" (which we studied in Experiment 5) when the hand was paired with semantically related object (e.g., a foot) than a semantically unrelated object (e.g., a stroller) (Bergelson & Aslin, 2017a). Nonetheless, semantic interference effects were observed for the majority of word-object pairs, for both six-month-olds and 12- to 20-month-olds. Although further research is needed to establish the semantic scope of and relations between infants' early words, this work raises the possibility that some of infants' early words may not have the same semantic representations as those in the adult lexicon.

In summary, Experiments 5 and 6 demonstrated that the same infant at a single stage in development comprehends both a word (the name for mother) with individual scope and a word ("hand" or "ball") extendible across category members. In Experiment 5, the evidence for this claim came from six-month-olds who are at the very outset of lexical development. We were further able to replicate and extend these findings in nine-month-olds. This work stands as the first demonstration that infants of six and nine months have words of two different lexical types in their lexicon.

4 Chapter 4: Infants' Comprehension of Different Lexical Types for the Same Object

4.1 Introduction

In Experiments 5 and 6, we examined whether infants at an early stage of lexical development comprehend both a word for an individual object (i.e., a proper name for their mother) and a word for an object category (i.e., a count noun for either hand or ball). The results from those experiments were consistent with the *narrow-and-broad* account of word learning which posits that young infants have the capacity to acquire both lexical types from the beginning of language development (Hall, 2009; Macnamara, 1982). Experiment 7 goes an important step further beyond Experiments 5 and 6 by asking whether infants have the ability to learn both an individual term and a category term *for the same object*. In other words, Experiment 7 assesses whether infants have the same capacity for lexical learning studied in Experiments 5 and 6, along with the additional capacity to flexibly understand two words with distinct referential meanings for the very same object. This flexibility is a hallmark of the adult lexicon —we have the capacity to talk about the same object in myriad ways. For example, we can speak of our pet dog as Fido or as a dog, among many other possibilities. Experiment 7 examined whether 12- to 15-month-old infants understand both a word with an individual scope and a word with a categorical scope for their family pet (i.e., dog or cat).

Although previous work has not examined young infants' ability to learn both an individual label and a categorical label for a single object, several studies have examined toddlers' and preschoolers' ability to learn two words for one object. As will be discussed, the prior work has assessed toddlers' ability to learn multiple labels for a single object, and work with preschool-aged children has found evidence supporting the claim that children are capable of learning both a proper name and a count noun for the same object. Experiments demonstrating children's

ability to learn multiple labels for single object have commonly used one of two methodologies: One involves explicitly assessing children's comprehension of two labels for the same object, and the other involves assessing children's comprehension of one novel label for a familiar object with a known category label (e.g., learning a novel word for a dog where it is assumed that the child understands the word "dog"). The following paragraphs will describe both lines of evidence.

To date, the youngest age at which there has been a clear demonstration of the ability to learn two labels for the same individual object is 24 months. Taylor and Gelman (1989) probed children of this age for their interpretation of a familiar common noun ("car" or "bear") *and* a novel label (e.g., "fep") for a target artifact (i.e., a car) or an animal (i.e., a bear). Children were presented with two pairs of objects – two similar artifacts and two similar animals (two similar cars and two similar bears), or two dissimilar artifacts and two dissimilar animals (two dissimilar cars and two dissimilar bears). Whether infants were presented with the similar objects or dissimilar objects, children appeared to interpret the *familiar* common noun ("car" or "bear") as a category label that extended to both category members. Their interpretation of the *novel* label was different. Those children who viewed the two similar artifacts appeared to generalize the novel label to both category members; however, those who viewed two dissimilar artifacts appeared to restrict the label to the target object. These results suggest that toddlers interpreted the novel word for the artifact as a subcategory term (i.e., a subordinate-level count noun). In contrast, the children who viewed the animals restricted the novel label to the originally named animal regardless of whether they viewed the two similar-looking object pairs or the two dissimilar-looking object pairs. Children thus appeared to interpret the novel label for the target animal as a label with individual scope (i.e., a proper name). This work demonstrates that by 24

months of age, children are capable of learning multiple labels with different referential scope for a single object. Moreover, the findings from the animal condition are consistent with the possibility that they can learn both a label with categorical scope and a label with individual scope for the same animal.

Further work has demonstrated that the preceding capacity is not limited to learning a single novel word for a familiar object. Specifically, 25-month-olds appear to be able to learn two *novel* labels with different interpretations for a single novel object (Waxman & Senghas, 1992). In this study, when children were shown two similar objects (e.g., Object A and Object B) and taught a novel count noun for one of the objects (e.g., Label A for Object A); they interpreted this word as a category term extendable to both objects. When a second novel count noun was then taught for the previously unlabelled object (e.g., Object B), infants restricted this label to the newly labelled object (e.g., Object B). These results are consistent with children's interpreting the first label as a category label and second label as a word with restricted scope (e.g., a label for a subcategory or individual) for the same object (Waxman & Senghas, 1992). The work demonstrates that young toddlers have the capacity to learn two novel labels for a single artifact (i.e., a basic-level category label and a subcategory-level label). Moreover, this work provides evidence that by 25 months of age children can learn two novel labels with different referential scope for the same object.

The preceding studies demonstrate that young 2-year-olds can acquire two labels for one object – one that extends across object category members (a category term) and one that is restricted to a single target object (a subordinate category term or an individual term). A recent study of somewhat younger toddlers' comprehension of two labels for one object raises the possibility that even these younger children may be capable of learning both a word that extends

across object category members (a category term) and a word that is restricted to a single object, picking out a property (Kandhadai, Hall, & Werker, 2016). In this study, 18-month-old monolingual English-learning toddlers (bilingual results not discussed here) were familiarized with the words "cat" and "dog" while viewing a purple cat and an orange dog, respectively. Children were then shown a teal-coloured dog paired with a novel word (i.e., "zabe"). To assess whether toddlers interpreted the novel label as a term for a property (the colour, teal) of the labelled dog, they received two types of test trial: an across-category trial, followed by a within-category trial. On each trial, infants heard the test word uttered twice preceded by an attention-getting sound (e.g., "Ah! X! Oo! X!"). On the across-category test trial (e.g., shown a teal cat and a purple dog), toddlers extended the word to the teal cat, an extension that suggested a property interpretation of the word. These results were not, however, robust: Toddlers showed this behaviour only in response to the second of two repetitions of the novel label. Moreover, toddlers did not appear to interpret the novel label as a property term on the within-category test trial (where they saw a teal dog and an orange dog), leaving questions about their interpretation of the novel label. The results suggest that children's ability to learn a novel property (colour) term is tenuous at this age. Finally, toddlers were shown a dog and cat, and their interpretation of the familiar category labels "dog" and "cat" was assessed. On across-category trials, infants appeared to extend the words appropriately to the dog and to the cat, respectively. Together, these findings suggest that 18-month-olds are capable of learning two words for the same object (a cat) – both a count noun that does not extend to a member of another category and an adjective for one of its salient properties.

The preceding evidence of toddlers' ability to learn two words differing in scope for the same object (Taylor & Gelman, 1989; Waxman & Senghas, 1992; Kandhadai et al. 2016) has not

focused specifically on cases involving an object category label (count noun) and an individual object label (proper name); however, there is some evidence of the ability to learn words of these two lexical types for one object from prior work examining toddlers' ability to learn a novel proper name for a familiar object for which children already know a category label. Although this work did not explicitly assess children's understanding of the familiar category label, it suggests that children have the ability to learn both an individual object term and an object category term for one object. In one study with 30-month-olds, children saw a stuffed cat that was introduced either with a category label (i.e., "this cat") or with no label (i.e., "this one") (Hall, 1991). The experimenter then labelled the cat with a novel word, "Zav", modeled as a proper name (e.g., "See? This is Zav"). To assess toddlers' understanding of the novel label, the experimenters presented infants with the named animal alongside an animal from the same category (i.e., a same-looking cat with different clothing), a familiar animal from a different category (i.e., a rabbit) and an unfamiliar animal (i.e., a stuffed monster). Toddlers restricted the novel word to the labelled object, consistent with interpreting it as an individual term (a proper name). This work provides evidence that by 30 months of age, children can learn a label with individual scope for an object with a known label with categorical scope.

The results of the preceding study are consistent with those of studies involving older children. For example, in one study one group of 3- and 4-year-olds saw an image of a familiar animal and heard a novel word introduced with syntactic framing that was consistent with either a proper name or an adjective interpretation (e.g., "This bird is ZAVY") (Hall, 1994). Children then saw five images: the labelled animal (e.g., a bluetit-like bird with fluorescent multicoloured circles on it), a subordinate category member (e.g., a bluetit-like bird with different colouration), a basic category member (e.g., a cardinal-like bird), a property matched object (e.g., a bottle with

fluorescent multicoloured circles on it), and a distractor object (e.g., an apple). To assess children's understanding, an experimenter asked whether the novel word applied to each image (e.g., "Is this bird ZAVY?"). Children extended the label to the target animal but not to any of the other images. Children's responses were thus consistent with their interpreting the novel word for the target animal as an individual term for the labelled object (a proper name). In contrast, another group of children saw an analogous set of images involving an artifact target (e.g., a shoe with fluorescent multicoloured circles on it). These children extended the label to both the target object and the other object that matched the target in terms of the salient property (e.g., the bottle with fluorescent multicoloured circles on it). Thus, children who saw an artifact target appeared to interpret the novel label as a term for a salient property (an adjective). The findings from this study and the preceding study indicate that children are able to learn a label with individual scope for a familiar object for which they (presumably) already know a category label. Together this work supports the claim that toddlers are capable of learning two words – one with categorical scope and one with individual scope – for the same object.

In the current work, we sought to determine whether infants younger than those studied in prior work have the ability to learn two words with different extensions for the same object – one with scope over an individual object and one with scope over an object category. The findings from Experiments 5 and 6 indicate that young infants can learn a label with individual scope and a label with categorical scope for two different objects. Our approach was similar to the one taken in the previous experiments – namely; we focused on assessing infants' comprehension of familiar words in their early lexicons. Pets (e.g., dogs and cats) are perhaps the first objects for which many young infants appear to know both a count noun and a proper name. For example, parents report that both proper names (e.g., "Fido") and count nouns (e.g., "dog") for family pets

appear the infants' productive lexicons early sometime during the second year of life (15 to 24 months old) (Macnamara, 1982; Nelson, 1973). Although it is unclear from these reports whether infants comprehend these words as labels with individual scope and categorical scope, the existence of these words in the early lexicon indicates that young infants soon after their first birthday may be able to learn both a label with individual scope and a label with categorical scope for the family pet. The goal of Experiment 7 was to determine whether this is the case.

