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The Role of Context in Early Language Development

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The Role of Context in Early Language Development

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Psychology

by

Elizabeth Rose Goldenberg

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ABSTRACT OF THE DISSERTATION

The Role of Context in Early Language Development

by

Elizabeth Rose Goldenberg

Doctor of Philosophy in Psychology

University of California, Los Angeles, 2015

Professor Catherine M. Sandhofer, Chair

Early word learning takes place across different contexts. For example, in a single day a child may hear the noun "cup" in a wide range of places (e.g., in the car, at the playground, in the stroller) and from a wide range of speakers (e.g., mother, father, sibling). Understanding the role of spatial and speaker context in word learning is important because context affects learning and memory (Godden & Baddeley, 1975; Hayne, MacDonald, & Barr, 1997; Rovee-Collier & Default 1991; Smith 1982; Smith, Glenberg, & Bjork, 1978 and Vlach & Sandhofer, 2011). By examining the role of context using two methodologies to examine multiple contexts, this dissertation suggests context is an integral component of the basic characteristics of word learning.

In Paper 1, I experimentally asked what role visual attention plays in an infant's category generalization in a new context. Forty-eight English monolingual infants, ages 16-20 months (25 males, M_{age} = 17.42 months, SD_{age}= 1.46 months), were presented with eight novel noun

generalization categories. During the learning phase infants were presented with five category exemplars in either: (1) all of the same background context, (2) all varied background contexts, or (3) a combination of same and varied background contexts. All infants' category generalization performance was tested in a never before seen context. Results suggest that visual attention during learning is associated with category generalization abilities in a new context only for infants whose learning took place in a combination of same and varied background contexts.

In Paper 2, I used naturalistic methods to examine what contexts children were in when they (a) were exposed to nouns and (b) produced nouns. Eight families, whom were selected from a larger study conducted by the UCLA Sloan Center on Everyday Lives of Families (CELF: Ochs & Kremer-Sadlik, 2013), participated in the current study. All families had a focal child who was between the ages of 1.5-4.5 years old. Families were filed over multiple days as they carried out everyday-family activities. Video recordings were coded for the spatial and speaker contexts in which the focal child's language input and output took place. The results describe the spatial and speaker contexts in which children are exposed to and produce nouns. Further, results suggest a positive association between the number of spatial and spatial contexts in which children were exposed to words and the children's rate of production of those words.

By examining how contextual factors affect word learning, this dissertation elucidates some of the learning mechanisms children use to learn language. Moreover, by demonstrating the effect of context on language, this dissertation will validate the need to include contextual factors in word learning research. Together, the results of these studies add to a small but growing body of research suggesting the environmental factors in children's early learning environments that may support early language learning.

The dissertation of Elizabeth Rose Goldenberg is approved.

Alison Bailey

Scott P. Johnson

Rena Repetti

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University of California, Los Angeles

2015

DEDICATION

The dissertation is dedicated to my family. My dad who always pushed me to work harder and stay dedicated. My mom who instilled in me positive morals and virtues. My brothers for being my playmates and friends throughout life. My husband who was my rock and number one supporter throughout my entire graduate career. Thank you for helping me achieve my goal.

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Portions of the research reported in this dissertation are currently published, or in prep for publication. Specifically, portions of Paper 1 is published as: Elizabeth Goldenberg and Scott Johnson, Category Generalization in a New Context: The Role of Visual Attention. *Infant Behavior and Development*. 2015. *38*, 49-56. doi:10.1016/j.infbeh.2014.12.001. I want to thank Dr. Johnson for being the PI on this paper and providing me with fruitful resources and productive guidance to publish this research. Dr. Johnson supported me in the initial stages of designing the experiment, collecting and analyzing the data, and writing the report for publication.

There are many people I want to thank for their contributions to Paper 1. Bryan Nguyen provided invaluable technical support as I collected and analyzed data. I'm grateful to the families who participated in my research and to the research assistants in the UCLA Baby Lab, especially Connie Lam who was integral to data collection. Further, I would like to thank the graduate students in the UCLA Baby Lab who provided never-ending feedback to this project, especially, Ho Jin Kim, Lauren Burakowski, Lauren Slone, Natsuki Atagi, Christina Schonberg, and Tawny Tsang. The research in Paper 1 was supported by NIH Grants R01-HD73535.

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Additionally I would like to thank the following people for their contribution to Paper 2. I am grateful to the families that participated, and the researchers who collected the data, in the greater CELF study. The researchers at the CELF study collected the data, created the family floor plans and transcribed all of the audio in the videos that were used in Paper 2. I also thank my research assistants, especially, Sara Veeraswami, Ping Rochanavibhata, Ann Lee, Zoe Cheung and Caylor Davis. I am grateful for support provided by the members of Drs. Sandhofer and Repetti's labs. Meredith Sears, Delana Parker, Sunhye Bai, Kate Herts and Dr. Ted Robles from the Repetti lab group offered invaluable support as did Emily Russell, Amber Ankowski, Mariel Kyger, Lauren Slone, Natsuki Atagi and Christina Schonberg from the LCD lab. In addition, the members in the LCD lab provided enormous support from the start of my graduate career. The work from Paper 2 was supported by the Alfred P. Sloan Foundation's Program on Dual-Career Working Middle Class Families.

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Goldenberg, E. R. & Sandhofer, C. (2011, April). *The Effect of Context on Word Learning.* Paper presented at the annual Symposium Of Cognition And Language Development, Los Angeles, CA.

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Introduction

Children's environments affect their language development. One potentially influential environmental factor is the context in which word learning takes place. Here *context* refers to the spatial location of the child (spatial context) and the persons who are interacting with the child (speaker context). These contexts are ever present in young children's lives; early word learning takes place among many spatial and speaker contexts. That is, young children hear and say words in many different spaces and to many different people. Understanding the role of spatial and speaker context in word learning is important because context affects learning and memory (Godden & Baddeley, 1975; Hayne, MacDonald, & Barr, 1997; Rovee-Collier & Default 1991; Smith 1982; Smith, Glenberg, & Bjork, 1978 and Vlach & Sandhofer, 2011). By examining the role of context using multiple methodologies to examine multiple contexts, this dissertation suggests context is an integral component of the basic characteristics of word learning.

Learning in Context

The context in which information is learned and tested affects memory and generalization. Context dependency refers to the detriments to memory when learning and testing take place in different environments (Smith & Vela, 2001). Consider a practical example of context dependency in which someone calls your name in the grocery store, but you cannot discern who the person is or how you know her. With conversation, you realize this person is your dental hygienist, Sue. Although you can immediately recognize Sue when she is in the dental office, you do not initially recognize her in the grocery store because you have never seen her in this context. Your memory of Sue was tested in a different context that impaired your initial memory of her. A large body of literature documenting context dependency validates such practical examples. In the laboratory, contexts dependency has been documented across a wide range of age, tasks, and contexts.

In their seminal study, Godden and Baddeley (1975) found a context dependency effect using an innovative methodology. Students participating in a diving club listened to a list of words later tested through a free recall task. All participants participated in four randomly ordered conditions (Table 1-1). In condition one, participants were presented with all of the words and tested for their memory of the words on the deck of a diving boat (context match). In condition two, the participants were presented with the same words and tested for their memory of the words underwater (context mismatch). In condition three, learning took place under water and testing took place on the deck of the boat (context match). Lastly, in condition 4, learning and testing both took place under water (context mismatch). Participants performed higher on the free recall test when learning and testing took place in the same contexts than when the contexts switched between learning and test. That is, no difference in recall existed between water and land when learning and testing were in the same context. However, when learning and testing were not matched, recall suffered, suggesting the participants' memory was context dependent.

Table 1-1. *Conditions used in Godden and Baddeley (1975)*

	Learning Environment	
Testing Environment	On boat	On Water
On Boat	Condition 1	Condition 3
On Water	Condition 2	Condition 4

The encoding specificity hypothesis can explain context dependency. This hypothesis suggests retrieval is highly dependent on the state in which the information was encoded (Tulving & Thomson, 1973). More specifically, contextual differences in cues between learning and testing reduce memory performance. Retrieval cues aiding the learner to access memories at test must overlap with encoding cues aiding the learner to form memories at learning for successful recall. Different contexts between learning and test impair memory.

So how do humans recall information in a new context? Experiments find no effect of context dependency when learning takes place in multiple contexts (Smith 1982; Smith, Glenberg, & Bjork, 1978). Researchers have presented participants with word lists in one or multiple rooms and tested them for their memory in a new room. The more rooms in which the participants learned the information, the better the participant's memory was in a new room. The increase in learning contexts increases the encoding cues, which may match retrieval cues when in a new context, enabling successful recall.

Infants and Young Children's Learning in Context

To understand the developmental trajectory of learning and memory in context, researchers have conducted studies examining infants and young children. Infants and young children are highly context dependent; changes in rooms, colored backgrounds, or even crib bumpers between learning and test affect young children's memory performance (Hartshorn et al., 1998; Hayne, Boniface, & Barr, 2000; Robinson & Pascalis 2004; Rovee-Collier, Griesler, & Early, 1985). Infants' performance on delayed imitation tasks demonstrates strong context dependency effects. Hayne et al. (2000) presented 6-month-old infants with an action sequence (i.e. removing a puppet's mitten and shaking the bell inside the mitten) in the either in their homes or in the laboratory. Twenty-four hours later, all infants were tested for their memory of the action through an imitation task in the laboratory. Infants who were trained in the laboratory outperformed the infants who were trained at home. The discontinuity between the learning and testing contexts disrupted infant's memory performance. The deficient overlap between encoding and retrieval cues decreased memory in these 6-month old -infants (Tulving & Thomson, 1973).

Robinson and Pascalis (2004) demonstrated context dependency effects in 6- and 12-month-old infants, using a visual paired comparison paradigm. They familiarized infants to an object presented on a screen (learning phase). They then paired the object with a novel object and measured the infants' looking time (testing phase). When infants were tested in the same context, they looked significantly longer at the novel object than the familiar object, demonstrating they remembered the familiar object from the learning phase. In contrast, infants had no looking time preference when testing took place in a new context. In the changed context condition, not enough overlap existed between encoding and retrieval cues for infants to recognize the object from the learning phase (Tulving & Thomson, 1973). Thus, the infants were dependent on the learning context to recognize the familiar object.

Using a mobile conjugate reinforcement procedure, Rovee-Collier et al. (1985) examined context dependency in 3-month-old infants. In the mobile conjugate reinforcement procedure, one end of a ribbon is tied to an infant's foot and the other end is tied to the mobile of their crib. During the learning phase, the infant naturally kicks his or her foot, which makes the mobile move. After many instances, the infant learns that their kicking moves the mobile. After the learning phase, the researchers then tested the infants for their memory by placing them back in the crib with the ribbon attached to their foot. To manipulate context, Rovee-Collier et al. (1985) operationally defined context as the color and pattern of the crib bumper inside the infant's crib. Results suggest that when tested, infants kicked more to make the mobile move when the bumper was the same color pattern as in training, rather than a different color and pattern. This suggests infants as young as three months are sensitive to the overlap between encoding and retrieval cues. Altogether, these studies suggest infants' and young children's memory and generalization are context dependent.

One important question is how infants and young children overcome context dependency. This is because infants and young children must be able to recall information in new contexts. For example, an infant who learns information in their living room benefits from recalling the information in their bedroom or their grandmother's living room.

Research suggests one way infants can overcome context dependency when learning takes place in multiple contexts, similar to adults (Amabile & Rovee-Collier, 1991; Rovee-Collier & Default, 1991). In two studies, Rovee-Collier and colleagues presented infants with a mobile conjugate training task to examine the role of multiple learning context on context dependent memory. Infants who were trained in two contexts (two distinct bumpers) and tested in a new context performed above baseline. Infants who were trained in one context (one bumper) and tested in a new context did not perform above baseline. Thus, training in multiple contexts facilitates memory in a new context. At retrieval the infants had a more diverse set of learning cues to draw on from the multiple context training, which increased memory performance.

In summation, a variety of studies have shown context affects learning and memory. One aspect of children's lives regularly requiring the ability to learn and remember is that of learning language. Children learn a vast amount of language in their first two years of life (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994), so it is crucial to examine the learning and memory mechanisms responsible for early word learning.

Word learning in context. Context is an influential factor in young children's early word learning. The evidence suggests infants' and young children's word input and output changes as a function of context (see: Bornstein, Painter, & Park, 2002; Bornstein, Tamis-LeMonda, & Haynes, 1999; Hoff, 2010; Hoff-Ginsberg, 1991; Lewis & Gregory, 1987; O'Brien & Xiufen 1995; Walker & Armstrong, 1994; Wells, 1986; Yont, Snow, & Vernon-Feagans, 2003). For example, early in word learning, children use labels only in specific contexts (Barrett, 1986). Barrett (1986) reports in a case study that a child only used the label “duck” when pushing a duck off the edge of the bathtub. Later in childhood, language experiences change based on context. For example, children speak to an adult and initiate conversation more in their home than in school (Wells, 1986). Throughout children’s everyday lives, the context surrounding their early word learning affects them.

Further, in more rigorous tests of context effects, laboratory tasks suggest infants’ and young children’s word learning is context bound. Vlach and Sandhofer (2010) and Goldenberg and Sandhofer (2013a) gave 2- through 4-year-old children a noun generalization task. Children were presented with an object, which was given a novel name (e.g., “It’s a toma”), on a colored and patterned cloth. After multiple presentations, the child was asked to choose the target object (among three additional dissimilarly shaped objects) by providing its novel name (e.g., “Which one is the toma?”). When learning and testing took place in different contexts, generalization performance in a new context was no different from chance levels, suggesting word learning is context dependent.

Older children can overcome context dependency when word learning takes place in multiple contexts (Vlach & Sandhofer, 2011). This is similar to adult learning and memory performance, and infants’ and young children’s learning and memory for non-word learning tasks. When 3- and 4-year-old children were presented with a novel noun generalization task across multiple contexts, generalization performance in a new context was above chance levels (Vlach & Sandhofer, 2011). These word learners could use the multiple encoding cues (i.e., aspects of the learning situation), which supported their ability to generalize the object label to a similarly shaped object upon test in a new context.

For older children, the effect of context on word learning seems to mirror that of adults. However, less is known about how context affects novice word learners. One study suggests novice word learners cannot overcome context dependency when learning takes place across multiple contexts (Goldenberg & Sandhofer, 2013a; Vlach & Sandhofer, 2011). Specifically, 2-year-old children failed to generalize category labels when they learned object names in multiple contexts and were tested in a new context. However, Goldenberg, and Sandhofer (2013a) suggested that with a combination of same *and* varied context, 2-year-old children can overcome context generalization in a new context.

