

Copyright
by
Lauren Carol Billingsley
2017

**The Thesis Committee for Lauren Carol Billingsley
Certifies that this is the approved version of the following thesis:**

**Specifying the Nature of the Vocabulary Gap through Children's Word
Learning Skills**

**APPROVED BY
SUPERVISING COMMITTEE:**

Co-Supervisor:

Amy E. Booth

Co-Supervisor:

James Booth

**Specifying the Nature of the Vocabulary Gap through Children's Word
Learning Skills**

by

Lauren Carol Billingsley, B.H.S. C.S.D.

Thesis

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Master of Arts

The University of Texas at Austin

May 2017

Dedication

This thesis is dedicated to my family, friends, and mentors who have helped me through this process and helped me achieve everything I have.

Acknowledgements

I would like to extend my deepest gratitude to everyone who helped me complete my thesis. Firstly, I would like to thank Dr. Booth for including me in this amazing and important research project and for her guidance and support during the execution and writing of this project.

I would also like to thank my graduate cohort for the never-ending support, laughter, and love throughout these two years in pursuing our Master's degrees. I would particularly like to acknowledge Caitlin Baker and Caitlin Secrist, my two best friends and supporters who laughed and cried with me through the most stressful moments.

Finally, I would also like to thank my family, especially my parents, Turner and Katherine Billingsley. Thank you for encouraging me in my academic career and pushing me to do my best even when I was feeling the pressure.

Abstract

Specifying the Nature of the Vocabulary Gap through Children’s Word Learning Skills

Lauren Carol Billingsley, M.A.

The University of Texas at Austin, 2017

Co-Supervisors: Amy Booth and James Booth

Abstract: Currently, a serious gap in vocabulary development and knowledge exists between children of higher socioeconomic status (SES) and their less advantaged peers. An important finding highlighted that children of higher SES know 600 more words on average than children from lower SES backgrounds. This disparity in vocabulary knowledge puts children from low SES backgrounds at a significant disadvantage when entering school because vocabulary is an essential tool for later school success. However, this ‘gap’ has only been described in terms of the number of words known by children. This is unlikely to wholly reflect their vocabulary knowledge and potential for learning. We looked to word learning strategies as way to further explore the nature of this ‘vocabulary gap’ as word-learning skills have been implicated as a significant factor in mediating the relationship between early experiences and vocabulary knowledge. The goal of this study was to examine the relationship between significant SES factors on children’s word learning skills. Such information could significantly contribute to creating better vocabulary intervention approaches for at-risk

children and further inform our understanding of the ‘vocabulary gap’. Research goals were explored by having 145 2 ½ to 3 ½ year old subjects participate in 3 different word learning tasks. We selected particular tasks that were well documented in the literature, could be easily implemented within our target age range, had strong face validity, reflected a variety of types of information that children might use in word learning, and were relevant to the core challenges children face as they develop vocabulary. Results indicated that performance on one word-learning task, Mutual Exclusivity, was significantly associated with both of our indicators of SES, maternal education ($r = .33, p < .001$) and income ($r = .30, p < .01$). Children’s performance on the Gaze following task was only significantly associated with maternal education ($r = .27, p < .01$). These results indicate that the ‘vocabulary gap’ can be further specified by some, but not all, children’s word-learning skills. Future research should include studies of intervention based in word-learning skills like Mutual Exclusivity to help children further generalize vocabulary development.

Table of Contents

List of Tables	x
List of Figures	xi
1. Introduction.....	1
1.1 History of the Vocabulary Gap	2
1.2 Word Learning Skills.....	4
1.3 Importance	7
1.4 Current Study	8
2. Methods.....	10
2.1 Participants.....	10
2.2 Design Overview	11
2.3 Coding and Reliability	12
2.4 Assessment of Socioeconomic Status	12
2.5 Assessment of Vocabulary.....	13
2.6 Assessment of Word-Learning Skills	13
2.7 Assessment of Attention and Executive Function	18

3. Results.....	19
3.1 Computation of Results.....	19
3.2 PPVT	21
3.3 Mutual Exclusivity.....	21
3.4 Gaze Following	22
3.5 Shape Bias.....	22
3.6 MEFS	23
4. Discussion	24
4.1 Future Directions	26
4.2 Limitations	28
5. Conclusion	30
References.....	31

List of Tables

Table 1: Maternal Education Level Percentages Across Participants	11
Table 2: Outline of Sessions and Tasks	11
Table 3: Descriptive Statistics for Primary Study Variables	20
Table 4: Correlation Results between Study Variables	20

List of Figures

Figure 1: Performance on Mutual Exclusivity Across Maternal Education

Categories 22

1. Introduction

An ongoing and consistent concern in the United States is that well over 25% of young children experience significant socioeconomic (SES) disadvantages (Addy & Wight, 2012). Further, the United States is facing an education crisis as our country is lagging in children's school success (National Center for Educational Statistics, 2011). Research has identified that children's problems begin early and are strongly associated with social disparities, such as socioeconomic disadvantage (Hoff, 2013; Lee & Burkham, 2002). Fernald, Marchman, and Weisleder (2013) found that by 18 months, children of higher socioeconomic status know 60% more words and are faster at comprehending words than their peers from lower socioeconomic backgrounds. Because vocabulary development is cumulative in nature (Hindman, Wasik, & Snell, 2016), these disparities are magnified over time, with differences growing to a full standard deviation by kindergarten (Farkas & Beron, 2004). This disparity in vocabulary knowledge puts children from low SES backgrounds at a significant disadvantage when entering school because vocabulary is an vital tool for cracking the code of printed words and understanding what they mean (Ilgaz, Hassinger-Das, & Hirsh-Pasek, 2014), essential skills throughout school and life. As these children continue through school, this gap in knowledge will continue to affect their academic success, (Francis, Shaywitz, Steubing, Shaywitz, & Fletcher, 1996).

Over time, this 'vocabulary gap' has been well documented in the United States (Hart & Risley, 1995) and around the world (Schady et. al, 2015). Despite much empirical attention and exploration, so far the gap has only been described in terms of the

number of words known by children. Hart & Risley's finding highlighted that, at age 3, high-SES children knew 600 more words, on average, than children from lower SES backgrounds. Some studies have importantly highlighted how this gap in vocabulary knowledge widens over time (Biemiller & Slonim, 2001), while others highlight the effects of this gap on skills such as reading comprehension (Chall, Jacobs, & Baldwin, 1990). However, it is unlikely that the number of words a child knows is wholly reflective of their vocabulary knowledge and potential for learning. Here, we look to word learning strategies as a way to further explore the nature of this 'vocabulary gap'. Word-learning skills have been implicated to be a significant factor in mediating the relationship between early experiences, such as socioeconomic disadvantage, and vocabulary knowledge (Henderson & Sabbagh, 2013). Further, the very same factors that affect vocabulary knowledge could be affecting children's early word learning skills, further specifying the nature of the 'vocabulary gap'. In this study, we examined the relationship between significant socioeconomic factors on children's word learning skills.