4.2 Experiment 7

The work carried out in Experiments 5 and 6 suggests that young infants are able to learn both labels for individuals and labels for categories, but the findings leave open the question of whether young infants can learn words of these lexical types for a single object. Previous work has shown that by two years of age, children are able to learn multiple labels with different referential scope for a single object (e.g., Gelman & Taylor, 1989; Kandhadai et al., 2016; Waxman & Senghas, 1992). Moreover, work with toddlers and preschoolers has demonstrated support for the claim that toddlers and preschoolers can learn an individual label for a common animal for which children already have a category label (Hall, 1991; 1994). Yet parental reports suggest that infants may be able to learn words with both individual and categorical scope for the same object by the start of the second year– specifically both a proper name and a count noun for their family's pet (Macnamara, 1982). Assessing infants' comprehension of familiar labels for their own pets may thus offer insight into their earliest capacity to learn words of both lexical types for one object.

In this experiment, we tested whether 12- to 15-month-old infants comprehend both a label with individual scope (a proper name) and a label with categorical scope (the word "dog" or "cat") for their family's pet dog or cat. At 12 months of age, parental report data indicate that

approximately 50% of infants understand the labels "dog" and "cat"; at 15 months, the data suggest that the percentage is approximately 70% (Frank et al., 2016). Since we tested only infants who had a pet dog or cat at home, we expected that these parental report data underestimate the percentage of infants in our sample who had some understanding of these count nouns. In addition, we expected that these infants would have had extensive exposure to a proper name for their pet and thus also have some comprehension of it.

4.2.1 Methods

4.2.1.1 Participants

To participate in the experiment, infants had to have lived with a dog or cat since their birth. We adopted this criterion to ensure that all infants included in the experiment were familiar with their family pet. We also included only infants whose parents reported that their child heard both the individual name and category label in reference to their family pet. Those infants whose parents reported only using one label for their pet were not included in the study since we wanted to ensure that the words presented in the study were familiar to all infants.

Participants were 48 English-learning infants between 12 and 15 months of age. We recruited twenty-four younger participants between the ages of 12 and 13.49 months (*M* = 12 months 29 days, *SD* = 11 days) and older twenty-four participants between the ages of 13.51 and 15 months (*M* = 14 months 9 days, *SD* = 13 days). Within each of these groups, we recruited 12 infants who lived with dogs and 12 infants who lived with cats. In addition to the 24 younger infants, we additionally recruited five infants who were excluded from the analysis due to fussiness (n = 2), distraction by a toy (n = 1) and equipment error (n = 2). In addition to the 24 older infants, we additionally recruited eight infants who were excluded from the analysis due to fussiness (n = 4) and experimenter error (n = 4). A power analysis revealed that the sample size

needed to detect the mean effect reported by Kandhadai et al. (2016) for infants' preference to look at the target object (e.g., a dog) over a different category member (e.g., a cat) in response to hearing the familiar count noun (e.g. “dog”) (d = .72) at alpha = .05 and a power of 80% was 18 participants. Although our infants were younger than those in Kandhadai et al., we believe that our sample of 48 infants gave us an adequately powered experiment.

4.2.1.2 Stimuli

Prior to arriving in the lab, parents were asked to email our centre a photo of their family pet. Parents were asked to take a photo of their pet standing up, with its body in profile to the camera, head turned towards the camera, and entire body visible. Pilot data showed that dog-owning families were able to satisfy these criteria in most cases, but some cat-owning families had difficulty in taking pictures with the cat standing up. As a result, we accepted photos of sitting cats. Upon receiving the pictures of pets, a researcher paired each pet with a contrastive within-category (within-breed) animal (for within-category trials) and an across-category animal (for across-category trials; if the pet was a dog, this animal was a cat; if the pet was a cat, this animal was a dog). The animals paired with the pets on both within-category and across-category trials were always chosen to be visually distinctive from the pets. In all cases, the paired animals differed from the pets in fur colour. For example, if a participant’s pet was a black poodle, then the within-category match may have been a white poodle, and the across-category animal may have been a brown cat. Finally, for parents who did not report a clear breed for their cat (e.g., a short-haired cat of no obvious breed), we selected the within-category animal based on its appearance as judged by the researcher (e.g., its comparable size, fur length, coat pattern) rather than breed.

The auditory stimuli were produced live into a microphone during the experiment by an experimenter located in an adjacent room, as in Experiment 1. The auditory stimuli were produced live rather than via a recording because in this study children heard the proper name for their pet. These names varied widely across pets. The category words for the dogs in this experiment were "dog" (n = 14), "doggy" (n = 7), and "puppy" (n = 3). The category words for the cats in this experiment were "cat" (n = 15), "kitty" (n = 7), "kitty cat" (n = 1), and "pussy cat" (n = 1). Each pet had a unique name such that none of the infants heard the same proper name. The names for dogs were "Judo", "Jakey", "Izzy", "Riley", "Jersey", "Twinkles", "Buster", "Harv", "Rex", "Justice", "Cheddar", "Tux", "Harriet", "Lucy", "Danie", "Louie", "Piki", "Avon", "Bean", "Dexter", "Vince", "Stoke", "Woogie", and "Al". The names for cats were "Gin", "Misha", "Dex", "Alice", "Edith", "Rookie", "Tiki", "Meadow", "Buddy", "Luc", "Lydia", "Phoebe", "Edgar", "Chairman", "Poppy", "Bandit", "Wu", "Milly", "Earl", "Juby", "Hania", "Toby", "Cavier", and "Scrape".

4.2.1.3 Procedure and Analyses

Prior to beginning the task, parents were asked to complete the MacArthur Short Form Vocabulary Checklist: Level I (Fenson et al., 1993). Additionally, a trained researcher verbally administered to parents a short questionnaire analogous to the questionnaire used in Experiment 1 except that this questionnaire included questions pertaining to the family pet. The questionnaire included a section asking how many waking hours the family pet spent with the infant in an average week and whether the child understood the name for their pet and the count noun for their pet's basic category (i.e., "dog" or "cat"). See Appendix F for the complete questionnaire.

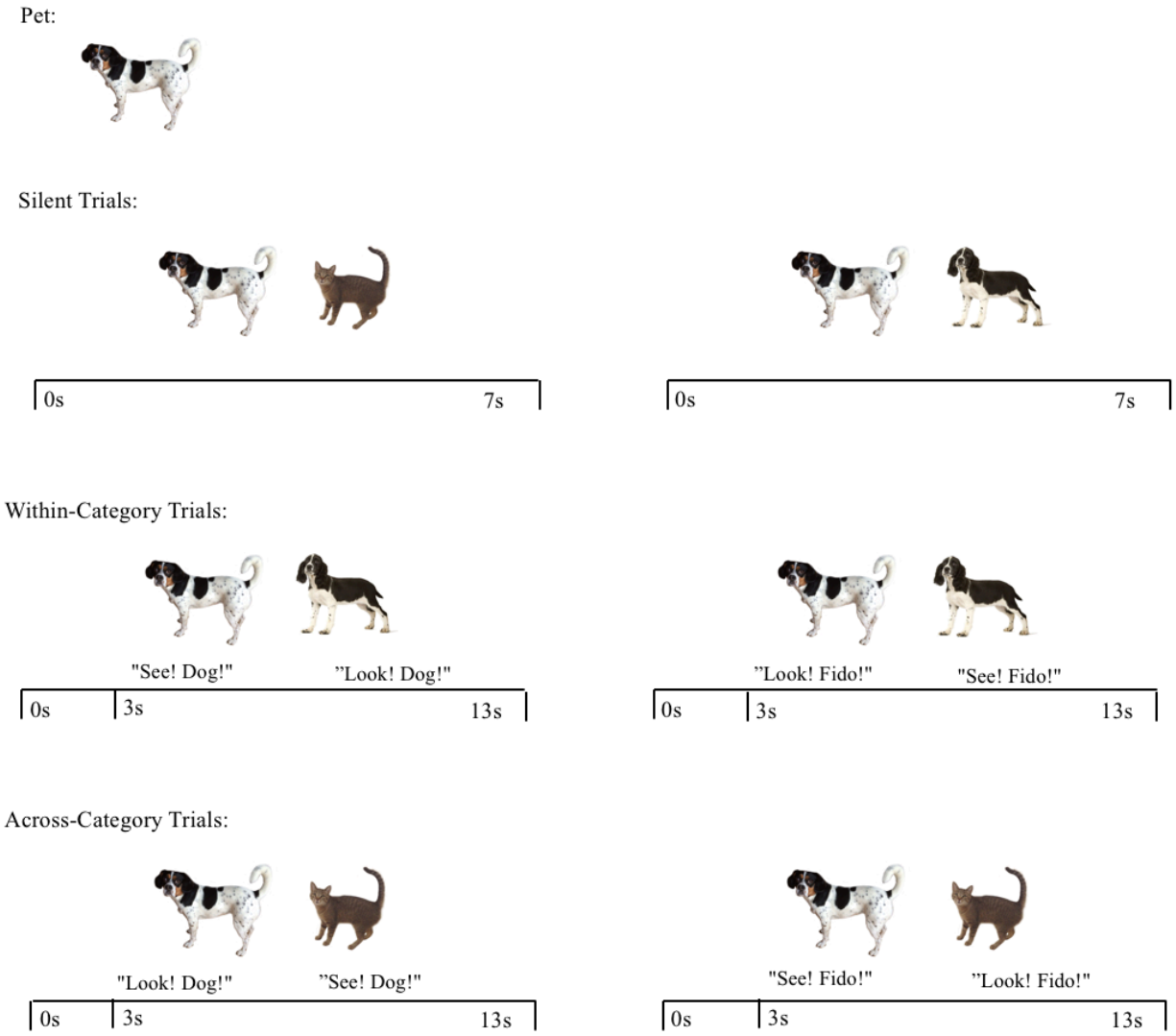
In the experiment, infants watched a short video to allow us to assess their understanding of two labels for their pets—both the proper name and the count noun. Infants sat on their

caregivers' lap in front of a television screen that displayed the video. The procedure in Experiment 7 included elements from previous studies which have examined infants' comprehension of multiple labels within a single experiment (Kandhadai et al., 2016, Experiments 5 and 6 of this dissertation). The experiment consisted of three blocks: *silent block*, *count noun block*, and *proper name block*. Like our previous experiments, we included separate blocks to assess each label (Experiments 5 and 6 of this dissertation); however, we did not include a *baseline block* in this experiment (Kandhadai et al., 2016).

