Graduate Student Journal of Psychology
Fall 2025 - Vol. 25

The Pertinent Prenatal Period: A Secondary Analysis Examining the Relationship Between Prenatal Maternal Anxiety and Child Language Development at 18 Months

Melanie Lucia Esterine

Department of Counseling and Clinical Psychology, Teachers College at Columbia University, New York, NY USA

Maternal mental health is thought to be an important factor that may shape child development as early as the prenatal period. Prenatal maternal mental health has been linked to both physiological and factors that are theorized to explain the links between mental health and child language development. Whereas some past research has examined the associations between prenatal mental health and child language development, most have examined broad measures that include both anxiety and depression. Given that there are distinct mechanisms by which these aspects of maternal mental health are hypothesized to impact development, this study aims to parse the association between anxiety and child language development specifically. This study utilized data from a longitudinal prospective study to examine the associations between prenatal anxiety and child language development at 18 months in 167 families. We conducted a series of three regression models beginning with a simple linear regression examining prenatal anxiety and language development, followed by two models, first adding demographic covariates, then including prenatal depression. We did not find associations between maternal anxiety and child language development; inadvertently raising the question of when and by which mechanisms maternal mental health may or may not impact aspects of child development, which are crucial answers to be discerned in order to determine the most effective way to support pregnant mothers and their children throughout the prenatal period.

Keywords: prenatal anxiety, language development, maternal mental health, child outcomes

Prenatal anxiety, an issue impacting pregnant persons with a prevalence ranging from 21% to 25% (Field, 2017), could potentially play an important role in shaping child language development. While few studies have examined the links between anxiety and language development, existing studies suggest that greater anxiety is associated with poorer development (Ibanez et al., 2015). In studies that have examined prenatal anxiety as an independent variable, maternal mental health tends to be discussed broadly without consideration for distinct aspects of prenatal mental health (e.g., anxiety versus depression; Rogers et al., 2020). Moreover, there has been a focus on child cognitive outcomes such as memory or learning rather than language development (Keim et al., 2011).

One prominent study exploring the association between prenatal mental health, as encompassed by depression and anxiety, and children's cognitive outcomes found that prenatal anxiety was significantly associated with lower scores on assessments of cognition (Ibanez et al.,
2015). In this study, the MacArthur Communicative Development Inventory (CDI) was used to assess language as a cognitive domain, and it was observed that higher levels of prenatal anxiety were associated with lower CDI scores in children (Ibanez et al., 2015).
However, this study did not disentangle the influence of anxiety from that of depression. Additionally, the CDI is based entirely on maternal reports, which may introduce outcomes such as social desirability bias or the inability to accurately attribute differences in reported vocabulary skills to true differences in skill, in addition to the possibility that more anxious mothers may simply report differently than non-anxious mothers.

Additionally, two studies investigated the trajectory of maternal prenatal anxiety throughout pregnancy and developmental outcomes in 1-year-old infants (Irwin et al., 2020; Keim et al., 2011). These studies examined prenatal anxiety as an independent variable but did not control for varying mental health disorders that are highly comorbid. Both studies found that higher prenatal anxiety was associated with lower scores on assessments of cognition. Specifically, Irwin et al. (2020) found that increasing maternal anxiety across pregnancy was associated with lower receptive language, also known as the "input" of language.

Next, a study conducted by Rogers et al. (2020) aimed to assess whether maternal prenatal depression and anxiety were adversely associated with varying developmental skills in children during the first 18 years of life. They found that prenatal anxiety was associated with poorer language abilities in early childhood, as measured through a composite, without controls for varying mental health disorders.

In a study that controlled for confounding mental

health comorbidities, Brouwers et al. (2001) showed that high prenatal anxiety during late pregnancy was uniquely associated with lower attention-related process skills at three weeks, one year, and two years. This finding may lend insight to investigations of language acquisition, given that attention-related processes are thought to be related to language acquisition and processing abilities (de Diego-Balaguer et al., 2016; Kannass & Oakes, 2008). Finally, a pertinent study conducted by Clifford et al. (2022), which examined the association between postnatal maternal mental health and children's expressive language (i.e., output of language) at approximately one and a half years of age (Mage = 17.03 months), found that postnatal maternal anxiety was negatively related to child language production scores, as reported by a parent. In this study, prenatal anxiety is not the independent variable; however, its relevance lies in the dependent variables falling within the domain of language.

Researchers have theorized that both physiological and psychological processes could underlie the associations between prenatal anxiety and postnatal child development. Physiological issues have been proposed as one mechanism by which prenatal anxiety could shape development. Notably, greater prenatal anxiety has been associated with poorer fetal development, including reduced fetal head circumference (Lewis et al., 2015), with slower or decreased fetal head growth during gestation associated with language difficulties in children two years of age compared to their typically developed peers (Villar et al., 2021). Research has also found that extremely high levels of prenatal anxiety may restrict blood flow and oxygen to developing fetal organs (Hobel & Culhane, 2003). Restricted blood flow in particular can cause Maternal Vascular Malperfusion, a placental abnormality, which has been linked to poor language development (Straughen et al., 2017). These findings highlight physiological pathways through which prenatal anxiety may implicate a child's language abilities.

