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Speaking of State of Mind: Maternal Mental Health Predicts Children's Home Language Environment and Expressive Language

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(Received 3 April 2020; revised 10 September 2020; accepted 19 January 2021;
first published online 5 April 2021)

Abstract

Maternal depression and anxiety are potential risk factors to children's language environments and development. Though existing work has examined relations between these constructs, further work is needed accounting for both depression and anxiety and using more direct measures of the home language environment and children's language development. We examined 265 mother-infant dyads (49.6% female, $M_{age} = 17.03$ months) from a large city in the Western United States to explore the relations between self-reports of maternal depression and anxiety and observational indices of the home language environment and expressive language as captured by Language Environment Analysis (LENA) and parent-reported language comprehension and production. Results revealed maternal depressive symptoms to be negatively associated with home language environment and expressive language indices. Maternal anxiety symptoms were found to be negatively associated with children's parent-reported language production. These findings provide further evidence that maternal mental health modulates children's home language environments and expressive language.

Keywords: language environment; expressive language; maternal depression; maternal anxiety

Introduction

Language development is a complex and multifaceted process that requires both person-centered and environmental factors (Hindman, Wasik & Snell, 2016). Researchers have consistently shown that language exposure and the quality of the language environment in which the child develops are important predictors to children's later linguistic skills and cognitive development (e.g., Romeo, Leonard,

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Robinson, West, Mackey, Rowe & Gabrieli, 2018). Additionally, maternal mental health is a known risk factor to child development. Particularly, maternal depressive symptoms have been related to poorer child language scores in the first few years of life (Paulson, Keefe & Leiferman, 2009; Stein, Malmberg, Slyva, Barnes & Leach, 2008). However, researches regarding maternal mental health and children's language development have generally relied on parental reports of children's language and have focused mainly on maternal depression. Thus, the current study seeks to extend the current literature by examining maternal mental health as it relates to young children's home language environment and indices of expressive language using in-home observational measures.

Fostering children's language development

The complex process of language development is heavily influenced by various child and environmental-level factors. According to the emergentist coalition model, child-level factors include various domain-general and domain-specific cognitive processes (Hollich, Hirsh-Pasek, Golinkoff, Brand, Brown, Chung, Hennon & Rocroi, 2000). From initial exposure to mastery, these cognitive processes and strategies are used intermittently to foster progression in language learning. For example, a child initiates learning a specific word at the initial exposure of a novel object, utilizing domain-general processes (e.g., object representation, memory). Other domain-specific processes (e.g., whole-object bias, taxonomic bias) also work at various points of word learning, progressing towards mastery of the specific word. These processes are critical for language development; however, children can only learn words that are present in their environment.

In addition to these individual child-level processes, social-interactional cues are utilized more often as maturation of child-level processes progress (Hollich *et al.*, 2000). Thus, the emergentist coalition model posits that children need the guidance and help of others to foster language learning. Indeed, children are better able to utilize their cognitive processes when presented with initial and repeated exposures to new stimuli (Clay, Gill, Glynn, McNaughton & Salmon, 2007), including language. Though contextual factors such as SES may place some children at a disadvantage for developing language, previous work has demonstrated the important role of caregivers in fostering language development (National Institute of Child Health and Human Development Early Child Care Research Network, 2005; Fernald, Marchman & Weisleder, 2013). Further, in addition to the quantity of parental speech (Weisleder & Fernald, 2013), research has shown that the quality of speech is important when fostering children's language development (Song, Demuth & Morgan, 2018; Zimmerman, Gilkerson, Richards, Christakis, Xu, Gray & Yapanel, 2009). Moreover, research has discovered specific social-interactions that facilitate language learning. For example, children are better able to learn words when they are presented in a meaningful context rather than in isolation (Han, Moore, Vukelich & Buell, 2010). Next, children benefit when encouraged to connect word meanings to their own personal experience and background knowledge, thereby extending what they already know onto new knowledge (Harris, Golinkoff & Hirsh-Pasek, 2011). Lastly, adults can foster language development by participating in meaningful, elaborate, and repeated exchanges with children (Tamis-LeMonda, Kuchirko & Song, 2014). In sum, children's language development is the result of various cognitive processes and can be scaffolded and enhanced through positive social-interactional processes.

Maternal mental health, the home language environment, and language development

Given the importance of positive social interactions in children's language development, the mental health of mothers can be a risk factor for children's home language environment and language development (Cooper & Murray, 1998). Indeed, Goodman and Gotlib theorized multiple mechanisms through which mother's prenatal and postnatal mental health may transmit risk to children in developing various vulnerabilities and outcomes (1999). One of these mechanisms is through mother's maladaptive cognitions, behaviors, and affect. These factors may make mothers less able to be an adaptive social partner by creating a rich, stimulating environment for their children (Wu, East, Delker, Blanco, Caballero, Delva & Gahagan, 2018). Empirical work has supported this notion. For example, Lovejoy, Graczyk, O'Hare and Neuman (2000) conducted a meta-analysis and reported associations between maternal depression and negative/coercive behavior (e.g., intrusive, rough, unpleasant tone), disengagement (e.g., lack of gaze toward child, less responsivity, flatter affect), and fewer positive behaviors (e.g., playing, affectionate interactions, warmth). Hence, it appears that the maladaptive interactions that often accompany depressed mothers may place these children at risk for delayed language development by creating a less stimulating environment. Less work has examined relations between maternal anxiety and its impact on the home environment. Further, few studies (e.g., Rowe, Pan & Ayoub, 2005) have examined associations between aspects of maternal mental health and the quantitative and qualitative characteristics of their parental speech to their children.

