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PRIMARY LANGUAGE, MATERNAL
LANGUAGE USE, AND COGNITIVE
OUTCOMES AMONG PRESCHOOLERS
BORN VERY LOW BIRTH WEIGHT

Natalia Moss

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by

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B.A., Psychology, University of California Los Angeles, 2008

M.A., Psychology, Pepperdine University, 2012

THESIS

Submitted in Partial Fulfillment of the
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ABSTRACT

Very low birth weight (VLBW; ≤ 1500 grams) preschoolers are at risk for cognitive and executive functioning (EF) difficulties. Maternal language quality may impact cognitive development in VLBW children. The aims of this study were to explore differences in maternal language (Spanish, English) and child cognitive abilities, and to explore associations between maternal language use (verbal scaffolding and structuring) and child cognitive abilities in VLBW preschoolers (3.5-4 years). Caregivers reported sociodemographic information. Cognitive abilities were measured using the WPPSI-III (VIQ, PIQ), Bear Dragon, and Gift Delay Peek scores. Results showed English speaking children scored higher on VIQ. For English speaking children, verbal scaffolding was positively correlated with VIQ, and structured statements were negatively associated with PIQ. When controlling for maternal education, the associations remained significant. Findings suggest maternal language use plays an important role in child cognitive development; these associations may vary by language group and be influenced by socioeconomic factors.

Keywords: Prematurity, Spanish speaking, maternal verbal behavior, development

TABLE OF CONTENTS

LIST OF TABLES.....	vi
CHAPTER 1 INTRODUCTION.....	1
Cultural Influences on Play.....	2
Language Exposure.....	3
Maternal Verbal Scaffolding.....	3
Maternal Verbal Structuring.....	4
Cultural Differences in Maternal Language.....	5
Executive Functioning.....	5
Cognitive Abilities.....	7
Verbal Abilities.....	7
Performance Abilities.....	9
Cultural Considerations in Assessment.....	9
CHAPTER 2 METHODOLOGY.....	11
Aims and Hypotheses.....	11
Sample and Participant Selection.....	12
Measures.....	13
Sociodemographic Variables.....	13
Executive Functioning.....	14
Intelligence.....	15
Mother Infant Play.....	15
Language Exposure.....	16
Translation of Measures.....	16

Analyses.....	16
CHAPTER 3 RESULTS.....	19
CHAPTER 4 DISCUSSION.....	27
Limitations.....	31
Conclusions and Future Study.....	32
REFERENCES.....	34

LIST OF TABLES

Table 1. Demographic Characteristics by Primary Language for all Participants.....	19
Table 2. Primary Language Group Differences on Cognitive and EF Measures.....	20
Table 3. Association Among Maternal Education, Child Outcome Measures, and Maternal Behaviors for Total Group and by Language Group.....	21
Table 4. Primary Language Group Differences on Maternal Verbal Language Measures.....	22
Table 5. Association Among Maternal Verbal Scaffolding and Verbally Laden Outcome Measures.....	22
Table 6. Association Among Structured Maternal Statements and Less Verbally Laden Outcome Measures.....	24

Chapter 1

Introduction

The Center for Disease Control reports that in the United States in 2012, the rate of babies born very low birth weight (VLBW) (< 1,500 grams) was about 1.44%, and the rate of preterm births (< 37 weeks) was around 12% of all births that year (Martin, Hamilton, Ventura, Osterman, & Mathews, 2013). A large number of children born VLBW or preterm have been found to be at risk for neurodevelopmental disabilities including reduced cognitive test scores and behavior difficulties entering school age (Bhutta, Cleves, Casey, Craddock, & Anand, 2002). Incidence of learning disabilities, low cognitive abilities, attention deficit hyperactivity disorders (ADHD), neuropsychological deficits, and behavior problems occur in as many as 50%-70% of children born VLBW (Taylor, Klein, & Hack, 2000). Long term delays have been found in cognitive functioning, language development and non-verbal problem solving skills in children born VLBW (Smith, Landy, & Swank, 2000).

The preschool period is particularly of interest in this population because it is a time of rapid change in neural development and self-regulation (Clark et al., 2013). Dowsett and Livesey (2000) discuss observed improvements in inhibitory control from ages three to five years that may be attributed to maturation in the prefrontal cortex. Although preschoolers may have the cognitive capacity for inhibitory control, they appear to have difficulty displaying inhibitory control through motor responses (Dowsett & Livesey, 2000). Additional cognitive and behavioral outcomes are identified for children born VLBW when they begin to enter school age (Aylward, 2002). Aylward (2002) recommends children be evaluated on tests of executive functions, attention,

language, sensorimotor functions, visuospatial processes, memory and learning, and behavioral adjustment in addition to the traditional IQ and achievement tests. Assessing preschoolers with a specific emphasis on particular deficits may help to better understand academic and social functioning at this age.

To better understand the cultural differences in maternal verbal behavior during play on different aspects of cognitive development, it may be informative to look at differences between Spanish speaking and English speaking mothers and preschoolers during unstructured play. There are mixed findings on how differences in culture, household income, and maternal education may be affecting executive functioning (EF), verbal and performance abilities in preschoolers born VLBW.

Cultural Influences on Play

Due to the impact of family environment and social interaction on development, one must take into account cultural differences in parent-child interactions. Cross-cultural studies have questioned assumptions of universality of children's developmental processes influenced by maternal interaction and suggest one must consider the opportunities for mother-child play (Gauvain, 1995). Children in some non-Western or in low-income communities do not have the same opportunities for play (Goncu & Mosier, 2000). For example, if parents work long hours, they may not spend time in specific child-centered activities involving play. Additionally, one should not assume that all communities value and seek to provide comparable play opportunities for their children. Children's play is not always considered a valuable, productive activity, and managing children's play may not always be culturally appropriate. Some communities do not even consider adult-child play to be necessary (Farver & Howes, 1993). In these instances,

more importance is placed on young children's imitative play being guided by older children's play rather than adults (Farver & Howes, 1993). Due to the differences in values, communication style, and socioeconomic status (SES) across cultures, these variables should be considered when evaluating a diverse group of preschoolers.