It is also possible that prenatal anxiety forecasts or precedes less developmentally supportive parenting behaviors. Research has demonstrated prenatal anxiety to be a distinct predictor of postnatal mood disturbance (Blackmore et al., 2016), which has the potential to negatively influence child development, including language development, through the possible presence of these less developmentally supportive parenting behaviors. The Family Stress Model, originally introduced by Conger et al. (1992), suggests that parental psychological distress, including anxiety, can lead to parenting practices that may negatively impact child development (Masarik & Conger, 2017). Developmentally unsupportive parenting practices may include insensitivity (Newland et al., 2013); reduced time and quality of time spent with children (Iruka et al., 2012); and harsh, punitive, and over-controlling behaviors (Emmen et al., 2013) that increase the risk of child abuse or neglect (Warren & Font, 2015). Furthermore, maladaptive maternal behaviors and affect, as encompassed by diminished mental well-being, yield a less stimulating environment for children as it relates to the home language environment (i.e., the language that happens in the home, including the words that the child hears and reciprocal back-and-forth parent-child conversations; Clifford et al., 2021). Research has suggested that the quality of a child's early home language environment is a crucial predictor of their later linguistic skills and cognitive development (Dailey & Bergelson, 2022; Romeo et al., 2018). It is the exposure to more words and engagement that yield more successful linguistic developmental outcomes, such as the ability to learn vocabulary faster, exhibit increased processing speed, and produce overall stronger language (Gilkerson & Richards, 2009; Hart et al., 1997; Hurtado et al., 2014). Examining these kinds of developmental outcomes around 18 months of age is crucial, given the rapid growth in vocabulary skills that happens around this time (Kuhl, 2010).

Despite much theory suggesting various pathways through which prenatal anxiety could impact child language development, research on the associations between these constructs is limited. Child language development is important to understand, given the crucial insight it may provide into other aspects of child development, such as cognitive and social abilities (Anderson & Freebody, 1981; Gertner et al., 1994).

Objectives and Rationale

The present research aims to examine the association between prenatal anxiety and child language development at 18 months of age. Relatively few published studies have examined the association between prenatal maternal mental health and language development, let alone the specific association between prenatal anxiety and language at 18 months. An important consideration for correlational research on

this topic is the susceptibility to omitted variables bias (Duncan et al., 2004). Given this possibility, examining the links between prenatal maternal anxiety and child development with a full set of controls for potential confounders may yield a better sense of whether these associations reflect bias or a true association. It is important to understand that although various mental health disorders may be comorbid with one another, they present with different symptoms, require different therapeutic interventions, and–in the case of parent-child dyads–signify different implications for the child (Rogers et al., 2020).

Insofar as this correlational work could lay the foundation for testing whether interventions that target maternal mental health have positive effects on child language development, establishing whether these associations are robust is an important first step. By focusing specifically on prenatal anxiety, we can hone in on this construct as it relates to child language development. Furthermore, by controlling for numerous potentially confounding variables, including prenatal maternal depression, this research may strengthen the current research on this topic. Not only does the present research hope to lay the framework for possible interventions for mothers struggling with mental health, anxiety in particular, but it also strives to do so for children who may be susceptible to some of the unintentional consequences prenatal anxiety may bring. By distinguishing the potential implications of prenatal anxiety from those of prenatal depression and narrowing the scope, we enhance our understanding and ability to develop tailored interventions aimed at the prevention of any adverse developmental outcomes that may surface in the presence of prenatal maternal anxiety.

Hypothesis

The present research hypothesizes that higher levels of prenatal maternal anxiety are associated with lower levels of expressive and receptive language skills in children as measured at 18 months.

Methods

Participants

The mothers included in the current research were originally recruited for participation in a longitudinal study known as BUDDY, a study examining associations among various sociocultural factors, early experiences, and child development, particularly language, memory, and cognition. This study was approved by the Teachers College Institutional Review Board (IRB), and all participants provided written informed consent after being briefed on the study's purpose and procedures. They were also informed that they could refrain from specific measure collection or withdraw at any point. Participation was voluntary, though participants were compensated with differing cash amounts based on the time point. Participants were recruited in New York City through social media, community events, and prenatal clinics. An intentionally racially and socioeconomically diverse sample was recruited for participation. Recruitment for this study occurred in two waves, with a pause due to the COVID-19 pandemic. Thus, 93 mothers were recruited in the first cohort (before the pandemic) and 116 were recruited in the second cohort (after the height of the pandemic). In this study, we used data from both cohorts. Before enrollment in the study, mothers were screened over the phone to ensure that they met inclusion requirements, including that they were 18 years or older, were at least 35 weeks along in their pregnancy, and had no knowledge of fetal neurological or developmental issues. Upon successful enrollment in the study, all 209 mothers completed the prenatal visit. After the child was born, further inclusion criteria were enforced for subsequent participation. These criteria included the child's gestational age being greater than or equal to 37 weeks with no known neurological or developmental issues at birth. 205 mother-child dyads met these criteria. Participants were invited to participate in visits occurring from approximately every six months after birth through their child's third birthday.