Maternal depression

According to the U.S. National Institute of Mental Health, depression is especially prevalent among women, with 8.7% experiencing a major depressive episode in 2017 (NIMH, 2018). This estimate potentially excludes the millions of women who experience SOME level of depressive symptoms. Previous studies have suggested maternal depression to have negative effects on children's language development. For example, scholars in one study found a negative relation between postnatal maternal depression at 18 months and seven and eight-year-old children's verbal intelligence as measured by the Wechsler Intelligence Scale for Children (WISC-III; Barker, Jaffee, Uher & Maughan, 2011). Another study indicated that maternal depression at both 1.5 and 12 months was negatively related to 12-month-old children's receptive and expressive communication scores on the Bayley Scales of Infant Development III (Bayley-III) (Quevedo, Silva, Godoy, Jansen, Matos, Tavares Pinheiro & Pinheiro, 2012). Kawai, Takagai, Takei, Itoh, Kanayama and Tsuchiya (2017) also found postpartum depression at 1 month (but not 3 months) to be negatively related to children's non-verbal communication skills at 14 months as measured by the Japanese version of the MacArthur-Bates Communicative Development Inventory (MCDI). Ahun, Geoffroy, Herba, Brendgen, Séguin, Sutter-Dallay and Côté (2017) found relations between postpartum maternal depression and children's language. Specifically, mothers who were chronically depressed over five years postpartum had children who scored lower on the Peabody Picture Vocabulary Test-Revised (PPVT-R). However, in another study, no relations were found between postpartum depression at six weeks or six months and children's language composite scores on the Bayley-III at 18 months (Piteo, Yelland & Makrides, 2012). Similarly, no

relations were found between postpartum depression at 14 months and children's receptive vocabulary at 5 years (Chazan-Cohen, Raikes, Brooks-Gunn, Ayoub, Pan, Kisker, Roggman, & Fuligni, 2009). Interestingly, Keim, Daniels, Dole, Herring, Siega-Riz and Scheidt (2011) found negative relations between postpartum depressive symptoms at four months and children's receptive language ability captured by the Mullen Scales of Early Learning at 12 months. However, when examining these relations non-linearly, children scored higher in receptive language at lower and higher levels of postpartum depression but lower in receptive language near the average scores of postpartum depression. In sum, previous studies of direct relations between postpartum depressive symptoms and children's language have shown divergent results that require further clarification.

Additionally, some scholars have investigated mediating mechanisms between parental depression and children's language outcomes. For example, in one longitudinal study, Stein, Malmberg, Slyva, Barnes and Leach (2008) found maternal caregiving to mediate the relations between maternal depression at ten months and children's language development (Reynell Developmental Language Scale) at 36 months. In another longitudinal study, parent-child reading activities were found to mediate the relations between parental depression at nine months and children's expressive vocabulary (MCDI) at 24 months (Paulson *et al.*, 2009). Lastly, Baydar, Küntay, Yagmurlu, Aydemir, Cankaya, Göksen, and Cemalcilar, (2014) examined several protective and mediating factors that support children's vocabulary development and found varying results depending on the level of environmental risk experienced by the child (e.g., depression and economic distress). The studies reviewed here contribute to our understanding of the relations between postpartum depression and children's language outcomes. Further, they point to possible moderating and mediating factors in these relations. Taken together, additional research is needed to clarify some of the discrepant findings and explore potential moderating and mediating mechanisms in these relations.

Maternal anxiety

As another aspect of mental health, feelings of anxiety can be a normal reaction to stress or anticipation of future events. However, when these feelings of nervousness or fear become excessive and affect one's ability to function normally, these individuals are at risk for developing anxiety disorders. As much as 30% of adults are affected by anxiety disorders at some point in their lives and anxiety is more common among women compared to men (APA, 2019). Research has indicated maternal anxiety to be related to maternal depression (Walker, Timmerman, Kim & Sterling, 2002). However, compared to the work regarding maternal depression, there is substantially less empirical work suggesting relations between maternal anxiety and children's language environments and language development. For example, in one study, several indices of mental health were investigated and researchers found no significant associations with maternal anxiety at four months and receptive or expressive language at 12 months as measured by the Mullen Scales of Early Learning (Keim *et al.*, 2011). However, some have noted that stress during prenatal development or in the home can negatively affect productive language abilities (e.g., Laplante, Barr, Brunet, Du Fort, Meaney, Saucier, Zelazo & King, 2004).

Despite the lack of empirical research on the relations between maternal anxiety and children's home language environments and language development, these constructs may still be conceptually related. Indeed, similar to mothers experiencing depression,

maternal anxiety is linked to less effective mother-child interactions, which can be a hindrance in creating a stimulating, rich environment. For example, research has found mothers experiencing anxiety to use less structure and to be less sensitive (Feldman, Granat, Pariente, Kanety, Kuint & Gilboa-Schechtman, 2009), to have fewer instances of positive engagement (Reck, Tietz, Müller, Seibold & Tronick, 2018), and to exert higher levels of control or intrusiveness with their children (van der Bruggen, Stams & Bögels, 2008). Hence, if children of more anxious mothers tend to experience fewer of the positive interactions needed to foster positive language development, these children may be at risk for a less stimulating, rich home language environment and subsequent positive language development (Zimmerman et al., 2009).

The current study

Despite the findings of previous work regarding the relations between maternal mental health, children's home language environments, and language development, a number of gaps exist that necessitate further work. First, more research is needed to understand potential associations between maternal anxiety and children's home language environments and language development. Second, direct measures of the home language environment and expressive language are needed to provide more precise estimates of the relations between these constructs. Third, the majority of previous research focuses on one aspect of maternal mental health, rather than considering anxiety and depression together (e.g., Quevedo et al., 2012). This is important given the associations between these constructs (Keim et al., 2011) and the unique impact anxiety and depression may have on children's home language environments and language development. Thus, the current study aims to address these gaps by (a) examining two aspects of mental health in relation to the home language environment and children's language development in the same model and (b) utilizing a more precise methodology to capture children's home language environments and their expressive language. To guide our examination, we generated two hypotheses.

Hypothesis 1: Maternal mental health (i.e., depression and anxiety) will be negatively related to indices of the children's home language environment (i.e., observed number of adult words spoken and observed number of conversational turns).

Hypothesis 2: Maternal mental health (i.e., depression and anxiety) will be negatively related to indices of children's language development (i.e., number of child vocalizations, observed language production scores, and parent-reported language production and comprehension).