Goldenberg and Sandhofer (2013a) presented 2-year-old children with a novel noun generalization task in one of three contextual conditions (Figure 1-1). In the "same context" condition, training always took place in the same context (i.e., Context A). In the varied context condition, training always took place in a different context (i.e., Context A, Context B, Context C, Context D, and Context E). In the interleaved context condition, the first, third, and fifth target exemplars were in one context, whereas the second and fourth exemplars were in different contexts (i.e., Context A, Context B, Context A, Context C, and Context A). All children's generalization performance was tested in a new context.

Results reveal that children in the interleaved context condition correctly generalized more category labels than the children in the same or varied context conditions. Goldenberg and Sandhofer (2013a) suggested the interleaved condition provided novice word learners with two key types of support: support to aggregate and support to decontextualize. The repeated (same) contexts provided redundant context cues, which increased the level of similarity between the disparate experiences and increased the likelihood that the instances were aggregated together in memory. The different (varied) context contexts aided the word learners in separating the irrelevant contextual features from the relevant category information (i.e., decontextualizing). Context affects word learning and may do so differently depending on the age of the learner.

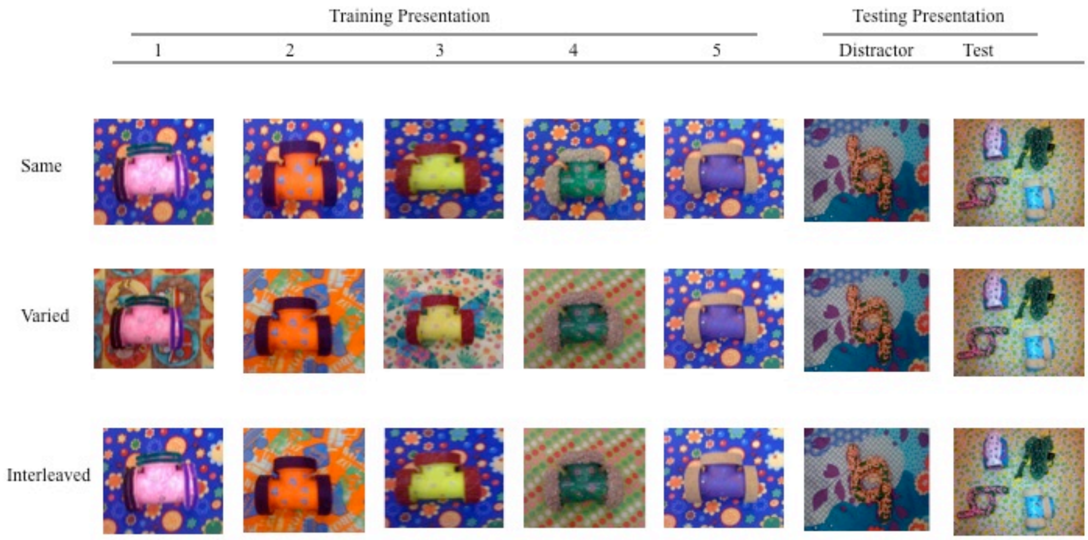

Figure 1-1. Example stimuli on background context from Goldenberg and Sandhofer (2013a). Each row depicts one trial. All stimuli and contexts were randomized between participants.

The current dissertation will focus on how context affects novice word learners' ability to learn new words. By further examining the role of context in word learning, the current dissertation will illuminate the mechanisms that aid children in word learning throughout their everyday lives.

The Current Approach

The goal of this dissertation is to examine context as an integral component of the basic characteristics of word learning. My strategy is to examine multiple types of contexts through both experimental and naturalistic methodologies. In this section, I will outline 1) the two types of contexts examined and 2) the two types of methodologies this dissertation will use.

Types of Context

Examining multiple types of context is crucial to understanding the role of context in word learning, because contextual factors are broad and may affect word learning in different ways. In terms of language development, a rich history of various contextual cues has been shown to affect word learning. The types of contexts that have been found to aid learners to understand a words meaning are most often integral to the to-be-learned information. For example, linguistic contextual cues such as, syntax, sentence structure, and semantic content can affect learning and recognition of new words (see: Hills, Maouene, Riordan, & Smith, 2010; Naigles, 1990; Wells, 1979). Further, pragmatic cues, such as facial expression, body expression, and tone can aid the learner to understand information (Tomasello, 2000). However, the types of context examined in this dissertation are different from the types previously described in that the types of context examined here are incidental to what is being learned. That is, the contexts I investigate are background contexts, which are nonessential to the actual material to be learned.

In research examining the effect of context dependency on various cognitive tasks, context has been defined by many incidental factors. For example, the odor presented (Fagen et al., 1997 and Rubin, Fagan, & Carroll, 1998), the room the participant was in (Hayne et al., 2000), and the color of the background an image was presented on (Robinson & Pascalis, 2004) have been the context in which learning and memory have been tested. Similarly, Rovee-Collier and colleagues (1985) defined context as the colored and pattered bumper inside the crib the child was in when trained and tested for their memory of kicking behavior.

Types of context in word learning research: Person and background. Two types of context emerge in the word learning literature: person context and background context. The learner's conversational partner or the person supplying the information to the learner defines the person context. The background context is defined by the background stimuli the learner is exposed to while learning.

For example, Goldenberg and Sandhofer (2013b) examined the whether changing the person who is with the children between learning and testing affects generalization. One experimenter trained 3-, 4-, and 5-year-old children on eight novel noun categories. Children were tested for their ability to generalize the label to a new category member either by the same experimenter who trained them or by a novel experimenter. Four- and 5-year-old children were better able to generalize the novel label when the same person trained and tested them, rather than when a different person tested them. This suggests the person a child is interacting with while learning words is influential to their word learning ability.

In a series of category generalization studies, Sandhofer and colleagues (2011; 2013) defined context as the background colored and patterned cloth on which an object was presented. They placed one piece of 21- by 26-inch piece of fabric under the object exemplar. The context varied by the design and color of the cloth. These studies suggest a change to the background context affects generalization of categories. For example, children ages 2 to 4 years old have a difficult time generalizing a category exemplar when their learning and testing of that category took place on top of varying colored and patterned cloths. The incidental background context (i.e. colored and patterned cloth) in which a learning task takes place can affect word learning.

In addition to background context, people are crucially important to how children learn (Baldwin et al., 1996; Tomasello 2000; Henderson, Gerson & Woodward, 2008). Examining how children's language input and output changes as a function of their conversational partner is important to understanding how the persons interacting with the child affect children's word learning. The spatial background in which learning takes place affects word learning (Goldenberg & Sandhofer, 2013a; Vlach & Sandhofer, 2011). Understanding how such background stimuli influence young children's word learning is a key factor in understanding the role of context in language development. In paper 1, I will examine how background context affects attention to novel objects and, in turn, word learning. In Paper 2, I will examine how the person and background context in which children are exposed to language affects their word learning.

Methodology

Experimental methods. In the field of word learning, researchers often collect data in laboratory-based experiments. Experimenters test children's lexicons, or measure language the child hears, while in laboratory (Waxman & Lidz, 2006). In the past, researchers examining the role of context in word learning have used the novel noun generalization tasks under different contextual conditions (Goldenberg & Sandhofer, 2013a; Vlach & Sandhofer, 2011).

The novel noun generalization task consisted of a training, distractor, and testing phase (Figure 1-2). Experimenters created novel objects designed and constructed to be unfamiliar to the child. In the training phase, they presented the child with successive presentations of the novel object; each time the child was presented with an exemplar of the same shape but different color and texture. In each presentation, the target exemplar was labeled with a novel word (e.g., ‘‘This is the toma. See the toma?’’). During the distractor phase, which took place immediately after the training phase, the child was presented with a distractor object (never before seen object) while the experimenter brought attention to it without labeling it (e.g., ‘‘Look at this!’’). The function of the distractor object was to provide a test choice option the child has recently seen but was not the target object. The distractor object ensured that a child did not choose the target object during test based on familiarity or recency of exposure. During the test phase, the child was presented with four choices: a target exemplar, the distractor object, an unfamiliar object, and a familiar object. An unfamiliar object and a familiar object were included in the test to ensure the child could differentiate among the correctly labeled object (target), a never before labeled object (unfamiliar), and an object for which the child already had a label, such as a toy duck (familiar). Once the child had a chance to touch all of the objects, the experimenter asked the child to retrieve the target object using the target name (e.g., ‘‘Where is the toma?’’). If the child did not respond to the first request, the experimenter repeated the request. If the child chose the target exemplar, they received credit for learning the new category.

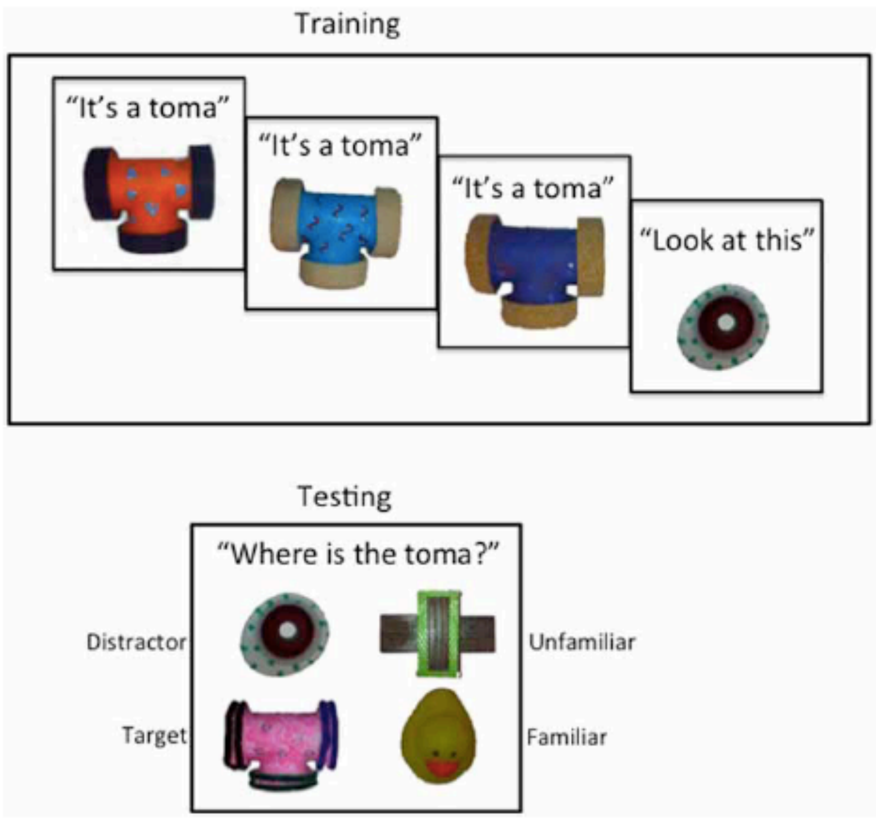

Figure 1-2. Example of novel noun generalization procedure.

This methodology allows researchers to understand the role of specific contextual manipulations and eliminate confounding correlation effects. However, experimental methodologies have their disadvantages largely because the laboratory does not represent the child’s everyday language environment. When children’s lexicons are tested in the laboratory, they are under certain constraints not representative of their daily lives. These can include constraints on time, space, people, conversation topic, and materials. For example, many studies take place in only one experimental room with novel materials that are perhaps confusing to children. For these reasons, researchers often use naturalistic data collection to understand children's language environments.

Naturalistic methods. Researchers have examined children's word learning environments using naturalistic methods for decades (Wootton, 1974). By going into children's homes and video or audio recording interactions with their caregivers, researchers have gained a greater understanding of what children's everyday word learning environments entail. In typical naturalistic word learning research, researchers enter a child's home, provide a structured activity using such elements as toys or conversation topics, and record the interaction between the child and caregiver (Bornstein et al., 1992; Hladik & Edwards, 1984; Hoff, 2010; Hoff-Ginsberg, 1991; Rowe, Pan, & Ayoub, 2005; Walker & Armstrong, 1994).

Many researchers have understood the importance of measuring children's language development in an environment mirroring their everyday experience. Naturalistic measurement has led to understanding many aspects of children's language environment. These aspects include cultural and socioeconomic differences in language input (Bornstein et al., 1992; Rowe et al., 2005), the relation between parental responsiveness and parent-child communication (Evans, Maxwell, & Hart, 1999), and children's language production (Nicely, Tamis-LeMonda, & Bornstein, 1999).

Bornstein et al. (1992) collected in-home language recordings to examine cross-cultural differences in children's language environments. These researchers collected 45-minute video recordings of 5-month-old infants and their parents in three different countries (United States, France, and Japan). The researchers found that the American based coding system was valid and consistent when used in other countries. Additionally, the research suggests both culturally specific and culturally invariant behaviors. For example, there were no differences in mother's nurturing and imitative response types between cultures. There were, however, cultural differences in mothers' responses to social looking. Overall, this study demonstrated that naturalistic methods in language development can be used to investigate both similarities and difference in parental language behaviors in different countries.

Researchers have also used naturalistic measures to assess the ever-present socioeconomic differences in children's language input. Rowe et al. (2005) gathered in-home observational data from 108 families when the child was between the ages of 14 and 36 months. During the home-visit, the experimenters provided the child and parent with three bags of toys and books. The dyad was instructed to play with the toys and books in their own home as they would on a daily basis. Researchers videotaped 10-minute interactions with each bag and coded the language children heard from their parent. The researchers remarked on the overwhelming variation between dyads. Additionally, input differences related to maternal education, mental health, and literacy skills. Rowe et al. (2005) demonstrated that by collecting rich naturalistic language data, we can further understand the how the relation between socioeconomic status and language development is affected by children's language environment.

In addition to a one time in-home recording, naturalistic measures can also be conducted on longitudinal time scales. For example, Evans et al. (1999) collected in-home observations of 42 families over a two-and-a-half year period. Each family began the study when their child was 6 months old. The family participated in monthly one-hour long observations until the child was 3 years old. This longitudinal design yielded a long-term picture of the child's language environment, which allowed the researcher to understand the relation between parental verbal responsiveness and parent-child verbal communication

Naturalistic methods to examine context. The large body of research described in the previous section has used naturalistic methods to understand language development. Less research has used naturalistic methods to examine specifically the role of context in word learning. The studies that have investigated this question hint at the idea that context affects the way parents talk to children and the way the children produce language (see: Bornstein, Painter, & Park, 2002; Bornstein, Tamis-LeMonda, & Haynes, 1999; Hoff, 2010; Hoff-Ginsberg, 1991; Lewis & Gregory, 1987; O'Brien & Xiufen 1995; Walker & Armstrong, 1994; Wells, 1986; Yont, Snow, & Vernon-Feagans, 2003).