Language Exposure

Maternal verbal scaffolding.

Higher levels of language exposure may be essential for children to reach expected cognitive levels for their age. Maternal verbal scaffolding is described as types of prompts that the mother offers the child when directing their attention towards objects, activities, or conversations (Landry, Miller-Loncar, & Smith, 2002). Scaffolding statements are considered to lay a foundation for problem-solving skills in helping the child to begin to make connections among people, activities, objects, and functions (Smith et al., 2000). Rich maternal language input such as scaffolding supports memory, attentional, cognitive and language abilities (Smith et al., 2000). At the preschool age, parents have been found to begin to modify their linguistic support to allow children to take more of an active role in their problem solving. As a result, children begin to internalize and apply skills they have learned through maternal verbal scaffolding (Smith, et al., 2000).

In a study conducted by Smith and colleagues (2000), the researchers found that maternal verbal scaffolding helped explain differences in cognitive abilities of preschoolers such that mothers who used more verbal scaffolding statements showed greater cognitive abilities in verbal and nonverbal problem solving skills. Additionally, they found maternal verbal scaffolding to have an even stronger relationship with

nonverbal skills in children born preterm compared to children born full term.

Comprehending complex verbal information may be more difficult for children born preterm (Smith et al., 2000). Other factors that have shown to impact children's exposure to maternal scaffolding statements are the home environment and available resources (Dieterich, Assel, Swank, Smith, & Landry, 2006). In a predominantly low-income sample, mothers used fewer verbal scaffolding statements in their interactions during play and children had lower cognitive scores when compared to higher SES populations (Smith et al., 2000).

Maternal verbal structuring.

Mothers use structured verbal statements to maintain their child's attention in play. Maternal verbal structuring statements provide the child with specific information about what to do by restricting choices. In contrast, unstructured verbal statements focus the child's attention while providing more options and less information about what to do (Landry et al., 2002). Unstructured statements may include asking a question, making a suggestion, commenting on a behavior or conversational exchanges. At six months, infants were found to be more likely to increase their level of play if mothers used structured rather than unstructured strategies (Landry, Garner, Swank & Baldwin, 1996). When mothers provided structured statements including specific directives and information about toys rather than simple orienting gestures without information about how to use toys, structuring was associated with increased complexity of exploratory play for children born preterm. Mothers of developmentally at risk infants have been found to be more likely to use structured verbal statements with their children at six months in comparison to mothers of typically developing children (Landry et al., 1996). Although

structured statements appear to be beneficial at six months, when children move into the toddler period, less structured statements appear to allow the child to gradually have more autonomy in task completion (Landry et al., 2002).

Cultural differences in maternal language.

Maternal communication provides a rich context for children's learning. It is possible that cultural differences such as primary language spoken in the home may help to explain differences in maternal communication style among diverse populations. Past research has found Latino parents to use verbal commands within a framework of their identified cultural values such as importance on the family, and respect for adult authority figures (Halgunseth, Ispa, & Rudy, 2006). In a study conducted with children (13-15 months) and their mothers, Anglo families endorsed having more individualistic goals for their children compared to more sociocentric goals endorsed by the Puerto Rican moms (Harwood, Schoelmerich, Schulze, & Gonzalez, 1999). In this study Anglo mom's stated they valued providing opportunities for children to learn individually whereas the Puerto Rican mom's reported they valued teaching their children through direct examples. Anglo mom's showed more indirect structuring compared to Puerto Rican mom's who used more direct structuring when facilitating a learning experience (Harwood et al., 1999). Similarly, in a recent study with mothers and their four year old children Livas-Dlott and colleagues (2010) found mothers of Mexican decent to use a higher proportion of direct verbal commands in comparison to Anglo mothers who allowed for more autonomy in their child's play.

Executive Functioning

EF refers to a complex set of cognitive processes such as working memory,

reasoning, task flexibility, problem solving, planning, and execution and has been shown to be a predictor of school readiness in preschool aged children (Espy et al., 2002).

Deficits in EF have been found to be associated with a variety of psychological and developmental problems such as aggression (Séguin & Zelazo, 2005), ADHD (Clark, Pritchard, & Woodward, 2010), and autism (Pennington & Ozonoff, 1996). As a result, identifying factors that underlie individual differences in children's EF constitutes an important target for developmental research. It has been suggested that individual differences in EF may have implications for long-term social, academic and behavioral outcomes (Clark et al., 2013).

In a recent meta-analysis researchers Mulder and colleagues (2009) found EF to be a weakness for children born preterm in areas of selective attention, sustained attention, inhibition, working memory, planning, and verbal fluency across studies and age groups. Similarly at the age of five children born preterm with average IQ displayed significantly higher rates of impairments on EF tasks (Aarnoudse-Moens et al., 2009). In a study comparing MRI measures of working memory in two year olds born full term and preterm, clear differences were found between the groups such that the preterm group had marked deficits in working memory (Woodward, Clark, Pritchard, Anderson, & Inder, 2011). Given the central role of EF in a variety of domains including learning, problem solving, and language development these deficits are likely to impact their academic and social performance later in life.

Specific tasks that have been found useful in assessing preschool aged children include delayed response tasks because of the nonverbal component, simple demands, and their sensitivity to age related differences (Espy et al., 2002). Other skills often

included in the assessment of EF include the ability to inhibit goal-irrelevant impulses or attention responses and the ability to adapt flexibility to changes in the environment (Anderson & Doyle, 2008). Previous studies have suggested that parent–child interactions play an important part in the development of prefrontal cortical systems that support executive control (Hackman & Farah, 2009). As a result, socioeconomic factors such as maternal education and income are relevant to consider when interpreting individual differences in EF (Bernier, Carlson, & Whipple, 2010). Recent studies have found children from lower SES families to perform worse on working memory and executive control at 6-14 months (Lipina, Martelli, Vuelta, & Colombo, 2005), and executive attention at 6 years (Mezzacappa, 2004).