1.1. HISTORY OF THE VOCABULARY GAP

In 1995, a now classic study by Hart and Risley examined language input and output in three groups: children from welfare, working class, and professional families. They found on average that the number of words heard per hour in the children from the welfare group was 616 compared to the 1,251 in the working class group and 2,153 in the professional group. Further, they found that by age four children from the working class group had heard 32 million fewer words than their peers from professional family

backgrounds. They also found that children's vocabularies at three years of age were a significant predictor of language skills at nine and ten years of age. Empirical evidence has attributed this 'vocabulary gap' to differences in children's early socio-linguistic experiences (Hoff, 2013). Further evidence indicates that the amount, variability, complexity and quality of speech directed to children by their caregivers, especially mothers, is a key factor in influencing the development of vocabulary size (e.g. Hart & Risley, 1995a; Hoff, 2006a; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010).

Regrettably, the 'vocabulary gap' does not narrow meaningfully over time. In fact, Biemiller and Slonim (2001) found that the gap widens over time and can contribute significantly to achievement in other areas. Vocabulary knowledge in kindergarten was found to be highly predictive of vocabulary in later elementary, and even secondary, school years (Walker, Greenwood, Hart, & Carta, 1994). Evidence also supports that early vocabulary is an important predictor for the development of reading (Biemiller, 2012; Stahl & Nagy, 2006), and even for reading comprehension (Cunningham & Stanovich, 1997; Muter, Hulme, Snowling, & Stevenson, 2004; Tabors, Snow, & Dickinson, 2001). Recently, a longitudinal study found that early vocabulary abilities at 16 to 30 months were a strong predictor for educational outcomes in decoding and reading comprehension (Bleses, Makransky, Dale, Hojen, & Ari, 2016). Early vocabulary has also been critically associated with other measures of language, intelligence, and academic achievement (Graves, 2006, Hart & Risley, 1995b; Stahl & Nagy, 2006). This

empirical evidence indicates that children from lower socioeconomic standing are at a critical risk for reduced achievement and success in mainstream American culture.

So far, the ‘vocabulary gap’ has only been described in terms of the number of words known by children. Hart & Risley’s (1995) research highlighted how children coming from economically disadvantaged backgrounds enter school with as many as 3000 fewer words in their vocabulary than their more advantaged peers. Consistent with this focus, many intervention attempts have primarily concentrated on expanding the vocabulary size of children with less developed vocabulary knowledge (Biemiller, 2012). However, vocabulary size is unlikely to reflect the whole of children’s vocabulary knowledge and potential for learning.

1.2. WORD-LEARNING SKILLS

Word learning requires children to analyze the word from an ongoing speech context, identify the intended referent of the new word, (e.g., object, person, or place) and then make an inference about the meaning of the word (e.g., the function, name, color, etc.) (Henderson & Sabbagh, 2013) As children grow, they continue to expand upon their vocabulary size as they identify new words and referents in their environments. Research has demonstrated that there are considerable individual differences in vocabulary and language development. In particular, studies have shown that lexical development, as measured by factors such as vocabulary size, could be affected by experiential factors such as the amount of speech children hear or even socioeconomic status (Hoff, 2006). A more “cognitive” perspective on word learning aims to understand how children learn the

meanings of new words (Hall & Waxman, 2004). This perspective characterizes that the skills and knowledge that children have can help them solve parts of the word learning process (e.g., identifying the intended referent of a new word within an environment) (Henderson & Sabbagh, 2013).

Many researchers have proposed that word learning skills and strategies develop gradually and in the context of plentiful, content-rich, and sensitive communicative exchange (Gelman, Ware, & Kleinberg, 2010; Hirsh-Pasek, Golinkoff, & Hollich, 2000; Huttenlocher et al., 2010; Smith, 2000, Tomasello, 1992; Waxman, 1998). In their study, Hart & Risley (1995) highlighted how children from disadvantaged economic backgrounds heard 32 million less words than their more advantaged peers. A review of the literature on socioeconomic status (SES) and parenting found consistent evidence, across cultures, that higher SES mothers talk more to their children than do lower SES mothers, that the speech of higher SES mothers more frequently is used for the purpose of engaging in conversation than the speech of lower SES mothers, and that the speech of lower SES mothers more frequently is used for directing their children's behavior than the speech of higher SES mothers (Hoff, Laursen, & Tardif, 2002). Hoff (2006b) proposes that vocabulary development is affected by the context. Children whose social experiences provide more communicative opportunities and richer input build vocabularies at a faster rate than children with less communicative experience and input.

The very same contextual factors that have been implicated in contributing to differences in children's vocabulary knowledge may also be contributing to differences in the development of word learning skills and strategies. There might be a similar effect of

socioeconomic status (as an index of parent talk, and other relevant factors of culture, family structure and stress) on children's word learning skills. Henderson & Sabbagh (2013) further proposed that the link between SES and vocabulary size is mediated by effects on children's word learning skills.

However, Horton-Ikard and Weismer (2007) found evidence against this possible connection. In their study on the effect of socioeconomic status on early lexical performance in African American toddlers, they unsurprisingly found that children from low socioeconomic status homes performed significantly lower on measures of receptive and expressive vocabulary than their peers from middle socioeconomic status homes, a finding that is well supported in the literature and further supports the existence of the 'vocabulary gap'. They also found that children from low socioeconomic status homes and middle socioeconomic status homes differed significantly in the number of different words they used in their spontaneous speech. However, they found no significant differences between low and middle socioeconomic status toddlers in their ability to 'fast-map' novel words onto objects, thereby suggesting that word-learning skills were not influenced by early communicative experience.

However, empirical evidence shows that word learning involves more than just basic information processing skills (i.e. attention, memory, and associative learning) that underlie the 'fast-mapping' task examined in Horton-Ikard and Weismer's study. Indeed, it is understood that word learning is an emergent product of multiple factors, interactions and skills (Hollich et. al, 2000). Word learning requires skills such as identifying the intended referents for new words (Markman, Wasow, & Hansen, 2003), determining their

appropriate extensions for new words, and elaborating upon their meanings. What we need to explore further is the possible affect of socioeconomic factors on children's word learning skills and how that could further our understanding of the 'vocabulary gap'.

1.3. IMPORTANCE

Better specifying the nature of the vocabulary gap and understanding the more nuanced individual differences that are present in vocabulary acquisition with respect to word learning skills is important for several reasons. By understanding the role of word-learning skills in the relationship between factors of socioeconomic status and vocabulary development, interventions can be developed to help those at-risk children who are beginning school without important foundational vocabulary knowledge catch up to their more advantaged peers. A recent meta-analysis by Marulis and Neuman (2010) revealed that current vocabulary intervention programs were not sufficiently powerful to close the 'vocabulary gap' and are still not providing effective intervention for at-risk children. The results of this study could lay the groundwork for innovative approaches for early intervention that are focused more on teaching word learning skills rather than teaching specific words. Thus, it is important for us to identify the specific word learning skills in which disparities due to socioeconomic factors exist.