The *silent block* always came first, but the order of the *count noun block* and *proper name block* was counterbalanced. Each block consisted of four trials: two across-category trials where infants viewed their family pet paired with an animal of a different category (e.g., pet dog with cat), and two within-category trials where infants viewed their family pet paired with a different animal of the same category (e.g., pet dog with a dog of a different breed). The order of these four trials was randomized within each block. The *silent block* trials lasted seven seconds and were used to acquaint the infant with the novel animal exemplars. We made these trials shorter than the trial lengths used in the previous infant studies presented in this dissertation because the purpose of these trials was merely to familiarize infants with the images used in the experiment, not to assess comprehension. Both the *count noun block* trials and the *proper name block* trials were 13 seconds long. We extended these trials from the length used in the previous infant experiments since we included a three-second silent phase (included in both the *count noun block* trials and the *proper name block* trials) prior to any naming. There were four unique visual presentations (i.e., two pairing types – pet on the left of the screen, and pet on the right of the screen) within each block, and we wanted to give infants an initial three seconds to process the visual information before presenting any labels. The first three seconds of the trials on these two

blocks were silent, and in the last ten seconds, infants heard a label (i.e., a proper name or a count noun) embedded in a carrier phrase, presented twice. The two phrases presented on each trial were "Look! (count noun/proper name)!" and "See! (count noun/proper name)!". We used carrier phrases beginning with the word "Look!" or "See!" to help keep infants engaged in the experiment. We did not provide any linguistic cues to distinguish the count noun and proper name (for similar designs, see Kandhadai et al., 2016; Waxman, Lidz, Braun, & Lavin, 2009; Havy & Waxman, 2016; Waxman & Braun, 2005). An experimenter in a separate room from the infant spoke the auditory stimuli live through a microphone connected to speakers that were in front of the infant, as in previous experiments. Infants heard the category label for their pet that was reported by parents to be the most frequent category term used for their pet. The researcher speaking the labels could see the experimental presentation but not the infant. The experimenter used a stopwatch to space the repetitions of the auditory stimuli appropriately on each trial. Between each trial in the experiment, infants saw a video of a colourful spinning wheel which served to maintain their attention throughout the study. Once an infant fixated on the colourful wheel, an experimenter began the next trial. See Figure 1.17 for the trial structure.

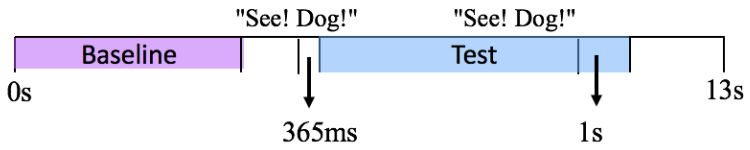
Figure 1.16 Example of Trial Structure for Experiment 7 (Dog Group)



During the experiment, infants' eye gaze was recorded by a small camera located in front of the infant. To statistically account for infants' visual preferences to look at one animal over the other unrelated to word processing, we divided the test segment into two sub-segments: The baseline segment and the test segment (Kandhadai et al., 2016; Shukla, White & Aslin, 2011, Weatherhead, & White, 2015). The baseline segment was defined as the initial part of each trial before the audio stimuli began. This baseline for each test trial was approximately three seconds

but varied slightly for each child because of the use of a live speaker. Recall that a live speaker timed the trials using a stopwatch and thus auditory timing varied somewhat from child to child. The test segment was measured from 365ms after the onset of the first repetition of the word to 1000ms after the offset of the second repetition of the word. Prior work has demonstrated that it takes infants about 365ms to respond to a spoken word (Swingley, 2009). Therefore eye gaze responses earlier than this time point are unlikely to be in response to a spoken word. We decided to determine our analysis window based on word onset and offset times rather than trial times because we used a live speaker and the timing of word utterances varied slightly across participants. Terminating the analysis window at 1000ms after offset ensured that infants' analysis windows did not include a long length of silence and instead focused on the time segment during which infants were hearing labels via the live speaker. See Figure 1.18 for an example of the baseline and test segments for a trial in the count noun block (dog group).

Figure 1.17 Trial Segments Used in the Analysis for Experiment 7



We calculated a proportional-looking-to-pet score for both the within-category and across-category trials on the *count noun block* and the *proper name block.* First, we calculated a proportional-looking-time-to-pet score for both the baseline segment and the test segment by taking the total looking time to an infant's pet and dividing this value by the total looking time to both animals (i.e., looking time to pet plus looking time to the other animal). Second, we subtracted the mean-proportional-looking-time-to-pet during the baseline segments from the mean-proportional-looking-time-to-pet during the test segments that involved the presentation of

a label. We called this difference score a baseline-corrected target looking score. A positive baseline-corrected target looking score indicated an increase in looking time to the pet on test segments (when infants heard a label) compared to baseline segments (when they heard no label). We attributed a category interpretation of a label to the infant if the baseline-corrected target looking score was positive on the across-category trials but not different from zero on the within-category trials. We predicted that infants would show this interpretation of the category label presented in the *count noun block*. We ascribed an individual object interpretation of a label to the infant if the baseline-corrected target looking score was positive on both the across-category trials and the within-category trials. We predicted that infants would show this interpretation of the labels presented in the *proper name block*. See Figure 1.19 for the formulae used to calculate baseline-corrected target looking scores.

Figure 1.18 Baseline-Corrected Target Looking Score Formulae for Experiment 7

Within-Category Trials: Baseline-Corrected Target Looking Score for the name or category label for the pet

$$\left(\frac{\text{Looking time to the picture of pet in the test segments}}{\text{Total looking time to pictures of pet and within-category animal in the test segments}}\right)$$

$$-\left(\frac{\text{Looking time to the picture of pet in baseline segments}}{\text{Total looking time to pictures of pet and within-category animal in the baseline segments}}\right)$$

Across-Category Trials: Baseline-Corrected Target Looking Score for the name or category label for the pet

$$\left(\frac{\text{Looking time to the picture of pet in the test segments}}{\text{Total looking time to pictures of pet and across-category animal in the test segments}}\right)$$

$$-\left(\frac{\text{Looking time to the picture of pet in baseline segments}}{\text{Total looking time to pictures of pet and across-category animal n the baseline segments}}\right)$$

4.2.2 Results

Prior to examining how infants' baseline-corrected target looking scores differed by word type and trial type, we first explored whether there were any differences in baseline-corrected target looking score by animal type. We did not predict any difference between infants' comprehension of labels for cats or dogs. We conducted a preliminary repeated-measures analysis of variance (ANOVA) of baseline-corrected target looking scores, with the word (proper name and count noun) and trial type (within-category and across-category) as within-subjects factors and animal type (dog and cat) as a between-subjects factor. There was no interaction between animal type and word, $F(1, 46) = 1.51$, $p = .226$, $\eta_p^2 = .03$, nor between animal type and trial type, $F(1, 46) = .126$, $p = .72$, $\eta_p^2 = .003$. Finally, we did not find a significant three-way effect between word, trial type and animal type, $F(1, 46) = 1.10$ $p = .299$, $\eta_p^2 = .02$. Since infants' baseline-corrected target looking scores were not affected by animal type, we conducted all further analyses without this factor.

Next, we conducted a repeated-measures analysis of variance (ANOVA) of baseline-corrected target looking scores, with word type (proper name and count noun) and trial type (within-category and across-category) as within-subjects factors and age (young, old) as a between-subjects factor. We found a significant main effect of word, $F(1, 46) = 4.36$, $p = .042$, $\eta_p^2 = .09$, and a significant main effect of trial type, $F(1, 46) = 8.88$, $p = .005$, $\eta_p^2 = .16$. However, we did not find a significant main effect of age, $F(1, 46) = .50$, $p = .48$, $\eta_p^2 = .01$. We also did not find significant two-way interactions between word and age, $F(1, 46) = 1.44$, $p = .236$, $\eta_p^2 = .03$, or between trial type and age, $F(1, 46) = .85$, $p = .361$, $\eta_p^2 = .02$. Yet we did find a significant two-way interaction between word and trial type, $F(1, 46) = 4.90$, $p = .032$, $\eta_p^2 =$

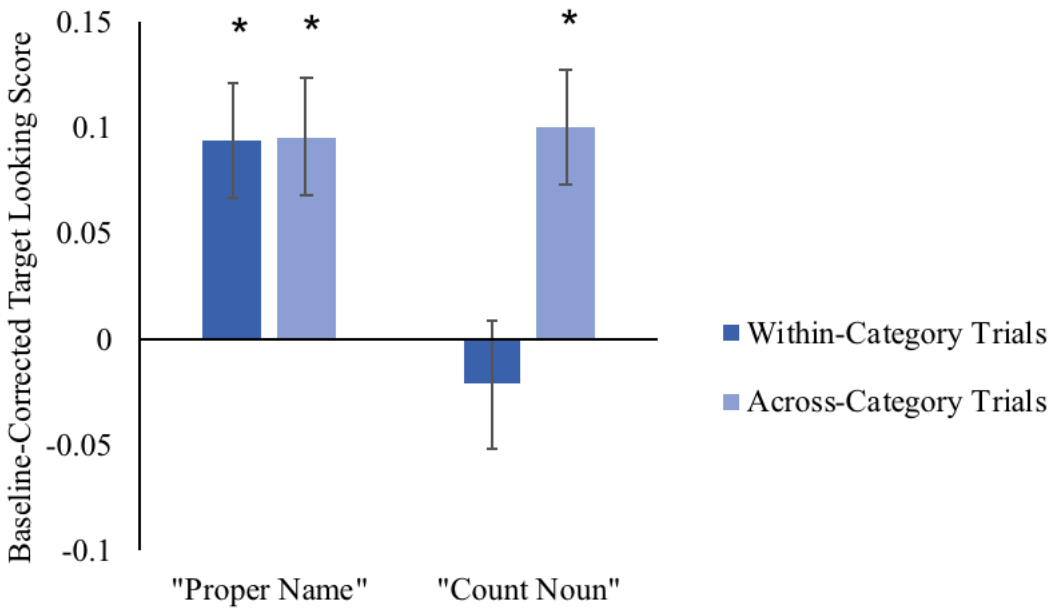
.10. Finally, we did not find a significant three-way effect between word, trial type, and age, $F(1, 46) = .41$ $p = .525$, $\eta_p^2 = .01$.