Method

Participants

Upon receiving approval from the university's institutional review board (application number F16089; Project Media Effects on Development from Infancy to Adulthood [MEDIA]), 250 primary caregiver-infant (under 1 year) dyads completed in-home assessments and surveys in the Denver metro-area in the Spring/Summer of 2017. Participants were recruited through mailers sent to the participant home through the

Colorado Office of Health and Vital Records, which identified anyone in the local area who had birthed a child in the past year (34.4% of final sample). Research assistants were then sent to potential participants' homes to invite them to participate, which yielded a participant rate of 66% in Wave 1 of Project MEDIA.

Participants were also recruited using multiple methods, including flyers in pediatrician offices, free clinics, social services offices, businesses focused on entertainment for young children, public parks and play spaces, and referral from a friend who participated (17.8%). A large proportion of the sample (47.8%) was recruited through an external data collection company. Participants were contacted again in 2018, with a 98.9% retention rate. All measures from the current study are from Wave 2 except for the demographic information, which is from Wave 1. In 2018, 19 additional very low-income families (10 household income below \$30,000, 8 household income below \$50,000, 1 below \$60,000) were recruited through a Colorado Office of Health and Vital Records mailer in order to increase the diversity of our sample in terms of household income.

Participants included 269 infants-primary caregiver dyads (infants 49.6% female and 50.4% male, $M_{age} = 17.03$ months, $SD = 3.44$ months. Range = 11 to 29 months). The majority of the participants were mothers as the primary caregiver ($N = 260$; fathers $N = 5$; 2 missing; 3.2% of the sample was under 20, 20.4% were between 21–25, 31.2% were between 26–30, 26.6% were between 31–35, 15.6% were between 36–39, and 4.8% were above 40). Observations with the father as the primary caregiver were excluded from the analyses.

The participants were ethnically and socioeconomically diverse. Twenty-one percent of the participants were Latino, 3% Asian, 10% Black, 59% White, 1% Mixed Race, and 6% "Other." Many participants (31.6%) had a household income below \$30,000, 25.1% had a household income over \$30,000, but below \$50,000, 19.4% between \$50,000 and below \$70,000, 19.3% between \$70,000 and under \$100,000, and 4.4% more than \$100,000. Approximately 37.2% currently receive public assistance and 46.6% received public assistance in the last year. In regard to education, 20.1% of primary caregivers' highest level of education completed was high school (or equivalent), 36.5% had completed some college, 26.7% had completed a bachelor's degree, and 16.5% had completed graduate education. All families recruited for the current study were proficient in English. Approximately 22% of primary caregivers reported that their child was spoken to in two or more languages and approximately 70% reported only speaking to their child in one language at home. Primary caregivers who could not complete the survey and the in-home assessments in English were excluded from the study. Families that did not have children within the target range were excluded from the study.

Measures

Home language environment

To measure the home language environment, we used the Language Environment Analysis System designed to provide clinicians and researchers detailed information regarding the language environment of infants and toddlers. Parents placed a small digital recording device (language processor) in the pocket of a custom-made shirt, and this device recorded everything the infant uttered and heard during a 24-hour period. The raw audio files were transferred to LENA through a secure cloud-based system and analyzed by the LENA language environment analysis software. LENA

software uses advanced language related algorithms to produce core reports related to the infants' home language environment (Xu, Yapanel & Gray, 2009). The estimates in these core reports have been found to be valid and reliable in previous studies (e.g., Gilkerson, Richards, Warren, Montgomery, Greenwood, Kimbrough Oller, Hansen & Paul, 2017; Romeo et al., 2018). This methodology yielded two measures of the home language environment (i.e., number OF ADULT WORDS SPOKEN and number OF CONVERSATIONAL TURNS). Number of adult words spoken is a count of adult words spoken to or overheard by the child. This measure accounts for clear and unclear speech that has communicative intent including: interjections, reductions, contractions, and vocal play. Number of conversational turns is a count of back and forth alterations between the child and adults. Conversational turns are responses that include speech, interruptions, and communicative vocalizations (e.g., whining) occurring within five seconds. These LENA home language environment measures were standardized by age for analysis

Infant expressive language

Infant's expressive language was captured using both LENA and parental reports. LENA software produced three indices of children's language production including: NUMBER OF CHILD VOCALIZATIONS, VOCAL PRODUCTIVITY SCORE (an automated canonical syllable count per conversational turn score), and AUTOMATIC VOCALIZATION ASSESSMENT (AVA; a categorized and quantified score of children's protophones and phonemes). These LENA expressive language scores were standardized by age for analysis. Further discussions of each of these expressive language measures are presented as technical reports by the LENA foundation (e.g., Richards, Xu, Gilkerson, Yapanel, Gray & Paul, 2017).

Infant language production and comprehension

Parents completed the Words and Gestures Vocabulary Checklist short form of the MacArthur-Bates Communicative Development Inventory (MCDI) to capture language production and comprehension. Parents reported on 100 words and their infants' ability to produce and comprehend these words. Examples included cookies, diaper, boots, bed, flower, and eat. Infant language development scores are then normed for age and gender for production and comprehension separately. This inventory has been found to be reliable and valid in English and several other languages (Fenson, Marchman, Thal, Dale & Bates, 2007).

Maternal depression

Depression was measured using the ten-item Center for Epidemiological Studies Short Depression Scale (CES-10; Levine, 2013). Mothers answered statements regarding their own feelings and behaviors in the last week. Mothers answered statements on a four point Likert scale from 1 (Rarely or none of the time [less than 1 day]) to 4 (All of the time [5–7 days]). Two items were reverse-coded and the items were summed. Higher scores are indicative of more depression symptoms. Scores of 10 or higher are considered sufficient for clinical depression. Example items include "I could not get going" and "I felt depressed." Cronbach's alpha reliability was $\alpha = .81$.

Maternal anxiety

Anxiety was measured using the 16-item Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger & Borkovec, 1990). Mothers rated statements on how

characteristic they are of themselves on a five point Likert scale from 1 (*Not at all typical of me*) to 5 (*Very typical of me*). Five of the items were reverse-coded and higher scores indicated more worry. The PSWQ has been found to be a reliable measure of generalized anxiety disorder (GAD), as worry is the dominate feature of GAD. Scores of 62 or higher are recommended for balancing specificity and sensitivity in detecting GAD in the general population (Behar, Alcaine, Zullig & Borkovec, 2003). Example items include “Many situations make me worry” and “When I am under pressure, I worry a lot.” Cronbach’s alpha reliability was $\alpha = .93$.