1.4. CURRENT STUDY

The current study centers on examining the relationship of children's word learning skills to the 'vocabulary gap'. Specifically, we asked whether the 'vocabulary gap' extended beyond differences in the absolute size of children's accumulated vocabulary to differences in children's word-learning skills. We predict that significant indicators of socioeconomic status, maternal education and income, will be associated with children's performance on specific word learning tasks, meant to represent the various ways children learn and access new words in their environment. For this project, the novel words taught to children will primarily be count nouns because these represent a large portion of the early vocabulary of most English speaking children (Bates et al., 1994, Gershkoff-Stowe & Smith, 2004). Further, research suggests that noun learning is fundamental to the acquisition of both adjectives and verbs (Waxman & Lidz, 2006). Although evidence suggests that the contexts that are most supportive for learning different types of words vary (Hirsh-Pasek & Golinkoff, 2006; Maguire, Hirsch-Pasek, Golinkoff, & Brandone, 2008; Waxman & Klibanoff, 2000), young children tend to rely on similar basic strategies in learning different types of words (e.g., Akhtar, Jipson, & Callanan, 2001; Childers & Tomasello, 2002; Golinkoff, Hirsch-Pasek, Mervis, & Frawley, 1995). The word learning tasks in our study do not completely examine all of the possible word learning skills and strategies that young children use when learning new words. However, we selected three tasks based on theories of children's word learning that were well documented in the literature and had strong face validity: Shape

Bias, Mutual Exclusivity, and Gaze following. These tasks are relevant to the core challenges that children face as they learn new words; finding the referent and determining appropriate extensions. Further these tasks reflect the variety of types of information that children could use in word learning. Because completing these tasks do require children to use some basic processing skills that might threaten their precision in tapping the construct of interest, we will intentionally minimize these demands by using simple and slow speech, keeping tasks short and engaging, requiring the encoding and retention of as little information as possible over brief periods of time, and testing in minimally distracting settings.

2. Methods

2.1. PARTICIPANTS

Data for this study were collected over three to four sessions lasting approximately 45-60 minutes each. All subjects were recruited from efforts at University of Texas Austin's Early Learning Laboratory. 145 2 ½- to 3 ½-year old subjects from the Austin, Texas area participated in the study (M = 2.92 years, SD = 0.31 years, Range = 2.38-3.70 years). Exclusion criteria were hearing impairment, language impairment or delay, and child exposure to more than 50% non-English language in the home to ensure full understanding of tasks. Data from six participants were excluded from data analysis for suspected language delay, incomplete data, not meeting inclusion criteria for English proficiency, and poor attention and behavior during the sessions. We aimed for a culturally and ethnically diverse sample. 29% of mothers reported at most completion of a high school degree, 13% completed some college or additional training beyond high school, 28% had a four-year bachelor's degree, and 30% held a master's degree or higher with seven subjects with no information on maternal education. Each of the four maternal education levels was assigned a numeric label used during coding and is included in the table below.

Maternal Education Level	Percentage of Sample
(1) High School Degree or Less	29%
(2) Some college (technical degree, associate's degree or additional training after high school)	13%
(3) Bachelor's Degree	28%
(4) Advanced Degree	30%

Table 1: Maternal Education Level Percentages Across Participants. Seven participants completed a demographic survey but did not provide information for maternal education level.

2.2. DESIGN OVERVIEW

One standardized test of children's vocabulary, one behavioral and one parent-report measure of executive functioning, one behavioral measure of phonological working memory, and four experimental tests of word learning skills were administered over the course of three to four sessions. It was intended for all sessions to be conducted over the course of a 2-month period as indicated below. This design ensured that 1) all word-learning skills/strategies were assessed in a short time period to minimize developmental effects on performance across different tasks and 2) children were not overwhelmed with too many novel word-learning tasks in any single session. Parents or guardians also participated in two short demographic and home environment interviews and completed a checklist survey regarding their child's executive functioning skills.

Session 1	PPVT (child) + Shape Bias (child) 1 st demographic survey (parent)
Session 2	Mutual Exclusivity (child) + Minnesota Executive Function Scale (child) BRIEF-P (parent)
Session 3	Gaze (child) + Preschool Repetition (child) 2 nd demographic survey (parent)

Table 2: The outline of sessions and tasks.

2.3. CODING AND RELIABILITY

Recordings of each task were used to code children's choice responses following the session. Coders recorded children's responses to each trial and attention level during each task on a 5-point scale. Fidelity of implementation, looking patterns, level of engagement, and any other comments were also noted for each task. Two coders were used for each task to check the reliability of these records. All standardized tests were scored according to their published instructions and were checked by a second scorer to ensure accuracy. Children were tested in a quiet room in the Little Learners Laboratory (within the Children's Research Center) in the Seay Building on the UT Austin campus. Some children were also tested at off-site preschools.

2.4. ASSESSMENT OF SOCIOECONOMIC STATUS

The mothers or primary caregivers of children were interviewed about aspects related to socio-economic status at two different points during the sessions. Because no clear consensus exists regarding which factors best and most accurately index socio-economic status, we primarily collected information regarding maternal education and income, the two leading indicators (Ensminger & Fothergill, 2003). We conducted computer assisted personal interviews with mothers or primary caregivers using questions excerpted from those used by Angel, Burton, Chase-Lansdale, Cherlin, Moffitt & Wilson (1999). The interview also included questions assessing other aspects of the child's experience (e.g. mother-child communication, home literacy, daycare/preschool characteristics) that might also influence the development of language-related skills.

From this assessment of socio-economic status, we extracted two main variables of maternal education level and an income-to-needs ratio to be used as variables in data analysis. We predict that these factors will correlate with measures of vocabulary and with performance on word-learning task tasks.

2.5. ASSESSMENT OF VOCABULARY

To assess participants' vocabulary, we utilized the Peabody Picture Vocabulary Test-Fourth Edition (Dunn & Dunn, 2007). This measure is appropriate for use with children as young as 2.5 years of age and took approximately 10-30 minutes to administer. This test was extensively evaluated to minimize item bias and was normed on a large and diverse sample.

2.6. ASSESSMENT OF WORD-LEARNING SKILLS

Due to constraints on the length and frequency of testing sessions that were included in this project, the chosen tasks do not completely test all of the possible word learning skills and strategies that young children use when learning new words. We selected particular tasks that were well documented in the literature, could be implemented within the target age range, had strong face validity, reflected a variety of types of information that children might use in word learning (i.e. visual, syntactic, socio-pragmatic), and were relevant to the core challenges children face as they learn new words; finding the referent and determining appropriate extensions. The following

descriptions of the specific word-learning tasks utilized are organized with respect to those two challenges.

2.6.1. Finding the referent.

One problem that children must solve when learning new words involves identifying their referents from a selection of many possible objects, properties and actions in a labeling situation. Here we focused on two strategies that young children appear to use to solve this problem.

2.6.1.1. Gaze Following

Previous research has established that young children use social and pragmatic cues such as eye gaze to infer the intended referents of novel words (Baldwin & Tomasello, 1998; Hollich et al. 2000). Some pose that children's sensitivity to gestural cues derives from a biological attunement to eyes and motion (Farroni, Johnson & Csibra, 2004). However, social-pragmatic theorists argue that this skill arises from children's interactions with adults who are highly attuned to the attentional focus of young social partners (Tomasello, Carpenter, & Liszkowski, 2007; Woodward & Guajardo, 2002). As children grow in coordinating their own attention with others in social interaction, they come to understand the importance of cues like eye gaze as indicators of attentional focus, and more specifically in naming contexts, of referential intent. Research has documented the socio-economically related variability in caregiver sensitivity and responsiveness to children's attentional cues and the degree to which they use communicative gestures (Hart & Risley, 1995; Raver & Leadbeater, 1995; Rowe &

Goldin-Meadow, 2009). Indeed, this variability might affect children's sensitivity to, and skill at using, joint attention cues to word meaning.