In the current research project, we examined data from families who completed both the measure of prenatal anxiety and the measure of child language development at 18 months. The total number of mother-child dyads with complete data was 65 for cohort one and 104 for cohort two. Two mothers failed to complete demographic measures used as covariates in the analyses. Thus, my final analytic sample comprised 167 participants. Table 1 presents descriptive statistics corresponding to demographics and covariate variables.

Prenatal Anxiety

Prenatal anxiety was measured by the Beck Anxiety Inventory (BAI). The BAI is a 21-item questionnaire that helps in rating anxiety levels. It is a self-report

assessment developed in 1988 that asks about common anxiety symptoms and their impact over a week (Rung, 2024). The questionnaire assesses short-term symptoms, primarily those that are physical. Sample items include: "Numbness or tingling" and "Unable to relax". For each question, there is a uniform set of four answer choices with scores ranging from zero to three. As a result, overall scores ranged from 0 to 63 characterized by grouping as follows: 0 to 7 = minimal anxiety; 8 to 15 = mild anxiety; 16 to 25 = moderate anxiety; and 26 to 63 = severe anxiety (Rung, 2024). While the BAI is not a diagnostic tool, this score can help mental health professionals determine the severity of anxiety. The measure shows high discrimination (between anxious and non-anxious persons) in clinical populations and high internal consistency (α = .93) and test-retest reliability as measured over a week (r_{ICC} = .84; Oh et al., 2018). However, it is important to note that the measure shows limited discriminant validity against depressive disorders (Oh et al., 2018).

Language Development

Child language development at 18 months was measured by the Language Environment Analysis (LENA) Snapshot. The LENA snapshot is a 52-question, parent-completed questionnaire that measures a child's expressive and receptive language skills (LENA Foundation, 2022). Sample items from the LENA snapshot include "Does your child spontaneously produce sentences that are 10 or more words in length?" and "Does your child understand concepts like 'least', 'most', and 'first'?" The questionnaire is norm-referenced to a sample of typically developing children who participated in a natural language study by its creators (LENA Foundation, 2022). The LENA system uses an algorithm to automatically score responses and compares the score to the normative dataset of the language development of other monolingual, North American English-speaking children at that age. Following this, the system generates a standard score that estimates the child's developmental language age, placing them at below or above their true age (LENA Foundation, 2022). The assessment has strong test-retest reliability, acquiring a correlational value of ~.93 over two years (LENA Foundation, 2022). This tool has also been correlated to various standardized language and cognitive assessments, including the Cognitive Adaptive Test and the Preschool Language Scale 4th Edition, both the expressive and receptive measures. These correlations attained a rounded value of 0.93 with significance (LENA Foundation, 2022). The LENA snapshot has proven to be efficacious as it relates to monitoring the progress of language development as well as helping to identify the probability of language delay (LENA Foundation, 2022). Especially given the multilingual nature of the participants recruited for BUDDY, it is crucial to mention that the LENA snapshot has demonstrated limited validity in multilingual contexts.

Covariates

Prenatal Depression

Prenatal depression was measured by the Patient Health Questionnaire Depression Scale (PHQ-8). The PHQ-8 is an 8-item scale used as a diagnostic and severity measure for depression (Kroenke et al., 2009). It is a self-report questionnaire that implements a Likert scale with responses for items ranging from zero ("not at all") to three ("nearly every day"). The questionnaire asks respondents to consider the presence of the items' corresponding symptoms during the previous two weeks (Arias-de la Torre et al., 2023). The items correspond to symptoms outlined in the DSM-IV as diagnostic criteria for major depressive disorder. Sample items for this measure include "I am sad all the time and I can't snap out of it" and "I am so sad or unhappy that I can't stand it". The PHQ-8 is scored by summing the respondents' scores to each of the items, with total scores closer to zero representing lower levels of depression and total scores closer to 24 representing higher levels (Arias-de la Torre et al., 2023). The tool displays high internal consistency reliability (α = .82) and construct validity (Pressler et al., 2011). For the purposes of BUDDY, the PHQ-8 was administered as opposed to the PHQ-9, which includes a ninth question on suicidal ideation, due to the study's desire to focus on the core aspects of depression while avoiding potential issues that may arise with Item Nine in non-clinical settings.

Demographic Variables

Demographic variables included child sex, child age at LENA snapshot completion, mother's race/ethnicity (with White mothers as the reference group), years of formal education completed by the mother (i.e., maternal education), and family income.

Data Analysis Plan

To examine the associations between maternal prenatal anxiety and child language development, we

ran a series of three regression models using SPSS v29 (IBM Corp). First, we ran a simple linear regression model to test the relationship between prenatal anxiety and language development. Next, we conducted a multiple linear regression model to account for demographic covariates: child sex, child age at LENA snapshot completion, mother's race/ethnicity, maternal educational attainment, and family income. Finally, we ran a multiple linear regression model in which we included prenatal depression in addition to the demographic covariates introduced in model two. We tested this final model to probe the unique association between prenatal anxiety and child language development while holding constant the influence of prenatal depression, given the robust high correlation between depression and anxiety.