Cognitive Abilities

Cognitive abilities are commonly used to assess outcomes in preschool children born VLBW. Children born VLBW are likely to obtain lower scores on cognitive tests compared to preschoolers born normal birth weight (NBW) however most remain in the average range when major disabilities are accounted for (Bhutta et al., 2002). Hack et al. (2005) claimed that measures of cognitive abilities may identify areas of future risk in academic and social functioning, it is not predictive of subnormal cognitive functioning in school aged children. Finally, negative consequences of low SES on neurocognitive functioning should be assessed (Neville, Stevens, Pakulak, & Bell, 2013).

Verbal abilities.

Verbal abilities can be described as acquired knowledge, verbal reasoning and comprehension, and attention to verbal stimuli. Subtle differences in language ability between VLBW and NBW children may significantly impact social and academic

performance. Links between language ability and cognitive control have been established in recent studies (Cragg & Nation, 2010). For example, language may facilitate reflection and awareness of one's own thoughts and response tendencies (Cragg & Nation, 2010). Language is also thought to be a pathway for learning how to regulate behavior. Carlson and Beck (2009) found that verbal ability in children, as measured by receptive vocabulary, was related to the strategies used to wait in a delay of gratification task. Similarly, verbal skills may be critical in the development of inhibition of impulsive responses (Blair, Zelazo, & Greenberg, 2005). Verbal skills appear likely to play a central role in the transmission of knowledge and the development of self-control strategies for solving problems. These claims are supported by abundant research documenting significant relations between children's expressive or receptive verbal ability at varying ages and their performance on EF tasks entailing different degrees of inhibition, set shifting, and/or working memory (Carlson & Beck, 2009; Fuhs & Day, 2011; Landry et al., 2002).

Researchers have suggested that the quality of parent-child interactions plays a key role in the development of verbal abilities (Plomin & Dale, 2000). There has been little research on the association of primary language spoken in the home on verbal abilities of children born VLBW. A recent study found toddlers (18 months) born extremely preterm who came from Spanish speaking homes scored significantly lower on language abilities when compared to English speaking toddler born VLBW even after adjusting for medical severity and SES (Lowe, Erickson, MacLean, Schrader, & Fuller, 2013a). However, there were no differences found in cognitive scores between Spanish and English speaking toddler (Lowe et al., 2013a). More research is needed to understand

this discrepancy in verbal abilities to best assess children from non-English speaking households.

Performance abilities.

Performance abilities can be described as fluid reasoning, visual-spatial processing, attentiveness to detail, and visual-motor integration. These nonverbal abilities are likely to impact school readiness and academic success particularly in areas involving mathematics (Dilworth-Bart, Poehlmann, Hilgendorf, Miller, & Lambert, 2010).

Performance learning abilities allow children to create mental representations of numerical information, providing the foundation for abstract thinking. Vicari and colleagues (2004) found preschoolers born preterm to have specific difficulties in visuospatial processing, and spatial working memory. Findings such as these highlight the importance of research in this area to the development of appropriate early interventions to improve outcomes for children born preterm before entering school age.

Cultural Considerations in Assessment

Despite the growing Latino population in the United States, little Latino-specific data are available for children born VLBW. Child development is often measured quantitatively however, there is some research that indicates qualitative measures may capture additional concepts relevant to development (e.g., IQ, EF, play) especially in diverse and low-income populations (Dumka, Gonzales, Wood, & Formoso, 1998). Research is needed with non-English speaking participants and researchers should go beyond the translation or even the validation of English-based tools (Lowe et al., 2013a; Badr, 2001). In an ethnically diverse group of extremely preterm (<28 weeks gestation) toddlers it was found that psychosocial factors were associated with increased risk for

cognitive impairment (Duncan et al., 2012). However, language differences appear to be unique in that differences in language ability among minority groups (Black and Hispanic) were sustained regardless of risk factors. Emphasis on culturally important constructs in addition to standardized tools to determine factors that influence child development is especially important when assessing individuals from diverse backgrounds (Badr, 2001).

Chapter 2

Methodology

Aims and Hypotheses

A primary aim of this study was to explore the differences in maternal verbal language (Spanish, English), cognitive abilities and EF in Spanish speaking compared to English speaking preschoolers born VLBW. A secondary goal of this study was to better understand the associations between maternal language use (verbal scaffolding, structured statements, and unstructured statements), and child cognitive abilities and EF in preschoolers born VLBW. Specifically, it was hypothesized that: 1) There would be a difference between the Spanish speaking and English speaking participants on verbally-laden outcome measures such as verbal IQ (VIQ) and the Bear Dragon but there would be no difference between the groups on less verbally laden measures such as performance (PIQ) and Gift Delay Peek, such that Spanish speaking children would score significantly lower on verbally laden outcome measures, and this difference between the groups would be driven by maternal education, 2) There would be more maternal verbal scaffolding, as measured by the Maternal Attention Directing Manual (Landry et al., 2002), in the English speaking group compared to the Spanish speaking group, and this difference between the groups would be driven by maternal education, 3) Increased maternal verbal scaffolding during play would be positively associated with higher scores on verbally-laden child outcome measures such as the Bear Dragon and VIQ for Spanish speaking and English speaking preschoolers, and this positive association would primarily be driven by maternal education, 4) There would be more maternal verbal structuring, as measured by the Maternal Attention Directing Manual (Landry et al., 2002), in the

Spanish speaking compared to the English speaking group, and more unstructured maternal verbal statements, as measured by the Maternal Attention Directing Manual (Landry et al., 2002), in the English speaking compared to the Spanish speaking group, and this difference between the groups would be driven by maternal education and 5) Increased maternal verbal structuring during play would be positively associated with higher scores on less verbally-laden child outcome measures such as the Gift Delay Peek and PIQ for Spanish speaking and English speaking preschoolers and this positive association would primarily be driven by maternal education.