Naturalistic research suggests differences in word input. Hladik and Edwards (1984) defined context as 2- and 3-year-old children's conversational partners. They examined language input during three contextually different 30-minute play sessions in the child's own home. The first session included the mother and child, the second included the father and child, and the third included the mother, father, and child. All of the interactions were audio recorded. This type of data collection allowed the researchers to measure the parent's speech, specifically the number of responses, number words, total number of morphemes, mean length of utterance, and sentence types. The results of this study suggest when both mother and father were present both parents spoke in longer utterances, indicating that children's conversational partners influences their language input.

To examine differences in children's language output based on context, Hoff (2010) videotaped 1- and 2-year-old children in their homes. Context was defined as the activity in which the mother and child were partaking; each dyad participated in mealtime, toy play, and book reading. Children's speech was coded for any verbal output, vocabulary use, grammatical complexity, and discourse continuity. The results suggest differences in children's language output based on activity. In particular, children used more word types in book reading than in the other two activities. Further, more of the children's utterances followed their mother's previous utterance (discourse continuity) in book reading than toy play or mealtime. Hoff (2010) suggests the context of the child's activity influences their verbal output. This is important for our understanding of language development because it suggests children's opportunities to employ and develop their lexicon differ based on the activity in which they are participating.

In an innovative longitudinal design, Gordon Wells (1986, 1979) audio recorded samples of children's language performance from when they were 1 year old to 11 years old. They programmed the audio recording to switch on at various times throughout the day. This design allowed the researchers to assess children's linguistic performance in home and school environments. A systematic analysis suggests multiple factors affecting children's language differ between their home and school. For example, children exhibited more speaking turns within a conversation at home than at school.

Naturalistic methodologies often provide a clear and less biased picture of children's linguistic environments. However, naturalistic studies do still have limitations. First, the experimenter or the nature of the study often creates some level of bias. For example, the observations are often collected for a short period (e.g., 30 minutes; Lewis & Gregory, 1987), objects are often artificially supplied (Yont, Snow, & Vernon-Feagans, 2003), the activities of the parent and child are often controlled (Hoff-Ginsberg, 1991), the space where the child and parent are is often restricted (Bornstein, Tamis-LeMonda, & Haynes, 1999), and participants' behavior may be influenced by the presence of an observer (i.e. demand characteristics; Orne, 1962). Second, without the level of control provided by experimental methodologies, naturalistic methods are limited in their ability to explain causal relations. These methods can inform researchers of important relations between constructs and allow for predictions. However, researchers cannot imply cause and effect. By using multiple methodologies, I can more accurately understand the role of context in word learning.

This dissertation will use both experimental and naturalistic methodologies. Paper 1 will use the novel noun generalization task in addition to eye tracking technology. Paper 2 will use naturalistic methodologies by coding various words in context from video-recorded samples of everyday family life.

The Current Studies

The two papers comprising this dissertation aim to understand how context influences young children's word learning. By examining how contextual factors affect word learning, this dissertation elucidates some of the learning mechanisms children use to learn language. Moreover, by demonstrating the effect of context on language, this dissertation will validate the need to include contextual factors in word learning research. Together, the results of these studies add to a small but growing body of research suggesting the environmental factors in children's early learning environments that may support early language learning.

In Paper 1, I experimentally asked what role visual attention plays in an infant's category generalization in a new context. Infants (16-20 months; n=48) were presented with eight novel noun categories in one of three contextual conditions (same context, varied context, or a combination of same and varied context), and tested for their generalization abilities in a new context. The colored and patterned fabric upon which the object was presented defined context. Results suggest that visual attention during learning is associated with category generalization abilities in a new context only for infants whose learning took place in a combination of same and varied background contexts. I discuss the results in terms of the mechanisms by which context affects generalization.

In Paper 2, I used naturalistic methods to examine what contexts children were in when they (a) were exposed to nouns and (b) produced nouns. A larger, previous study conducted by the UCLA Sloan Center on Everyday Lives of Families, video-recorded eight families over multiple days as they carried out their daily lives. I coded all of the nouns the child (3-5 years old) was exposed to and produced for two contextual factors (speaker and space). The results describe the relation between the number of speaker and spatial contexts in which children were exposed to words and the children's rate of production of those words. By using this rich methodology, this study is the first to describe the contexts in which children's linguistic input and output take place and how these contexts affect their word learning.

Category Generalization in a New Context: The Role of Visual Attention

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Abstract

Infants and children have difficulty categorizing objects in new contexts. However, learning in both same and varied contexts can help young word learners overcome contextual learning difficulties. We examined the relation between infants' visual attention to the category member and background context during learning and their ability to generalize a new category member in a new context. Of particular interest is how this relation is affected by learning in various contextual conditions. Infants (16-20 months; n=48) were presented with eight novel noun categories in one of three contextual conditions (same context, varied context, or a combination of same and varied context), and tested for their generalization abilities in a new context. Context was defined as the colored and patterned fabric upon which the object was presented. Results suggest that visual attention during learning is associated with category generalization abilities in a new context only for infants whose learning took place in a combination of same and varied background contexts. The results are discussed in terms of the mechanisms by which context affects generalization.

Keywords: context, generalization, visual attention, word learning, aggregate, decontextualize

Category Generalization in a New Context: The Role of Visual Attention

Children's category generalization is affected by surrounding contextual information (Vlach & Sandhofer, 2011). Past research suggests that young children have difficulty generalizing category labels in a new context when learning takes place in *either* all of the same background context, *or* all varied background contexts. However, when learning takes place in *both* same *and* varied contexts, young children's ability to generalize category labels in a new context increases (Goldenberg & Sandhofer, 2013). Despite previous research, it is unknown how visual attention supports category generalization in a new context, specifically when learning takes place in different contextual conditions. To understand the role of visual attention, the current study examined infants' visual attention to the category member and the background context during a category generalization task to further understand the mechanisms by which context affects generalization.

1.1 Learning in Context

Memory and generalization are affected by the context in which information is learned and tested. Specifically, recall is more accurate when the information in recalled in the same context in which it was learned (e.g., Borovsky & Rovee-Collier, 1990; Godden & Baddeley, 1975; Hartshorn et al., 1998; Hayne, Boniface, & Barr, 2000; Hayne, MacDonald, & Barr, 1997; Learmonth, Lamberth, & Rovee-Collier, 2004; Rovee-Collier & Dufault, 1991; Rovee-Collier, Griesler, & Earley, 1985; Smith 1982; Suss, Gaylord & Fagen, 2012). Context dependency has been robustly demonstrated across a wide range of contexts, tasks and ages (Amabile & Rovee-Collier, 1991; Smith, Glenberg, & Bjork, 1978)

Likewise, young word learners' ability to generalize category labels is context dependent. When 2- and 3-year-old children were presented with category members one at a time in a distinct context (a colored and patterned fabric square on which the object was placed) and subsequently tested for generalization of the category label to a new category exemplar, performance was enhanced when training and testing took place in the same context (i.e., the same fabric) relative to a condition in which training and testing took place in different contexts (i.e., a new fabric; Vlach & Sandhofer, 2011).

One possible reason children's word learning is context dependent is that the to-be-learned information was strongly associated with the context in which it was learned. For example, participants tested by Vlach and Sandhofer (2011) may have associated the object-label pair with the fabric. When generalization performance was tested on a new fabric, the novice word learners had difficulty generalizing the object label to the new category exemplar at test because the fabric they had associated with the object-label pair during learning was not present (Goldenberg & Sandhofer, 2013).

Consistent with the possibility that context dependency is due to a lack of decontextualizing the to-be-learned information from the context, context dependency can be overcome (in some cases) by learning in varied contexts (Jones, Pascalis, Eacott & Herbert, 2011; Smith, Glenberg & Bjork, 1987). When 3- and 4-year-olds were presented with category exemplars across multiple varied contexts, for example, they were able to generalize the category label to a new exemplar in a new context (Vlach and Sandhofer, 2011), perhaps because variability helps decontextualize the learning process, increasing the likelihood that information can be generalized to new settings (Amabile & Rovee-Collier, 1991; Rovee-Collier & Dufault, 1991). Varied contexts, therefore, may signal to the child that the to-be-learned information (object-label pair) is not associated with any specific context.

However, 2-year-olds' category generalization performance is context-dependent even when learning takes place in varied contexts. When 2-year-olds were presented with category exemplars on multiple varied fabrics and tested on a never before seen fabric, generalization was not different from chance levels (Goldenberg & Sandhofer, 2013; Vlach & Sandhofer, 2011). The support to decontextualize that aided 3- and 4-year-olds (learning across multiple varied contexts) was not sufficient to aid 2-year-olds when generalizing was tested in a new context. Goldenberg and Sandhofer (2013) suggest this difficulty is because when learning takes place in varied contexts, novice word learners have little support to aggregate the different instances in memory. Category learning requires the learner to aggregate similarities between the object-label instances. For example, to learn the category "spoon," the learner must aggregate what is similar across all instances of spoons (i.e., shape; Gentner & Namy, 1999). When learning takes place in varied contexts, there is little support for a novice word learner to aggregate the category exemplar instances; there is a lack of aggregative cues.

Redundant correlated cues, such the category label and repetitive contexts, support aggregation of category exemplar features (Dueker & Needham, 2005; Smith & Yu, 2008; Thiessen & Saffran, 2003; Yoshida & Smith, 2005). The only aggregative cue provided when learning takes place in varied contexts is the label, which may not be sufficient for novice word learners (Goldenberg & Sandhofer, 2013). *Repetitive* contexts, however, do support category learning. When 2-year-old children learned object labels in one repetitive context (on top of one colored and patterned fabric), and tested for their generalization in the same context (on top of the same colored and patterned fabric as learning), they were able to successfully generalize (Vlach & Sandhofer, 2011).

Novice word learners, therefore, may need two distinct types of support when generalizing category labels in a new context in order to decontextualize the object label pair and to aggregate features common to the category exemplars presented during training. Support for decontextualization is provided by learning in varied contexts, signaling to the learner that object-label pairs are not to be associated with the context. Support for aggregation of the category exemplar features is provided by learning in the same repetitive context, which may highlight feature similarities. Goldenberg and Sandhofer (2013) found that 2-year-olds overcome context dependency when learning provided support to decontextualize (learning in varied context) *and* support to aggregate (learning in the same context). Yet decontextualization and aggregation will facilitate word learning only if infants attend to this information. Our goal in the present study was to examine how individual differences in visual attention to category members and contexts yield categorization under conditions that vary by context.

1.2 Visual Attention

Learning categories requires attention to the right aspects of the learning situation (Smith, Jones, Landau, Gershkoff-Stowe, Samuelson, 2002; Samuelson & Smith, 1998). Past research has focused on infants' attention to specific aspects of the object-label category, such as the object's features and syntactic properties. For example, when learning a new object-label category, young children are reliably able to focus on features by which the category is organized. That is, early in word learning, children focus on object shape when learning to categorize (Smith et al., 2002).

When learning object categories in context, learners are presented with two distinct visual stimuli: the object and the background context. Infants presented with an object on a background context were found to attend to both the object and the background. Haaf, Lundy and Coldren (1996) habituated 6-month-old infants to a stimulus presented on a colorful patterned background. The stimulus was presented on either the same background or varied backgrounds. Infants were slower to habituate when the background varied, suggesting that infants attended to both the background and the stimuli; longer looking times were interpreted as indicating attention to the changes in background across trials, which are presumably more interesting than a single background across trials.

However, little is known regarding how visual attention supports category generalization in various contextual conditions. It is unknown how visual attention to the object exemplar and the background context during learning affects infant's ability to generalize the category label to a new exemplar in a new context. Further, it is unknown whether various types of contextual support affect infants' attention to the object and context when learning new categories.

The current study investigated how visual attention during learning affects infants' ability to generalize a category label in a new context. Further, we examined how different types of contextual support during training affect visual attention during training and generalization performance. We presented infants with novel categories in contexts that provided support for decontextualization (i.e., varied contexts), for aggregation (i.e., the same context), or for both (i.e., both the same and varied contexts). Infants' category generalization abilities were then tested in a never before seen context. We examined three hypotheses. First, we hypothesized that infants look more to the target object when presented with an object on a background context during the learning phase regardless of what type of contextual support they were provided. Second, we hypothesized that infants who were provided with support to decontextualize and aggregate during learning have higher rates of looking to the target object during testing (when the label was presented) than infants who were only provided support to *either* decontextualize *or* aggregate. Lastly, we hypothesized that infants' visual attention to the target object during learning facilitates category generalization, specifically for infants provided with support to decontextualize and aggregate.

Method

2.1 Participants

A total of 48 English monolingual infants, ages 16-20 months (25 males, $M_{\text{age}} = 17.42$ months, $SD_{\text{age}} = 1.46$ months), were included in the final sample. Infants were randomly assigned to one of three conditions (n=16 per condition). Thirteen infants were excluded due to fussiness (n=6), technical/experimenter error (n=2), poor calibration (n=4), or outlier status (n=1; this infants' data were more than two standard deviations away from the mean on all analyzed eye tracking measurements). Of the 35 infants for whom we have parental education information, two had at least one parent whose highest degree was a high school diploma, two had at least one parent whose highest degree was a diploma from a community college, 11 had at least one parent whose highest degree was a diploma from a four year university, and 20 had at least one parent whose highest degree was a graduate or professional degree. All infants were recruited from a university child-database, and the experiment was conducted at a university-based laboratory. All participants were given a t-shirt for their participation.

2.2 Design

Infants were presented with eight novel noun generalization categories on a video screen, each of which consisted of a training phase and testing phase. During the training phase, infants were presented with five exemplars of the novel category and one novel label (e.g., ‘‘wug’’). During the test phase, infants were presented with a sixth exemplar of the novel category, a never before seen distractor object, and the novel category label (e.g., ‘‘wug’’). All six category exemplars were shape-matches, but differed in color and texture.