We followed up the significant two-way interaction between word and trial type by examining the results by word type separately. On the proper name trials, infants' baseline-corrected target looking scores did not significantly differ on the within-category trials ($M = .09$, $SD = .19$) and across-category trials ($M = .09$, $SD = .19$), $t(47) = -.14$, $p = .887$, 95% CI [-.07, .06]. On the count noun trials, infants' baseline-corrected target looking scores were significantly lower on the within-category trials ($M = -.03$, $SD = .17$) than on the across-category trials ($M = .10$, $SD = .16$), $t(47) = 3.50$, $p = .001$, 95% CI [.05, .20].

As in the previous experiments, we then further analyzed the baseline-corrected target looking scores for each word on the within-category and across-category trials. On the proper name trials, infants had significantly positive baseline-corrected target looking scores on both within-category trials, $t(47) = 3.24$, $p = .002$, 95% CI [.03, .17], and across-category trials, $t(47) = 3.30$, $p = .002$, 95% CI [.04, .15]. On the count noun trials, infants' baseline-corrected target looking score was not significant on the with-category trials, $t(47) = -1.04$, $p = .305$, 95% CI [-.07, .02], but it was significant on the across-category trials, $t(47) = 4.23$, $p < .001$, 95% CI [.05, .14]. See Figure 1.20.

Figure 1.19 Baseline-Corrected Target Looking Scores in Experiment 7

Infants' baseline-corrected target looking scores in response to hearing the proper name for their pet (e.g., "Fido") and the count noun for their pet (e.g., "dog") on within-category trials and across-category trials. Asterisks indicate a significant difference from chance, $p < .05$.



4.2.3 Discussion

In Experiment 7, we found evidence that infants as young as twelve months are capable of learning both a word with individual scope (a proper name) and a word with categorical scope (a count noun) for one object –their family's pet dog or cat. Specifically, we provided evidence that infants interpreted the proper name for their pet as a label for the individual pet and did not extend this label to either another animal of the same category or another animal of a different category. In contrast, the very same infants interpreted the basic count noun category label for their pet as extending from their pet to another animal of the same category but not to another animal of a different category. This work establishes that by twelve months of age, infants are

able to learn two labels with different referential scope for a single object. Our findings here are consistent with previous work which has shown that older toddlers can learn multiple words for a single object (Gelman & Taylor, 1989; Kandhadai et al., 2016; Waxman & Senghas, 1992). Our work is also consistent with previous studies that have reported finding that toddlers and preschoolers can learn both an individual label and categorical label for a single object (Hall, 1991, 1994). The work here, however, goes well beyond previous findings by demonstrating for the first time this ability at 12 months.

The findings from this experiment are consistent with the predictions put forth by the *narrow-and-broad* account of language development. Recall that this account of language development posits that from the outset of word learning, infants are capable of learning labels for individuals as well as for category members. In Experiment 5, we found support of this claim by demonstrating that six-month-olds on the cusp of word learning are able to learn words with differing referential scopes. In Experiment 6, we replicated and extended the findings to nine-month-olds. The results from Experiment 7 further replicate and extend these findings by demonstrating 12- to 15-month-olds' ability to learn labels with both individual and categorical scope in a more complex task in which both words apply to the same object.

In this experiment, we focused on infants' comprehension of labels for pets since previous research has demonstrated that older children are able to learn both an individual label and a category label for animals, particularly pets (Hall, 1991; 1994), and parents have reported that pets' proper names and category terms appear in the early infant vocabulary (Macnamara, 1982). We found that infants, like adults, appear to know both an individual label and a category label for their pet. One question raised by this discovery is whether infants' early knowledge of both types of words for their *pets* is a coincidence, or whether the knowledge reflects infants' ability

to conceptualize pets flexibly in ways that make it relatively easy for them to learn both individual labels and categorical labels.

As discussed previously, early object word learning may be guided by certain biases in the way in which infants conceptualize objects of different types (see Hall, 2009; Macnamara, 1982). Specifically, infants may naturally tend to construe objects of certain types (e.g., people) as individuals and objects of other types (e.g., body parts, artifacts) as category members. Infants may construe only some objects (e.g., people) as individuals because of their tendency to see these objects as agents who are important in their own right, often having social importance (e.g., Bloom, 2004; Carey, 2009). If learners possess such biases, they may tend to interpret labels for objects that are construed as individuals (e.g., people) as words with individual scope, whereas they may tend to interpret labels for objects that are viewed as category members (e.g., body parts, artifacts) as words with categorical scope. This possibility is consistent with the tendency in children's early lexicons for proper names to be words for people and for count nouns to be terms for body parts and artifacts (Nelson, 1973; Tardif et al., 2008). Yet is clear from the adult lexicon that any bias to view some objects (e.g., people) as individuals and others (e.g., body parts, artifacts) as category members is not a hard constraint: Obviously, we learn to speak and think about people as both individuals and category members (e.g., a man could be labelled either "John" or "a person"); and we are able to speak and think about artifacts as both category members and individuals (e.g., a ship could be labelled either "a ship" or "Titanic").

Given that the proposed conceptual biases are not inviolable constraints, it is possible that we understand objects as falling along a continuum–from those that we strongly conceptualize as individuals (e.g., people or perhaps more generally, agents) to those that we strongly construe as category members (e.g., artifacts). If this is the case, then some types of objects may fall

somewhere in the middle, being readily thought of either as individuals or as category members. Pets (e.g., dogs, cats) plausibly fall into this middle category. As animals, pets have agency, and their social importance may lead to their being viewed as important in their own right and thus construed as individuals (e.g., a dog may be construed as Fido); however, pets are not people, and many members of the same animal categories are socially unimportant, and thus easily construed as mere members of their category (e.g., a dog may be construed simply as a dog). Infants may thus infer that a word for a pet animal is either a label for the individual (proper name) or a label for the category (count noun).

The results from Experiment 7 are consistent with the idea that infants are able to construe their pet either as an individual or as a category member. Moreover, results from previous experiments examining toddlers' and preschoolers' comprehension of labels for stuffed animals support the claim that animals and especially pets – unlike artifacts – may be flexibly construed either as individuals or as category members. In a seminal study, Gelman and Taylor (1984) demonstrated that toddlers' assumptions about the scope of a novel word depend on the type of object being labelled (see also Macnamara, 1982). In this study, 2.5-year-olds were presented with four objects: two stuffed unfamiliar animals and two block-like toys. An experimenter labelled one of the objects with a novel proper name or a novel count noun and then, with all four objects within reach, asked children to perform a series actions with the referent of the novel word. Regardless of the type of object initially labelled, children appeared to interpret the novel count noun as having categorical scope. However, when experimenters labelled one of the objects with a novel proper name, toddlers interpreted the word as restricted to the originally labelled individual if it was animal, but not if it was an artifact (Gelman & Taylor, 1984). This work demonstrates that toddlers assign a different referential scope to a novel word depending on

the type of the object (animal or artifact). Specifically, children appear to interpret a novel word for an *animal*-like object as either a category term or an individual term but do not readily interpret the same word for a *block*-like object as an individual term.

Can infants younger than twelve months learn both an individual label and a categorical label for a pet? The results of Experiment 5 suggest that infants are capable of learning words of both these lexical types from the outset of lexical development. Furthermore, the parental reports from Experiment 7 indicate that children learned both the name of their pet and the category label of their pet well before their first birthday: Parents reported that the mean age at which children learned their pet's name was 9 months 17 days (SD = 2 months 22 days) and that the mean age at which they learned their pet's category label was 10 months 0 days (SD = 2 months 12 days). Although our parental report data do not speak to the question of whether infants younger than twelve months of age understand these words as labels with individual scope or categorical scope, the data are consistent with the possibility that infants have an earlier comprehension of these labels at between 9 and 10 months. Further work will be required to understand the age at which infants first gain the ability to learn two words differing in referential scope for the same object.

In summary, the results of Experiment 7 replicated the findings from Experiments 5 and 6 with a sample of 12- to 15-month-olds, revealing that infants are capable of learning both a word with individual scope and word with categorical scope for the same individual object. At the same time, the findings Experiment 7 extend the previous findings, indicating that as early as 12 months of age, infants possess the cognitive flexibility to be able to think about the same physical object in two distinct ways – as an individual and as a member of a category.

5 Chapter 5: Conclusions

A longstanding question in the study of language development concerns the referential nature of infants' first object words: Do these labels have individual or categorical scope? Recent research has established that infants show comprehension of several object words at around six months of age. Among these words are labels for people (e.g., "Mommy") and labels for body parts, artifacts, and foods (e.g., "hand," "ball," "banana") that would be classified as proper names (i.e., words with individual scope) and count nouns (i.e., words with categorical scope) in the adult lexicon. Yet the referential scope of these labels for young infants has not yet been clearly established (e.g., Bergelson & Swingley, 2015). The experiments in this dissertation explored the nature of infants' earliest object word comprehension, with a particular focus on whether these terms have individual scope or categorical scope.

5.1 Summary of Results and Implications

The infant's early lexicon contains words that are proper names and count nouns in the adult lexicon; however, it is unclear whether these terms are labels for individuals and category members, respectively. The *narrow-and-broad* account of lexical development proposes that infants can learn both words for object categories (i.e., count nouns) and words for individual objects (i.e., proper names) from the outset of development (Hall, 1999; Macnamara, 1982). Although previous work has found evidence of object word comprehension by six months of age, prior research has not focused in detail on whether infants understand their earliest words as labels for individuals (i.e., proper names) and as labels for categories (i.e., count nouns) (Bergelson & Swingley, 2012, 2015, 2017; Tincoff & Jusczyk, 1999, 2012). The experiments in this dissertation attempted to fill this gap in the literature by examining the nature of infants' comprehension of their early proper names and count nouns.