Sample and Participant Selection

The University of New Mexico's Human Research Review Committee provided review and approval for this study, which was in compliance with institutional research standards for human research. Participants included 82 children between the ages of three and four years six months (54% male) born VLBW and their mothers. Children were excluded if they were prenatally exposed to illicit substances, had vision/hearing impairment, or had a genetic abnormality. To recruit participants pediatric nurses from the University of New Mexico Hospital (UNMH) Clinical and Translational Science Center (CTSC) identified eligible participants. Graduate students then called the caregivers of the eligible preschoolers to provide a brief description of the study and schedule an assessment if mothers and children were interested in participating.

All caregivers provided informed consent at the start of their scheduled assessment prior to filling out questionnaires, participating in testing, or being videotaped. Evaluation of the maternal-child interaction, as well as preschooler's

cognitive and EF abilities were conducted at the MIND Research Network in Albuquerque, NM. Medical information was obtained for the VLBW cohort through hospital record review. Children within the study sample were 50.5% Hispanic or Latino, 22.4% non-Hispanic White, 15.3% Native American, 4.7% African-American, 4.7% Asian-Pacific Islander, and 1.2% identified with of three or more ethnicities (including combinations of Caucasian, Native American, and Hispanic or Latino ethnicities). Primary language spoken in the home varied with 18.3% speaking Spanish and 81.7% speaking English. Primary caregivers reported their annual household income to be as follows: 13.1% claimed < \$10,000, 17.9% claimed \$10,000-\$20,000, 25% claimed \$20,001-\$30,000, 9.5% claimed \$30,001-\$40,000, 4.8% claimed \$40,001-\$50,000, 11.9% claimed \$50,001-\$60,000, 2.4% claimed \$60,001-\$70,000 and 15.5% claimed greater than \$70,000. The distribution of mother's education was 35.7% completed less than or equal to High School/GED, 47.7% completed some college or an Associates degree, 19.1% completed a Bachelors degree or higher.

Measures

Sociodemographic variables. Demographic variable data collected through caregiver report included child ethnicity, primary language spoken, household income, and maternal education. Caregivers indicated income by selecting one of eight choices for annual household income: 1) from \$0 to \$10,000, 2) income between \$10,001 and \$20,000, 3) income between \$20,001 and \$30,000, 4) income between \$30,001 and \$40,000, 5) income between \$40,001 and \$50,000, 6) income between \$50,001 and \$60,000, 7) income between \$60,001 and \$70,000 and, 8) income greater than \$70,000. Maternal education was indicated as one of seven

different choices: 1) less than 12th grade, 2) high school graduate, 3) 1 year of college, 4) an Associate's degree, 5) a Bachelor's degree, 6) some graduate school, or 7) Masters degree or higher.

Executive functioning. The Bear Dragon (Kochanska, Murray, Jacques, Koenig, & Vandegest, 1996; and Kochanska, Murray, & Harlan, 2000) is a measure of inhibition and working memory in children where children are instructed to inhibit certain responses to commands. The examiner introduces children to a “nice” bear puppet (using a soft, high-pitched voice) and a “grumpy” dragon puppet (using a gruff, low-pitched voice). It is then explained that in this game, “we will listen to the nice bear and do what he asks us to do” (e.g., touch your head), but “we will not listen to what the grumpy dragon tells us, so we will not do what he asks us to do.” Practice trials are administered where the bear gives a command in a nice voice (“touch your nose”) and the dragon gives a command in a gruff voice (“touch your tummy”). The child passes the practice trial if they comply with the bear and do not comply with the command given by the dragon. Up to six practice trials are given, in addition to verbal rule reminders after each trial until the child passes one command by each puppet. If the child is unable to pass the practice trials they are given a score of 0. After the practice trials, there are 10 test trials with alternating bear and dragon commands. A reminder of the rules is provided halfway through the testing regardless of performance. This assessment is scored by assigning a score of 0 (fail item), 1 (wrong move), 2 (partial correct), or 3 (full correct) to each trial. Points are added to obtain a total score out of 33 possible points (3 points pretrial plus 3 points for correctly completing at least one of the practice trial items) (Carlson & Moses, 2001; Carlson, 2005).

The Gift Delay Peek (Carlson, 2005) is a measure of inhibition in children. A child is told the examiner has a gift for the child but they forgot to wrap it. The child is then instructed to turn away and not peek until the examiner finishes wrapping the gift. Examiner wraps the gift for one minute. Next the wrapped gift is placed in front of the child and they are told not to touch or open it while the examiner finishes making them a card. The examiner then turns her back to the child and works on a card for two minutes. No reminders are given. The task is discontinued and the child receives the gift at two minutes or when the child begins to open the gift. A score is provided for the number of seconds prior to the child peeking at the examiner, touching, and opening the gift.

Intelligence. The Wechsler Preschool and Primary Scale of Intelligence-Third Edition (WPPSI-III; Wechsler, 2002) is a standardized cognitive assessment measuring verbal and performance abilities in children ages 2.5-7.25 years. The assessment involves activities such as pointing at pictures, naming pictures, answering questions about daily information, building with blocks, and assembling puzzles. The WPPSI-III generates VIQ, PIQ, and Full Scale IQ (FSIQ) scores; the FSIQ was not used in the current study.