This study used one between-subjects variable, which was contextual condition. All three contextual conditions differed in the training phase, but were identical in the testing phase (Figure 2-1). Context was defined as the color and pattern of the background the novel objects were presented on while they were labeled. In the same context condition, all five category-exemplars were presented on the same colored and pattern background (i.e., context A). In the varied context condition, the five category exemplars were presented on different colored and patterned backgrounds (i.e., context A, context B, context C, context D, context E). In the interleaved context condition, the first, third, and fifth target exemplars were presented on the same colored and patterned background, and the second and fourth exemplars were presented on different colored and patterned backgrounds (i.e., context A, context B, context A, context C, context A). In all conditions the testing phase was presentd on a never-before-seen colored and patterned background.

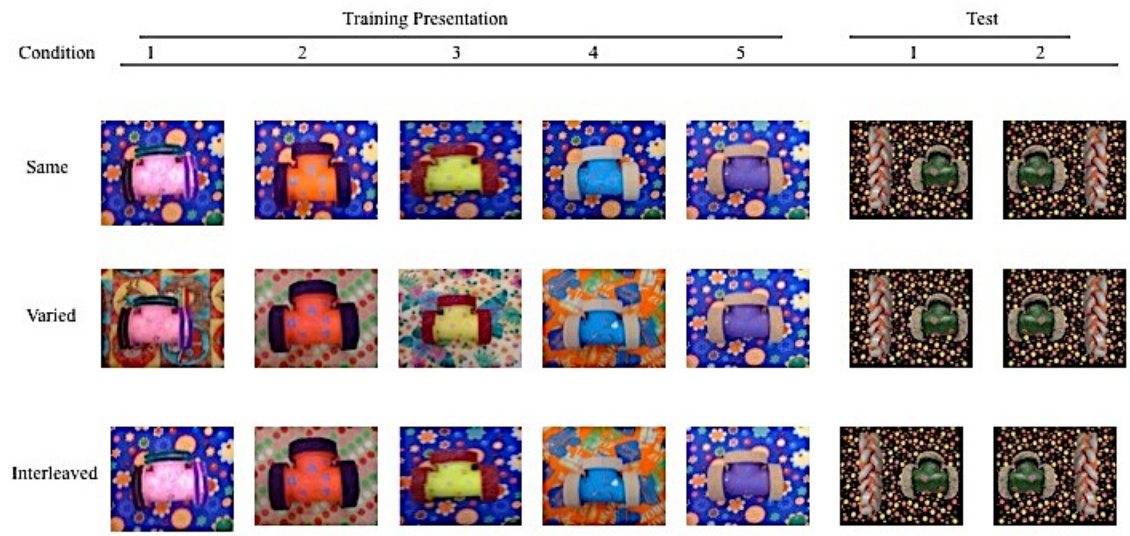

Figure 2-1. Example stimuli presented on background contexts. Each row depicts one category. All objects and contexts were randomized between and within participants.

2.3 Apparatus and stimuli

Novel objects were constructed out of arts and crafts supplies, photographed and presented on the video screen. Each category consisted of six category exemplars (five presented in the training phase and one presented in the testing phase) and a distractor object (presented in the testing phase). To equate for the size of all of the objects, each object occupied between 12% and 20% of the screen. Large (21x26 inch) pieces of colorful patterned fabric were photographed and presented on the video screen to serve as the background “context”. Object labels that followed the phonotactic probabilities of English (e.g., dax, wug, toma, blicket, fop, gipple, modi and riff), but were not English words, served as object labels (see: Berko, 1958). All object label recordings were one second in duration and recorded using a female voice. All objects, object-label pairs, and fabrics were randomized and counterbalanced within and between participants in order to ensure that performance differences were not due to particular fabric patterns or object shapes.

All of the objects were positioned on top of the fabric and presented on a Viewsonic vx2268wm 22-inch monitor and the labels were presented through the monitor's speakers. Eye tracking data were collected using an SR Research Eyelink 1000. The eye-tracking system recorded infants' point-of-gaze in terms of x and y coordinates (spatial resolution within <1.0 degree of visual angle) at a rate of 500 Hz. The areas of interest (AOI) for the target and distractor objects were defined as the area inside the object's border. The AOI for the background context was defined as the area inside of the background's border that was not occluded an object.

2.4 Procedure

Before the experiment began, the infant was seated on the parents lap 60 cm from the monitor. The experimenter asked the caregiver to not comment on anything presented on the screen or instruct the infant in any way. Once the infant and parent were seated, the experimenter dimmed the lights and began the calibration procedure. To attract the infant's attention and calibrate the infant's point of gaze, retracting circular stimuli, with sound, were presented in five different locations on the screen (bottom left, bottom right, top left, top right, and the center). Following calibration the infant was shown an "attention getter" (small moving toy with sound in the center of screen) to regain their attention. After the initial attention getter, the infant was presented with the eight novel noun categories, each consisting of training and testing phases. For each category the testing phase immediately followed the training phase. In between each category, an attention getter was presented to retain the infant's attention.

2.4.1 Training phase. During each of the eight category training phases the infant was presented with five successive trials. In each trial a category exemplar was presented on a colored patterned background for three seconds. For the first second there was no audio; during the middle second, the target label was played (e.g., "toma"); and for the third second there was no audio.

2.4.2 Testing phase. During each of the eight category testing phases the infant was presented with two successive trials. In each trial a category exemplar and a distractor object were presented (side by side) on a colored and patterned background for nine seconds. During the first three seconds no audio was played; during the fourth second the target label was played for one second (e.g., "toma"); during the fifth and sixth seconds no audio was played; during the seventh second the target label was played for one second (e.g., "toma"); during the eight and ninth seconds no audio was played. The two testing trials only differed in the side of the screen each object was presented. The position was counterbalanced between the two presentations.

Results

We first asked whether there were differences between the three contextual conditions in infants' proportion looking to the target object or background context during the training phase. Infants' *proportion looking to target during training* was defined as looking to the target divided by looking to both the target and background, averaged across all training trials. Infants' *proportion looking to background during training* was defined as looking to the target divided by looking to both the background and target, averaged across all training trials. A 2(AOI) X 3 (Condition) mixed ANOVA revealed a significant main effect of AOI across conditions, $F(1,45)=154.79$, $p<.001$. Infants looked significantly longer to the target object ($M=.72$, $SD=.14$) than the background context ($M=.33$, $SD=.14$) during the training trials. No main effect of condition or interaction between condition and AOI were revealed ($ps>.05$). Age was not significantly positively correlated with looking to the target or the background during learning (*ps*>.05).

Second, we asked whether there were differences between the three contextual conditions in infants' proportion looking to the target object, distractor object or background context during the testing phase. All analyses for the testing phase were split into two time frames, 1) before the onset of the first label and 2) after the onset of the first label. All measures were averaged across all testing trials. For the first time frame, *proportion looking to target during testing- before onset of label,* was defined as looking to the target divided by total looking (target, distractor, and background combined) before the onset of the first label. *Proportion looking to distractor during testing- before onset of label* and *Proportion looking to background during testing- before onset of label* were defined as looking to the distractor and background, respectively, divided by total looking, before the onset of the first label. A 3(AOI) X 3 (Condition) mixed ANOVA revealed a significant main effect of AOI, $F(2,90)=55.41$, $p<.001$. Repeated measures t-tests with a Bonferroni correction to maintain an alpha of .05 revealed that infants looked significantly longer to the target object ($M=.37$, $SD=.07$) than the background context ($M=.22$, $SD=.08$), $t(47)=7.09$, $p=<.001$ and significantly longer to the distractor object ($M=.48$, $SD=.06$) than the background context, $t(47)=10.31$, $p=<.001$. There was no significant difference between infants' looking to the target and distractor objects ($p>.016$). No main effect of condition or interaction between condition and AOI were revealed (*ps*>.05). Age was not significantly positively correlated with looking to the target object, the distractor object, or the background context before the label was presented (*ps*>.05).

The second time frame within the testing phase was the 6 s after the onset of the first label. The *proportion looking to target during testing- after onset of label* was defined as looking to the target divided by total looking, after the onset of the first label. *Proportion looking to* *distractor or background during testing- after onset of label* were defined in similar fashion. A 3(AOI) X 3 (Condition) mixed ANOVA revealed a significant main effect of AOI across conditions, $F(2,20)=16.29$, $p<.001$. Infants looked significantly longer to the target object ($M=.39$, $SD=.08$) than the distractor object ($M=.26$, $SD=.11$), $t(47)=5.20$, $p=<.001$. Further, infants looked significantly longer to background context ($M=.35$, $SD=.09$) than to the distractor object, $t(47)=3.41$, $p<.001$. There was no significant difference between infant's looking to the target object and background context across conditions after the onset of the first label ($p>.016$). No main effect of condition or interaction between condition and AOI were revealed ($ps>.05$). Age was not significantly positively correlated with looking to the target object, the distractor object, or the background context after the label was presented. ($ps>.05$).

Lastly and most importantly, we asked whether looking to the target during training predicted looking to the target during testing, and whether this association differed based on condition. We regressed proportion looking to the target during testing on proportion looking to the target during training, condition (interleaved, same, or varied) and their interaction. We conducted separate analyses for the two testing measurements: before the onset of the first label and after the onset of the first label. For all regression analyses, the same and varied conditions were combined because past research suggests the interleaved condition provides a qualitatively different type of support to infants learning new categories (Goldenberg & Sandhofer, 2013).

For the 3 s of the testing phase before the first label was presented we hypothesized that there is no association between looking to the targeting during training and testing. Analysis revealed that neither of the main effects (looking to the target during training or condition) nor the interaction were significant predictors of looking to the target during testing ($|\beta s| < 0.173$, $ps > .350$). This suggests that looking to the target during training did not predict looking to target during testing before the first label was presented. This was expected because this is the portion of the testing phase during which no label was presented.

For the 6 s after the first label was presented, we hypothesized that increased looking to the target during training is associated with increased looking to the target during testing. This hypothesis was supported: Looking to the target during training was a significant predictor of looking to the target during testing (β = .31, $t[44]$ =2.2, p = .033). Infants who looked more to the target during training tended to look more to the target during testing when the label was presented. Importantly, because this study focused on differences between contextual support during training, the interaction between condition and proportion looking to the target during training was tested. The interaction between condition and proportion looking to the target during training was a significant predictor of proportion looking to target during testing after the label was presented (β = -.38, $t[14]$ = 2.4, p = .021; Figure 2-2). Tests of simple effects revealed that proportion looking to the target was a significant predictor of proportion looking to the target during testing for infants in the interleaved condition (β = .76, $t[30]$ = .76, p = .001), but not for infants in the same and interleaved conditions combined (β = .09, $t[30]$ = .52, p = .610). These results suggest that when provided with both types of contextual support (interleaved condition), greater looking to the target during training leads to greater looking to the target during testing when the target label is presented.

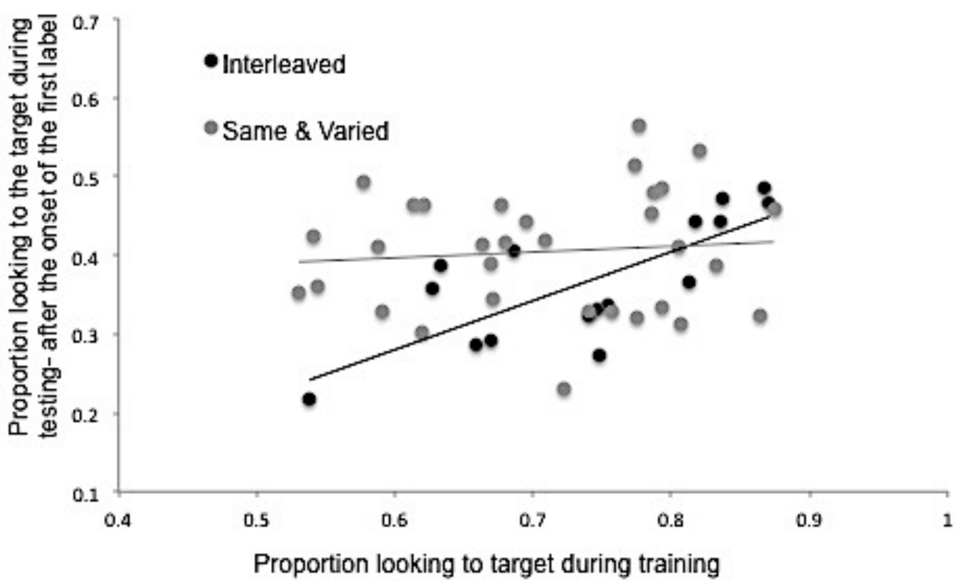

Figure 2-2. Regression of proportion looking to target during training on proportion looking to target during testing, after the onset of the first label. Proportion looking to target during training significantly predicts proportion looking to target during testing after the first label is presented for infants in the interleaved condition, but not for infants in the same and varied conditions.

Discussion

Our principal question was whether infant's visual attention during object category learning predicted category generalization performance in a new context. During training infants were provided with support to 1) decontextualize, 2) aggregate or 3) decontextualize and aggregate. Based on past research, we hypothesized that support for both decontextualization and aggregation is the most supportive contextual condition to infants' category generalization performance in a new context. Specifically, we hypothesized that looking to the target during learning predicts looking to the target during testing for infants who were provided with support to decontextualize and aggregate. To test this hypothesis, we examined the relation between looking to the target object during training and looking to the target object during testing, and we investigated the possibility that the relation between looking to the target during training and testing was influenced by the contextual condition (same, varied or interleaved) infants experienced during training.

For infants who were provided support to decontextualize and aggregate (i.e., training that took place in the interleaved context), visual attention during object training predicted category generalization. Category generalization was defined as looking to the labeled object during the testing phase while the label was presented. Past research suggests that when presented with a label, and two objects (a match to the label and a mismatch), infants look more to the object that matched the label (Fernald, Pinto, Swingley, Weinberg, McRoberts, 1998; Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987). Infants' visual attention to the correctly labeled object is a reliable measure of their ability to match the label to the object. Thus, in the current study, looking to the target when the label was presented during the testing phase was a measure of infants' ability to generalize the category label to the never before seen category exemplar.

Interestingly, the relation between looking to the target during the training phase and the testing phase (when the label was presented) only emerged for the infants in the interleaved condition, and not for infants in the same or varied conditions. This suggests that only when provided with support to 1) decontextualize the target object from the background (provided by training in varied context) and 2) aggregate the category instances (provided by training in same repeated context) does visual attention to the target object during training predict category generalization in a new context. Further, because proportion looking to target during training and proportion looking to the background context during training are inverse measures, our results suggest that more attention to the background context during training predicts less attention to the target during testing for infants in the interleaved condition.