Experiments 1 to 4 examined the nature of six-month-olds' understanding of proper names. Specifically, these experiments assessed whether infants restrict the name for their mother to their individual mother and refrain from extending this name to other people. Across these experiments, we also examined infants' comprehension of names for other familiar individuals (the child's father, the child's grandmother, the child's maternal aunt, the child's mother's female friend). The findings support the claim that infants understand the name for their mother as a word with individual scope. Six-month-old infants do not appear to extend this word to a range of other familiar or unfamiliar adults – men or women, old or young. Thus, infants' early name for their mother appears to have scope over an individual object rather than an object category. We also found clear evidence that infants of this age understand of the name for their father (cf. Jusczyk & Tincoff, 1999) and some evidence of comprehension of the name for the maternal grandmother among infants who had extensive exposure to her. We also found no evidence that infants' tendency to restrict the name for mother to her alone is related to the mothers' similarity to the other people we studied. Together, these findings significantly bolster the claim that infants on the cusp of word learning can acquire an understanding of object words with individual scope.

Experiments 5 and 6 helped to further elucidate the nature of infants' earliest object word comprehension by examining whether they comprehend *both* words with individual scope *and* words with categorical scope from the outset of lexical development. As noted, the *narrow-and-broad* account of language learning posits that at the beginning of word acquisition infants have the capacity to learn individual labels and category labels. In these experiments, we examined whether six- and nine-month-olds comprehend both words with individual scope (i.e., a proper name for their mother, such as "Mommy") and words with categorical scope (i.e., the count

nouns "hand" and "ball"). The results provide further evidence that young infants comprehend the label for their mother as a word for an individual object. Moreover, the findings offer support for the claim that infants understand the words "hand" and "ball" as having categorical scope. Together these findings suggest that infants at the earliest age at which there is evidence of object word comprehension have the capacity to learn both labels for individual objects and labels for object categories.

Experiment 7 extended the findings from the previous experiments by examining whether 12- to 15-month-olds can learn *both* an individual term *and* a category term *for the same object.* In Experiment 7, we assessed infants' understanding of both the proper name for their pet (e.g., "Fido") and the count noun for their pet (e.g., "dog"). The results indicate that by 12 months of age, infants are able to learn two words with distinct referential scope for the same individual object – our infants understood the proper name as restricted to the individual pet but comprehended the count noun as extending to another category member. These findings provide the first demonstration that by their first birthday children have the linguistic capacity, coupled with the conceptual flexibility, to acquire two words (with different extensions) for the same object.

By offering new evidence about the nature of infants' earliest object label comprehension, these results provide insight into the linguistic and conceptual capacities of infants at the cusp of word learning. The following discussion explores in greater depth the implications of the findings. First, the discussion will focus on the implications of the finding that infants' initial word-learning capacities are richer than previously believed – specifically, that they include the ability to acquire object words with individual scope and categorical scope. Next will come a discussion of what infants' early words may tell us about their natural conceptualization of

objects that come from different types of categories. The findings that infants understand words for people as having individual scope and words for body parts and artifacts as having categorical scope may reflect infants' default conceptualization of some objects as individuals and others as category members. Third, there will be a discussion of how the preceding conceptualization differences may, in turn, help to explain how infants learn the grammatical distinction between proper names and count nouns. Finally, we will discuss how the discovery that infants can acquire their first words at six months of age fits into the larger context of language development. Specifically, we will discuss the implications of the fact that infants are acquiring their first words at about the same age at which they are acquiring knowledge about the sound properties of their language.

5.1.1 Referential Scope of Infants' Early Words

The data from the experiments presented here provide evidence consistent with the *narrow-and-broad* account of language development. Recall that this account posits that infants have the capacity to learn both labels for individuals and labels for categories from the outset of word learning. This account stands in contrast to the *narrow-to-broad* accounts of empiricist philosophers like John Locke (1689) who have suggested that infants first interpret all words as labels for individuals and only later gain the ability to learn labels for category members. Moreover, the account also contrasts with the *broad-to-narrow* accounts of developmental psychologists like Waxman and Booth who have proposed that infants first assume that all words have broad links to groups of objects (e.g., Waxman & Booth, 2003b). Through several experiments, we found support for the claim that infants do not assume that all labels are terms for individuals nor do they assume that all labels are expressions for category members.

In the experiments in this dissertation, six-month-old infants appeared to be able to learn both words with referential scope restricted to individual object and words with referential scope over an object category. In Experiments 1 to 3, we found evidence that six-month-old infants understand the label for their mother as a label for an individual person. Moreover, in Experiment 4 we found that infants' tendency to restrict the label for their mother to her alone in each of our experiments was not related to her perceptual similarity to other people. Although we cannot rule out the possibility that infants would extend this label to highly similar people (e.g., to the twin of their mother), we did not find any evidence that infants interpreted these labels as labels for categories that included their caregiver and another person. Moreover, in Experiment 5, we found evidence that six-month-olds can learn both labels with individual scope and labels with categorical scope. Specifically, we found evidence consistent with the claim that six-month-olds interpret the name for their mother as restricted to her alone and interpret the word "hand" as extending from the infant's own hand to another hand. This research provides support for the claim that from the earliest stages of word learning infants comprehend labels with both individual scope and labels with categorical scope.

To the extent that infants begin to comprehend object labels at six months of age, the work presented here supports the claim that infants understand both labels with individual scope and labels with categorical scope from the outset of word learning. To date, there is no evidence that infants prior to six months of age comprehend object labels. If future work establishes that infants younger than six months of age understand any object labels, then it will be important to determine whether they comprehend these words as having individual scope or categorical scope in order to tease apart the predictions of the *narrow-to-broad*, *broad-to-narrow,* and *narrow-and-broad* accounts.

Although it was known from earlier work that infants around six months have some comprehension of labels for people (Tincoff & Jusczyk, 1999) and words for port parts, artifacts, and foods (e.g., Bergelson & Swingley, 2012), previous work left it unclear whether infants understood these as labels with individual scope and labels with categorical scope, respectively. Our work here is the first to demonstrate that infants' lexicon appears to have words with these distinct referential scopes. The results from the experiments in this dissertation argue against the view that infants are universally conservative word learners, who initially assume that all object labels are labels for individuals. At the same time, the findings indicate that infants do not exclusively use a generalization strategy, initially assuming that all object labels are labels for categories. From the outset of word learning, infants instead appear able to learn object words with different lexical scopes. The findings from the experiments have potential implications for infants' conceptual and linguistic development. Each of these topics will be discussed further in the following sections.

5.1.2 Conceptualization of Object Types

Infants' interpretation of an object label as a word with individual scope or a word with categorical scope indicates an underlying conceptualization of that object either as an individual or as a member of a category. As has been previously discussed in this dissertation, the current work and prior work suggests it may not be arbitrary that individual scope labels in the early lexicon tend to be words for people, while early categorical scope words tend to be words for body parts, artifacts, and foods (Macnamara, 1982; Nelson, 1973). This section will discuss how infants' object word learning may reflect systematic differences in the way they conceptualize objects of different types.

First, recall that the focus of this dissertation was on the referential scope of infants' *actual* earliest understood object words. Specifically, we sought to examine whether infants *actually* understood both labels with individual scope and labels with categorical scope. To this end, we selected for investigation object labels which are proper names and count nouns in the adult lexicon. In Experiments 1 to 4, we sought first to clarify infants' comprehension of the names for their caregivers – in particular, for their mother – and other familiar people. Here we established that infants appeared to understand these names as words with individual scope. In Experiments 5 and 6, we found evidence that infants understood the names for their mother as individual terms but comprehended the count nouns "hand" and "ball" as categorical terms. Finally, in Experiment 7, we explored whether infants can comprehend both a word with individual scope and word with categorical scope for the same object. For this investigation, we studied words for pets (dogs, cats) since these objects often receive both a proper name and count noun in the adult lexicon. The results indicated that infants can learn both an individual label and categorical label for their pet. Across all experiments, then, we found evidence that infants knew words with individual scope for people; words with categorical scope for body parts and artifacts; and words with both referential scopes for their family pet. This pattern of people being labelled with individual terms, artifacts and body parts being labelled with categorical labels, and animals (pets) being labelled with both referential types may not be random.

It may not be accidental that early-learned labels for *people* are individual terms; that early-learned labels for *body parts* and *artifacts* are category terms, and that early-learned labels for *animals (pets)* are both individual and category terms. Instead, it is possible that infants have a bias to view people as entities that are important as individuals in their own right but to view body parts and artifacts as entities that are interchangeable with other instances of the category

(Hall, 2009; Macnamara, 1982). As a result, infants may naturally interpret words for people (and perhaps other agents) as having individual scope; in contrast, they may naturally interpret words for other objects (including body parts and artifacts) as having categorical scope. If this is the case, then we might expect that words for individuals in the early lexicon would tend to be labels for people (and perhaps other agents), whereas words for object categories would tend to be labels for other sorts of things, such as body parts, artifacts, and food. This prediction is supported by parental reports of the composition of infants' early productive vocabulary (Fenson et al., 1994; Nelson, 1973; Tardif et al., 2008). Furthermore, experimental work with older infants supports the claim that infants are sensitive to the type of object being labelled when learning new words. Specifically, 16- and 17-month-olds appear to assume that a novel label for a human face is a label that is not extendable to another face, whereas they assume that the same novel label for an artifact (e.g., a ball) is extendable to other artifacts of the same category (Leung, 2011). This work supports the claim that infants are sensitive to information about an object's type; that they tend to conceptualize objects of some types as individuals and objects of other types as category members; and that these conceptualizations guide their interpretations of words for these objects. As described earlier, people may be more readily thought of as individuals and objects like artifacts may be more readily thought of as interchangeable instances of a category. Our work presented here is consistent with the possibility that conceptual biases thus lead infants to interpret words for people (and perhaps other agents) as proper names for individuals, and words for other objects (like artifacts) as count nouns for categories.