Results

Descriptive Statistics

Beginning with some discussion on descriptive statistics of the sample, the sample for the present study was relatively diverse. 44% of mothers in the sample identified as White and 55% identified as non-White, while 40% identified as Hispanic or Latino and 59% as not. As for family income and maternal education, the range for these variables was vast, though both distributions did skew towards the right (i.e., the higher end of the spectrum). On average, child age at LENA snapshot completion was 18 months, and the total score on the PHQ-8 had an average of five (M = 5) with a left-leaning distribution (i.e., the lower end of the spectrum) representing lower levels of prenatal depression for the mothers in the sample, on average. Regarding the BAI and prenatal anxiety, the average score was approximately nine (M = 9) with the data skewing left as well, representing lower levels of prenatal anxiety for the mothers included in the present study. Lastly, the total LENA snapshot score (i.e., child language development) skewed right toward higher scores and greater language abilities with an average score of 104 (M = 104).

Table 3 shows the correlations among variables included in my analyses. Of note, a low negative correlation was observed between prenatal anxiety and language development, and a moderate negative correlation was observed between prenatal depression and language.

Interestingly, in the context of the effect it had on results, a high positive correlation was observed between prenatal anxiety and depression, which likely impacted the results attained by the third regression, which included all the covariates.

Analyses

First, we ran a linear regression model to examine the relation between prenatal anxiety and language development at 18 months without the inclusion of any covariates. The model results are presented in Table 4, alongside all of the results produced by my analyses. The model's standard deviation indicated a small negative association (SD = -0.06), indicating that a one standard deviation increase in maternal anxiety was associated with a .06 reduction in language development. In raw units, this corresponded to a reduction of -0.15 units on the measure of language development. However, importantly, this association was imprecise and not statistically significant (p = .43), indicating that the association is not statistically distinct from a correlation of zero.

To examine the extent to which this small association was biased by child and family characteristics, we then ran a model that controlled for the following variables: child sex, child age at LENA snapshot, mother's race and ethnicity, maternal education, and income. The association between anxiety and language development became slightly larger but remained imprecise and statistically non-significant. Despite this slight increase, the first and second regression analyses produced consistently small estimates that hovered around 0, suggesting a near zero effect. Although the association remained statistically non-significant, interestingly, in this second regression analysis, the direction of the β value flipped from negative to positive (β = .03). On the other variables included in this regression model, notably, two attained statistically significant coefficients, child sex (β = .20, p = .01) and mother's race when specified to be Black (β = -.20, p = .03).

The last regression model we ran included the previously mentioned covariates in addition to prenatal depression. The inclusion of depression in the model substantially changed the association between prenatal anxiety and children's language development. Indeed, the association increased from near zero in earlier models (β = .20) and became nearly statistically significant by conventional standards (p = .06). This pattern of results looks a lot like what we might expect if suppressor effects were at play, leading me to be suspicious

about the estimate. Such effects will be discussed further; however, they tend to occur with highly correlated variables when simultaneously input as predictors. Of note, there was an observed negative association between maternal depression and child language (β = -.25, p = .02) as well as an association between child sex and child language (β = .20, p = .007). And, as mentioned earlier, there was a strong positive correlation between prenatal anxiety and prenatal depression (r = .70).

Discussion

Overall, this study found little evidence to suggest an association between prenatal anxiety and child language development at 18 months of age.

In the first analysis, which most closely replicated existing literature due to its refrain from controlling for covariates, opposing results to current literature were observed. For example, Ibanez et al. (2015) explored the associations between prenatal depression and anxiety with children's cognitive outcomes without controlling for depression. In contrast to the current study, they found that prenatal anxiety was significantly associated with poorer cognitive development, as characterized by language, at three years old (Ibanez et al., 2015). Results also conflict with those of Rogers et al. (2020), which aimed to assess the association between prenatal depression and anxiety with various developmental skills, including language, during the first 18 years of life. Again, in this study, there was no control for the covariate prenatal depression, yet researchers found that prenatal anxiety was associated with diminished language abilities. This pattern is consistent with other prominent studies such as Irwin et al. (2020) and Clifford et al. (2022), which found higher prenatal anxiety to be associated with poorer receptive communication skills and postnatal maternal anxiety to be associated with child expressive language, respectively.

The antithetical nature of these results alone emphasizes the need to continue conducting research within this realm to better understand the implications of prenatal mental health on child language development and other facets of child development at large in order to design and implement tailored interventions geared towards positive outcomes for mothers and children as needed. One can hypothesize many reasons why this first analysis, and ultimately all of the analyses in this study, yielded null results. In the context of this particular study, one important consideration is the small sample size. The small sample size of 167 participants can pose a myriad of limitations for data analysis and interpretation. For starters, smaller sample sizes make it more difficult to ascertain the validity of a found effect, especially small effects. This is attributed to the lower statistical power often achieved by smaller sample sizes. Small sample sizes also yield unreliable results due to low generalizability, making it difficult to accurately attribute results to the broader population.