Thus, we assessed children's sensitivity to eye gaze as a cue to reference using a procedure modeled after Booth, MacGregor, and Rohlfing (2008). Children were presented with three novel objects at the start of each of 8 trials. The experimenter then lined up the objects on a table out of the child's reach. In order to minimize demands on inhibition of attention towards objects of particular interest to the child, the experimenter drew attention to a neutral location at the experimenter's chest with a squeaker toy. The first 4 trials had the experimenter only looking intently at one of the objects and saying its name 3 times (e.g. 'Look it's a teeg!'). The experimenter then put the objects in random order in a basket and pushed them towards the child while asking for the target object (e.g. 'Where is the teeg?'). The last 4 trials had the experimenter looking at and pointing to the target object and naming it 3 times, followed by the same prompt to identify the target. The proportion of trials on which the correct referent is chosen will serve as the dependent variable. In total, 3 dependent variables were collected; gaze alone, gaze and point, and overall proportion correct for all 8 trials. For the purpose of this study, results were analyzed using gaze total proportion correct.

2.6.1.2. The Mutual Exclusivity Assumption

Previous research has shown that young children tend to map new words onto referents that they do not already know a name for (Golinkoff, Hirsch-Pasek, Bailey, & Wengner, 1992; Markman, Wasow, & Hansen, 2003; Mervis & Bertrand, 1993). This Mutual Exclusivity assumption (Markman & Wachtel, 1988) permits children to rule out

potential referents in a naming context that are already represented in their vocabulary. Golinkoff, Mervis, and Hirsh-Pasek (1994) further explained how Mutual Exclusivity likely emerges from children's experiences mapping new words onto referents on the basis of other available cues (e.g. eye gaze). Because the novel words typically map to objects for which children don't already know names in these naming episodes, children come to make this assumption for all new words they encounter. Other research has explained that the application of the Mutual Exclusivity assumption likely hinges on socio-pragmatic cues (Diesendruck & Markson, 2001; Saylor, Sabbagh, & Baldwin, 2002). Because children vary along the socioeconomic spectrum in terms of the amount of speech they hear overall and the number of labeling episodes they experience, their opportunities for conceptualizing the Mutual Exclusivity assumption will also likely vary.

Thus, we assessed children's adherence to the Mutual Exclusivity Assumption using a procedure modeled after Golinkoff, Hirsh-Pasek, Bailey and Wenger (1992). Children were presented with a set of four objects at the beginning of each trial, three of which had a name known to the child. In eight of the eleven trials, the experimenter asked for the novel item (e.g. 'Where is the noop?'). In three of the eleven trials, the experimenter asked for a familiar item with a known name (e.g., an apple) to ensure that the children did not perseveratively choose the novel object. The proportion of unfamiliar name trials on which the novel object was selected served as the dependent variable.

2.6.2. Determining Appropriate Extensions

After a child has identified the intended referent of a novel word in a specific labeling context, they still have to determine what else can be accurately labeled with that

same word. If children did not acquire strategies for extending words beyond explicitly labeled referents, they would have to learn new labels for every new referent encountered. In this way, we assessed children's abilities to determine appropriate extensions in one strategy.

2.6.2.1. The Shape Bias

Research has shown that young children are biased to extend word labels on the basis of shape rather than other object properties (e.g. color) (Booth, Waxman, & Huang, 2005; Diesendruck & Bloom, 2003; Jones, Smith, & Landau, 1991; Landau, Smith, & Jones, 1992; Samuelson, 2002). Although the Shape Bias may derive from biological attunement to shape (Biederman, 1987; Samuelson & Smith, 2005), it is generally understood that it emerges from children's experiences with categories that are well defined by shape (Smith, 2000; Ware & Booth, 2010). Because children vary across the socioeconomic spectrum in the frequency with which they hear objects labeled, or the number of different referents from specific categories that encounter in the context of labeling, they will also vary in their opportunities for conceptualizing a Shape Bias from this input.

Thus, we assessed children's reliance on the Shape Bias using procedures modeled after Ware and Booth (2010). The children participated in eight trials. The experimenter began each trial by labeling a novel three-dimensional target object with a novel name (e.g. 'This is a yoot'). The experimenter then presented the child with three new novel objects: one matching the target in shape (but differing in texture and color), one matching in texture (but differing in shape and color), and one matching in color (but

differing in shape and texture). The objects were then placed in fixed positions for each trial, with the placement of the shape-match differing on consecutive trials. The experimenter asked the child to extend the novel word presented at the beginning of the trial to one of the three new novel objects (e.g. ‘Can you hand me another yoot?’). The proportion of shape-match selections will serve as the dependent measure.

2.7. ASSESSMENT OF ATTENTION AND EXECUTIVE FUNCTIONING

Careful attention was paid to minimizing the information processing demands of the word-learning tasks. However, we also explicitly evaluated the potential influence of attentional factors on performance. We used digital recordings of each task to rate each child’s overall level of engagement (on a 5-point scale) based on clues like facial expression, fidgeting, and looks to mother or exit. A score of less than 3 indicated insufficient engagement for meaningful interpretation of performance and was grounds for discarding the data for that task. Further, we maintained that executive functioning (EF) skills might have impacted children’s performance. We therefore included a behavioral (EF Test Battery; Mulder, Hoofs, Verhagen, van der Been Lesemen, 2014) measure of children’s executive functioning. The Minnesota Executive Function Scale tests the executive function abilities of children by having them participate in a digital game on an ipad in which they sort picture cards into boxes.

3. Results

3.1. COMPUTATION OF RESULTS

We predicted that performance on tasks of word-learning skills would be related to measures of vocabulary, and specific measures of socioeconomic status. Correlations were computed to examine associations between variables in a bivariate framework. Results were considered significant at $p < 0.05$. Table 3 outlines descriptive statistics including means and standard deviations for primary study variables. The simple correlation results for the primary study variables are presented in Table 4. Boys and girls performed similarly on all tasks; thus, sex was not considered in our analyses. Maternal education is reported below using numeric labels assigned as follows: (1) high school degree or less, (2) some college, (3) bachelor's degree, and (4) advanced degree.

Statistic	N	Mean	St. Dev.	Min	Max
Child Age	145	2.923	0.317	2.382	3.704
Maternal Education	162	2.599	1.198	1	4
Household Income (per year)	103	\$86,288	67,692	\$12,000	\$360,000
Income to Needs Ratio	101	3.748	2.843	0.509	14.392
PPVT	145	102.848	19.369	40	148
Gaze (Total)	111	0.623	0.248	0	1.0
Mutual Exclusivity	120	0.616	0.296	0	1.0
Shape Bias	137	0.732	0.271	0	1.0
MEFS (percentile rank)	114	51.044	25.709	4	97

Table 3. Descriptive Statistics for primary study variables.

Variable	1	2	3	4	5	6	7
1. Maternal Education							
2. Household Income	0.40***						
3. Income to Needs	0.40***	0.95***					
4. PPVT	0.37***	0.32**	0.38***				
5. Mutual Exclusivity	0.33***	0.30**	0.26*	0.54***			
6. Gaze	0.27**	0.08	0.09	0.19	0.31**		
7. Shape Bias	0.13	0.05	0.04	0.38***	0.29**	0.011	
8. MEFS	0.33***	0.19	0.21*	0.58***	0.46***	0.26*	0.25**

Table 4: Correlation results between study variables. Note: simple correlation coefficients are shown. *** $p < .001$, ** $p < .01$, * $p < .05$

3.2. PPVT

Our sample of children performed slightly better than average on the PPVT ($M = 102.848$). As expected, age standardized PPVT scores were correlated with maternal education ($r = .37, p < .001$), further confirming data from previous studies on the relationship between SES and vocabulary size. PPVT scores were also significantly correlated with household income ($r = .32, p < .01$) and income to needs ratio ($r = .95, p < .001$).