If objects fall along a continuum from those that are naturally conceptualized as individuals (e.g., people) and those that are naturally conceptualized as members of categories (e.g., body parts, artifacts, foods), then animals (specifically pets) may fall somewhere in the middle

between being strongly construed as individuals and strongly construed as members of a category. Pets may be more likely than artifacts to be construed as an individual because they are agents with social importance to a family and thus more likely to be seen as important in their own right. At the same time, pets are not people, and other animals of their category may not be socially important. It may, therefore, be easy for young learners to construe pets either as individuals or as members of their categories.

The results presented in this dissertation are consistent with the idea that infants conceptualize people as individuals; that they conceptualize body parts and artifacts as members of a category; and that they conceptualize pets as either individuals or members of a category. In Experiments 1 to 6, we found evidence from infants' looking behaviour that they construe their caregivers as individuals that are not interchangeable with other people; and in Experiments 5 and 6 we found evidence from the same source that infants construe inanimate objects such as hands and artifacts as members of categories. Finally, in Experiment 7 we found evidence that infants can construe their own pets either as individuals or as members of categories. The preceding conceptual biases could reflect a number of differences across object categories (e.g., people, animals, body parts, artifacts). For example, a bias to construe an object as an individual could be due to that object's agentive properties and/or its social properties. The following paragraphs will consider the possible roles of each of these properties may have in leading infants to conceptualize some objects as individuals and others as category members.

Animate objects that are able to act independently and behave in a goal-directed manner may be more likely to be viewed as distinctive and independent of other members of their category. Previous work has shown that young infants have a number of expectations about agents distinct from their expectations about non-agents. For instance, infants selectively

attribute goals, an expectation of the efficient execution of goals, and an expectation of contingent interaction to human agents but not to non-human agents (Gergely & Csibra, 2003; Johnson et al., 2001; Woodward, 1998). It is possible that infants tend to construe agents as individuals and non-agents as members of categories, and that this distinction underlies their differential interpretations of object words (e.g., words for people vs. words for body parts and artifacts). Moreover, infants may be equipped with a foundational cognitive system which guides them to conceptualize agents differently than non-agents (see Carey & Gelman, 1991; Spelke, 2003). If this were the sole basis for infants' conceptualization of objects as individuals, however, then non-human agents would also be conceptualized as individuals. Yet the results from Experiment 7 appear to indicate that infants flexibly construe pets either as individuals or as members of categories. Moreover, older children do not invariably interpret labels for animals as labels for individuals but rather do so particularly when the animals are pets or pet-typical (Hall, 1991; 1994). The tendency to construe exemplars of some, but not all, object types as individuals may thus also reflect another factor.

A bias to conceptualize an object as an individual – rather than as a member of a category – could also be related to the object's perceived social importance. People are highly important social figures, whereas objects like body parts, artifacts, and foods are not. In the case of animals, infants' conceptualization may be sensitive to the object's status as a family member (a social standing), such that some category members (e.g., pets) may tend to be construed as individuals, but others (i.e., non-pets) may tend to be conceptualized as category members. This proposed flexibility in the construal of animals is consistent with the possibility that children experience some instances of particular animal categories, like dogs and cats, as individuals (e.g.,

their own pets), but experience other instances of the same categories as mere category members (e.g., other dogs).

Infants' capacity (indicated by the results of Experiment 7) to learn both an individual label and a category label for a single object indicates that their tendency to construe an object either as an individual or as a member of a category is not a hard constraint. Thus, although our results are consistent with the claim that some objects are more likely to be construed as individuals and other objects are more likely to be construed as members of categories, the findings also suggest that infants are flexible in making these assumptions. The results from these experiments indicate that infants do not enter into word learning with fixed tendencies to construe objects in only one manner. Moreover, the cognitive flexibility shown by infants at around their first birthday will also certainly help them to learn other new words from other lexical types (e.g., labels for properties) later in development.

The results from the experiments in this dissertation are consistent with the claim that infants approach word learning not only with the ability to learn object words with different referential scope but also with expectations about which types of object will likely be the referents of words with individual scope; which types will likely be the referents of words with categorical scope; and which types could be the referents of words with either scope. From the outset of lexical development, infants appear to interpret some object labels, such as those for people, as individual labels and others, such as those for body parts and artifacts, as categorical labels. These findings may reflect infants' underlying default tendency to think of objects (like people) as individuals but other objects (like body parts and artifacts) as members of categories. Infants' object construal biases may guide them to interpret some words as labels with individual scope and others as words with categorical scope. These biases may also provide infants with a

mechanism to learn proper names and count nouns. The following section will discuss this proposal.

5.1.3 Infants' Acquisition of Proper Names and Count Nouns

As discussed earlier, prior experimental work has established that by 17 months of age, English-learning infants have begun to acquire knowledge of the linguistic distinction between proper names (i.e., labels for individuals) and count nouns (i.e., labels for category members) (Hall & Bélanger, 2010; Katz et al., 1974). This previous research demonstrates that, by 17 months, infants have learned the morphological and syntactic cues that distinguish between proper names and count nouns in the language and thus also have the ability to learn individual labels and categorical labels. The findings from the experiments in this dissertation suggest that infants are able to acquire labels with individual scope and labels with categorical scope from the outset of word learning. It is currently unknown how infants progress from an ability to learn individual labels and categorical labels to full mastery of the grammatical count noun–proper name distinction; however, one possibility is that infants' object conceptualization biases facilitate this learning.

The facilitation may work in the following way: Infants may approach the task of word learning with a bias to conceptualize some objects as individuals and others as members of categories. This bias then may lead infants to interpret some labels as labels with individual scope and others as labels with categorical scope. Specifically, labels for people may be more likely to be interpreted as individual labels while labels for body parts, artifacts, and foods may be more like to be interpreted as categorical labels. In the adult language, labels for people may tend to be proper names, whereas labels for body parts, artifacts, and foods may tend to be common nouns. Infants' conceptual biases, coupled with the adults' natural labeling practices,

may thus simplify infants' task of discovering the grammatical correlates of words from these lexical categories (proper names, count nouns) by helping them to "pre-categorize" words from the two lexical types, allowing infants to analyze more easily the shared grammatical features of words of each type. For instance, infants may more readily learn that categorical labels are often preceded by a determiner whereas individual labels are not. Prior work has shown that around their first birthday, infants are already attending to the presence of determiners in speech. Specifically, infants are sensitive to which determiners are used in their native language (Shi, Werker, & Cutler, 2006) and can use them to segment words (Shi & Lepage, 2008). With experience, infants may then learn that in English the presence or absence of a determiner can serve as a reliable cue to distinguish between proper names and count nouns.

Further research will be needed to determine whether object conceptualization biases such as the ones under discussion in this research play a role in the acquisition of the grammatical count noun-proper name distinction. The fact that infants show knowledge of this grammatical distinction by around 17 months of age indicates that infants solve this task very early in development. A learning mechanism constrained by the conceptual biases discussed in this work would enormously simplify the problem facing infants, but future work is required to determine whether they are, in fact, a part of the solution.

5.1.4 Foundations of Early Language Development Revisited

The research findings presented in this dissertation fit within a growing body of evidence suggesting that infants show comprehension of their first words at a surprisingly young age. Several prior experimental studies have now found word comprehension beginning at six months of age (Bergelson & Swingley, 2012, 2015, 2017; Tincoff & Jusczyk, 2012). Experiments 1 to 5 in this dissertation also found evidence supporting this claim, along with new evidence indicating

that infants comprehend words of different lexical types (i.e., labels for individuals and labels for categories) from the outset of word learning. Up until these recent findings appeared in the literature, it was believed that, with few exceptions, word learning did not begin until close to an infant's first birthday (for review see Werker, 2018). The now-extensive evidence of word comprehension at six months of age calls for an examination of how these new findings fit into the broader account of early language development.

At six months of age, infants are just beginning to learn about the phonetic properties of their native language(s). While they demonstrate some knowledge at this age of their native language(s)' phonetic properties – and they can discriminate between their language and another of the same rhythmic class – they have not yet attuned to their native language(s)' phonetic categories (e.g., Mehler et al., 1988; Werker & Tees, 1984). Specifically, before six months of age, infants are sensitive to both native and non-native phonetic contrasts; but over the first year of life, they show increased sensitivity to native contrasts and a decline in sensitivity to non-native contrasts. The findings from the experiments in this dissertation support the suggestion that word acquisition is occurring at the same time as infants are perceptually attuning to their native phonetic categories.

The evidence that perceptual attunement and word learning begin to occur at about the same point in infancy calls for a reconsideration of how these two processes are related. As discussed by Werker (2018), the evidence that infants are learning words at six months of age challenges the idea that perceptual attunement is a prerequisite to lexical acquisition; instead, it suggests that attunement to the phonetic contrasts in one's own language occurs within the context of word learning. Moreover, this possibility is consistent with the claim that infants' knowledge of their native phonetic categories and word learning abilities develop in parallel to

each other (Werker, 2018). To the extent that these two processes occur in parallel, they may influence each other early in linguistic development. While some prior work has demonstrated that infants' word learning is guided by their knowledge of native sound categories (for a review, see Werker, 2018), it is also possible that there is an influence in the opposite direction, such that early word learning helps to shape the acquisition of native sound categories. Further work will be needed to explore how infants' knowledge of their native phonetic categories and word acquisition interact and affect one another early in development.

5.2 Future Directions

5.2.1 Conceptual biases and early word learning

The experiments in this dissertation focus on the nature of infants' object word comprehension and provide evidence that infants have both labels for individuals and labels for category members from the onset of word learning. Across the experiments, we found that infants understood labels for people as names for individuals and labels for body parts and artifacts as terms for category members. These findings are consistent with the possibility that objects of some types are likely to be construed as individuals whereas objects of other types are likely to be construed as category members; and that infants may use this object type information to guide their word learning. To date, the youngest age at which this idea has been examined is 16 and 17 months (Leung, 2011). That work demonstrated through a series of experiments that infants of this age appear to assume that novel labels given to faces are words for individuals whereas the same labels given to artifacts are terms for category members.

The findings from Experiment 5 are consistent with the findings from Leung (2011) and raise the possibility that six-month-old infants also approach word learning with a bias to construe people as individuals and other objects like body parts and artifacts as members of

categories. If young infants are biased to construe some objects as individuals but others as category members, then this fact could explain how infants can learn both individual labels and category labels from the outset of lexical development. As discussed previously, biases of this nature could also help to explain how infants learn the grammatical distinction between proper names and count nouns by the middle of the second year. Future research is required to examine whether infants from the outset of word learning are guided by biases to construe some types of objects as individuals and others as category members and whether these biases influence word learning.