In the second regression analysis, we similarly found a statistically nonsignificant association between prenatal anxiety and child language development. However, as previously noted, a peculiar change occurred with the standardized coefficient value for this association from the first analysis to the second– the direction of this value shifted from negative to positive. Though we should be careful not to heavily interpret these coefficients, given that they were both very close to zero, this hypothetical interpretation opposes current literature in the field, highlighting the need for continued research. On top of this, it raises the question of whether there could be cases in which the experience of anxiety confers advantages to parent-child interactions that support child development. However, again, ultimately the estimate from this model was quite small and suggestive of no association. Interestingly, in this second regression, we did observe two statistically significant associations. An association was found between child sex and language development, a finding that aligns with a substantial amount of literature in the field, depicting significant gender differences in language acquisition spanning from early childhood through adolescence. Though empirical evidence is not robust and findings are mixed, numerous studies highlight a female advantage in various aspects of language acquisition in early childhood (Clarke-Stewart, 1973; Heister, 1982). We also observed a negative association between maternal race when identified as Black and child language development. This finding raises concern that warrants further examination, given its illustration of a vulnerable population that may benefit from interventions geared towards the promotion of early childhood language development. This association has been observed in other literature, such as Cho et al. (2007),

which observed that at three years old, White children of White mothers had a lesser likelihood of presenting with language delays than non-White children and mothers (the majority of them Black). The consistent nature of this association highlights an exceedingly real equity issue that needs to be addressed to attain more positive outcomes for all children, regardless of their race or their mother's race.

Lastly, in the third linear regression, though it yielded a statistically insignificant relationship between total prenatal anxiety and language development, a notable change was observed in the estimate attained for the prenatal anxiety–child language development relationship. The p-value for this relationship changed significantly from the second analysis (p = .72) to the third (p = .06). This change, although there is a lack of association, represents a marked increase in the predictive power of prenatal anxiety. This compelling finding signifies what this research hypothesizes to be a suppressor effect induced by the control of prenatal depression. A suppressor effect in a regression occurs when controlling for a variable increases the predictive power of the model, as observed here. This represents the possibility of a rather complex relationship between prenatal anxiety and child language development that is somehow mediated by the presence of prenatal depression, should said relationship exist. Moreover, in this regression model, two statistically significant associations were observed: one between child sex and language development and another between prenatal depression and language development. The former of the two was also noted in the previous regression; however, the latter is specific to this regression, given that prenatal maternal depression was introduced here. A negative association between prenatal depression and child language development at 18 months was observed, representing a relationship characterized by a diminishing of language abilities in the presence of higher prenatal maternal depression. This coincides with existing literature which has found that at 12 months, children of mothers who were diagnosed with major depressive disorder while pregnant showcased lower language abilities compared to the control group (O'Leary et al., 2019).

Limitations

Myriad factors limit the conclusions of the current study. As previously mentioned, the small sample size is a large limitation of the current study for its potential to lead to difficulties in detecting small effects and unreliable results. It is also worth noting the two-cohort study design necessitated by the pandemic. As previously mentioned, participants were recruited at two different time points due to the pandemic, resulting in two cohorts. Recruitment for cohort one began before the pandemic and was interrupted once restrictions were imposed. Under "normal" circumstances where participants are recruited at different time points, a study faces the risk of the "cohort effect", which is described as the variation in characteristics of a group of people over time based on a shared experience (Caruana et al., 2015). This effect is all the more applicable in this study where participants of cohort two were recruited after a shared experience as life-changing as the COVID-19 pandemic. The cohort effect implies that different experiences attributed to a given period can impact the perceptions and responses of a participant in a research study (i.e., economic circumstances; Caruana et al., 2015). Meaning that participants of cohort two may showcase attitudes and behaviors that are highly attributed to their shared exposure to and experience with the pandemic. This phenomenon can ultimately introduce bias into the research because it signals a possible distortion of observed trends attributed to differences in shared life experiences that may have independently implicated the results.

Additionally, the lack of consistency in the child's age at which mothers completed the LENA snapshot serves as a limitation. Considering the correlation between prenatal anxiety and age at snapshot completion is low (r = .1), this limitation would be more pertinent if there were some sort of correspondence between prenatal anxiety and child age at snapshot completion, such that mothers with higher levels of prenatal anxiety were systematically completing the LENA snapshot at a different time than those with lower levels of prenatal anxiety. However, it remains an important factor to consider. The target age for the current study was 18 months; however, mothers with children as young as 16 months and as old as 21 months filled out the snapshot for the 18-month time point, contributing to the data the current study used. Though the mean age at snapshot completion was approximately 18 months (M = 17.98), the standard deviation was 0.895, signaling that the data is rather spread out. This standard deviation– though not exorbitantly high–is notable given that, as mentioned previously children's vocabu-

lary is characterized by rapid growth at 18 months of age, with studies showcasing that infants may add up to 10-20 new words to their vocabularies daily (Fenson et al., 1993; Reznick & Goldfield, 1992). It is important to note that in the current study we controlled for child age, which addresses this concern.