Control variables

Socio-economic status (SES) was measured using participants responses to questions about their family income “What is your yearly gross combined household income (including you and your partner)?” ranging from 1 (Less than \$15,000) to 8 (\$150,000 or more) and maternal education “What is the highest level of education you have completed?” ranging from 1 (No formal school) to 6 (Doctoral/Professional degree). Scores on these separate items were standardized and then mean averaged to create a SES variable. Parents also answered questions regarding their ethnicity “What is your ethnicity” (White, African American, U.S. Latino or Hispanic, Asian American, Other) and age “How old are you?”.

Procedure

All procedures were approved by the Institutional Review Board of (Brigham Young University application number F16089 titled Project MEDIA). All data were collected in the homes of primary caregiver-infant dyads. The data and measures used for the present study are part of a larger longitudinal study of children’s development. Primary caregivers completed online surveys concerning their demographic information and answered questions about themselves and their children. A subset of the larger sample also participated in two in-home visits (1.5 hours and 45 minutes, three days apart) where parents and/or children completed tasks and assessments with research assistants. LENA records were completed during a 24-hour period the day before the second in-home assessment. Primary caregivers were unaware of the specific research questions of the study and were instructed to place the LENA device in the infant’s shirt (and given a special shirt with a pocket for the device) for the next 24-hour period. During bath and sleep times the parents were instructed to leave the LENA device in the room with the infant and close enough to infant to capture the language spoken. When the LENA was picked up from the parent during the second in-home visit, parents were asked if the previous day was a typical day. If it was not (e.g., the child or parent was sick, family members were in town, etc.), the parents were asked to have the infant wear the LENA device for an additional 24-hour period that was reflective of a typical day. Primary caregivers provided informed consent, completed several play-based assessments with their infants, and were compensated \$125 in either Visa or Amazon gift cards for participating in both the online and in-home portions of the study.

Analysis plan

First, we checked that our data met statistical assumptions by examining the descriptive statistics and distributions of each variable. Next, we examined the scatter plots and

Table 1. Descriptive statistics for study variables.

Variable	<i>M</i>	<i>SD</i>	<i>Range</i>
P1 Depression	8.37	4.78	2–24
P1 Anxiety	48.34	12.76	18–80
MCDI-Production	40.61	30.88	0–100
MCDI-Comprehension	50.41	30.09	0.93–99.12
Adult Words	36.66	31.79	1–99
Conversational Turns	28.85	28.60	1–99
Child Vocalizations	29.21	28.01	0–98
Vocal Productivity	44.31	28.81	1–99
AVA Score	38.42	26.81	1–99

used correlational analyses to examine the relations between our variables. Finally, we used a path model to examine the relations between maternal mental health (i.e., depression and anxiety), indices of the home language environment (i.e., number of adult words and number of conversational turns), and indices of the children's language development (i.e., LENA reported number of child vocalizations, vocal productivity, AVA, parent-reported language production and comprehension percentile scores). To help account for demographic heterogeneity, we included our SES, parent ethnicity, and parent age variables as covariates in the path model. Descriptive statistics for each variable are displayed in [Table 1](#). Correlational analyses revealed several relations between variables and are displayed in [Table 2](#).

Results

Model specification

To test our hypotheses, we specified and estimated a path model using MLMV (i.e., full information maximum likelihood; Maydeu-Olivares, 2017) using STATA 15 MP to examine the relations between maternal mental health and indices of the home language environment and children's language development while accounting for our control variables. The exogenous independent variables included maternal depression and anxiety predicting our endogenous dependent variables (i.e., adult words, conversational turns, child vocalizations, vocal productivity, AVA, language production, and language comprehension percentile scores). The control variables (i.e., SES, ethnicity, and parental age) predicted the dependent variables and were covaried with the independent variables (i.e., maternal depression and anxiety) and each other. Finally, we covaried the errors of our endogenous variables. This specification yielded a saturated model with $N = 265$ observations. Thus, our analysis did not report model fit statistics.

Path model

Results revealed numerous relations between maternal mental health and indices of children's language environment and language development. Since all our dependent

Table 2. Correlations between maternal mental health, children's language environment, language development, and control variables.

	Age	SES	Ethnicity	P1 Anxiety	P1 Depression	Production	Comprehension	Adult Words	Conversational Turns	Child Vocalizations	Vocal Productivity	AVA Score
Age	--											
SES	.51***	--										
Ethnicity	-.07	-.12 ⁺	--									
P1 Anxiety	-.02	.04	-.05	--								
P1 Depression	-.03	-.01	-.07	.54***	--							
Production	-.05	-.09	.04	-.15*	-.06	--						
Comprehension	.08	-.03	.22*	-.04	-.04	.44***	--					
Adult Words	.25***	.33***	-.16*	.02	-.11 ⁺	.05	-.20*	--				
Conversational Turns	.23***	.27***	-.15*	-.02	-.15*	.17*	-.06	.66***	--			
Child Vocalizations	.19**	.18**	-.11	-.02	-.12 ⁺	.25***	.00	.37***	.86***	--		
Vocal Productivity	-.04	-.00	.01	-.02	-.01	.15 ⁺	.04	-.23**	.17*	.46***	--	
AVA Score	.01	.12 ⁺	-.04	-.14*	-.19**	.27***	-.12	.14*	.46***	.50***	.39***	--

Note: *** $p < .001$; ** $p < .01$; * $p < .05$; ⁺ $p < .10$

variables were standardized into percentiles, we used b 's to interpret our coefficients. Maternal anxiety was found to negatively predict children's parent-reported language production percentile scores ($b = -.41$; $p = .04$). As an example of interpretation, a one-unit increase in maternal anxiety predicted at least a .41 percentile decrease in parent-reported language production scores while accounting for the other independent and control variables in the model. Further, maternal depression negatively predicted the percentile scores for the number of adult words spoken ($b = -1.06$; $p = .03$) and conversational turns ($b = -1.07$; $p = .01$) over a 24-hour period. Lastly, maternal depression negatively predicted the percentile scores for number of child vocalizations ($b = -.93$; $p = .04$) and AVA ($b = -.91$; $p = .04$). See Figure 1 for path model.