Further work is also needed to determine the strength and malleability of infants' object conceptualization biases. Although infants may hold a bias to construe people as individuals, people can also be construed as category members and labelled with count nouns (e.g., "person", "woman", "adult"). By the same token, infants may have a bias to construe artifacts as members of categories; however, many artifacts can be construed as individuals and given proper names (e.g., a security blanket, a toy train). It is not well understood at what age infants are able to learn category labels for people and learn individual labels for objects like artifacts – or how the ability to acquire object labels that run counter to infants' natural conceptualization biases develops. In Experiment 7, we found that as early as twelve months of age infants have the cognitive flexibility to understand both an individual label and category label for a family pet. This finding suggests that by their first birthday, children are able to construe at least some objects in multiple ways.

To date, no research has explored infants' ability to learn both a proper name and a count noun for a person or an artifact. If it is conceptually difficult for children to construe people as members of categories because it requires overcoming a bias to construe people as individuals,

then we may expect that the ability to learn a category label for people would emerge later than the ability to learn both label types for animals. Similarly, we may expect that infants' ability to learn an individual label for an artifact would emerge later than the ability to learn both label types for animals, because of the need to overcome a bias to construe artifacts as category members. If this pattern of results were found in future research, it would provide further support for the claim that infants hold conceptualization biases that lead them to interpret labels for some objects (like people) as labels for individuals but to interpret labels for other objects (like artifacts) as labels for members of categories. This work would thereby help to elucidate how infants learn labels for individuals and labels for category members. Moreover, work of this nature could thereby help to shed further light on the mechanism by which infants later master the proper name – count noun distinction.

5.2.2 Neural correlates of proper name and count noun processing

The experiments in this dissertation used behavioural measures to examine infants' early word comprehension, but new developments in neural imaging may offer a different opportunity to assess the referential nature of infants' early words. Recall that the experiments in this dissertation involved showing infants pairs of objects and recording their eye movements in response to hearing auditory stimuli. Using this procedure, we examined whether infants had a preference to look at one object over another in response to certain labels. Although the use of this procedure led to insights into infants' early word comprehension, other measures may also be able to elucidate infants' object word understanding.

Future research may be able to illuminate infants' comprehension of object labels for individuals and categories by examining their neurological responses to labels of these types. Many studies with infants and adults have found a centro-parietal N400 (negative deflection

signal 400 ms after stimulus onset) in response to a mismatch between a count noun and image or a count noun and sentence context (for review see Friedrich & Friederici, 2004; Wang et al., 2016). Although there has been no examination of how the N400 signal differs when infants process a proper name versus a count noun, there is some work in adults which supports the claim that this signal differs for words of different lexical types. In lexical decision reading tasks, there is a larger N400 (negative deflection 400 ms after stimulus onset) effect in the central and parietal sites when adults process incorrect proper names than when they process incorrect common nouns (Adorni, Manfredi, & Proverbio, 2014). This research with adults raises the possibility that neuroimaging techniques could be used to examine infants' early word comprehension.

These findings raise the possibility that distinct neural signals in the infant brain may be associated with the processing of labels for individuals and labels for categories. If we were able to measure infants' neural signals for proper names and count nouns, then we might be able to shed new light on the questions raised by this dissertation research. For example, the results from neuroimaging may indicate that individual labels are processed differently than category labels, helping to further support the claim that six-month-olds understand multiple lexical types. Moreover, neuroimaging may be more sensitive to the question of whether infants' early word comprehension differs from that of adults – and to the question of whether infants' comprehension of words for individuals and categories at six months differs from their comprehension at 17 months upon mastering the proper name – count noun distinction. The use of neuroimaging could thus shed further light on how infants first comprehend object labels for different types of objects and how this comprehension changes across development.

5.3 Concluding Statement

For many years, researchers have sought to understand the nature of infants' first object words – in particular, whether these terms have individual scope or categorical scope. Among infants' earliest-understood labels are words that are proper names and count nouns in the adult lexicon; however, it is unclear whether for infants these words are labels for individuals and labels for category members. Word learning accounts like the *narrow-and-broad* account posit that from the outset of word learning infants are capable of learning labels for individuals and labels for category members. The findings in this dissertation offer support for this account of word learning by providing evidence that infants have labels for individuals and labels for category members from the earliest stages of word learning – by six months. Furthermore, the results demonstrate that one-year-olds have the capacity to learn both a label with individual scope and a label with categorical scope for the same object. This work is the first to establish that infants are capable of learning words with individual scope and categorical scope at the beginning of word learning and that the learning of these two lexical types develops in parallel from the outset of lexical development. These studies raise the possibility that infants begin word learning with the capacity to acquire both proper names and count nouns. Moreover, this research provides the earliest evidence to date that infants can learn multiple words for a single object and represent the same object as an individual and as an instance of an object category. The work in this dissertation thus makes an important contribution to our understanding of early language-learning capacities.

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Appendices

Appendix A

Questionnaire for Experiment 1 (Questions for Mother and Father)

1. Is your child exposed to any languages other than English?

    a. If so, what percent of English does s/he hear?

    b. What is the other language?

    c. Who speaks the other language to the infant?

Questions about Mother and Father:

1. Who is your child's primary caregiver?

2. On a typical day, how many hours is your baby awake?

3. How much time does your child spend with his/her mother? (waking hours)
   (please fill in one of the following blanks)
   ____All the time
   ____Hours per day on weekend
   ____Hours per day on weekday
   ____Hours per day ___ Number of days per week

4. Which label do you use when you refer to your child's mother? If more than one, select all and give the percentage that the infant hears each.
   a. Mommy
   b. Mama
   c. Mom
   d. Other: _____

5. Does your child understand the label for his/her mother? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

6. How confident are you that your child understands the label for his/her mother? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

7. How much time does your child spend with his/her father? (waking hours) (please fill in one of the following blanks)
    ____All the time
    ____Hours per day on weekend
    ____Hours per day on weekday
    ____Hours per day ___ Number of days per week

8. Which label do you use when you refer to your child's father? If more than one, select all and give the percentage that the infant hears each.
    a. Daddy
    b. Dada
    c. Dad
    d. Other: _____

9. Does your child understand the label for his/her father? (circle one)

    Yes No Not Sure

    If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

10. How confident are you that your child understands the label for his/her father? (circle one)

    Low confidence 1------2------3------4------5------6------7 High confidence

11. Which of the following words does your child understand? (circle one)

    a. Cup:
    Yes No Not Sure

    b. Ball:
    Yes No Not Sure

    c. Dog:
    Yes No Not Sure

    d. Cat:
    Yes No Not Sure

12. How confident are you that child understands the following words? (circle one)

a. Cup:
Low confidence 1------2------3------4------5------6------7 High confidence

b. Ball:
Low confidence 1------2------3------4------5------6------7 High confidence

c. Dog:
Low confidence 1------2------3------4------5------6------7 High confidence

d. Cat:
Low confidence 1------2------3------4------5------6------7 High confidence

13. Are there any other words that your child understands? For each word, please also indicate how confident you are that child understands this word.

a. _____
Low confidence 1------2------3------4------5------6------7 High confidence

b. _____
Low confidence 1------2------3------4------5------6------7 High confidence

c. _____
Low confidence 1------2------3------4------5------6------7 High confidence

d. _____
Low confidence 1------2------3------4------5------6------7 High confidence

Appendix B

Questionnaire for Experiment 2 (Questions for Mother and Grandmother)

1. Is your child exposed to any languages other than English?

    a. If so, what percent of English does s/he hear?

    b. What is the other language?

    c. Who speaks the other language to the infant?

Questions about Mother and Father:

1. Who is your child's primary caregiver?

2. On a typical day, how many hours is your baby awake?

3. How much time does your child spend with his/her mother? (waking hours)
   (please fill in one of the following blanks)
   ____All the time
   ____Hours per day on weekend
   ____Hours per day on weekday
   ____Hours per day ___ Number of days per week

4. Which label do you use when you refer to your child's mother? If more than one, select all and give the percentage that the infant hears each.
   a. Mommy
   b. Mama
   c. Mom
   d. Other: _____

5. Does your child understand the label for his/her mother? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

6. How confident are you that your child understands the label for his/her mother? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

7. How much time does your child spend with his/her father? (waking hours) (please fill in one of the following blanks)
    ____All the time
    ____Hours per day on weekend
    ____Hours per day on weekday
    ____Hours per day ___ Number of days per week

8. Which label do you use when you refer to your child's father? If more than one, select all and give the percentage that the infant hears each.
    a. Daddy
    b. Dada
    c. Dad
    d. Other: _____

9. Does your child understand the label for his/her father? (circle one)

    Yes No Not Sure

    If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

10. How confident are you that your child understands the label for his/her father? (circle one)

    Low confidence 1------2------3------4------5------6------7 High confidence

11. Which of the following words does your child understand? (circle one)

    a. Cup:
    Yes No Not Sure

    b. Ball:
    Yes No Not Sure

    c. Dog:
    Yes No Not Sure

    d. Cat:
    Yes No Not Sure

12. How confident are you that child understands the following words? (circle one)

    a. Cup:
    Low confidence 1------2------3------4------5------6------7 High confidence

    b. Ball:
    Low confidence 1------2------3------4------5------6------7 High confidence

    c. Dog:
    Low confidence 1------2------3------4------5------6------7 High confidence

    d. Cat:
    Low confidence 1------2------3------4------5------6------7 High confidence

13. Are there any other words that your child understands? For each word, please also indicate how confident you are that child understands this word.

    a. _____
    Low confidence 1------2------3------4------5------6------7 High confidence

    b. _____
    Low confidence 1------2------3------4------5------6------7 High confidence

    c. _____
    Low confidence 1------2------3------4------5------6------7 High confidence

    d. _____
    Low confidence 1------2------3------4------5------6------7 High confidence

Questions about Grandmother:

1. What is the grandmother's relation to the child? (e.g., maternal grandmother)

2. How much time does the grandmother spend with the child? (waking hours) (please fill in one of the following blanks)
   ____All the time
   ____Hours per day on weekend
   ____Hours per day on weekday
   ____Hours per day ___ Number of days per week

3. What label is used for the grandmother (in reference to the child) (e.g., Granny)?

4. Does the child understand this label for his/her grandmother?

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

5. How confident are you that the child understands this label for his/her grandmother? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

Appendix C

Questionnaire for Experiment 3 (Questions for Mother and Aunt/Friend)

1. Is your child exposed to any languages other than English?

    a. If so, what percent of English does s/he hear?

    b. What is the other language?

    c. Who speaks the other language to the infant?