3.3. MUTUAL EXCLUSIVITY

Performance on the Mutual Exclusivity task was significantly correlated with indicators of socioeconomic status including both maternal education ($r = .33, p < .001$) and income to needs ratio ($r = .26, p < .05$). Performance on Mutual Exclusivity was also correlated with household income ($r = .30, p < .01$). This word learning skill also correlated significantly with PPVT scores ($r = .54, p < .001$), indicating a connection with vocabulary size. The table below demonstrates the strong association between maternal education level and performance on Mutual Exclusivity. On average, children from lower SES backgrounds performed worse on the task than children from higher SES backgrounds.

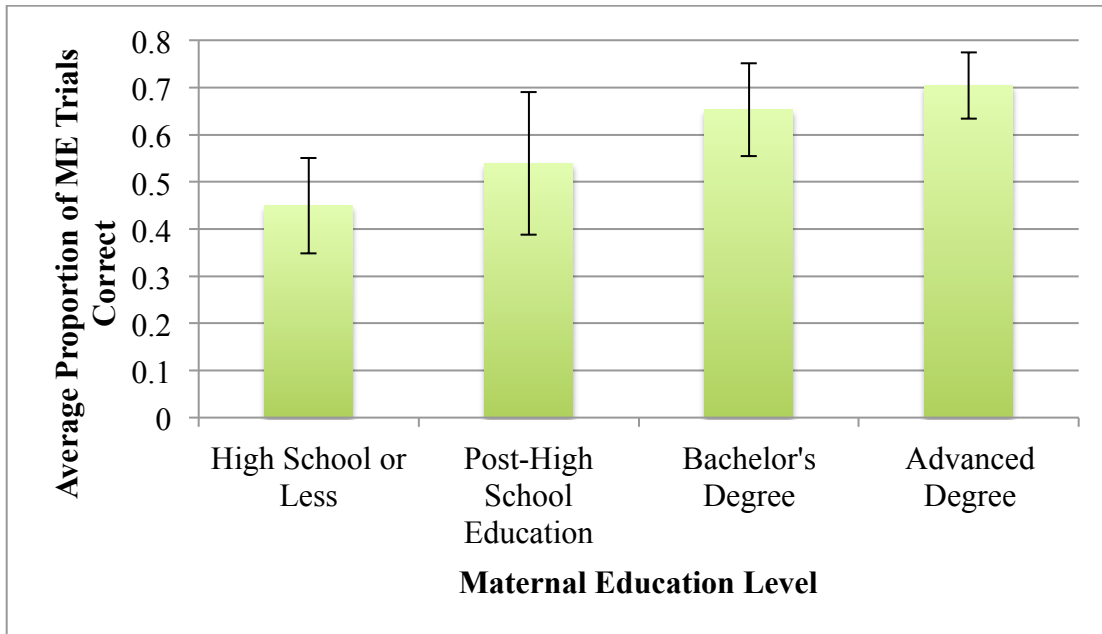


Figure 1: Average performance on Mutual Exclusivity according to maternal education levels.

3.4. GAZE FOLLOWING

Performance on the Gaze task was significantly correlated with maternal education ($r = .27, p < .01$), but not with income to needs ratio ($r = .08, p > .05$) or with household income ($r = .09, p > .05$). Further, performance on the gaze task was not significantly correlated with PPVT scores ($r = .19, p > .05$), indicating that performance on the gaze task was not related to children’s vocabulary size.

3.5. SHAPE BIAS

Performance on the Shape Bias task was not significantly correlated with indicators of socioeconomic status including maternal education ($r = .13, p > .05$), household income ($r = .05, p > .05$), and income to needs ratio ($r = .04, p > .05$). But,

performance on the Shape Bias task was found to be significantly correlated with PPVT scores ($r = .38, p < .001$). This indicates that Shape Bias performance is not significantly related to indicator's of children's socioeconomic status, but is significantly related to their vocabulary size.

3.6. MEFS

Performance on the Minnesota Executive Function Scale (MEFS) was significantly correlated with maternal education ($r = .33, p < .001$) and income to needs ratio ($r = .21, p < .05$). Further, performance on MEFS was significantly correlated with performance on the Mutual Exclusivity task ($r = .46, p < .001$), the Gaze task ($r = .26 p < .05$), the Shape Bias task ($r = .25, p < .01$), and with PPVT scores ($r = .58, p < .001$). Although careful attention was paid to minimizing the informational processing demands of the word learning tasks, these results indicate that attentional factors were significantly associated with children's performance on all three word learning tasks and was significantly related to indicators of socioeconomic status.

4. Discussion

The goal of this study was to further explore the nature of the already well established ‘vocabulary gap’. We already know that children from lower SES backgrounds have smaller vocabulary sizes than their same aged peers and that this disparity is related to differences in children’s early socio-linguistic experiences (Hart & Risley, 1995; Hoff, 2013). These very same factors were predicted to affect children’s word-learning skills. In order to test this possibility, we further examined the ‘vocabulary gap’ by exploring the connection between indicators of socioeconomic status, maternal education and income, and young children’s performance on three different word-learning tasks: Shape Bias, Mutual Exclusivity, and Gaze following. We predicted that aspects of socioeconomic status would predict children’s performance on these tasks, with children from lower SES backgrounds performing worse than children from higher SES backgrounds.

In a correlational analysis of the data, both indicators of socioeconomic status (i.e., maternal education and income) were significantly associated with children’s performance on the Mutual Exclusivity word-learning task. On average, children from lower socioeconomic status backgrounds performed worse on this task than their peers from higher socioeconomic status backgrounds. Performance on the Gaze following task was only significantly correlated with maternal education. Performance on the Shape Bias task was not associated significantly with any indicator of socioeconomic status and only significantly correlated with children’s performance on the PPVT (Dunn & Dunn, 2007). Our correlational analyses also revealed additional data to support the established

‘vocabulary gap’ with both indicators of SES being significantly associated with children’s receptive vocabulary.

Additional analyses revealed that our measure of executive functioning, the Minnesota Executive Function Scale (MEFS) (EF Test Battery; Mulder, Hoofs, Verhagen, van der Been Lesemen, 2014) was significantly correlated with performance on the Mutual Exclusivity task, the Gaze following task, the Shape Bias task and with PPVT scores. Although we attempted to minimize the informational processing demands of the tasks, these results indicated that attentional factors might partially account for children’s performance on these tasks.