Discussion

The current study examined maternal mental health factors and their relations to a variety of home language environment and language indices. This study was unique in that it a) captured multiple aspects of maternal mental health, and b) utilized observational measures of the home language environment and expressive language in addition to parent-reported language comprehension and production. Each of these variables were then analyzed together in a single path model.

Our first hypothesis was partially supported – in that maternal depression (but not anxiety) was negatively related to indices of the home language environment (i.e., observed number of adult words spoken and observed number of conversational turns). Our second hypothesis was also partially supported – in that maternal depression was negatively related with indices of children's expressive language (i.e., number of child vocalizations, AVA scores) but not child vocal productivity scores or parent-reported language production or comprehension scores. Further, maternal anxiety was negatively related to parent-reported child language production scores. Previous researchers have shown that maternal depression is a risk factor to child development (Goodman, Rouse, Connell, Broth, Hall & Heyward, 2011; Goodman & Gotlib, 1999), and the current study lends support to this previous work. These results are in line with previous studies finding negative associations between maternal depression and assessments of children's language development (Ahun, et al., 2017; Kawai et al., 2017; Quevedo et al., 2012; Stein et al., 2008). Relatedly, our finding of a negative relation between maternal anxiety and parent-reported language production is novel: in that previous research has not found this association. Each of our findings is strengthened by the fact that we examined each of these constructs together in the same model. Another strength of the present study is the use of more precise observational measures of the home language environment and children's expressive language to examine each of these relations.

Relations between maternal mental health, the home language environment, and expressive language

These results were interpreted within the framework of the emergentist coalition model of children's language development (Hollich et al., 2000). Language acquisition is a complex process that requires child-specific cognitive, environmental and social factors working in tandem to produce optimal conditions for language acquisition, comprehension, and production (Hollich et al., 2000). Parents are a vital component

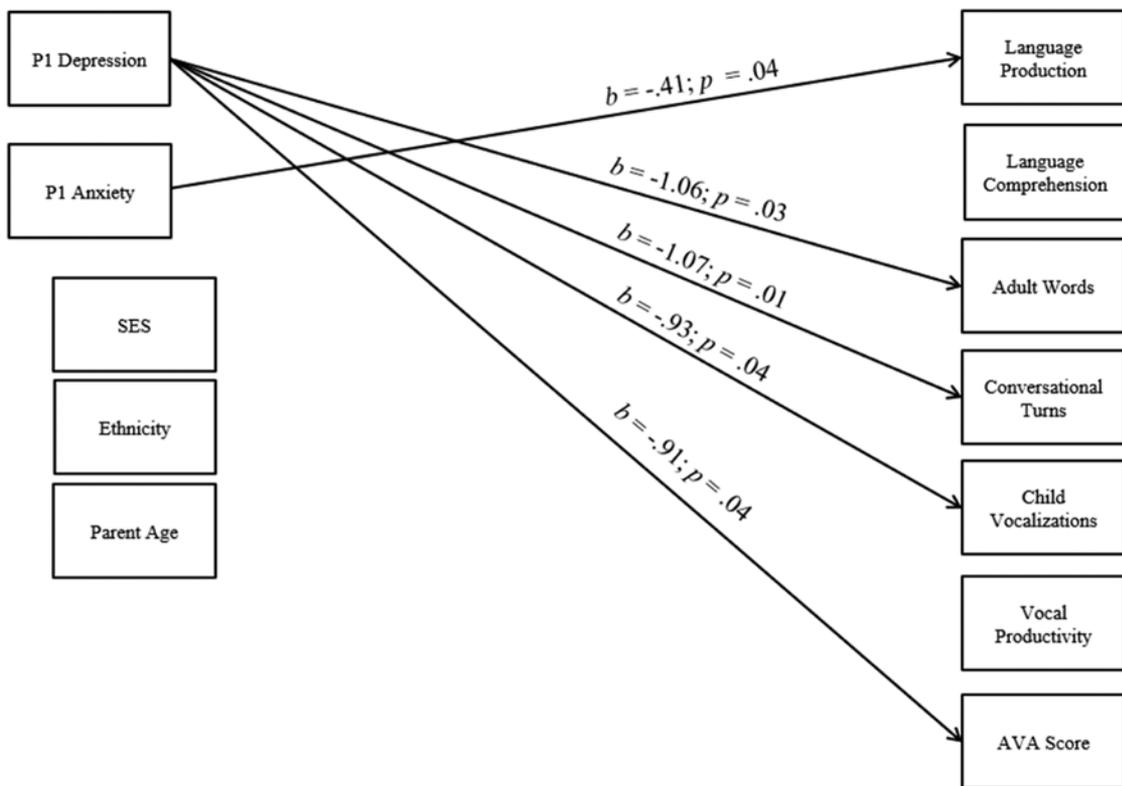


Figure 1. Path model of maternal mental health, the home language environment, language production and comprehension, expressive language, and control variables. *Note: Non-significant paths, paths from control variables to dependent variables, covariances between exogenous variables, and covariances between residuals of endogenous variables are not displayed for parsimony.*

of this process as they provide language exposure, support, scaffolding, and context which are all essential for language development (Clay et al., 2007). Previous researchers have shown maternal depression to be related to less effective parenting (Hoffman, Crnic & Baker, 2006), harsher responses to children (Lovejoy et al., 2000), and less maternal warmth and engagement (Campbell, Cohn & Meyers, 1995).

Maternal depression

The current study lends support to these previous studies and extends previous work by examining the effect of maternal depression on the quality of the home language environment. In line with past work, the results of the current study suggest maternal depression to modulate the quality of the home language environment and place children at increased risk for experiencing language delays (Ahun et al., 2017; Kawai et al., 2017; Quevedo et al., 2012; Stein et al., 2008).