The data was also limited by the measures used to capture the independent and dependent variables–the Beck Anxiety Scale and the LENA snapshot. Both measures relied on parent reporting, which introduces the potential for social desirability bias, where individuals answer questions in a way that might make them seem more "acceptable" (Paulhus, 2017). One specific limitation of the LENA snapshot includes what may be perceived as a limited scope, given that the snapshot primarily focuses on expressive and receptive language, failing to capture other parts of language, such as metalinguistic awareness and higher-order language skills (LENA Foundation, 2022). Additionally, currently, there is limited validity for multilingualism with the snapshot questionnaire, given that responses are compared to norms established by monolingual, North American English-speaking children. This fails to account for the nuances which multilingualism adds to language development and acquisition. A large portion of the study's participants, mothers and children alike, fall into this demographic, raising a concern regarding the accuracy of language abilities as captured by LENA snapshot scores. A specific limitation of the Beck Anxiety Inventory (BAI) is its low discriminant validity in distinguishing between symptoms of anxiety and depression (Muntingh et al., 2011). This raises a concern for the present study's aim to isolate the effects of anxiety, as BAI scores may not accurately capture anxiety independent of depressive symptoms.

The study's correlational design also limits its implications for drawing causal inferences. While we had causal theories about the links between maternal anxiety and child development, it's impossible to discern whether a causal relationship exists due to the lack of experimental manipulation in correlational research. Indeed, a range of confounding variables–including those that we did and did not control for–could have biased any observed associations between the constructs in our study. Though no significant association was observed in the present study, this limitation impacts all studies conducted without random assignment. Thus, it is important to consider how future studies may account for the inability to interpret correlation as causation.

Lastly, the current study is limited in its failure to account for or consider pregnancy-specific anxiety (PSA). Though often conceptualized interchangeably with prenatal anxiety, PSA is a unique phenomenon (Langille et al., 2023). PSA is common, affecting 20-40% of women during pregnancy (Araji et al., 2020). It differs from trait anxiety in that PSA is an affective state in which a pregnant person feels worry, fear, or nervousness surrounding matters related to their pregnancy such as their prenatal health, the baby's health, labor and delivery, and parenting (Dunkel et al., 2022). It is important to consider these phenomena distinctly considering they have distinct clinical impacts (Langille et al., 2023).

Conclusion

Despite the limitations mentioned above, the current study serves as a significant step in understanding the role that maternal mental health may play in child development, especially as it pertains to prenatal mental health and child language outcomes. Moreover, it contributes to the literature surrounding the importance of distinguishing between the ramifications of varying clinical disorders, which are crucial given their differences in treatment. Though the current study did not provide evidence that prenatal maternal anxiety influences child language development at 18 months, this null hypothesis suggests a need to achieve greater clarity into its true impact, given that these findings oppose current literature. The implications of improperly understanding the effects of prenatal anxiety, or maternal mental health, on child development are such that we remain incapable of providing adequate resources to children who may be at a disadvantage or to mothers who may be unaware of possible consequences. It also provides thoughtful insight into other associations present within this realm such as maternal race and child gender's seeming to influence child development as well. By means of attempting to answer a question and shed light on prenatal mental health, the current study raises new questions regarding patterns and relationships that may exist in the sphere of the mother-child matrix. It's important to understand the implications that may arise for child development based on prenatal maternal mental health to know how to best support pregnant mothers and their children not only during pregnancy but at other stages as

well—including pre-conception, the postnatal period, and various time points throughout the child's lifespan.

Future Recommendations

The current paper posits a few recommendations for future research within the prenatal mental health-child development domain. As previously mentioned, a limitation of the current research is the small sample size. Thus, it is recommended that future studies replicate this research with larger sample sizes to be able to detect small effects and draw reliable conclusions from the observed results more confidently. This characteristic would also improve the representativeness of the dataset, allowing for the well-informed curation and tailoring of interventions.

Another recommendation for studies examining the impacts of prenatal anxiety alone is to emphasize and find a way to distinguish prenatal anxiety from what is known as pregnancy-specific anxiety. The current study does not account for these types of mental health that are vastly different in factors such as longitudinal course and prediction of postnatal mood disturbance (Blackmore et al., 2016). Most importantly, these ideas are different in their foundations. Pregnancy-specific anxiety encompasses feelings of nervousness or worry regarding personal health and appearance while pregnant, the baby's health, experience with the birthing process, and the healthcare system, and so on (Chandra & Nanjundaswamy, 2020), whereas prenatal state anxiety represents more general feelings of anxiety that happen to occur during pregnancy. Due to these differences, future research examining anxiety during pregnancy should individualize these two forms and assess their implications for not only children but also the pregnant person separately. The discourse surrounding prenatal mental health is minimal, let alone that of pregnancy-specific anxiety. However, existing research has found that higher levels of maternal pregnancy-specific anxiety are associated with lower inhibitory control in girls aged 6–9 years old and lower visuospatial working memory in girls and boys of the same age (Buss et al., 2011). Thus, preliminary research has found that child outcomes associated with maternal pregnancy-specific anxiety are distinguishable from those of prenatal state anxiety, highlighting the pertinence of upholding this distinction in continued research.