Mother Infant Play. Mother and child dyads were videotaped for 8 to 10 minutes with a standard set of toys including pretend food, a cash register and blocks. Five minutes of the videotaped mother-child interaction were coded for maternal verbal scaffolding, and maternal verbal structuring strategies during play. A master coder initially trained additional coders ensuring that 85% reliability was obtained with the master coder. Once reliability was established, each videotape was double coded and reviewed for consistency. If differences were found, a third coder reviewed the videotape and a code was established.

Language exposure. The maternal verbal scaffolding behaviors and structuring strategies were defined using the Maternal Attention Directing Manual (Landry et al., 2002). A statement was considered maternal verbal scaffolding when it helped the child to make associations, or provided strategies to help the child solve a problem. The total number of maternal verbal scaffolding statements was summed. Statements considered maternal verbal structured strategies focused on attention while providing more information to the child about what to do and/or restricting choices (i.e., put the stamp here). Unstructured verbal strategies focus attention while providing more options but less information about what to do. These include asking a question, suggesting something the child might do, commenting about the child's behavior, and conversational exchanges (i.e., Are you going to put the stamp somewhere?). A percentage and ratio of structured verbal statements were calculated.

Translation of measures. Of the mother-child dyad in this sample, 15 were interviewed and assessed in Spanish. Translation methods were used to administer the measures to these caregivers. Because there were no existing translation measures for the Demographic Questionnaire, Bear Dragon script, Gift Delay Peek script, and the WPPSI-III a translated measure was created using a translation/back-translation procedure. A Spanish speaker created translated measures, and a second researcher back-translated the measure to English to ensure accuracy. The Spanish translation was then evaluated for readability during the interviewer training phase and additional revisions were made by the translators as needed.

Analyses

Frequency distributions for categorical items, skewness, and normality were

examined for all variables of interest. Demographic characteristics of the Spanish speaking and English speaking groups were compared using chi-square tests for categorical characteristics and t-tests for continuous characteristics. Measured outcome variables included WPPSI-III VIQ and PIQ scores, the Bear Dragon scores, and Gift Delay Peek scores. Primary language (Spanish, English) was the independent variable.

Analyses by hypotheses:

- 1) T tests were used to compare the two language groups (Spanish, English) on all outcome measures. Significance levels of t tests were used to determine if there was a larger discrepancy on the verbally-laden tasks. Follow up ANCOVAS were used to compare the two language groups (Spanish, English) on all outcome measures when controlling for maternal education.
- 2) A T test was used to compare the two language groups (Spanish, English) on verbal scaffolding. Follow up ANCOVAS were used to compare the two language groups (Spanish, English) on verbal scaffolding when controlling for maternal education.
- 3) A Pearson correlation was used to determine the strength of the relationship between maternal verbal scaffolding and verbally laden outcome measures (VIQ and Bear Dragon) for all participants. Secondary Pearson correlations were calculated by language group (Spanish, English), to compare against the larger group correlation. Z scores were calculated to determine the difference between the correlations. Partial correlations using maternal education as a covariate were used to determine if the associations were driven by maternal education.
- 4) T tests were used to compare the two language groups (Spanish, English) on

structured maternal verbal statements and unstructured maternal verbal statements. Follow up ANCOVAs were used to compare the two language groups (Spanish, English) on structured maternal verbal statements and unstructured maternal verbal statements when controlling for maternal education.

- 5) A Pearson correlation was used to determine the strength of the relationship between structured maternal verbal statements and less verbally laden outcome measure (PIQ and Gift Delay Peek) for all participants. Secondary Pearson correlations were calculated by language group (Spanish, English) to compare against the larger group correlation. Z scores were calculated to determine the difference between the correlations. Partial correlations using maternal education as a covariate were used to determine if the associations were driven by maternal education.

Chapter 3

Results

Demographic characteristics for the study participants by primary language are presented in Table 1. Differences between the groups include that the English speaking participants had a significantly higher yearly income and maternal education level in comparison to the Spanish speaking group. The groups did not significantly differ on gestational age, birth weight, or ratio of male to female participants.

Table 1 <i>Demographic characteristics by primary language for all participants</i>			
	English (n=67)	Spanish (n=15)	p-value
Gestational age at birth (weeks) Mean (SD)	28.81 (2.33)	29.29 (1.71)	.21
Birth weight (grams) Mean (SD)	1134.57 (270.25)	1233.73 (264.73)	.96
Yearly income Mean	\$30,000-\$40,000	\$10,000-\$20,000	<.001***
Sex			.24
Female (%)	44	60	
Male (%)	56	40	
Maternal Education			<.01**
<High school (%)	6	20	
High school degree (%)	21	60	
Some college (%)	52	20	
≥ College degree (%)	21	0	
* $p < .05$ ** $p < .01$ *** $p < .001$			

The first hypothesis predicted that there would be a difference between the Spanish speaking and English speaking participants on verbally-laden outcome measures such as VIQ and the Bear Dragon but not on the less verbally laden outcome measures such as PIQ and Gift Delay Peek. This was examined using a series of t tests to compare the two language groups on these outcome measures and comparing the significance

levels of these two sets of two t tests. Partially aligned with our hypothesis, we found that the English speaking group scored significant higher on VIQ ($p=.003$) whereas no significant difference between the language groups was found on the Bear Dragon, PIQ, or Gift Delay Peek measures. See Table 2. To see if there was difference between the Spanish speaking and English speaking participants on verbally-laden outcome measures such as VIQ and the Bear Dragon but not on the less verbally laden outcome measures such as PIQ and Gift Delay Peek when controlling for maternal education, a series of ANCOVAS was used. Results remained the same: we found that the English speaking group scored significant higher on VIQ ($p=.041$) whereas no significant difference between the language groups was found on the Bear Dragon, PIQ, or Gift Delay Peek measures. In the total group maternal education was positively correlated with VIQ ($p=.004$). However, maternal education was not correlated with any of the child outcome measures in the Spanish speaking or English speaking groups alone. See table 3.