Importantly, maternal depression was not related to concurrent parental reports of their child's language production or comprehension. There are three possible explanations for this finding. The first is that parents' reports of language differ from observed measures of children's expressive language – in that the former is a parent's assessment of the words that children understand and/or have produced whereas the latter captures various measures of children's expressive language during one 24-hour period. The second explanation is that depressed mothers may not be accurate reporters of their own children's language development. Maternal depression is known to influence maternal reports of children's temperament (McGrath, Records & Rice, 2008) and behavior (Briggs-Gowan, Carter & Schwab-Stone, 1996). However, less is known regarding the effects of maternal depression on mothers' ability to accurately report on their child's language development. The fact that we found relations between maternal depression and observational measures of children's expressive language and not parental reports of children's language production provides some indication that mothers with depression may struggle to accurately report on their child's language development. Lastly, the relationship between maternal depression and children's parent-reported language production and comprehension may take more time to manifest (Goodman & Gotlib, 1999). For example, one study found relations between maternal depression and children's language only when maternal depression reached chronic levels over five years (Ahun et al., 2017). Further, some previous studies finding associations between maternal depression and language development occurred across years, allowing for differences between children to possibly become more exacerbated (Barker et al., 2011).

Maternal anxiety

In contrast, maternal anxiety was not related to observational measures of the home language environment (i.e., number of adult words and number of conversational turns) or children's observed expressive language (e.g., child vocalizations). Past research examining relations between maternal anxiety and child development has been inconclusive (e.g., Keim et al., 2011). However, we found a negative association between maternal anxiety and parental reports of children's language production. This finding highlights that maternal anxiety may influence the way in which mothers view their own children, their behavior, and their development. It is possible that anxious mothers may be at increased risk for underreporting their child's language, perhaps due to their own anxiety (Briggs-Gowan, Carter & Schwab-Stone, 1996). While previous researchers have found these discrepancies in children's

behavior, with anxious parents overreporting on their child's behavioral and externalizing symptoms (Briggs-Gowan *et al.*, 1996), it is unclear whether this may be the case for children's language.

We did find an association between maternal anxiety and one index of observed expressive language (i.e., AVA scores) when examined using bivariate correlations. However, this association did not hold after controlling for maternal depression and other variables in our path model. This suggests that maternal depression may be more problematic for children's home language environments and language development compared to maternal anxiety (Porritt, Zinser, Cachorowski & Kaplan, 2014).

Limitations and future directions

While the current study contributes important information to our knowledge of the relations between maternal mental health and children's home language environments and expressive language, it is not without limitations. First, the cross-sectional nature of the data prevents us from inferring causation. Future research should examine observational measures of the child's home language environment, language, and parental reports of children's language comprehension and production across time and development. By examining these relations longitudinally, a better understanding of sensitive periods for child susceptibility to maternal mental health issues can be captured. Further, longitudinal data is needed to examine mediating mechanisms in the relations between contextual (e.g., SES) and relational factors (e.g., parent-child interactions), maternal mental health (e.g., depression, anxiety, stress), the home language environment, and children's language development. By identifying mechanisms in these relations and the timing of these effects, scholars, interventionists, and practitioners will be better enabled to gain further knowledge on these topics and provide improved treatment to children and families. Additionally, we examined these relations using depressive and anxiety symptoms rather than clinical diagnoses of these mental disorders. Although elevated scores on our measures of depressive and anxiety symptoms are indicative of mental disorders, future work is needed using clinical and non-clinical samples when examining these relations. Lastly, a proportion (22%) of the parents in our sample reported their child being spoken to in two or more languages. Though in this study we only included families who could complete the in-home assessments and surveys in English, future research should examine the role of multiple languages being present in children's environments as this may relate to their home language environments and expressive language.

Conclusion

Despite its limitations, the current study was an important step in the literature connecting both maternal depression and anxiety to children's home language environments and expressive language. By examining each of these constructs simultaneously within the same model, the results provide a more comprehensive insight of these relations. Children acquire language through the constant interplay between child-centered cognitive characteristics and characteristics of their social world and environment (Hollich *et al.*, 2000). Parents are a vital source of language exposure, repetition, contextual support, and scaffolding; thus, when parents are less able to be involved in this process, children may struggle in their language development. The current study provided evidence that maternal mental health may

modulate the quality of the home language environment and the expressive language of children. Lastly, the current study provided some indications that maternal depression and anxiety may have an impact on mother's ability to accurately report on their children's language development. These findings highlight the need to better understand how caregivers' mental health shapes children's environments and language development over time.

Acknowledgements. We thank the School of Family Life, and the College of Family, Home, and Social Sciences at BYU, and recognize the generous support of the many private donors who provided assistance for this project. We also thank those families who were willing to spend valuable hours with our team in interviews and the many students who assisted in conducting the interviews.