The interleaved condition provided infants with support to both decontextualize the object from the background and aggregate the multiple category exemplars. Because this association was not found in the same or varied condition, which provided infants with *either* support to de-contextualize *or* support to aggregate, we conclude that only when infants have both types of support is looking to target during training beneficial to category generalization. The support to de-contextualize the object from the background *or* the support to aggregate category instances is not enough in isolation.

Further, only in the interleaved condition did the infants who looked more at the object during training look more to the object during testing. In other words, the infants who had a high amount of looking to the target object during training were more likely to generalize the object label (evidenced by looking to the target object when the label was presented). This result suggests that the infants who had more overall looking to the target during training were able to benefit from the superior support of the interleaved condition. These results are consistent with previous research suggesting that 2-year-old children's generalization performance is higher in a new context when learning takes in interleaved context, than the same or varied contexts (Goldenberg & Sandhofer, 2013).

As a control, we measured infants looking before the label was presented during the testing phase. We found no relation between looking to the target during training and looking to the target during testing phase (before the label was presented) for any condition. In other words when both the target object and distractor object were presented, without a label, looking to the target during learning did not predict looking to the target during testing. We used this interval as a control to rule out any relation between looking to the target during training and testing that was not due to category generalization. If a relation were found during this interval, it suggests that looking to the target during training predicts looking to the target during testing regardless of if the label is presented. Because no relation was found during the interval where no label was presented, we suggest that the relation found between looking during the training and testing phases when the label *was* presented is due a true relation between looking to the target during training and infants generalization of the category label.

A second question we asked was how infants allocate their visual attention when presented with a target object on a background context as a novel label was heard during learning. Consistent with our prediction, infants spent more time looking to the target object than the background context. However, infants did look at the background object as well (about 30% of the time). This finding is consistent with results reported by Haaf, Lundy and Coldren (1996), who suggested infants as young as 6 months old look to the background an object is presented on. Interestingly, there was no difference between contextual conditions in infants' attention to the target object or background object during training. These results suggest that no matter what type of contextual support is provided (aggregation, decontextualization or both), infants successfully attend to the labeled object during the training phase. Lastly, we examined differences between conditions in visual attention during the testing phase. We found no significant differences between conditions in looking to any of the aspects on the screen (background context, target object, distractor object) during the first 3 s. Thus, before the label was presented there was no effect of condition on looking during testing. Interestingly, across conditions, infants did not look longer to the distractor or target object, suggesting neither a novelty nor familiarity preference. Rather, infants scanned both objects before the label was presented during the testing phase.

The second testing time frame we examined during the testing phase was the 6 s after the onset of the first label. As in the first 3 s of the testing trial, there were no differences between conditions in looking to any of the AOIs. Thus, we conclude that the training condition did not systematically influence infants' overall looking during testing, although we had predicted that infants in the interleaved condition look longer to the target object during testing (after then label was presented) than infants in the same or varied conditions. Previous studies suggested, in contrast to our results, that generalization in a new context is more successful when learning takes place in interleaved contexts than in *either* the same context *or* varied contexts (Goldenberg & Sandhofer, 2013). One possible reason for the difference in results between these studies may be the ages of participants in the two studies (16-20 months in the current study vs. 20- to 28-month-old participants in the Goldenberg & Sandhofer, [2013] study). Vlach and Sandhofer (2011) suggested that older children are more likely to generalize in a new context when training takes place in either the same or varied context, and Hartshorn et al. (1988) suggested that memory is more contextually bound earlier in life. It is possible that the children in the current study had difficulty separating the object and context due to their younger age. This difficulty segregating the object for the background could have led to the lack of overall differences in looking to the target during training or testing between the three conditions. Another possible reason for the difference in the results may be attributed to the methodological differences in the two studies. The infants in the current study were not able to pick up the object and physically separate it from the background, but they were in the Goldenberg and Sandhofer (2013) study. Perhaps, such action experience facilitates independence from context under these conditions

The current study aimed to understand the relation between visual attention and category generalization in context. Infants were provided with three types of contextual support. Past research suggests that support to decontextualize and aggregate during learning enhances generalization performance in a new context. By examining infants' visual attention during training and testing, we suggest that when provided with both types of support, infants' looking to the object during training leads to greater generalization performance. Taken together, the results of this study suggest that visual attention supports generalization in a new context, when provided with support to aggregate and decontextualize during learning.

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The Role of Context in Word Learning: A Naturalistic Approach

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Abstract

Children are exposed to words by many different speakers and in many different spatial locations. We examined whether these contextual factors (speaker and spatial context) affect children's language production. Specifically, we asked whether the number of speaker and spatial contexts in which children were exposed to nouns affected their overall production of those nouns and the spatial contexts in which children produced those nouns. We analyzed video recordings of families interacting in their everyday lives; these recordings come from a novel naturalistic dataset generated by the Center on Everyday Lives of Families (CELF), an interdisciplinary research group located at the University of California, Los Angeles, and funded by the Alfred P. Sloan Foundation. All families included two parents and at least one child between the ages of 1.5 to 4.5 years old. Results suggest that both the number of speakers who exposed a child to a noun and the number of spatial locations in which a child was exposed to a noun, were positively associated with the frequency with which the child produced that noun. Further, the number of spatial locations in which a child was exposed to a noun, was positively associated with the number of spaces in which the child produced that noun. The role of contextual variation as a mechanism for word learning is discussed.

The Role of Context in Word Learning: A Naturalistic Approach

Early word learning takes place across different contexts. For example, in a single day a child may hear the noun "cup" in a wide range of places (e.g., in the car, at the playground, in the stroller) and from a wide range of speakers (e.g., mother, father, sibling). Understanding how these types of everyday contextual factors affect young children's word learning is crucial because research suggests context robustly affects basic learning and memory in a broad range of circumstances (e.g., Borovsky & Rovee-Collier, 1990; Edgin, Spanò, Kawa & Nadel, 2014; Godden & Baddeley, 1975; Hartshorn et al., 1998; Hayne, Boniface, & Barr, 2000; Hayne, MacDonald, & Barr, 1997; Learmonth, Lamberth, & Rovee-Collier, 2004; Rovee-Collier & Dufault, 1991; Rovee-Collier, Griesler, & Earley, 1985; Smith 1982; Suss, Gaylord & Fagen, 2012). Context has been defined in many different ways and previous studies have used various experimental manipulations to define context (e.g., background features and social partners); however, to our knowledge, no research has examined how the contexts in which children hear nouns throughout their everyday lives affect word learning. The current naturalistic study investigated how two contextual factors – 1) the spatial location the child occupied and 2) the speaker – were associated with children's noun input and production. We specifically aimed to 1) describe the contextual (spatial and speaker) variability of children's noun input and production and 2) examine how the contextual variability of children's noun input was associated with their noun production.

Learning in Context

Spatial context affects how humans learn and remember information. For example, even in infancy, memory for imitating a non-linguistic action is more successful when learning and recall take place in the same spatial context. Hayne, Boniface, & Barr (2000) exposed infants to an action in one of two spatial contexts (either in their homes or in the laboratory); subsequently all infants were prompted to imitate the action (i.e., recall) in the laboratory. Infants who learned the action in the laboratory (context match) outperformed the infants who learned the action in their home (context mismatch). Thus, recall was stronger when spatial context was held constant between learning and testing. Indeed, research suggests that learners of all ages benefit from overlapping cues between learning and testing contexts; and conversely, that changes in contextual cues between learning and recall reduce memory performance (Godden & Baddeley, 1975; Goldenberg & Sandhofer, 2013a; Hayne, Boniface & Barr, 2000; Robinson & Pascalis 2004; Rovee-Collier, Griesler, Early, 1985; Smith & Vela, 2001; Vlach & Sandhofer, 2011; Tulving & Thomson, 1973).

Recent research has begun to examine how spatial context affects children's early word learning. Findings suggest that children's generalization performance is context dependent (Vlach & Sandhofer, 2011; Goldenberg & Sandhofer, 2013a; Werchan & Gómez, 2014). Sandhofer and colleagues presented two- to four-year-old children with category members one at a time in a distinct context (a colored and patterned fabric square on which the object was placed) and tested children's ability to generalize the category label to a new category exemplar. Generalization performance was higher when training and testing took place in the same context (i.e., the same fabric) relative to a condition in which training and testing took place in different contexts (i.e., a new fabric; Goldenberg & Sandhofer, 2013a; Vlach & Sandhofer, 2011). Thus, generalization performance context dependent; when the learning and testing contexts differed, generalization performance suffered.

However, research also suggests that context dependency can be overcome with context variation during learning (Amabile & Rovee-Collier, 1991; Rovee-Collier & Default, 1991; Smith, Glenberg & Bjork, 1978; Vlach & Sandhofer, 2011). For example, when three- and four-year-old children were presented with category exemplars over multiple different contexts (i.e., a different fabric for each exemplar presentation), category generalization in a new context was successful (Vlach & Sandhofer, 2011). One explanation for this finding is that exposure to multiple contexts during learning increases the number of encoding cues that can potentially overlap with retrieval cues at test (Tulving & Thomson, 1973), thus improving memory and generalization performance. Altogether, the contextual variation present during learning seems to benefit memory for or generalization of new information in new contexts.

Spatial cues are not the only contextual factors that influence children's early word learning; the persons whom children are interacting are also important components of children's language learning environments. One study found that linguistic input changed as a function of the participants in an interaction. Specifically, when both mother and father were present (as opposed to only one parent), both parents spoke in longer utterances, suggesting that the language children were exposed to differed as a function of the speakers who were present in the interaction (Hladik & Edwards, 1984). Another study examined mothers and fathers' speech (e.g., number of words, word types, mean length of utterance) as they independently interacted with their child in a variety of activities. Results suggest that mothers' and fathers' speech differs in some activities (i.e., free play), but not others (i.e., book reading; Lewis & Gregory, 1987). Thus who is speaking to the child affects the language input the child receives.

Children's language *production* also appears to be influenced by the person the child is interacting with. Young children used more types of words (a measure of language diversity) when they were interacting with their mothers than with their older siblings (Hoff, 2010), and two year olds produced more utterances when playing with their mothers than when playing alone (with their mother present in the same room; Bornstein, Painter & Park, 2002). Additionally, children were more successful at generalizing an object category label when they were trained and tested by the same person, rather than by two different persons (Goldenberg and

Sandhofer, 2013b). In summary, the person with whom a child is interacting affects the child's language production.

Altogether, research suggests that the spaces that children occupy, and the partners with whom they interact, influence their language input and language production. Although contextual factors appear to be critical to language development, there has been little investigation of the actual contexts in which children are exposed to words in their everyday lives and how variability in those contexts affects children's language production.

Current Study

This naturalistic study explores how contextual variation in noun input affects children's noun production. In a small sample of 1.5 – 4.5, year olds we analyzed naturalistic recordings of children's spontaneous everyday interactions in family settings across multiple days. Participants were recorded going about their daily lives with no attempt to control language usage, what persons were present, their activities, or the spaces that were used. Thus, without extensive researcher control or interference, the current study contributes authentic observations of language contexts and behaviors in a small sample of toddlers and preschoolers (Repetti, Wang & Sears, 2013).

Using a naturalistic methodology, the current study aimed to 1) describe contextual variations in children's linguistic input and output and 2) analyze the association between the contextual variation in children linguistic input and their output. We focused our investigation on nouns because nouns dominate young children's vocabulary and thus are most likely to occur in children's language production (Fenson et al., 1994, Golinkoff, Mervis, & Hirsh-Pasek, 1994; Huttenlocher, Haight, Bryk, Seltzer, Lyons, 1991). Further, nouns are more frequent than verbs in parental speech to children (Cameron-Faulkner, Lieven, & Tomasello, 2003; Goldfield, 1993), specifically noun tokens (Gentner, 1982). For each noun in the child's language input and production, context was defined by 1) the child's physical location when hearing or producing the noun (spatial context) and 2) the speaker who produced the noun (speaker context).

The current study offers a comprehensive naturalistic description of children's noun input and production in relation to context by describing the contexts that characterize children's linguistic environments. We predicted that children heard and uttered nouns in multiple contexts and that the amount of variation in the two types of contexts (spatial and speaker) are correlated.

We were also interested in the association between contextual variability in children's noun input and their noun production. We hypothesized that a greater variety of contexts in which children heard nouns is associated with both a greater frequency of children's noun production and a greater variety of contexts in which children produced nouns. In other words, contextual variation in exposure to a noun may increase the likelihood that a child 1) utters that noun and 2) utters that noun in multiple contexts. These predictions are in line with research suggesting that contextual variation promotes noun category generalization in new contexts (Vlach & Sandhofer, 2011). By examining noun exposure and noun production in real life settings, this study adds ecological validity to the literature that examines how context affects word learning.

Method

Participants

The participants in this study were selected from a larger sample of 32 families who participated in a study conducted by the UCLA Sloan Center on Everyday Lives of Families (CELF: Ochs & Kremer-Sadlik, 2013). Eight families participated in the current study. In each of the families, the focal child was between the ages of 1.5-4.5 years old (M_{age}= 3 years, 5 months; Table 3-1). Of the eight focal children, five were male and three were female. All focal children were the youngest children in the families. All families included a father (M_{age}=39.75

years, $range_{age}$=33-48 years), a mother (M_{age}=37.95 years, $range_{age}$=28-43 years) and at least one sibling (i.e., Sibling 1) between the ages of 7 and 9 years old (M_{age}= 8 years, 4.5 months). Three families had a third child (i.e., Sibling 2; ages= 5 years, 2 months; 17 years 2 months & 10 years, 11 months).

Table 3-1. *Participant Information*

Family Number	Age of Focal Child (years; months)	Gender of Focal Child
1	1;3	F
2	1;7	M
3	1;10	F
4	2;3	F
5	2;7	M
6	2;8	M
7	4;4	M
8	4;4	M

All mothers and fathers each worked out of the home at least 30 hours per week. All families were middle class (M_{income}=\$105,937, $range_{income}$=\$58,500-\$164,999). Fathers' highest level of education was identified as the following: graduate degree (n=1), college graduate (n=2), some college (n=3), and high school graduate (n=2); mothers' highest level of education was identified as the following: graduate degree (n=2), college graduate (n=3), some college (n=2), and high school graduate (n=1). Fathers' ethnicity was identified as Caucasian (n=5), African American (n=1), and Asian American (n=2); mothers' ethnicity was identified as Caucasian (n=6), African American (n=1), and Hispanic (n=1). All families lived in a large metropolitan area in Southern California. All homes were monolingual English speaking homes. Families were recruited through school flyers, newspaper ads, and word of mouth.