Questions about Mother and Father:

1. Who is your child's primary caregiver?

2. On a typical day, how many hours is your baby awake?

3. How much time does your child spend with his/her mother? (waking hours)
   (please fill in one of the following blanks)
   ____All the time
   ____Hours per day on weekend
   ____Hours per day on weekday
   ____Hours per day ___ Number of days per week

4. Which label do you use when you refer to your child's mother? If more than one, select all and give the percentage that the infant hears each.
   a. Mommy
   b. Mama
   c. Mom
   d. Other: _____

5. Does your child understand the label for his/her mother? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

6. How confident are you that your child understands the label for his/her mother? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

7. How much time does your child spend with his/her father? (waking hours) (please fill in one of the following blanks)
    ____All the time
    ____Hours per day on weekend
    ____Hours per day on weekday
    ____Hours per day ___ Number of days per week

8. Which label do you use when you refer to your child's father? If more than one, select all and give the percentage that the infant hears each.
    a. Daddy
    b. Dada
    c. Dad
    d. Other: _____

9. Does your child understand the label for his/her father? (circle one)

    Yes No Not Sure

    If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

10. How confident are you that your child understands the label for his/her father? (circle one)

    Low confidence 1------2------3------4------5------6------7 High confidence

11. Which of the following words does your child understand? (circle one)

    a. Cup:
    Yes No Not Sure

    b. Ball:
    Yes No Not Sure

    c. Dog:
    Yes No Not Sure

    d. Cat:
    Yes No Not Sure

12. How confident are you that child understand the following words? (circle one)

    a. Cup:
    Low confidence 1------2------3------4------5------6------7 High confidence

    b. Ball:
    Low confidence 1------2------3------4------5------6------7 High confidence

    c. Dog:
    Low confidence 1------2------3------4------5------6------7 High confidence

    d. Cat:
    Low confidence 1------2------3------4------5------6------7 High confidence

13. Are there any other words that your child understands? For each word, please also indicate how confident you are that child understands this word.

    a. _____
    Low confidence 1------2------3------4------5------6------7 High confidence

    b. _____
    Low confidence 1------2------3------4------5------6------7 High confidence

    c. _____
    Low confidence 1------2------3------4------5------6------7 High confidence

    d. _____
    Low confidence 1------2------3------4------5------6------7 High confidence

Questions about Aunt/Friend:

1. What is the aunt's/friend's relation to the child? (e.g., maternal aunt, family friend)

2. How much time does the aunt/friend spend with the child? (waking hours) (please fill in one of the following blanks)
   ____All the time
   ____Hours per day on weekend
   ____Hours per day on weekday
   ____Hours per day ___ Number of days per week

3. What label is used to refer to the aunt/friend (in reference to the child) (e.g., Aunty Jo, Marie)?

4. Does the child understand this label for the aunt/friend?

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

5. How confident are you that the child understands this label for his/her aunt/friend? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

Appendix D

Questionnaire for Experiment 5 (Questions for Parents)

1. Is your child exposed to any languages other than English?

    a. If so, what percent of English does s/he hear?

    b. What is the other language?

    c. Who speaks the other language to the infant?

2. Who is your child's primary caregiver?

3. On a typical day, how many hours is your baby awake?

4. How much time does your child spend with his/her mother? (waking hours)
   (please fill in one of the following blanks)
   ____All the time
   ____Hours per day on weekend
   ____Hours per day on weekday
   ____Hours per day ___ Number of days per week

Questions about the label for the mother:

1. Which label do you use when you refer to your child's mother? If more than one, select all and give the percentage that the infant hears each.
   a. Mommy
   b. Mama
   c. Mom
   d. Other: _____

2. Does your child understand the label for his/her mother? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

3. How confident are you that your child understands the label for his/her mother? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

Questions about the word "dog":

1. Does your child understand the word "dog"? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

2. How confident are you that your child understands the word "dog"? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

3. Do you use a label other than "dog" to label dogs (for example, a pet dog)?

4. If Yes to 3, what is this other label?

5. If Yes to 3, does your child understand this other label? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

6. If Yes to 3, how confident are you that your child understands this other label? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

Questions about the word "hand":

1. Does your child understand the word "hand"? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

2. How confident are you that your child understands the word "hand"? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

Questions about the word "foot":

1. Does your child understand the word "foot"? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

2. How confident are you that your child understands the word "foot"? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

Questions about the word "feet":

1. Does your child understand the word "feet"? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

2. How confident are you that your child understands the word "feet"? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

Appendix E

Questionnaire for Experiment 6 (Questions for Parents)

1. Is your child exposed to any languages other than English?

    a. If so, what percent of English does s/he hear?

    b. What is the other language?

    c. Who speaks the other language to the infant?

2. Who is your child's primary caregiver?

3. On a typical day, how many hours is your baby awake?

4. How much time does your child spend with his/her mother? (waking hours)
   (please fill in one of the following blanks)
   ____All the time
   ____Hours per day on weekend
   ____Hours per day on weekday
   ____Hours per day ___ Number of days per week

Questions about the label for the mother:

1. Which label do you use when you refer to your child's mother? If more than one, select all and give the percentage that the infant hears each.
   e. Mommy
   f. Mama
   g. Mom
   h. Other: _____

2. Does your child understand the label for his/her mother? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

3. How confident are you that your child understands the label for his/her mother? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

Questions about the word "dog":

1. Does your child understand the word "dog"? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

2. How confident are you that your child understands the word "dog"? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

3. Do you use a label other than "dog" to label dogs (for example, a pet dog)?

4. If Yes to 3, what is this other label?

5. If Yes to 3, does your child understand this other label? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

6. If Yes to 3, how confident are you that your child understands this other label? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

Questions about the word "ball":

1. Does your child understand the word "ball"? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

2. How confident are you that your child understands the word "ball"? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

3. Do you use a label other than "ball" to label balls (for example, any balls in your house)?

4. If Yes to 3, what is this other label?

5. If Yes to 3, does your child understand this other label? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

6. If Yes to 3, how confident are you that your child understands this other label? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

7. How many toy balls do you have at home?

8. How attached is your child to the toy ball your brought today?

   Low attachment 1------2------3------4------5------6------7 Highly attachment

   Low attachment: My child rarely plays with this toy ball.
   High attachment: It is hard to take this toy ball from my child.

Questions about the word "cup":

1. Does your child understand the word "cup"? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

2. How confident are you that your child understands the word "cup"? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

3. Do you use a label other than "cup" to label cups (for example, any cups in your house)?

4. If Yes to 3, what is this other label?

5. If Yes to 3, does your child understand this other label? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

6. If Yes to 3, how confident are you that your child understands this other label? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

Appendix F

Questionnaire for Experiment 7 (Questions for Parents)

1. Is your child exposed to any languages other than English?

    a. If so, what percent of English does s/he hear?

    b. What is the other language?

    c. Who speaks the other language to the infant?

2. On a typical day, how many hours is your baby awake?

3. What kinds of pet(s) does your family have? (e.g., dog)

4. How long has each of your pets lived with your child?

Questions about First Pet (pet studied in experiment):

1. What kind of pet do you have? (e.g., dog, cat)

2. What breed of pet do you have?

3. What is the name of your first pet? (e.g., Fido)

4. Does your child understand the name for his/her pet? (circle one)

    Yes No Not Sure

    If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

5. How confident are you that your child understands the name for his/her pet? (circle one)

    Low confidence 1------2------3------4------5------6------7 High confidence

6. What category label do you use for this pet? (e.g., dog)

7. Does your child understand the category label for his/her pet? (circle one)

    Yes No Not Sure

    If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

8. How confident are you that your child understands the category label for his/her pet? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

9. How much time does your child spend with this pet?
   ____All the time
   ____Hours per day on weekend
   ____Hours per day on weekday
   ____Hours per day ___ Number of days per week

Questions about Second Pet (if applicable):

1. What kind of pet do you have? (e.g., dog, cat)

2. What breed of pet do you have?

3. What is the name of your second pet? (e.g., Fido)

4. Does your child understand the name for his/her pet? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

5. How confident are you that your child understands the name for his/her pet? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

6. What category label do you use for this pet? (e.g., dog)

7. Does your child understand the category label for his/her pet? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

8. How confident are you that your child understands the category label for his/her pet? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

9. How much time does your child spend with this pet?
    ____All the time
    ____Hours per day on weekend
    ____Hours per day on weekday
    ____Hours per day ___ Number of days per week

Questions about Dog:

1. Which label do you use when you refer to dogs, in general? If more than one, select all and give the percentage that the infant hears each.
    a. Dog
    b. Doggy
    c. Puppy
    d. Other: _____

2. Does your child understand this label? (circle one)

    Yes No Not Sure

    If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

3. How confident are you that your child understands this label? (circle one)

    Low confidence 1------2------3------4------5------6------7 High confidence

4. How many other dogs does your child see on a regular basis?

5. How often does your child see other dogs (other than your pet)? This answer can include time at dog parks.
    ____All the time
    ____Hours per day on weekend
    ____Hours per day on weekday
    ____Hours per day ___ Number of days per week

Questions about Cat:

1. Which label do you use when you refer to cats, in general? If more than one, select both and give the percentage that the infant hears each. Which one is most preferred?
    a. Cat
    b. Kitty
    c. Kitten
    d. Other: _____

2. Does your child understand this label? (circle one)

   Yes No Not Sure

   If answer is Yes or Not Sure: At what age do you think s/he first showed any understanding of this label? (e.g., just last week, a month ago)

3. How confident are you that your child understands this label? (circle one)

   Low confidence 1------2------3------4------5------6------7 High confidence

4. How many other cats does your child see on a regular basis?

5. How often does your child see other cats (other than your pet)? This answer can include time at parks.
   ____All the time
   ____Hours per day on weekend
   ____Hours per day on weekday
   ____Hours per day ___ Number of days per week