Table 2 <i>Primary language group differences on cognitive and EF measures</i>			
	English mean SD (n=67)	Spanish mean SD (n=15)	p-value
WPPSI-III Verbal IQ	95.51 (1.61)	84.60 (2.53)	<.01**
WPPSI-III Performance IQ	91.21 (1.58)	86.00 (3.47)	.17
Bear/Dragon	15.93 (1.63)	18.93 (3.37)	.42
Gift Delay Peek	36.72 (2.72)	36.07 (6.99)	.92
* $p<.05$ ** $p<.01$ *** $p<.001$ WPPSI-III, Wechsler Preschool and Primary Scale of Intelligence-Third Edition (Wechsler, 2002); Bear/Dragon (Kochanska, Murray, Jacques, Koenig, & Vandegest, 1996; and Kochanska, Murray, & Harlan, 2000); Gift Delay Peek (Carlson, 2005)			

Table 3 <i>Association among maternal education, child outcome measures, and maternal behaviors for total group and by language group</i>			
	Maternal Education		
	Total Group r-value (p-value)	Spanish Speaking r-value (p-value)	English Speaking r-value (p-value)
WPPSI-III Verbal IQ	.312 (.004**)	.100 (.722)	.227 (.064)
WPPSI-III Performance IQ	.104 (.352)	.122 (.666)	.041 (.740)
Bear/Dragon	-.020 (.865)	.150 (.593)	.003 (.981)
Gift Peek Delay	.067 (.552)	.326 (.235)	.034 (.785)
Maternal verbal scaffolding	.250 (.024*)	.168 (.550)	.108 (.382)
Maternal structured statements	-.249 (.024*)	-.167 (.552)	-.233 (.058)
Maternal unstructured statements	.056 (.618)	-.161 (.567)	-.081 (.514)

* $p < .05$ ** $p < .01$ *** $p < .001$
WPPSI-III, Wechsler Preschool and Primary Scale of Intelligence-Third Edition (Wechsler, 2002); Bear/Dragon (Kochanska, Murray, Jacques, Koenig, & Vandegest, 1996; and Kochanska, Murray, & Harlan, 2000); Gift Delay Peek (Carlson, 2005)

Our second hypothesis predicted that there would be more maternal verbal scaffolding among the English speaking group compared to the Spanish speaking group. This was examined by using a t test to compare the two language groups on maternal verbal scaffolding. In line with our hypothesis, we found that the English speaking group used significantly more maternal verbal scaffolding than the Spanish speaking group ($p < .001$). See Table 4. To see if there was significantly more maternal verbal scaffolding among the English speaking group compared to the Spanish speaking group when controlling for maternal education an ANCOVA was used. Results remained the same: we found that the English speaking group used significantly more maternal verbal scaffolding than the Spanish speaking group ($p = .002$). See Table 5. In the total group

maternal education was positively correlated with maternal verbal scaffolding ($p=.024$).

However, maternal education was not correlated with maternal verbal scaffolding in the Spanish speaking or English speaking groups alone. See Table 3.

	English mean (SD) (n=67)	Spanish mean (SD) (n=15)	p-value
Maternal Verbal Scaffolding	5.13 (.32)	2.33 (.50)	<.001***
Structured Maternal Verbal Statements	13.97 (1.27)	17.27 (2.87)	.28
Unstructured Maternal Verbal Statements	58.46 (2.29)	40.47 (5.61)	<.01**
* $p<.05$ ** $p<.01$ *** $p<.001$ Maternal Attention Directing Manual (Landry et al., 2002)			

		WPPSI-III Verbal IQ r-value (p-value)	Bear/Dragon r-value (p-value)
Pearson Correlation (All)	Maternal Verbal Scaffolding	.337 (.002**)	.067 (.563)
Pearson Correlation (English)	Maternal Verbal Scaffolding	.270 (.027*)	.113 (.386)
Pearson Correlation (Spanish)	Maternal Verbal Scaffolding	-.050 (.858)	.185 (.509)
Partial Correlation Covary Maternal Education (All)	Maternal Verbal Scaffolding	.245 (.027*)	.062 (.595)
Partial Correlation Covary Maternal Education (English)	Maternal Verbal Scaffolding	.191 (.144)	.094 (.476)
Partial Correlation Covary Maternal Education (Spanish)	Maternal Verbal Scaffolding	-.040 (.892)	.142 (.629)
* $p<.05$ ** $p<.01$ *** $p<.001$ WPPSI-III, Wechsler Preschool and Primary Scale of Intelligence-Third Edition (Wechsler, 2002); Bear/Dragon (Kochanska, Murray, Jacques, Koenig, & Vandegest, 1996; and Kochanska, Murray, & Harlan, 2000); Maternal Attention Directing Manual (Landry et al., 2002)			

Our third hypothesis predicted that maternal verbal scaffolding would be positively associated with verbally laden outcome measures for all participants and that this association would be driven by maternal education. This was examined with a Pearson correlation across both groups, and then conducting secondary correlations by language group to compare against the larger group correlation. Z scores were calculated to determine the difference between the correlations. We then partialled out maternal education in these three correlations. Partially in line with our hypothesis, we found that maternal verbal scaffolding was positively associated with VIQ ($p=.002$) but not the Bear Dragon scores in the total sample. When the participants were separated by primary language, we found that maternal verbal scaffolding was positively associated with VIQ in the English speaking group ($p=.027$) but not in the Spanish speaking group. The correlations did not significantly differ from one another ($z = 1.04$). Contrary to our hypothesis, maternal verbal scaffolding was not associated with the Bear Dragon in the total sample, Spanish or English speaking groups. When we used maternal education as a covariate, maternal verbal scaffolding remained associated with VIQ in the total sample ($p=.027$), but not in the Spanish speaking or English speaking groups independently. Additionally, when maternal education was used as a covariate, maternal verbal scaffolding remained unassociated with the Bear Dragon in the total sample or in either language group. See Table 6.