Design

The CELF study captured families in their natural environments; the families were recorded over two weekend days and two weekdays, but were not filmed when the parents were at work or when the focal children were at daycare or with another caregiver. Two trained videographers –who were instructed not to disrupt or interfere with the families' daily activities – collected the video recordings. Wireless microphones, worn by family members, were used to capture all dialogue. The families were instructed to go about their daily activities as if the videographers were not there; no intervention, direction, or stimuli were provided. Filming took place both in and out of the home. Families attended swim lessons at their local recreation center, as well as visited zoos, parks and stores while being recorded; many also interacted with extended family members or friends throughout the filming. Informed consent was obtained from all participants who were filmed in a participants' home. One videographer followed each parent; camera A predominantly followed the mother and camera B predominantly followed the father. If either parent was absent, the extra camera was free to film other family interactions (Ochs, Graesch, Mittman, Bradbury, & Repetti, 2006).

Procedure

Identifying language input. The strong naturalistic focus of this study allowed participants to freely move about their environment; this necessitated a unique language input identification procedure. Because the videographers primarily followed the mother and father, there were many instances in which the child was not exposed to the language captured on camera. Trained research assistants identified the video footage in which a focal child was potentially exposed to words (i.e., language input to the child). Language input was conservatively defined as any word a focal child could likely hear based on the location of the speaker and focal child. For example, if the speaker and child were in the same room or in adjacent open rooms (e.g., speech produced in the breakfast nook could be overheard by the child in the adjacent kitchen), the speaker's language would be rated as language input to the child. Importantly, the focal child need not have actively listened nor attended to the speaker for the words to be categorized as language input to the child. Thus, nouns in the child's input could have been directed to the focal child or to someone other than the focal child. Inter-rater reliability for language input, based on the 20% of the recordings that were double coded was excellent (κ=.87, p<.001).

Selecting video footage. The second step was to choose comparable subsamples of video footage for the eight families. Although all eight families were filmed across four days in the original study, the amount of time in which the focal children received language input were unequal among families. Thus, we selected roughly nine hours of language input footage for each family, which spanned across the four days of filming (M=8 hours, 59 minutes, SD=4 minutes; two weekdays and two weekend days). Video recordings from camera A contributed to one weekday and one weekend day, and the other weekday and weekend day was taken from camera B. The amount of video selected from each camera was proportional to the amount of language input the child received from each camera. For example, if 70% of the child's language input came from camera A and 30% from camera B, the same proportions were conserved when selecting the nine hours of video to code.

Coding Scheme. The focal child's language input and language production was coded with a specific focus on nouns.

Noun Input and Production. Coders transcribed and coded all of the common nouns present in the focal child's language input and all of the nouns the child produced. The coders transcribed nouns by watching the pre-selected video footage and concurrently consulted pre-existing transcriptions (created by trained research assistants for the larger CELF study) to disambiguate any noun instances. All nouns analyzed in the current study were included in the New Oxford American Dictionary (Stevenson & Lindberg, 2010). Each noun was coded for spatial context, and nouns in the child's input were also coded for speaker context. All coders were blind to the hypotheses.

Spatial Context. For each noun (input and production), we coded the space the child was in when the noun was spoken (i.e., the spatial context). There are multiple ways to define spatial context, both specific and broad. We took a broad approach to defining spatial context. Generally, spatial context was coded as the room the child occupied in a home (e.g., kitchen) or community dwelling they visited (e.g., park) at the moment they were exposed to the noun. When the focal child was at home, coders used a previously plotted family floor plan to determine the exact room the child was in (see Figure 3-1; Ochs, et al., 2006). When the focal child was in someone else's home (e.g., grandmother's house or a babysitter's apartment), the coders did not have a floor plan and used visual cues from the video recordings to code which room the focal child occupied (e.g., grandmother's kitchen, babysitter's living room). When the focal child was in a store or other community dwelling, the coders recorded which dwelling the focal child occupied (e.g., store, bank, park). If the coder was able to identify which specific store the child was in, they recorded the specific store name (e.g., Costco, Staples). If the community dwelling was large enough to have multiple functionally discrete sections the coders specified which area the focal child was in (e.g., petting area of zoo, pool at YMCA). Further, when the child was in a parking lot, the coders recorded that the focal child was in a parking lot and of which community dwelling (e.g., parking lot of bank). When the child was in a car, the coders specified who drove the car (e.g., mother's car). If the child was walking in a neighborhood, the coders denoted that the child was on the sidewalk and whose neighborhood the focal child was walking in (e.g., sidewalk in grandma's neighborhood). For a full list of spatial contexts coded for each family see the Appendix.

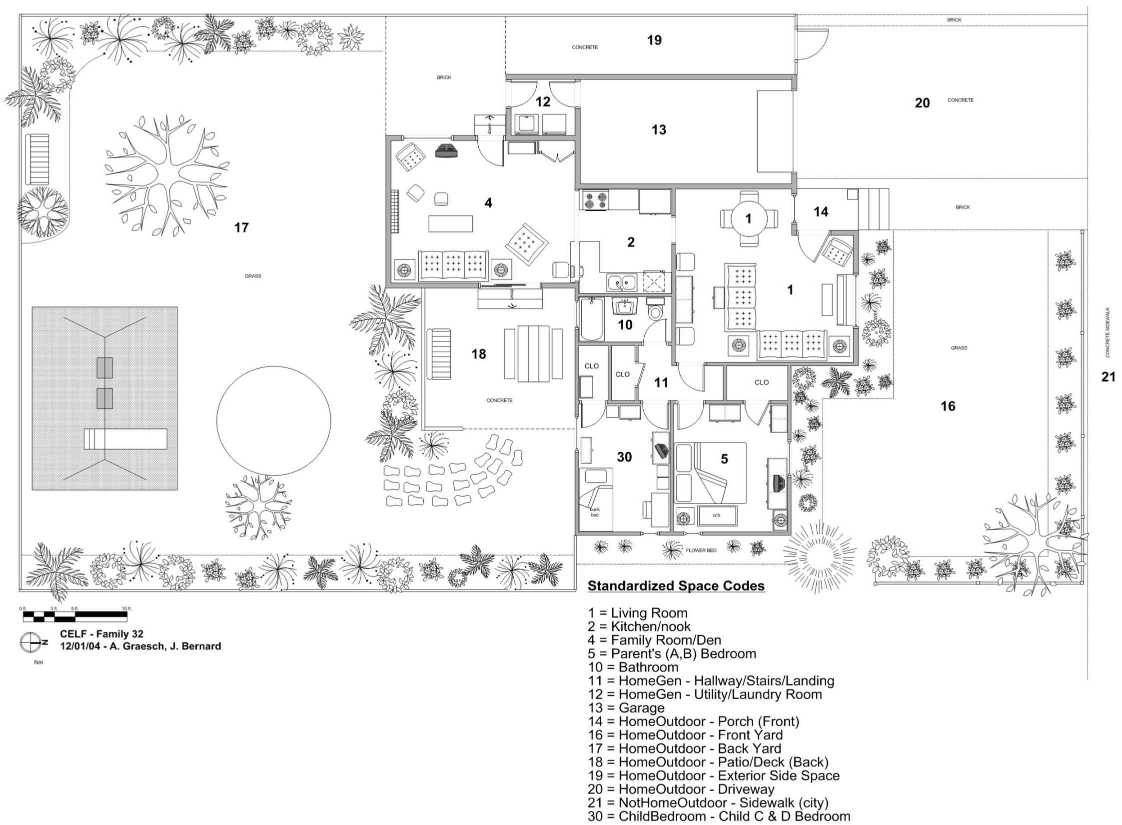

Figure 3-1. Example of family floor plan used to code spatial context.

Speaker context. For each noun (input) we coded the speaker who uttered the noun (i.e., the speaker context). The speakers were primarily members of the immediate family (i.e., mother, father, sibling), but also included other relatives (e.g., aunt, cousin), friends, or persons in the community (e.g., postman, grocery clerk). For a full list of speaker contexts coded for each family see the Appendix.

Percent Agreement. For each noun transcription (input and production) and the corresponding context codes, percent agreement was assessed. All coders were trained to a 95% agreement level prior to any coding for the study. Once coding began for the study, two coders were randomly paired and checked to confirm a 95% agreement between them for all codes. The two coders achieved 95% agreement regularly, and in the rare cases they did not, they recoded until they reached a 95% agreement level.

Results

Descriptives: Noun Types, Tokens and Contexts

The first goal of this study was to describe the contexts in which children were exposed to and produced nouns. Table 3-2 provides each focal child's *overall* noun input counts and noun production counts (separated by type and token count). Noun types refer to the count of *unique* nouns in speech, and noun tokens refer to the overall count of noun instances in speech (Tardif, Shatz & Naigles, 1997). With respect to noun input, the type and token counts were fairly consistent across families (type: M= 779, SD=125, range=605-927; token: M= 3786, SD=732, range=2807-4698) and type and token counts were significantly correlated (r=.95, p<.001), over and above age. This suggests that children who are exposed to more noun types are also exposed to more noun tokens. There were no significant age-related correlations with noun input type and token counts.

Table 3-2. *Noun Input and Focal Child Noun Production Count*

	Noun Type Count		Noun Token Count	
Family Number	Input	Child Production	Input	Child Production
1	764	5	3,869	20
2	650	13	3,468	174
3	909	61	4,698	178
4	836	155	4,450	859
5	897	204	4,638	839
6	646	147	2,754	1,110
7	826	204	3,827	888
8	594	271	2,807	1,238
Mean (SD)	765 (121)	133 (97)	3,786 (732)	670 (472)

Children's noun production showed high variability (type: *M*=134, *SD*=98, range=5-275; token: *M*=670, *SD*=472, range=20-1238), which was expected given the wide range in the children's ages. Age was correlated with both noun type and token production counts (type: r=.89, p<.05; token: r=.78, p<.05), and the two production counts were significantly correlated with each other, over and above the effect of age (r=.81, p<.05). The child with the lowest number of production noun counts, both types and tokens, was the youngest child in the sample (1 year, 3 months). Conversely, the child with the greatest number of production noun counts, both types and tokens, was one of the oldest children in the sample (4 years, 4 months).

Children were exposed to nouns in multiple spatial and speaker contexts and from multiple speakers in their everyday lives: on average, 24 different spatial contexts (*SD*=6, range=13-31) and 15 different speakers (*SD*=7, range=7-28). There was a marginal correlation between the number of spatial contexts and speaker contexts (r=.67, p=.06), indicating that children who were exposed to nouns in more spatial contexts, were also exposed to nouns by more speakers. The association between both types of context may be because families encountered different people as they traveled to new contexts. For a full list of the noun type and token counts children were exposed to in each spatial context and by each speaker, see Appendix.

Does Context Affect Children's Production?

The second goal of this study was to examine the association between the variety of children's noun input contexts and their noun production. Data were analyzed using a fixed effect negative binomial count regression model. To account for the non-independence of observations between focal children (i.e., repeated-measures nature of the data), we used a fixed effect model (Allison, 2005). Using the fixed effect model, we included family as a grouping variable; the model analyzed the data as a within-subjects model, and therefore all conclusions are at the within-subjects level. To account for the fact that the outcome variable (noun token production counts) was measured on a count scale, we used a count regression model rather than a linear regression model. Further, because the outcome variable was overdispersed (observed variance was higher than the variance of a theoretical model), the data were analyzed using a negative binomial count model.

To test this model, the dataset was organized with noun type as the unit of analysis. Each row in the analysis represented a different noun type (see Table 3-3.) Each noun could appear once for each child, and therefore any noun could appear up to eight times in the dataset. The columns represented the variables in the analysis: *family number, noun token production* (i.e, the total number of tokens in which the child produced that particular noun type, which included zero if the child never uttered that noun), *noun token input* (i.e., total number of tokens the child was exposed to that noun type), *spatial context input* (i.e., the total number of spatial contexts in which the child was exposed to that noun type) and *speaker context input* (i.e., the total number of speaker contexts in which the child was exposed to that noun type).

Table 3-3. *Example matrix used to analyze the association between spatial and speaker context input and noun token production.*

Noun Type	Family Number	Noun Token Production	Noun Token Input	Spatial Context Input	Speaker Context Input
Bike	1	0	5	2	4
Chicken	1	3	9	5	3
Gift	1	0	1	1	1
Airplane	2	0	2	1	1
Bike	2	0	1	1	1
Napkin	2	3	4	2	2
⋮	⋮	⋮	⋮	⋮	⋮

All three input variables were tested as simultaneous predictors of noun token production.

The likelihood ratio Chi-square test of the overall model was statistically significant (χ^2= 892.60, *p*<.001). All three predictor variables were significant predictors of noun token production frequency (Table 3-4). Because the model uses the natural log of the outcome variable, all results are presented as Incidence Rate Ratios (IRR), which are the expontentiated beta coefficients. As expected, noun token input positively predicted noun token production (IRR=1.012, *p*<.001), suggesting that for every token increase in input, the rate of the child's noun token production increased by a rate of 1.01, when all other predictor variables held constant. Spatial context input also positively predicted noun token production (IRR=1.09, *p*<.001): For every additional spatial context, the rate of the child's noun token production was estimated to increase by a rate of1.09, with all other predictor variables held constant. Lastly, speaker context input positively predicted noun token production (IRR=1.26, *p*<.001), suggesting that for every additional speaker context, the rate of noun token production was estimated to increase by a rate of 1.26, with all other predictor variables held constant. In summation, the number of spatial contexts a child occupied while exposed to a noun and the number of speakers who exposed a child to a noun each predicted an increase in the number of times the child produced that noun, independent of the total number of times the child was exposed to that noun[1].

[1] We ran the model associating noun token production with noun token input, spatial context input, and speaker context input independently for each child. We found noun token input was significantly associated with noun token production for seven of the children. Spatial context input was significantly associated with noun token production for one of the children. Lastly, speaker context input was significantly associated with noun token production for four of the children.