Overall, these results indicate that our predictions regarding relationships between socioeconomic status and children’s word learning skills were born out only with respect to the Mutual Exclusivity task. When following the Mutual Exclusivity assumption (Markman & Wachtel, 1988) children rule out potential referents in a naming context that are already represented in their vocabulary, allowing them to map a new word onto a referent they do not already know the name for (Golinkoff, Hirsch-Pasek, Bailey, & Wengner, 1992; Markman, Wasow, & Hansen, 2003; Mervis & Bertrand, 1993). Research has suggested children’s reliance on Mutual Exclusivity likely emerges from their experience using other socio-pragmatic cues to unambiguously identify the referents of novel words and abstracting from that experience the expectation that new words refer to things for which they don’t already know a name (Diesendruck & Markson, 2001; Saylor, Sabbagh, & Baldwin, 2002). Because children vary along the socioeconomic spectrum in terms of the amount of speech they hear overall and the number of

unambiguous labeling episodes they experience, their opportunities for accumulating the relevant experience and thereby acquire the Mutual Exclusivity assumption are potentially limited. Our results suggest that young children from lower SES backgrounds may not be accessing this Mutual Exclusivity assumption to learn new words due to these differences in experience.

4.1. FUTURE DIRECTIONS

The results of this study revealed significant correlations between indicators of children's socioeconomic status and their performance on the Mutual Exclusivity word-learning task. This finding helps us better understand the individual differences in vocabulary acquisition with respect to word-learning skills, and specifically skills based on the Mutual Exclusivity assumption. By understanding the role of this specific word-learning skill in potentially mediating the relationship between factors of socioeconomic status and vocabulary development, interventions can be developed around this specific skill.

Recent vocabulary interventions have only been focused on expanding children's vocabulary sizes. However, in their meta-analysis, Marulis and Neuman (2010) found that current vocabulary intervention programs are not sufficiently powerful to close the 'vocabulary gap'. These interventions are failing to provide effective intervention for at-risk children without important foundational vocabulary knowledge. In their review of different approaches to vocabulary instruction for at-risk children, Christ and Wang (2011) also recognized the importance of word-learning strategies. Being able to apply

word-learning strategies in their environment allows children to learn more words and gain more information about the new words. Further, their review highlighted how the empirical body of early childhood research has not explored this critical aspect of children's vocabulary development. Intervention studies have only previously focused on evaluating whether current practices close the 'vocabulary gap'. However, Christ and Wang (2011) highlighted how even if children from low socioeconomic status backgrounds learn many new words per year from an intervention, it cannot be expected that children from higher socioeconomic status backgrounds will not make the same vocabulary gains. By identifying the word learning skills that are most strongly associated with indicators of socioeconomic status and therefore might be most strongly associated with the 'vocabulary gap', innovative approaches for early intervention can be developed and implemented. Because children's performance on the Mutual Exclusivity task was most strongly associated with indicators of socioeconomic status, an intervention approach could be developed to focus specifically on this word learning assumption. A potential intervention could be based in providing at-risk children with multiple labeling episodes for both novel and familiar items in multiple learning contexts, similar to how this task was implemented in the study. This approach to word-learning intervention could facilitate strong generalization of vocabulary gains beyond the specific number of words learned and help at-risk children catch up to their peers in a meaningful way.

4.2. LIMITATIONS

A critical weakness of this investigation was participant attrition over the course of the sessions. Participants were only given one word-learning task per session with some participants not completing all three sessions. This attrition led to less data being available for the computation of results for the Mutual Exclusivity task, the Gaze following task, and the MEFS measure of executive function and attention.

Further, some of our participants were bilingual. Our inclusion criteria required that the parents speak at least 50% English with their child at home so that they were able to understand the verbal instructions of the task. In this way, bilingual children may have been placed at a disadvantage when completing some of these word-learning tasks. Specifically, bilingual children are often exposed to multiple labels for the same referents (e.g., “gato” and “cat”) – which is inconsistent with the mutual exclusivity assumption. Although existing literature has provided inconclusive evidence as to what degree bilingual children adhere to this Mutual Exclusivity assumption, (e.g., Bialystok & Barac, 2010; Davidson & Tell, 2005; Merriman & Kutlesic, 1993) this conflict may have interfered specifically with the Mutual Exclusivity word-learning task which is based on the assumption that one label refers to one object. Because bilingual children are often exposed to these multiple labels, these children may have been placed at a disadvantage when asked to correctly identify the unfamiliar object with the nonsense name. Based on participant’s responses to a demographics survey, about 40% of bilingual children who participated in the Mutual Exclusivity task were from a low socioeconomic status background with a maternal education level of High school or less. However, the other

bilingual children in the sample were distributed in all other education levels in the sample. Although there was a somewhat larger representation of bilingual children in the lowest socioeconomic status bracket, more information is needed to fully understand if this is an alternative explanation to our results for this task. A more detailed survey of parent's language use in the home with their children would better indicate if children's bilingualism affected their performance on this task.

Finally, the results of this study are limited by our finding that attentional factors as measured by the Minnesota Executive Function Scale (MEFS) were significantly correlated with children's performance on all word-learning tasks and on children's PPVT scores. This indicates that attentional factors could have affected children's performance on the tasks. Our predictions were that children's socioeconomic status would affect their performance on word-learning tasks and vocabulary measures. This finding suggests that additional factors might partially have accounted for children's performance on these tasks.

5. Conclusion

Results of this study confirmed previous findings of a ‘vocabulary gap’ with indicators of socioeconomic status, maternal education and income, being significantly correlated with children’s scores on the PPVT, a measure of receptive vocabulary. Results of this study further revealed significant correlations between children’s performance on the Mutual Exclusivity word-learning task and indicators of maternal education and income, with the other two word-learning tasks being less significantly associated with socioeconomic status. These findings implicate that the ‘vocabulary gap’ can be further specified by some, albeit by no means all, children’s word-learning skills. Future research should include studies of intervention based in word-learning skills such as Mutual Exclusivity to help children further generalize their vocabulary development. This study was limited due to participant attrition, influences of bilingualism, and attentional factors. However, because the ‘vocabulary gap’ continues to impact the educational outcomes of low SES children, the results from this study could help future researchers look more closely at interventions focused on expanding and growing at-risk children’s word-learning skills.

References

- Addy, S., & Wight, V. R. (2012, February). Basic Facts About Low-income Children, 2010: Children under age 3. Retrieved January 6, 2017, from http://www.nccp.org/publications/pub_1056.html
- Akhtar, N., Jipson, J., & Callanan, M. (2001). Learning words through overhearing. *Child Development, 72*(2), 416-430.
- Angel, R. J., Burton, L. M., Chase-Lansdale, A. J., Cherlin, R. A., & Moffitt, W. J. (1999). Welfare, Children and Families: A Three-City Study, Wave 1, March-December 1999 User's Guide.
- Baldwin, D. A., & Tomasello, M. (Eds.). (1998). *Word learning: A window on early pragmatic understanding*. Chicago: Center for the Study of Language and Information.
- Bates, E., Marchman, V. A., Thal, D., Fenson, L., Dale, L., Reznick, J. S., Pethick, S., & Hartung, J. (1994). Developmental and stylistic variation in the composition of early vocabulary. *Journal of Child Language, 21*(1), 85-123.
- Bialystok, E., & Barac, R. (2010). Word mapping and executive functioning in young monolingual and bilingual children. *Journal of Cognition and Development, 11*(4), 485-508.
- Biederman, I. (1987). Recognition-by-components: A theory of human image understanding. *Psychological Review, 94*(2), 115-117.
- Biemiller, A., & Slonim, N. (2001). Estimating root word vocabulary growth in normative and advantaged populations: Evidence for a common sequence of vocabulary acquisition. *Journal Of Educational Psychology, 93*(3), 498-520. doi:10.1037/0022-0663.93.3.498
- Biemiller, A. (2012). Words for English-Language Learners. *TESL Canada Journal, 29*, 198. doi:<https://doi.org/10.18806/tesl.v29i0.1117>
- Bleses, D., Makransky, G., Dale, P. S., Højen, A., & Ari, B. A. (2016). Early productive vocabulary predicts academic achievement 10 years later. *Applied Psycholinguistics, 37*(6), 1461-1476. doi:10.1017/S0142716416000060
- Booth, A. E., MacGregor, K., & Rohlfing, K. (2008). Socio-pragmatics and attention: contributions to gesturally guided word learning in toddlers. *Language Learning and Development, 4*(3), 179-202.
- Booth, A. E., Waxman, S. R., & Huang, Y. T. (2005). Conceptual Information Permeates Word Learning in Infancy. *Developmental Psychology, 41*(3), 491-505.
- Chall, J., Jacobs, V., & Baldwin, L. (1990). The reading crisis: Why poor children fall behind. Cambridge, MA: Harvard University Press.
- Childers, J. B., & Tomasello, M. (2002). Two-year-olds learn novel nouns, verbs, and conventional actions from massed or distributed exposures. *Developmental Psychology, 38*(6), 967-978.
- Christ, T., & Wang, X. C. (2011). Closing the vocabulary gap?: A review of research on early childhood vocabulary practices. *Reading Psychology, 32*(5), 426-458.