References

- Ahun, M. N., Geoffroy, M., Herba, C. M., Brendgen, M., Séguin, J. R., Sutter-Dallay, A., & Côté, S. M. (2017). Timing and chronicity of maternal depression symptoms and children's verbal abilities. *The Journal of Pediatrics*, 190, 251–257. doi:10.1016/j.jpeds.2017.07.007
- American Psychiatric Association (2019). *Anxiety Disorders*. Retrieved October 20th, 2019, from <https://www.psychiatry.org/patients-families-anxiety-disorders/what-are-anxiety-disorders>
- Barker, E. D., Jaffee, S. R., Uher, R., & Maughan, B. (2011). The contribution of prenatal and postnatal maternal anxiety and depression to child maladjustment. *Depression and Anxiety*, 28(8), 696–702. doi: <http://dx.doi.org.ezproxy1.lib.asu.edu/10.1002/da.20856>
- Baydar, N., Küntay, A. C., Yagmurlu, B., Aydemir, N., Cankaya, D., Göksen, F., & Cemalcilar, Z. (2014). "It takes a village" to support the vocabulary development of children with multiple risk factors. *Developmental Psychology*, 50(4), 1014.
- Behar, E., Alcaine, O., Zuellig, A. R., & Borkovec, T. D. (2003). Screening for generalized anxiety disorder using the Penn State Worry Questionnaire: A receiver operating characteristic analysis. *Journal of Behavior Therapy and Experimental Psychiatry*, 34(1), 25–43.
- Briggs-Gowan, M. J., Carter, A. S., & Schwab-Stone, M. (1996). Discrepancies among mother, child, and teacher reports: Examining the contributions of maternal depression and anxiety. *Journal of Abnormal Child Psychology*, 24, 749–766. doi:10.1007/bf01664738
- Campbell, S. B., Cohn, J. F., & Meyers, T. (1995). Depression in first-time mothers: mother-infant interaction and depression chronicity. *Developmental Psychology*, 31(3), 349. doi:<http://dx.doi.org.ezproxy1.lib.asu.edu/10.1037/0012-1649.31.3.349>
- Chazan-Cohen, R., Raikes, H., Brooks-Gunn, J., Ayoub, C., Pan, B. A., Kisker, E. E., & Fuligni, A. S. (2009). Low-income children's school readiness: Parent contributions over the first five years. *Early Education and Development*, 20(6), 958–977.
- Clay, M. M., Gill, M., Glynn, T., McNaughton, T., & Salmon, K. (2007). *Record of oral language: Observing changes in the acquisition of language structures* (3rd ed.). Portsmouth, NH: Heinemann.
- Cooper, P. J., & Murray, L. (1998). Postnatal depression. *British Medical Journal*, 316(7148), 1884–1886.
- Feldman, R., Granat, A., Pariente, C., Kanety, H., Kuint, J., & Gilboa-Schechtman, E. (2009). Maternal depression and anxiety across the postpartum year and infant social engagement, fear regulation, and stress reactivity. *Journal of the American Academy of Child & Adolescent Psychiatry*, 48(9), 919–927. doi:<http://dx.doi.org.ezproxy1.lib.asu.edu/10.1097/CHI.0b013e3181b21651>
- Fenson, L., Marchman, V. A., Thal, D., Dale, P. S., & Bates, E. (2007). *MacArthur-Bates Communicative Development Inventories (CDIs)* (2nd ed.). Baltimore: Brookes Publishing.
- Fernald, A., Marchman, V. A., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science*, 16(2), 234–248. doi:<http://dx.doi.org.ezproxy1.lib.asu.edu/10.1111/desc.12019>
- Gilkerson, J., Richards, J. A., Warren, S. F., Montgomery, J. K., Greenwood, C. R., Kimbrough Oller, D., Hansen, J. H. L., & Paul, T. D. (2017). Mapping the early language environment using all-day recordings and automated analysis. *American Journal of Speech-Language Pathology*, 26, 248–265. <https://doi.org/10.1044/2016/AJSLP-15-0169>

- Goodman, S. H., Rouse, M. H., Connell, A. M., Broth, M. R., Hall, C. M., & Heyward, D.** (2011). Maternal depression and child psychopathology: A meta-analytic review. *Clinical Child and Family Psychology Review*, *14*, 1–27. doi:10.1007/s10567-010-0080-1
- Goodman, S. H., & Gotlib, I. H.** (1999). Risk for psychopathology in the children of depressed mothers: A developmental model for understanding mechanisms of transmission. *Psychological Review*, *106*(3), 458–490. doi:<http://dx.doi.org.ezproxy1.lib.asu.edu/10.1037/0033-295X.106.3.458>
- Han, M., Moore, N., Vukelich, C., & Buell, M.** (2010). Does play make a difference? How play intervention affects the vocabulary learning of at-risk preschoolers. *American Journal of Play*, *3*(1), 82–105.
- Harris, J., Golinkoff, R. M., & Hirsh-Pasek, K.** (2011) Lessons from the crib for the classroom: How children really learn vocabulary. In S. B. Neuman & D. K. Dickinson (Eds.) *Handbook of Early Literacy Research*, NY: Guilford Press. p. 49–66
- Hindman, A., Wasik, B. A., & Snell, E. K.** (2016). Closing the 30 million word gap: Next steps in designing research to inform practice. *Child Development Perspectives*, doi:10.11111.cdep.12177
- Hoffman, C., Crnic, K. A., & Baker, J. K.** (2006). Maternal depression and parenting: Implications for children's emergent emotion regulation and behavioral functioning. *Parenting*, *6*, 271–295. doi:10.1207/s15327922par0604_1
- Hollich, G. J., Hirsh-Pasek, K., Golinkoff, R. M., Brand, R. J., Brown, E., Chung, H. L., Hennon, E., & 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. doi:<http://dx.doi.org.ezproxy1.lib.asu.edu/10.1111/1540-5834.00090>
- Kawai, E., Takagai, S., Takei, N., Itoh, H., Kanayama, N., & Tsuchiya, K. J.** (2017). Maternal postpartum depressive symptoms predict delay in non-verbal communication in 14-month-old infants. *Infant Behavior & Development*, *46*, 33-45. doi:<http://dx.doi.org.ezproxy1.lib.asu.edu/10.1016/j.infbeh.2016.11.006>
- Keim, S. A., Daniels, J. L., Dole, N., Herring, A. H., Siega-Riz, A., & Scheidt, P. C.** (2011). A prospective study of maternal anxiety, perceived stress, and depressive symptoms in relation to infant cognitive development. *Early Human Development*, *87*(5), 373–380. doi:10.1016/j.earlhumdev.2011.02.004
- Laplante, D. P., Barr, R. G., Brunet, A., Du Fort, G. G., Meaney, M. L., Saucier, J., Zelazo, P. R., & King, S.** (2004). Stress during pregnancy affects general intellectual and language functioning in human toddlers. *Pediatric Research*, *56*, 400–410. doi:10.1203/01.PDR.0000136281.34035.44
- Levine, S. Z.** (2013). Evaluating the seven-item center for epidemiologic studies depression scale short-form: A longitudinal US community study. *Social Psychiatry and Psychiatric Epidemiology: The International Journal for Research in Social and Genetic Epidemiology and Mental Health Services*, *48*(9), 1519–1526. doi:<http://dx.doi.org.ezproxy1.lib.asu.edu/10.1007/s00127-012-0650-2>
- Lovejoy, M. C., Graczyk, P. A., O'Hare, E., & Neuman, G.** (2000). Maternal depression and parenting behavior: A meta-analytic review. *Clinical Psychology Review*, *20*, 561–592. doi:10.1016/S0272-7358(98)00100-7
- Maydeu-Olivares, A.** (2017). Maximum likelihood estimation of structural equation models for continuous data: Standard errors and goodness of fit. *Structural Equation Modeling*, *24*(3), 383–394. doi:10.1080/10705511.2016.1269606
- McGrath, J. M., Records, K., & Rice, M.** (2008). Maternal depression and infant temperament characteristics. *Infant Behavior and Development*, *31*, 71–80. doi:10.1016/j.infbeh.2007.07.001
- Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D.** (1990). Development and validation of the penn state worry questionnaire. *Behaviour Research and Therapy*, *28*(6), 487–495. doi:[http://dx.doi.org.ezproxy1.lib.asu.edu/10.1016/0005-7967\(90\)90135-6](http://dx.doi.org.ezproxy1.lib.asu.edu/10.1016/0005-7967(90)90135-6)
- National Institute of Child Health and Human Development Early Child Care Research Network** (2005). Duration and developmental timing of poverty and children's cognitive and social development from birth through third grade. *Child Development*, *76*, 795–910. doi:10.1111/j.1467-8624.2005.00878.x
- National Institute of Mental Health** (2018). *Depression*. Retrieved October 20th, 2019, from <https://www.nimh.nih.gov/health/topics/depression/index.shtml>
- Paulson, J. F., Keefe, H. A., & Leiferman, J. A.** (2009). Early parental depression and child language development. *The Journal of Child Psychology and Psychiatry*, *50*, 254–262. doi:10.1111/j.1469-7610.2008.01973