Table 3-4. *Negative Binomial Fixed Effect Regression with Noun Token Production as Outcome Variable*

Predictor Variable	IRR	Standard Error	Z-value
Intercept	0.03	.002	-50.06**
Noun Token Input	1.01	.002	4.78**
Spatial Context Input	1.09	.023	4.00**
Speaker Context Input	1.26	.045	6.69**

Note. **p<.001

Lastly, we tested the association between the number of spatial contexts in which a child was exposed to a noun and the number of spatial contexts in which the child produced that noun. For this analysis, we used a fixed effect Poisson count regression. A Poisson regression was appropriate because the outcome variable (spatial context output) was not overdispersed. This model was tested with a dataset that was similar to the one described above, but this model included only the nouns that children were both exposed to and produced themselves (n=826 nouns across the eight families). The outcome variable was the number of spaces in which the child produced that noun type and the predictor variable was the number of spatial contexts in which the child was exposed to that noun type. The predictor variables were noun token input (i.e., total number of tokens the child was exposed to that noun type) and spatial context input (i.e., the total number of spatial contexts in which the child was exposed to that noun type). There was no significant association between noun token input and spatial context production (IRR=1.00, p>.05). The analysis revealed a significant positive association (IRR=1.10, p<.001); for every one-unit increase in spatial context exposure, the number of spatial contexts in which the child produced that noun was estimated to increase by a rate of 1.10, with all other predictor variables held constant. These results suggest that the number of spaces a child occupied when exposed to a noun positively predicted the number of spaces the child occupied when they produced that noun.

Discussion

The current study examined the role of spatial and speaker contexts in young children's everyday language exposure and production. The first aim was to describe the spatial and speaker contexts in which children were exposed to language during their everyday lives. This study coded 9 hours of family interactions for eight families, during which children were on average exposed to 765 noun types and 3,786 noun tokens. Similarly, over the 9 hours, children produced on average, 133 noun types and 670 noun tokens. These frequency counts are the first, to our knowledge, to span such a large time frame for children of this age.

Our description of children's noun exposure and production also includes several associations between different noun frequency measures. In terms of noun exposure, children who were exposed to a higher frequency of noun types were exposed to a higher frequency of noun tokens, which is consistent with past research (Rowe, 2008). In terms of noun production, children who produced a greater number of noun types, also produced a greater number of noun tokens. Further, children's age was positively associated to both noun type and token production counts. Thus, as reported in previous studies (e.g., Huttenlocher, Haight, Bryk, Seltzer, Lyons, 1991), as children's age increased, noun type and token production increased. Though these results are consistent with previous studies, the results are novel in that they span numerous hours over numerous days.

Further, no study to our knowledge has documented the contextual frequency in which children are exposed to nouns in their everyday lives. Our results suggest that children were exposed to nouns, on average, in 24 different spatial contexts and by 15 different speakers. Thus, within approximately 9 hours of their everyday lives, young children were exposed to language in a large variety of contexts. The contextual description afforded by the current study adds to the small but growing body of research examining contextual variation in children's everyday lives.

Importantly, our second aim was to investigate the association between the number of contexts in which children were exposed to nouns and children's noun production. Results suggest that above the effect of noun frequency, the frequency of spatial and speaker contexts are positively associated with children's noun production frequency. That is, the more spatial contexts in which a child was exposed to a noun, the more likely the child was to utter that noun. Thus, young children uttered nouns that were heard in many spatial contexts more frequently than nouns that were heard in fewer spatial contexts. Similarly, the more speaker contexts in which a child was exposed to a noun, the more likely the child was to utter that noun. In other words, nouns that are spoken by more speakers were more likely to be uttered by young children, than words that were spoken by fewer speakers. Thus, spatial and speaker contextual variability are beneficial to young word learners. These results are consistent with past research that suggests that learning in multiple contexts aids generalization performance (Amabile & Rovee-Collier, 1991; Rovee-Collier & Default, 1991; Smith, Glenberg & Bjork, 1978; Vlach & Sandhofer, 2011). Multiple contexts afford greater diversity in language learning experiences, which likely aids the learner in decontextualizing the to-be-learned information, thereby promoting early word learning. Perhaps by decontextualizing the noun from the surrounding spatial and speaker contexts, the child acquires an abstract understanding of the noun. Such an abstract representation likely aids their ability to relevantly and appropriately utter the noun, increasing the frequency in which they utter that noun.

We also asked if the number of spatial contexts in which a child was *exposed* to a noun was associated with the number of spatial contexts in which the child *produced* that noun. Our results suggest that, above the effect of noun frequency, the number of spatial contexts in which a child was exposed to a noun was positively associated with the number of spatial contexts in which the child produced that noun. In other words, the nouns that children produced in many spatial locations were the nouns the children heard in many spatial locations. Again, this finding is consistent with previous research, which suggests that contextual variation aids memory and generalization in a new context (Amabile & Rovee-Collier, 1991; Rovee-Collier & Default, 1991; Smith, Glenberg & Bjork, 1978; Vlach & Sandhofer, 2011). Contextual variation allows learners to decontextualize the to-be learned information (Goldenberg & Sandhofer, 2013a) and in the case of noun learning, contextual variation aids learners' decontextualization of nouns from the spatial context. By decontextualizing the noun, children learn that the noun is not tied to a specific spatial location and can be produced in multiple spatial locations. Thus, in the current study, it is possible that the nouns that were learned in many spatial locations were decontextualized from a specific spatial location, and therefore produced in many spatial locations. In addition, these results also suggest that some words are more context-bound than others. It is possible that certain words *are not* context-bound; for example the word water is likely to be heard and uttered by a child in many locations. Similarly, it is possible that certain words *are* context-bound; for example the word toothbrush is likely to only be heard and uttered by a child in the bathroom. Perhaps the words that the children in the current study heard and uttered in multiple contexts are non-context-bound words. Together, these results suggest that words can be context bound in children's everyday lives, and learning nouns in multiple contexts likely supports production in multiple contexts.

The current study suggests that contextual variation is both present in children's noun exposure and beneficial to early language development. By naturalistically examining the spatial and speaker contexts in which children were exposed to nouns, our results suggest that children were exposed to a wide variation in both spatial and speaker contexts. Children in our sample moved through their environments and heard words in many different locations both in and out of their homes. All of the children were exposed to language in their home, other people's homes, and in many cases, settings within their community. The children also interacted with many different speakers and thus heard language from multiple persons. All of the children were the youngest child in their family and were exposed to language from their parents, older siblings, other family members, and community members. Past research suggests that contextual variation in noun exposure indicates to the learner that the to-be learned information is not bound to the particular context, and thus should be decontextualized from the context (Goldenberg & Sandhofer, 2013a); such decontextualization aids children when generalizing in a new context (Vlach & Sandhofer, 2011). The children in the current study benefited from the contextual variation through decontextualization; children uttered nouns that were heard in more places and by more speakers more. Further, children produced nouns that were heard in more spaces in more spaces themselves. It is important to note that these effects are not due to the frequency in which the child was exposed to the noun. Rather, contextual variation benefited children's language production over and above the effect of frequency. Therefore, it is not the case that children simply utter words that are heard more often; children are more likely to utter nouns, in general and in multiple places, if the noun is heard in multiple spatial and speaker contexts, regardless of the frequency with which the noun was heard. Thus, contextual variation seems to be a beneficial (and naturally occurring) learning mechanism for young language learners.

The current study suggests contextual variation benefits young children's language production. However, previous studies suggest that young children's language learning is context bound, such that, contextual variation hinders word learning. In particular, Goldenberg & Johnson (2015) and Goldenberg & Sandhofer (2013a) found 1.5- and 2-year-old-children (respectively) were context dependent, even when the to-be-learned material was presented in multiple contexts. We suggest three possible reasons why age effects were found in previous experimental studies, but not in the current study. First, Goldenberg & Sandhofer (2013a) and Goldenberg & Johnson (2015) used experimental paradigms, in which children were taught novel information and asked to remember or generalize the information after a delay. This type of methodology often creates a memory demand, imposing constraints on children's cognition, which may promote contextual dependency and impede children's ability to benefit from contextual variation. Second, the former word learning experiments examined children's ability to learn *novel* words and objects in context. However, the current study examined children's production of familiar words (i.e., words the children have likely been previously exposed to). It is possible that the familiarity of the words in the current study decreases cognitive demands and aids children in using contextual variation when learning nouns. Third, the contexts in former studies were novel and often artificial, and the contexts in the current study were familiar to children. For example, the operationalization of what constitutes context in past studies is wide and has included, for example, the odor or audio present during learning (Fagen et al., 1997; Rubin et al., 1998), or the colored background on which an object was presented (Robinson and Pascalis, 2004). In contrast to past studies, the contexts in the current study were authentic and familiar to children, which may have helped children utilize contextual variability when producing nouns. The children in the current study benefited form contextual variation, while young children in past experimental designs did not. However, we suggest this discrepancy is due to various methodological differences between the current study and past studies.

Importantly, even though contextual variation has been shown to affect word learning in the current paper and in few previous studies (Goldenberg & Johnson, 2015; Goldenberg & Sandhofer, 2013a; Vlach & Sandhofer, 2011; Werchan & Gomez, 2014), contextual variation is not often present in laboratory studies. Laboratory studies generally take place in one specific location (e.g., lab playroom), with one specific person (e.g., experimenter), and are void of contextual variation. By eliminating contextual influences in laboratory studies, researchers are controlling the environment to make causal conclusions about the variables under investigation. However, by controlling the environment, contextual variation is minimized, and information regarding the role of context on language development is lost. By including contextual variation in experimental and naturalistic studies, research can further elucidate how language learning is affected by contexts.

The current study examined the role of contextual variation in early language learning. We used naturalistic methodologies to 1) describe the contexts which characterize children's language exposure and 2) examine the association between the number of contexts in which children are exposed to nouns and the frequency with which children produce nouns. We suggest that contextual variation is both present in children's noun exposure and children are more likely to produce nouns that they are exposed to in multiple contexts. Further, children produce nouns in multiple spatial locations if they are exposed to the noun in multiple spatial locations. Altogether, contextual variation is present in children's everyday lives and is beneficial to early language development.

Appendix

Table A1

Noun Type and Token Input within Spatial and Speaker Context: Family 1

Spatial Context	Noun Input	
	Type	Token
Kitchen	450	1877
Living Room	274	773
Front Yard	220	541
Mother's Car	112	240
Foyer	80	122
Bathroom	47	78
Driveway at Aunt's House	42	66
Hallway	39	60
FC Bedroom	27	39
Dining Room	24	33
Laundry Room	8	10
Sidewalk in Own Neighborhood	7	8
Sidewalk in Aunt's Neighborhood	7	9
Parent's Bedroom	5	5
Brick Walkway	5	5
Driveway of Babysitter's House	3	3
Speaker Context		
Mother	566	2641
Sibling 1	180	415
Adult B: Landscaper	164	348
Father	144	240
Researcher	86	167
Adult A: Aunt	22	34
Child A: Cousin	20	24

Table A2

Noun Type and Token Input within Spatial and Speaker Context: Family 2

Spatial Context	Noun Input: Type	Noun Input: Token
Living room	246	718
Breakfast Nook	194	575
Back Yard	171	567
Mother's Car	136	317
Kitchen	104	186
Sibling 2 & FC bedroom	93	228
Front Foyer	65	111
Parent's Bedroom	60	134
Driveway	58	112
Sidewalk at Shopping Center	44	58
Hallway	44	67
Dining Room	40	102
Sibling 1 Bedroom	38	74
Costco	26	35
Playroom	25	28
Staples	18	24
Bathroom	17	22
Sidewalk in Own Neighborhood	16	34
Back Deck	15	17
Front Porch	12	22
Laundry Room	12	15
Bank	9	14
Parking Lot of Shopping Center	9	11
Parking Lot of Costco	9	11
Sidewalk in Front of House	2	4
Father's Car	2	3
Speaker Context		
Mother	388	1382
Sibling 1	209	626
Father	182	392
Sibling 2	170	553
Researcher	72	103
Adult D: Family Friend	58	157
Adult F: Family Friend	49	49
Adult G: Family Friend	45	77
Adult B: Family Friend	37	46
Child A: Family Friend	23	28

(continued)

Table A2 (continued)

Speaker Context	Noun Input	
	Type	Token
Child B: Family Friend	14	21
Child C: Family Friend	8	18
Adult A: Customer at Costco	5	6
Adult C: Family Friend's Nanny	4	4
Adult E: Bank Teller	5	6
Adult H: Employee at Staples	1	1

Table A3

Noun Type and Token Input within Spatial and Speaker Context: Family 3

	Noun Input	
Spatial Context	Type	Token
Living Room	464	1479
Mother's Car	340	1009
Family Room/ Den	234	529
Parent's Bedroom	158	430
Father's Car	113	234
Kitchen	96	199
Pool at YMCA	79	393
Bathroom	62	170
Back Yard	42	67
Classroom at Daycare	24	46
Front Porch	23	39
Parking lot at YMCA	21	22
Hallway	17	24
Driveway	9	15
Driveway at Sibling's School	8	9
Sibling 1 & Sibling 2 Bedroom	6	8
Classroom at Sibling's School	4	6
Hallway at YMCA	4	4
Lobby at YMCA	4	5
Driveway at Daycare	3	3
Parking Lot at Daycare	3	4
Laundry Room	1	1
Garage	1	1
Entrance at YMCA	1	1
Speaker Context		
Mother	625	2349
Father	345	1116
Sibling 2	197	511
Sibling 1	170	323
Researcher	151	334
Adult A: Swim Instructor at YMCA	19	53
Adult B: Teacher at Daycare	6	9
Adult C: Patron at YMCA	2	2
Adult D: Patron at YMCA	1	1

Table A4

Noun Type and Token Input within Spatial and Speaker Context: Family 4

Spatial Context	Noun Input	
	Type	Token
Kitchen	309	992
Living Room	224	578
Garage	193	511
Family Room	191	432
Mother's Car	176	363
FC Bedroom	151	329
Driveway	101	199
Mother's Office at Mother's Workplace	84	140
Parent's Room	80	205
Hallway	63	93
Hallway at Mother's Workplace	48	81
Co-Worker Office at Mother's Workplace	45	82
Home Depot	45	86
Living Room at Baby Sitter's House	43	74
Sibling 2 Bedroom	31	45
Bathroom	27	49
Front Porch	25	33
Back Yard	19	19
Back Room at Mother's Workplace	18	27
Sidewalk at Mother's Workplace	15	17
Sibling 1 Bedroom	14	17
Sidewalk in Own Neighborhood	13	14
Parking Lot of Home Depot	11	18
Porch at Baby Sitter's House	7	11
Exterior Side Space	6	8
Sibling 1's Car	6	8
Stairs Mother's at Workplace	5	5
Drive Way at Baby Sitter House's	4	5
Entry Way at Mother's Workplace	4	4
Back Room at Baby Sitter House's	3	4
Lawn at Baby Sitter House's	1	1