Table 6 <i>Association among structured maternal statements and less verbally laden outcome measures</i>			
		WPPSI-III Performance IQ r-value (p-value)	Gift Peek Delay r-value (p-value)
Pearson Correlation (All)	Structured Maternal Statements	-.277 (.012*)	-.192 (.083)
Pearson Correlation (English)	Structured Maternal Statements	-.382 (.001***)	-.145 (.243)
Pearson Correlation (Spanish)	Structured Maternal Statements	.011 (.970)	-.338 (.217)
Partial Correlation Covary Maternal Education (All)	Structured Maternal Statements	-.306 (.005**)	-.135 (.229)
Partial Correlation Covary Maternal Education (English)	Maternal Verbal Scaffolding	-.388 (.001**)	-.092 (.460)
Partial Correlation Covary Maternal Education (Spanish)	Maternal Verbal Scaffolding	.046 (.877)	-.291 (.313)
* $p < .05$ ** $p < .01$ *** $p < .001$ WPPSI-III, Wechsler Preschool and Primary Scale of Intelligence-Third Edition (Wechsler, 2002); Gift Delay Peek (Carlson, 2005); Maternal Attention Directing Manual (Landry et al., 2002)			

Our fourth hypothesis predicted that there would be more structured maternal verbal statements in the Spanish speaking group and more unstructured maternal verbal statements in the English speaking group. To examine this hypothesis, t tests were run to compare the two language groups on these two maternal behaviors. Contrary to the first part of our hypothesis, we found no difference between the groups on structured maternal statements. In line with our hypothesis, we found English speaking mothers used more unstructured statements compared with Spanish speaking mothers ($p = .002$). See Table 4. To see if there were significantly more structured maternal statements among the Spanish speaking group and more unstructured maternal statements in the Spanish speaking group

when controlling for maternal education ANCOVAs were used. Results remained the same: we found no difference between the group on structured maternal statements and the English speaking mothers used more unstructured statements ($p=.001$). In the total group maternal education was negatively correlated with maternal structured statements ($p=.024$). However, maternal education was not correlated with maternal structured statements in the Spanish speaking or English speaking groups alone. See table 3.

Our final hypothesis predicted that structured maternal verbal statements would be positively associated with less verbally laden outcome measures for Spanish speaking and English speaking participants and that this association would be driven by maternal education. This was examined by a Pearson correlation and then running secondary correlations by language group to compare against the larger group correlation. Z scores were calculated to determine the difference between the correlations. Partial correlations controlling for maternal education were run for the three correlations to determine if maternal education explained associations. Contrary to our hypothesis, we found that structured maternal verbal statements were negatively associated with PIQ ($p=.012$) but not associated with Gift Delay Peek in the total sample. When the participants were separated by primary language, we found structured maternal verbal statements were negatively associated with PIQ in the English speaking group ($p=.001$) but not in the Spanish speaking group. The correlations did not significantly differ from one another ($z = -1.31$). Structured maternal verbal statements were not associated with the Gift Delay Peek in the Spanish or English speaking groups. When we used maternal education as a covariate, structured maternal verbal statements were still negatively associated with PIQ

for the English speaking group ($p=.005$) but not for the Spanish speaking group and lost significance for the total sample.

Chapter 4

Discussion

The primary aim of this study was to better understand the relationship between primary language spoken in the home and measures of cognitive abilities and EF in preschoolers born VLBW. The secondary aim investigated different aspects of maternal verbal language, including scaffolding, structured, and unstructured statements during mother-child play, to determine how maternal language use correlates with measures of cognitive and EF abilities. Results showed that English speaking children scored higher on VIQ but there were no significant differences between the groups on PIQ, Bear Dragon or Gift Delay Peek scores. More verbal scaffolding and unstructured statements were used by the English speaking moms. Verbal scaffolding was positively correlated with VIQ scores, and structured statements were negatively associated with PIQ scores, in the English speaking group but not the Spanish speaking group.

In further investigating the finding that the English speaking participants scored significantly higher on one measure of verbal ability (VIQ), but no significant language group differences were found on the Bear Dragon or on less verbally-laden measures including PIQ and the Gift Peek Delay, the role of SES was investigated. A primary consideration in interpreting our VIQ results is that the English speaking participants in our sample reported significantly higher income and maternal education levels in comparison to the Spanish speaking participants. Given the difference in SES between the groups, one would expect the Spanish speaking group to score significantly lower across measures of cognition and EF. Previous studies have documented the negative impact of lower SES on early cognitive development, including on standardized measures

such as VIQ (Bradley & Corwyn, 2002; McLoyd, 1998; Duncan, Brooks-Gunn, & Klebanov, 1994). However, we found that the Spanish speaking participants did not perform significantly worse than their English speaking peers on one of two verbally laden measures (Bear Dragon). One explanation for our finding of language-based group differences on VIQ but not Bear Dragon is that although the latter is correlated with verbally laden outcome measures such as the VIQ, it requires fewer verbal demands of the child during the administration of the measure in comparison to VIQ.

In examining the differences in mother's use of verbal language during play with their child, we found that the English speaking mothers used more maternal verbal scaffolding and more unstructured statements in comparison to the Spanish speaking mothers. However, the mothers did not differ in the amount of structured statements used. The increased use of maternal verbal scaffolding among the higher SES English speaking mothers is supported by previous studies that have found maternal scaffolding to be correlated with the home environment and available resources (Dieterich, Assel, Swank, Smith, & Landry, 2006). Lower SES has been found to be associated with fewer maternal verbal scaffolding statements (Smith et al., 2000). Although there are no previous studies examining the differences in maternal structured and unstructured statements in Spanish compared to English speaking mothers, it was hypothesized that unstructured statements, like maternal verbal scaffolding, would similarly relate to maternal education and income. This assumption is based on the notion that unstructured statements focus the child while allowing them more autonomy and encouraging problem solving, similar to verbal scaffolding, while structured statements give children specific instructions and restrict their choices during play. At six months of age, structured statements have been found to

be beneficial to infants, but when children reach preschool age, less structured statements have been found to be more beneficial in promoting learning through play (Landry et al., 2002). Unstructured statements like scaffolding provide the child with some guidance while providing the child the opportunity to regulate the activity and develop his or her own conception of the activity (Kermani & Brenner, 2000).