- Piteo, A. M., Yelland, L. N., & Makrides, M. (2012). Does maternal depression predict developmental outcome in 18 month old infants? *Early Human Development*, 88(8), 651–655. doi:10.1016/j.earlhumdev.2012.01.0
- Porritt, L. L., Zinser, M. C., Cachorowski, J., & Kaplan, P. S. (2014). Depressive Diagnoses and Fundamental Frequency-Based Acoustic Cues in Maternal Infant-Directed Speech. *Language Learning and Development*, 10, 51–67. doi:10.1080/15475441.2013.802962
- Quevedo, L.A., Silva, R. A., Godoy, R., Jansen, K., Matos, M. B., Tavares Pinheiro, K. A., & Pinheiro, R. T. (2012). The impact of maternal post-partum depression on the language development of children at 12 months. *Child Care Health Dev.* 38(3), 420–424. doi:10.1111/j.1365-2214.2011.01251.x
- Reck, C., Tietz, A., Müller, M., Seibold, K., & Tronick, E. (2018). The impact of maternal anxiety disorder on mother-infant interaction in the postpartum period. *PLoS ONE*, 13(5), 21. doi: 10.1371/journal.pone.0194763
- Richards, J. A., Xu, D., Gilkerson, J., Yapanel, U., Gray, S., & Paul, T. (2017). Automated assessment of child vocalization development using LENA. *Journal of Speech, Language, and Hearing Research*, 60(7), 2047–2063.
- Romeo, R. R., Leonard, J. A., Robinson, S. T., West, M. R., Mackey, A. P., Rowe, M. L., & Gabrieli, J. D. (2018). Beyond the 30-million-word gap: Children’s conversational exposure to associated with language-related brain function. *Psychological Science*, 29, 700–710. doi:10.1177/0956797617742725
- Rowe, M. L., Pan, B. A., & Ayoub, C. (2005). Predictors of variation in maternal talk to children: A longitudinal study of low-income families. *Parenting: Science and Practice*, 5(3), 285–310. doi:http://dx.doi.org.ezproxy1.lib.asu.edu/10.1207/s15327922par0503_3
- Song, J. Y., Demuth, K., & Morgan, J. (2018). Input and processing factors affecting infants’ vocabulary size at 19 and 25 months. *Frontiers in Psychology*, 9, 1–11. doi:10.3389/fpsyg.2018.02398
- Stein, A., Malmberg, L. E., Slyva, K., Barnes, J., & Leach, P. (2008). The influence of maternal depression, caregiving, and socioeconomic status in the post-natal year on children’s language development. *Child: Care, Health, and Development*, 34, 603–612. doi:10.1111/j.1365-2214.2008.00837.x
- Tamis-LeMonda, C., Kuchirko, Y., & Song, L. (2014). Why is infant language learning facilitated by parental responsiveness? *Current Directions in Psychological Science*, 23(2), 121–126. doi:<http://dx.doi.org.ezproxy1.lib.asu.edu/10.1177/0963721414522813>
- van der Bruggen, C. O., Stams, G. J., & Bögels, S. M. (2008). The relation between child and parent anxiety and parental control: A meta-analytic review. *Journal of Child Psychology and Psychiatry*. 49(12), 1257–1269. doi:10.1111/j.1469-7610.2008.01898.x
- Walker, L., Timmerman, G. M., Kim, M., & Sterling, B. (2002). Relationships between body image and depressive symptoms during postpartum in ethnically diverse, low income women. *Women & Health*, 36(3), 101–121. doi:10.1300/J013v36n03_07
- Weisleder, A., & Fernald, A. (2013). Talking to children matters: Early language experience strengthens processing and builds vocabulary. *Psychological Science*, 24, 2143–2152. doi:10.1177/0956797613488145
- Wu, V., East, P., Delker, E., Blanco, E., Caballero, G., Delva, J., . . . Gahagan, S. (2018). Associations among mothers’ depression, emotional and learning-material support to their child, and children’s cognitive functioning: A 16-year longitudinal study. *Child Development*, early view online. doi:10.1111/cdev.13071
- Xu, D., Yapanel, U., & Gray, S. (2009). *Reliability of the LENA Language Environment Analysis System in young children’s natural home environment* (Technical Report LTR-05-2). Boulder, CO: LENA Foundation.
- Zimmerman, F. J., Gilkerson, J., Richards, J. A., Christakis, D. A., Xu, D., Gray, S., & Yapanel, U. (2009). Teaching by listening: The importance of adult-child conversations to language development. *Pediatrics*, 124, 342–349. doi:10.1542/peds.2008-2267

Cite this article: Clifford BN, Stockdale LA, Coyne SM, Rainey V, Benitez VL (2022). Speaking of State of Mind: Maternal Mental Health Predicts Children’s Home Language Environment and Expressive Language. *Journal of Child Language* 49, 469–485. <https://doi.org/10.1017/S0305000921000131>