- Cunningham, A. E., & Stanovich, K. E. (1997). Early reading acquisition and its relation to reading experience and ability 10 years later. *Developmental Psychology*, 934-945.
- Davidson, D., & Tell, D. (2005). Monolingual and bilingual children's use of mutual exclusivity in the naming of whole objects. *Journal of Experimental Child Psychology*, 92(1), 25-45.
- Diesendruck, G., & Bloom, P. (2003). How specific is the shape bias? *Child Development*, 74(1), 168-178.
- Diesendruck, G., & Markson, L. (2001). Children's avoidance of lexical overlap: A pragmatic account. *Developmental Psychology*, 37(5), 630-641.
- Dunn, L. M., & Dunn, D. M. (2007). Peabody Picture Vocabulary Test, Fourth Edition: Pearson.
- Ensminger, M. E., & Fothergill, K. E. (2003). A decade of measuring SES: What it tells us and where to go from here. In M. H. Bornstein & R. H. Bradley (Eds.), *Socioeconomic Status, Parenting, and Child Development* (pp. 13-28). Mahwah: Lawrence Erlbaum Associates.
- Farroni, T., Johnson, M. H., & Csibra, G. (2004). Mechanisms of Eye Gaze Perception during Infancy. *Journal of Cognitive Neuroscience*, 16(8), 1320-1326.
- Fernald, A., Marchman, V., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science*, 16(2), 234-248.
- Francis, D. J., Shaywitz, S. E., Steubing, K. K., Shaywitz, B. A., & Fletcher, J. M. (1996). Developmental lag versus deficit models of reading disability: A longitudinal, individual growth curves analysis. *Journal of Educational Psychology*, 88, 3-17.
- Gelman, S. A., Ware, E. A., & Kleinberg, F. (2010). Effects of generic language on category content and structure. *Cognitive Psychology*, 61(3), 273-301.
- Gershkoff-Stowe, L., & Smith, L. B. (2004). Shape and the First Hundred Nouns. *Child Development*, 75(4), 1098-1114.
- Golinkoff, R. M., Hirsch-Pasek, K., Bailey, L. M., & Wenger, N. R. (1992). Young children and adults use lexical principles to learn new nouns. *Developmental Psychology*, 28(1), 99-108.
- Golinkoff, R. M., Hirsch-Pasek, K., Mervis, C. B., & Frawley, W. B. (1995). Lexical principles can be extended to the acquisition of verbs. In M. Tomasello & W. E. Merriman (Eds.), *Beyond names for things: Young children's acquisition of verbs* (pp. vi, 421). Hillsdale, NJ, USA: Lawrence Erlbaum Associates, Inc.
- Golinkoff, R. M., Mervis, C. B., & Hirsch-Pasek, K. (1994). Early object labels: the case for a developmental lexical principles framework. *Journal of Child Language*, 21(1), 125-155.
- Hall, D.G., & Waxman, S.R. (Eds.). (2004). *Weaving a lexicon*. Cambridge, MA: MIT
- Hart, B., & Risley, T. R. (1995a). The Importance of the First 3 Years of Family Experience *Meaningful differences in the everyday experience of young American children* (pp. 175-189).

- Hart, B., & Risley, T. R. (1995b). *Meaningful differences in the everyday experience of young American children*. Baltimore: Brooks Publishing.
- Henderson, A., & Sabbagh, M. A. (2013). Learning words from experience: An integrated framework. In L. J. Gogate & G. Hollich (Eds.), *Theoretical and Computational Models of Word Learning*:
- Hindman, A. H., Wasik, B. A., & Snell, E. K. (2016). Closing the 30 million word gap: Next steps in designing research to inform practice. *Child Development Perspectives*, *10*(2), 134-139. doi:10.1111/cdep.12177
- Hirsh-Pasek, K., Golinkoff, R. M., & Hollich, G. (2000). An emergentist coalition model for word learning: Mapping words to objects is a product of the interaction of multiple cues. In R. M. Golinkoff, K. Hirsh-Pasek, L. Bloom, L. B. Smith, A. L. Woodward, N. Akhtar, M. Tomasello & G. Hollich (Eds.), *Becoming a word learner: A debate on lexical acquisition* (pp. 136-164). New York, NY, US: Oxford University Press.
- Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development*, *74*(5), 1368-1378.
- Hoff, E. (2006a). Environmental supports for language acquisition. In D. K. Dickinson & S. B. Neuman (Eds.), *Handbook of Early Literacy Research* (Vol. 2). New York: Guilford Publications.
- Hoff, E. (2006b). How social contexts support and shape language development. *Developmental Review*, *26*(1), 55-88.
- Hoff, E. (2013). Interpreting the early language trajectories of children from low-ses and language minority homes: implications for closing achievement gaps. *Developmental Psychology*, *49*(1), 4-14.
- Hoff, E., Laursen, B., & Tardif, T. (2002). Socioeconomic status and parenting. In M. H. Bornstein (Ed.), *Handbook of parenting. Ecology and Biology of Parenting* (Vol. II, pp. 161-188). Mahwah, New Jersey: Lawrence Erlbaum
- Hoff, E., & Naigles, L. (2002). How children use input to acquire a lexicon. *Child Development*, *73*(2), 418-433.
- Hollich, G., Hirsh-Pasek, K., Golinkoff, R. M., Brand, R. J., Brown, E., Chung, H. L., . . . Rocroi, C. (2000). Breaking the language barrier: An emergentist coalition model for the origins of word learning. *Monographs of the Society for Research in Child Development*, *65*(3), v-123.
- Horton-Ikard, R., & Ellis Weismer, S. (2007). A Preliminary Examination of Vocabulary and Word Learning in African American Toddlers From Middle and Low Socioeconomic Status Homes. *American Journal of Speech-Language Pathology*, *16*, 382-392.
- Huttenlocher, J., Waterfall, H., Vasilyeva, M., Vevea, J., & Hedges, L. V. (2010). Sources of variability in children's language growth. *Cognitive Psychology*, *61*(4), 343-365.
- Ilgaz, H., Hassinger-Das, B. & Hirsh-Pasek, K. (2014). Language for reading. In P. J. Brooks & V. Kempe (Eds.), *Encyclopedia of language development* (pp. 324-