(continued)

Table A4 (continued)

Speaker Context	Noun Input	
	Type	Token
Mother	621	2779
Father	246	688
Sibling 2	197	444
Researcher	100	168
Adult D: Mother's Co-Worker	62	99
Sibling 1	49	120
Adult A: Baby-Sitter	29	49
Adult F: Phone Installer at Mother's Workplace	18	36
Adult C: Mother's Co- Worker	17	21
Adult I: Employee at Home Depot	15	16
Adult H: Employee at Home Depot	8	8
Adult G: Employee at Home Depot	6	6
Adult J: Employee at Home Depot	5	5
Child A: Neighbor/Sibling 2's Friend	3	3
Adult E: Mother's Co-Worker	2	4
Adult L: Employee at Home Depot	2	2
Adult B: Customer at Home Depot	1	1
Adult K: Employee at Home Depot	1	1

Table A5

Noun Type and Token Input within Spatial and Speaker Context: Family 5

Spatial Context	Noun Input	
	Type	Token
Living Room	507	1784
Parent's Bedroom	229	559
Hallway	116	227
Sibling 1 Bedroom	114	207
Kitchen	110	191
Office/ Computer/ Workspace	92	190
Bathroom	90	185
Soccer Field at Park	80	228
Garage	59	123
Back Yard	45	72
Sidewalk at Park	40	91
Father’s Car	35	56
Sidewalk in Own Neighborhood	34	49
Kitchen in Neighbor’s Condo	33	50
Track on College Campus	33	61
Exterior Side Space	31	46
Front Yard	31	46
Father’s Bike	23	38
Living Room in Neighbor’s Condo	21	29
Corridor on College Campus	20	28
Back Deck/Patio	18	28
Playground at Park	15	28
Field on College Campus	12	13
Front Porch	11	12
Grassy Patch at Park	10	14
Track Field Entrance on College Campus	9	13
Speaker Context		
Mother	565	2232
Father	402	1326
Sibling 1	242	498
Researcher	95	154
Adult G: Friend Of Parents	24	31
Adult D: Parent of Sibling 1 teammate	17	29
Adult C: Parent of Child at Park	7	10

(continued)

Table A5 (continued)

Speaker Context	Noun Input	
	Type	Token
Adult E: Friend of Parents	6	6
Adult F: Friend of Parents	6	8
Adult A: Neighbor	3	3
Adult B: Parent at Park	3	3
Child B: Sibling 1 Soccer Teammate	2	3

Table A6

Noun Type and Token Input within Spatial and Speaker Context: Family 6

Spatial Context	Noun Input	
	Type	Token
Living Room	283	744
Sibling 1 & FC bedroom	269	760
Kitchen	237	647
Mother's Car	142	247
Office/Computer Room/Workspace	49	92
Living Room in Grandparent's House	39	77
Bathroom	37	81
Hallway	32	44
Parent's Bedroom	22	32
Back Yard	14	18
Front Yard	7	7
Driveway	3	4
Sidewalk in Grandparent's Neighborhood	1	1
Speaker Context		
Mother	397	1149
Sibling 1	283	805
Father	264	673
Researcher	60	99
Adult A: Aunt	9	15
Adult C: Grandma	8	12
Adult B: Grandpa	1	1

Table A7

Noun Type and Token Input within Spatial and Speaker Context: Family 7

Spatial Context	Noun Input	
	Type	Token
Dining Room	292	764
Father's Car	261	657
Living Room	251	727
Mother's Car	140	289
Walkway at Zoo	134	381
Train Ride at Park	103	238
Soccer Field at School	98	214
Sibling 1 & FC Bedroom	91	131
Bathroom	44	87
Parking Lot at School	38	56
Animal Feed at Zoo	30	44
Duck Pond at Zoo	28	45
Classroom at Daycare	24	34
Parking Lot at Zoo	16	20
Playground at School	14	19
Front Yard	12	17
Driveway	11	13
Horse Stall at Park	10	15
Parent's Bedroom	9	10
Train Area at Park	9	12
Parking Lot at Park	8	11
Sidewalk at School	8	12
Kitchen	6	10
Parking Lot at Daycare	6	7
Basketball Court at School	5	6
Outside of Classroom at Daycare	5	7
Sidewalk in Commercial Area	1	1
Speaker Context		
Mother	502	1782
Sibling 1	390	1111
Father	265	638
Uncle	57	79
Researcher	43	64
Adult S: Employee at Train Ride	28	41
Adult M: Grandfather	17	20

(continued)

Table A7 (continued)

Speaker Context	Noun Input	
	Type	Token
Adult E: Friend of Parents	6	6
Adult F: Friend of Parents	6	8
Adult A: Neighbor	3	3
Adult B: Parent at Park	3	3
Child B: Sibling 1 Soccer Teammate	2	3
Adult B: Sibling 1's Soccer Coach	14	24
Adult H: Employee at Zoo	7	7
Adult L: Daycare Teacher	7	7
Adult N: Grandmother	7	9
Adult R: Employee at Train Ride	7	8
Adult A: Parent of Sibling 1's Soccer Teammate	4	4
Adult C: Parent of Sibling 1's Soccer Teammate	3	4
Child C: Sibling 1's Friend	4	4
Adult J: Employee at Zoo	3	5
Adult K: Employee at Zoo	2	3
Child A: Sibling 1's Soccer Teammate	3	4
Adult E: Customer at Zoo	2	2
Adult T: Employee at Horse Stall	2	2
Adult D: Parent of Sibling 1's Soccer Teammate	1	1
Adult F: Customer at Zoo	1	1
Adult G: Employee at Zoo	1	2
Adult I: Employee at Zoo	1	1
Adult O: Patron at Park	1	1
Adult P: Patron at Train Ride	1	1
Adult Q: Employee at Train Ride	1	1
Child B: Sibling 1's Soccer Teammate	1	1

Table A8

Noun Type and Token Input within Spatial and Speaker Context: Family 8

Spatial Context	Noun Input	
	Type	Token
Living Room	270	765
Dining Room	198	473
Front Yard	145	472
Kitchen	114	233
FC Bedroom	39	57
Father's Car	77	143
Mother's Car	64	112
Parent's Bedroom	48	75
Back Deck/Patio	36	57
Sidewalk in Neighborhood	33	58
Bathroom	29	46
Hallway	28	39
Office/Computer Room/ Workspace	26	32
Hallway YMCA	23	38
Back Yard	22	29
ChildWatch YMCA	16	22
Outside Classroom School	14	22
Sibling 1 Bedroom	13	38
Parkking Lot YMCA	13	17
Park	12	29
Front Porch	12	17
Driveway	9	11
Playground School	8	9
Classroom School	4	5
Walkway YMCA	4	4
Lobby School	2	2
Parking Lot School	2	2
Speaker Context		
Mother	349	1069
Father	316	965
Sibling 1	171	441
Researcher	57	102
Adult G: Uncle	32	70
Child A: Cousin	27	76
Child B: Sibling 1's Friend	18	27

(continued)

Table A8 (continued)

Speaker Context	Noun Input	
	Type	Token
Adult C: Leader of Religious Service	9	26
Child G: Neighbor	8	8
Child C: Patron at YMCA	4	5
Child D: Patron at YMCA	3	4
Child F: Sibling 1's Friend	3	6
Adult A: Patron at YMCA	2	2
Adult E: Teacher	2	2
Adult F: Teacher	2	2
Adult B: Patron at Park	1	1
Child E: Friend	1	1

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Conclusion

The two studies presented in this dissertation examined the role of context in the children's language development. Previous research suggests context affects children's linguistic input and output. However, in two studies, I examined the role of *contextual variation* in children's early word learning- utilizing both experimental and naturalistic methodologies. I analyzed how the numbers of contexts children learn language in influence word learning. The findings from these studies contribute new knowledge to how children use contextual variation to learn language early in life. In conclusion, I summarize the contributions made by each of the two studies.

The findings of Paper 1 provide information regarding the mechanisms by which context affects word learning. Our central question was whether infant's visual attention to the target object during category learning predicted category generalization performance in a new context. During learning infants were provided with various types of contextual support. We predicted that when presented with novel object label pairs on a background context, two types of support are central. Namely, support to decontextualize the object label pair from the background (provided by learning in varied contexts) and support to aggregate the instances in memory (provided by learning in the same context). Consistent with our hypothesis, greater visual attention to the target object during learning predicted higher category generalization performance for infants presented with both types of support.

The association between visual attention during learning and generalization performance only emerged for infants who were presented with the learning phase in both same and varied context; not infants who were presented the learning phase in *either* the same *or* varied contexts. Thus, we conclude that support to de-contextualize the object from the background *or* the support to aggregate category instances is not enough in isolation. Rather the presence of both types of contextual support is necessary. Further, the results suggest that for infants in the interleaved condition, greater attention to the target object during learning supported generalization performance. In other words, infants who had more overall looking to the target during training were able to benefit from the superior support of the interleaved condition. Thus, perhaps a certain amount of visual attention is necessary to profit from the support provided by learning in same and varied contexts. Further research should examine the whether other individual differences (e.g. age) influence how children use contextual support when generalizing in a new context. As a whole, Paper 1 provided a detailed understanding of how combining same and varied context together during learning supports category generalization.

The findings from Paper 2 are the first to indicate that naturally occurring contextual variation supports early word learning. By using a naturalistic methodology we described and analyzed the variation in the contexts in which children's linguistic input and output take place. We aimed to (1) describe the contexts which characterize children's language exposure, and (2) examine the association between the numbers of contexts in which children are exposed to noun and frequency in which children produce nouns. We suggest that contextual variation is both present in children's noun exposure and children are more likely to produce nouns that they are exposed to in more contexts. Further, children produce nouns in multiple spatial locations if they are exposed to the noun in multiple spatial locations.

Paper 2 provides information that adds to our understanding of the contextual variation in which children hear and produce language, and the effect of contextual variation on language production. We suggest that contextual variation supports children decontextualize a noun from its spatial or speaker context, which in turn supports children's abstract understanding of the noun. By acquiring an abstract representation of the noun, children are more likely to produce that noun in general, and in multiple contexts. Paper 2 is the first to suggest that children benefit from contextual variation in their everyday lives.

The current dissertation adds a unique approach to the current literature examining word learning. Currently three theories dominate the field of word learning. The first theory focuses on pre-existing assumptions children bring to the task of word learning, which simplify the learning problem (e.g. Markman & Hutchinson, 1984). For example, the taxonomic assumption suggests that children will generalize words to objects that are taxonomically similar rather than thematically similar. In other words, a child is more likely to generalize the word "dog" to similar things (other dogs, cats, and cows) than to thematically related items (leashes, bones, doghouses). The second theory focuses on how word learning is supported by domain general mechanisms. For example, children's attention to an object's shape increases as they acquire more shape based categories (Smith, Jones, Landau, Gershkoff-Stowe & Samuelson, 2002). The third theory posits that social pragmatic factors support word learning by allowing children to monitor speakers' referential intentions (e.g. Tomasello, 2000). For example, children are better able to learn object labels when jointly attending to the object with the speaker (Tomasello & Todd, 1983). In addition to these three theories, one theory ties all three accounts into the "Emergentist Coalition Model" (Hirsh-Pasek Golinkoff, & Hollich, 2000). One component of this inclusive model is the role of the "imageability" of a word; words that are more imageable (e.g., apple) are learned earlier than words that are less imageable (e.g., truth; Ma, Golinkoff, Hirsh-Pasek, McDonough, & Tardif, 2009).

Although all of the prominent theories examine young children's ability to learn new word learning, context is not the focus of any of the current theories. Rather, current accounts heavily focus on how factors the child brings to the word learning situation support word learning. However, the social pragmatic approach is most aligned with the current approach; in the current study we examine how the child's environment affects word learning. While the social pragmatic approach focuses on the social cues and referents of the speaker, we examine how learning from different speakers and in different spatial locations support word learning. The current project contributes findings that support and stretch the way we understand the role of environmental factors in word learning.

The vast amount of word learning research not only focuses on factors children bring to learning situation, but also aims to isolate specific mechanism that support word learning, which requires experimental control void of confounding factors. One such factor is contextual influence. Thus, context has been often overlooked as a possible contributor to word learning. For example, experiments often utilize different experimenters for separate training and testing phases to decrease "experimenter bias". However, the present dissertation suggests that context be viewed as an influential factor, and thus included in research examining language development. For example, what persons are present in experimental settings and the spatial context experiments take place should be considered in experimental design. By integrating contextual factors in word learning research, our understanding of early language development will be more complete.

The two methodological approaches used in this dissertation converge in beginning the examination of contextual affects on word learning. The experimental approach taken in Paper 1 offers a clear explanation of the mechanisms used when word learning takes place amid contextual variation. The eye tracking methodology allowed for precise measurements of visual attention to various aspects presented to the child. This method provides control over confounding factors, enabling a clear causal understanding of the role of context in word learning. The naturalistic approach taken in Paper 2 contributes an authentic explanation of the effect of contextual variation on word learning in children's everyday lives. The extensive information provided by the uninterrupted interaction between families offered an unbiased look at the contexts children's word learning take place in. This method avoids experimental control, enabling a comprehensive view of everyday family life in which to understand the role of context in language development. Together, these two methodologies compliment on another and offer different advantages to the studying how context affects word learning.

By examining how contextual factors affect word learning these studies discuss the various learning mechanisms children use to learn language development. Research on language development suggests that children are proficient word learners. In other words across many studies, children demonstrate they are efficient at and capable of learning new words (Klibanoff & Waxman, 2000; Samuelson & Smith, 2000; Smith, Jones, Landau, Gershkoff-Stowe & Samuelson, 2002; Soja, Carey, & Spelke, 1991). However, research examining language development in context, provides a different story. Namely, when learning takes place in context, generalization of a new word in a new context can be difficult for children (Goldenberg & Sandhofer, 2013a, Vlach & Sandhofer, 2011; Werchan & Gómez, 2014). By examining the role of context in two studies, I add to the small but growing body of research suggesting the environmental factors in children's early learning environments affect language learning. Specifically, I suggest how contextual factors can aid young children learn language. By examining how context aids word learning, further research can further understand the robust, and at time fragile, process of word learning.

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