Lastly, another recommendation for a study of this nature, within the same vein as the aforementioned recommendation, would be to control for more covariates, such as prenatal stress. It is important to note that the study whose data the current study used also measured maternal stress at the prenatal time point. To advance the mission of dissecting varying facets of mental health (i.e., depression vs. anxiety vs. stress, etc.) in order to further understand their differences and implications, it is important to account for as many variables as possible, including prenatal stress. Future studies could assess the association between prenatal mental health and child outcomes by comprehensively accounting for different components of the former. To date, in the domain of child language development, research has found that the level of prenatal stress can account for variance in 2-year-old toddlers' productive and receptive language abilities (LaPlante et al., 2004), showcasing the ability of prenatal stress to dictate child language development in some capacity. Differentiating aspects of maternal mental health and understanding their possible implications for not only children but also for mothers is incredibly pertinent. This is particularly evident given the intersection between research and understanding as well as intervention and policy. For the sake of best supporting these communities, it's essential to appreciate the intricacies of factors that may affect them.

Ultimately, the current study contributes to an under-researched area of child psychology and development. Although the findings do not necessarily demonstrate a cause for concern, it is essential to continue researching in this domain to identify opportunities for action.

References

Anderson, R. C., & Freebody, P. (1981). Vocabulary knowledge. *Comprehension and teaching: Research reviews*, 77-117.

Araji, S., Griffin, A., Dixon, L., Spencer, S. K., Peavie, C., & Wallace, K. (2020). An overview of maternal anxiety during pregnancy and the post-partum period. *Mental Health Journal, 4*(4), 47–56. https://doi.org/10.29245/2578-2959/2020/4.1221

Arias-de la Torre, J., Vilagut, G., Ronaldson, A., Valderas, J. M., Bakolis, I., Dregan, A., ... & Alonso, J. (2023). Reliability and cross-country equivalence of the 8-item version of the patient health questionnaire (PHQ-8) for the assessment of depres-

sion: Results from 27 countries in Europe. *The Lancet Regional Health – Europe, 31*, 100659. https://doi.org/10.1016/j.lanepe.2023.100659

Blackmore, E. R., Gustafsson, H., Gilchrist, M., Wyman, C., & O'Connor, T. G. (2016). Pregnancy-related anxiety: Evidence of distinct clinical significance from a prospective longitudinal study. *Journal of Affective Disorders, 197*, 251–258. https://doi.org/10.1016/j.jad.2016.03.008

Brouwers, E. P. M., Van Baar, A. L., & Pop, V. J. M. (2001). Maternal anxiety during pregnancy and subsequent infant development. *Infant Behavior and Development, 24*(1), 95–106. https://doi.org/10.1016/S0163-6383(01)00062-5

Buss, C., Davis, E. P., Hobel, C. J., & Sandman, C. A. (2011). Maternal pregnancy-specific anxiety is associated with child executive function at 6–9 years of age. *Stress, 14*(6), 665–676. https://doi.org/10.3109/10253890.2011.623250

Caruana, E. J., Roman, M., Hernández-Sánchez, J., & Solli, P. (2015). Longitudinal studies. *Journal of Thoracic Disease, 7*(11), E537–E540. https://doi.org/10.3978/j.issn.2072-1439.2015.10.63

Chandra, P. S., & Nanjundaswamy, M. H. (2020). Pregnancy-specific anxiety: An under-recognized problem. *World Psychiatry, 19*(3), 336–337. https://doi.org/10.1002/wps.20781

Cho, J., Holditch-Davis, D., & Belyea, M. (2007). Gender and racial differences in the looking and talking behaviors of mothers and their 3-year-old prematurely born children. *Journal of Pediatric Nursing, 22*(5), 356–367. https://doi.org/10.1016/j.pedn.2006.12.004

Clarke-Stewart, K. A. (1973). Interactions between mothers and their young children: Characteristics and consequences. *Monographs of the Society for Research in Child Development, 38*(6–7, Serial No. 153), 1–108. https://doi.org/10.2307/1165928

Clifford, B. N., Stockdale, L. A., Coyne, S. M., Rainey, V., & Benitez, V. L. (2022). Speaking of state of mind: Maternal mental health predicts children's home language environment and expressive language. *Journal of Child Language, 49*(3), 469–485. https://doi.org/10.1017/S0305000921000131

Conger, R. D., Conger, K. J., Elder, G. H., Jr., Lorenz, F. O., Simons, R. L., & Whitbeck, L. B. (1992). A family process model of economic hardship and adjustment of early adolescent boys. *Child Development, 63*(3), 526–541. https://doi.org/10.1111/j.1467-8624.1992.tb01644.x