Maternal verbal scaffolding has been found to support memory, attentional, cognitive and language abilities (Smith et al., 2000). We found that maternal verbal scaffolding was positively associated with verbal abilities (VIQ) but not with the measure of EF used (Bear Dragon) for the total group. When participants were separated by primary language, the positive association between maternal verbal scaffolding and verbal abilities was primarily driven by the English speaking participants. Furthermore, when we controlled for maternal education, the positive association between maternal verbal scaffolding and verbal abilities was no longer significant for the English speaking group, suggesting that maternal education was largely driving this association. Maternal verbal scaffolding and children's high verbal abilities were found among participants who reported high levels of maternal education. As noted above, this association between verbal scaffolding and SES is supported by the extant literature (Dieterich, Assel, Swank, Smith, & Landry, 2006). In addition to socioeconomic factors, a recent study investigating Latino parenting styles found less acculturated parents employed more directive parenting styles in comparison to Anglo and more acculturated Latino parents (Halgunseth, Ispa, & Rudy, 2006). Although the degree of acculturation was not measured in the current study, it is possible that families whose primary language was Spanish may be less acculturated than those who speak English and this variable should

be further explored in future studies.

Previous studies suggest that unstructured statements increase autonomy in task completion among toddlers (Landry et al., 2002). Structured statements have been found to help children ages 4-6 years when completing more difficult, goal-directed tasks however, children refused the mothers direct attempts to structure activities during free play suggesting it was not needed or welcomed by the child in that context (Kermani & Brenner, 2000). In the current study, structured maternal verbal statements were negatively associated with performance abilities (PIQ) but not a non-verbal inhibition measure of EF (Gift Delay Peek). When participants were separated by primary language, we found that the negative association between structured maternal verbal statements and performance abilities was primarily driven by the English speaking participants. Furthermore, the correlation was not driven by socioeconomic factors; when we controlled for maternal education, the negative association between structured maternal verbal statements and performance abilities remained significant for the English speaking group.

To our knowledge, previous studies have not examined the association between primary language and cognitive and EF outcomes among preschoolers born VLBW. Lowe and colleagues (2013b) examined the relationship between primary language and cognitive, language and behavioral outcomes in toddlers 18-22 months olds born extremely preterm. This study found that Spanish and English speaking children had similar Bayley III (Bayley III, 2006) cognitive scores. However, the Spanish speaking toddlers scored significantly lower on the Bayley III language composite score. This prior study hypothesized that this difference may have been due to the use of an English

language based testing (Bayley III) and differences in maternal education (Lowe et al., 2013b). Other studies have also found that bilingual children (6-7 years) score significantly lower on neuropsychological assessments and measures of language abilities (Garratt & Kelly, 2008), and relatively better on non verbal measures and measures of impulsivity (McLeay, 2003). Our findings may be due to a similar instrumentation artifact rather than children's differential verbal ability, as the WPPSI is not normed on Spanish speaking children. These results suggest caution is warranted when verbally laden tests are used with Spanish speaking preschoolers, especially when the tests are designed for and validated on English speakers.

Limitations

Because our outcome measures were developed and standardized in English, caution is warranted when interpreting the difference in performance between the Spanish speaking and English speaking participants. First, the measures are not validated in Spanish. Further, although the tests were administered in Spanish for participants whose primary language was Spanish, it is important to consider that there are different dialects of Spanish spoken regionally and some of the words used on the measures of verbal abilities may not have been familiar to all children. In line with this consideration, Gerken (1978) found Spanish speaking children obtained significantly higher IQ scores on the Leiter International Performance Scale (Leiter, 1969), a nonverbal test of intelligence, in comparison to their VIQ scores on the WPPSI.

Another important limitation of this study was the inability to account for the level of acculturation, amount of English exposure, and degree of bilingualism of participants, which may influence how mothers communicate and interact with their

children and contribute to within-group variation. SES has been found to significantly impact outcome measures in children, and in our study, the English speaking participants reported higher annual income and maternal education levels, likely increasing the language-based differences between the two language groups. Finally, our small sample size and uneven subsample sizes are a limitation to take into consideration, as the Spanish speaking group was significantly smaller than the English speaking group, thereby reducing power and assumptions of equal variances in our analyses.

Conclusions and Future Study

In conclusion, Spanish speaking preschoolers evidenced lower VIQ scores compared with English speaking preschoolers; and maternal education and income did not fully explain this difference. The two language groups did not differ on PIQ or any EF measure, suggesting outcome equivalence in non-verbal domains. Further investigation is warranted to determine the mechanism driving these VIQ group differences; because the measure is not normed on Spanish speaking children this may account for some or all of the difference observed. Caution should be used when verbally laden tests, especially those not normed in Spanish, are used with Spanish speaking preschoolers. The language-based groups also differed on maternal verbal behavior, with the English speaking mothers using more maternal verbal scaffolding and unstructured statements during play. Scaffolding was associated with verbally laden outcome measures for the English speaking participants only and structured statements were associated with perceptual-performance based outcome measures for the English speaking participants only. These differences, however, appear to be partially explained by maternal education levels. Overall findings suggest more research is needed to further

explain the relationship between maternal verbal behavior and how it may promote child development in different ways depending on primary language spoken and socioeconomic factors.

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