- 326). Thousand Oaks, CA: SAGE Publications Ltd. doi: 10.4135/9781483346441.n101
- Jones, S. S., Smith, L. B., & Landau, B. (1991). Object properties and knowledge in early lexical learning. *Child Development, 62*(3), 499-516.
- Klibanoff, R. S., & Waxman, S. R. (2000). Basic level object categories support the acquisition of novel adjectives: Evidence from preschool-aged children. *Child Development, 71*(3), 649-659.
- Landau, B., Smith, L. B., & Jones, S. (1992). Syntactic context and the shape bias in children's and adults' lexical learning. *Journal of Memory & Language, 31*(6), 807-825.
- Lee, V., & Burkham, D. (2002). *Inequality at the Starting Gate: Social Background Differences in Achievement as Children Begin School*. Washington, DC: Economic Policy Institute.
- Maguire, M. J., Hirsch-Pasek, K., Golinkoff, R. M., & Brandone, A. C. (2008). Focusing on the relation: fewer exemplars facilitate children's initial verb learning and extension. *Developmental Science, 11*(4), 628-634.
- Markman, E. M., & Wachtel, G. F. (1988). Children's use of mutual exclusivity to constrain the meaning of words. *Cognitive Psychology, 20*(2), 121-157.
- Markman, E. M., Wasow, J. L., & Hansen, M. B. (2003). Use of the mutual exclusivity assumption by young word learners. *Cognitive Psychology, 47*(3), 241-275.
- Marulis, L. M., & Neuman, S. B. (2010). The Effects of Vocabulary Intervention on Young Children's Word Learning. *Review of Educational Research, 80*(3), 300-335. doi: 10.3102/0034654310377087
- Merriman, W.E., & Kutlesic, V. (1993). Bilingual and monolingual children's use of two lexical acquisition heuristics. *Applied Psycholinguistics, 14*, 229-249.
- Mervis, C. B., & Bertrand, J. (1993). Acquisition of early object labels: The roles of operating principles and input. In A. P. Kaiser & D. B. Gray (Eds.), *Enhancing Children's Communication: Research Foundations for Intervention* (Vol. 12, pp. 287-316).
- Muter, V., Hulme, C., Snowling, M. J., & Stevenson, J. (2004). Phonemes, Rimes, Vocabulary, and Grammatical Skills as Foundations of Early Reading Development: Evidence From a Longitudinal Study. *Developmental Psychology, 40*(5), 665-681.
- National_Center_for_Educational_Statistics. (2011). Average Performance of U.S. Students Relative to International Peers on the Most Recent International Assessments in Reading, Mathematics, and Science: Results from PIRLS 2006, TIMSS 2007, and PISA 2009. 2012
- Raver, C. C., & Leadbeater, B. J. (1995). Factors influencing joint attention between socioeconomically disadvantaged adolescent mothers and their infants. In C. Moore & P. J. Dunham (Eds.), *Joint Attention: Its Origins and Role in Development*. Hillsdale: Lawrence Erlbaum Associates, Inc.
- Rowe, M. L., & Goldin-Meadow, S. (2009). Differences in Early Gesture Explain SES Disparities in Child Vocabulary Size at School Entry. *Science*.

- Samuelson, L. K. (2002). Statistical regularities in vocabulary guide language acquisition in connectionist models and 15-20-month-olds. *Developmental Psychology*, 38(6), 1016-1037.
- Samuelson, L. K., & Smith, L. B. (2005). They call it like they see it: Spontaneous naming and attention to shape. *Developmental Science*, 8(2), 182-198.
- Saylor, M. M., Sabbagh, M. A., & Baldwin, D. A. (2002). Children use whole-part juxtaposition as a pragmatic cue to word meaning. *Developmental Psychology*, 38(6), 993-1003.
- Schady, N., Behrman, J., Araujo, M. C., Azuero, R., Bernal, R., Bravo, D., ... Vakis, R. (2015). Wealth gradients in early childhood cognitive development in five Latin American countries. *Journal of Human Resources*, 50, 446-463.
- Smith, L. B. (1999). Children's noun learning: How general learning processes make specialized learning mechanisms. In B. MacWhinney (Ed.), *The emergence of language* (pp. 277-303). Mahwah, NJ, USA: Lawrence Erlbaum Associates, Inc., Publishers.
- Smith, L. B. (2000). Learning how to learn words: An associative crane. In R. M. Golinkoff, K. Hirsh-Pasek, L. Bloom, L. B. Smith, A. L. Woodward, N. Akhtar, M. Tomasello & G. Hollich (Eds.), *Becoming a word learner: A debate on lexical acquisition* (pp. 51-80). New York, NY, US: Oxford University Press.
- Smith, L. B., Jones, S. S., & Landau, B. (1992). Count nouns, adjectives, and perceptual properties in children's novel word interpretations. *Developmental Psychology*, 28(2), 273-286.
- Stahl, S. A., & Nagy, W. E. (2006). *Teaching Word Meanings*. Mahwah: Lawrence Erlbaum Associates.
- Tabors, P. O., Snow, C. E., & Dickinson, D. K. (2001). *Homes and schools together: Supporting language and literacy development*. Dickinson, David K (Ed); Tabors, Patton O (Ed). (2001). *Beginning literacy with language: Young children learning at home and school*.
- Tomasello, M. (1992). The social bases of language acquisition. *Social Development*, 1(1), 67-87.
- Tomasello, M., Carpenter, M., & Liszkowski, U. (2007). A New Look at Infant Pointing. *Child Development*, 78(3), 705-722.
- Walker, D., Greenwood, C., Hart, B. and Carta, J. (1994), Prediction of school outcomes based on early language production and socioeconomic factors. *Child Development*, 65: 606-621. doi:10.1111/j.1467-8624.1994.tb00771.x
- Ware, E. A., & Booth, A. E. (2010). Form follows function: The role of artifact function in the development of the shape bias. *Cognitive Development*, 25(3), 124-137.
- Waxman, S. R. (1998). Linking object categorization and naming: Early expectations and the shaping role of language. In D. L. Medin (Ed.), *The psychology of learning and motivation: Advances in research and theory, Vol 38* (pp. 249-291). San Diego, CA: Academic Press.
- Waxman, S. R., & Klibanoff, R. S. (2000). The role of comparison in the extension of novel adjectives. *Developmental Psychology*, 36(5), 571-581.

- Waxman, S. R., & Lidz, J. (2006). Early word learning. In D. Kuhn & R. Siegler (Eds.), *Handbook of Child Psychology* (6 ed., Vol. 2). Hoboken, NJ: Wiley.
- Waxman, S. R., & Markow, D. B. (1998). Object properties and object kind: Twenty-one-month-old infants' extension of novel adjectives. *Child Development*, *69*(5), 1313-1329.
- Weisleder, A., & Fernald, A. (2013). Talking to Children Matters Early Language Experience Strengthens Processing and Builds Vocabulary. *Psychological Science*, *24*(11), 2143-2152.
- Woodward, A. L., & Guajardo, J. J. (2002). Infants' understanding of the point gesture as an object-directed action. *Cognitive Development*, *17*(1), 1061-1084.