Dailey, S., & Bergelson, E. (2022). Language input to infants of different socioeconomic statuses: A quantitative meta-analysis. *Developmental Science, 25*(3), e13192. https://doi.org/10.1111/desc.13192

De Asis-Cruz, J., Krishnamurthy, D., Zhao, L., Kapse, K., Vezina, G., Andescavage, N., Quistorff, J., Lopez, C., & Limperopoulos, C. (2020). Association of prenatal maternal anxiety with fetal regional brain connectivity. *JAMA Network Open, 3*(12), e2022349. https://doi.org/10.1001/jamanetworkopen.2020.22349

de Diego-Balaguer, R., Martinez-Alvarez, A., & Pons, F. (2016). Temporal attention as a scaffold for language development. *Frontiers in Psychology, 7*, 44. https://doi.org/10.3389/fpsyg.2016.00044

Emmen, R. A., Malda, M., Mesman, J., van IJzendoorn, M. H., Prevoo, M. J., & Yeniad, N. (2013). Socioeconomic status and parenting in ethnic minority families: Testing a minority family stress model. *Journal of Family Psychology, 27*(6), 896. https://doi.org/10.1037/a0034693

Field, T. (2017). Prenatal anxiety effects: A review. *Infant Behavior and Development, 49*, 120–128. https://doi.org/10.1016/j.infbeh.2017.08.008

Gertner, B. L., Rice, M. L., & Hadley, P. A. (1994). Influence of communicative competence on peer preferences in a preschool classroom. *Journal of Speech, Language, and Hearing Research, 37*(4), 913–923. https://doi.org/10.1044/jshr.3704.913

Gilkerson, J., & Richards, J. A. (2009). The power of talk: Impact of adult talk, conversational turns, and TV during the critical 0–4 years of child development. *LENA Research Foundation*.

Hart, B., Risley, T. R., & Kirby, J. R. (1997). Meaningful differences in the everyday experience of young American children. *Canadian Journal of Education, 22*(3), 323.

Heister, G. (1982). Sex differences in verbal fluency: A short note. *Current Psychology, 2*, 257–260. https://doi.org/10.1007/BF02684518

Hobel, C., & Culhane, J. (2003). Role of psychosocial and nutritional stress on poor pregnancy outcome. *The Journal of Nutrition, 133*(5, Suppl), 1709S–1717S. https://doi.org/10.1093/jn/133.5.1709S

Hurtado, N., Grüter, T., Marchman, V. A., & Fernald, A. (2014). Relative language exposure, processing efficiency and vocabulary in Spanish–English bilingual toddlers. *Bilingualism: Language and Cognition, 17*(1), 189–202. https://doi.org/10.1017/S136672891300014X

Ibanez, G., Bernard, J. Y., Rondet, C., Peyre, H., Forhan, A., Kaminski, M., Saurel-Cubizolles, M. J., & EDEN Mother-Child Cohort Study Group. (2015). Effects of antenatal maternal depression and anxiety on children's early cognitive development: A prospective cohort study. *PLOS ONE, 10*(8), e0135849. https://doi.org/10.1371/journal.pone.0135849

Iruka, I. U., LaForett, D. R., & Odom, E. C. (2012). Examining the validity of the family investment and stress models and relationship to children's school readiness across five cultural groups. *Journal of Family Psychology, 26*(3), 359. https://doi.org/10.1037/a0028290

Irwin, J. L., Davis, E. P., Hobel, C. J., Coussons-Read, M., & Schetter, C. D. (2020). Maternal prenatal anxiety trajectories and infant developmental outcomes in one-year-old offspring. *Infant Behavior and Development, 60*, 101468. https://doi.org/10.1016/j.infbeh.2020.101468

Kannass, K. N., & Oakes, L. M. (2008). The development of attention and its relations to language in infancy and toddlerhood. *Journal of Cognition and Development, 9*(2), 222–246. https://doi.org/10.1080/15248370802022696

Keim, S. A., Daniels, J. L., Dole, N., Herring, A. H., Siega-Riz, A. M., & 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. https://doi.org/10.1016/j.earlhumdev.2011.02.004

Kroenke, K., Strine, T. W., Spitzer, R. L., Williams, J. B., Berry, J. T., & Mokdad, A. H. (2009). The PHQ-8 as a measure of current depression in the general population. *Journal of Affective Disorders, 114*(1–3), 163–173. https://doi.org/10.1016/j.jad.2008.06.026

Kuhl, P. K. (2010). Brain mechanisms in early language acquisition. *Neuron, 67*(5), 713-727.

Langille, C., Andreou, P., & Piccinini-Vallis, H. (2023). The prevalence of pregnancy-specific perinatal anxiety in Nova Scotia. *Maternal and Child Health Journal, 27*(7), 1127–1132. https://doi.org/10.1007/s10995-023-03639-y

Laplante, D. P., Barr, R. G., Brunet, A., Du Fort, G. G., Meaney, M. L., Saucier, J. F., Zelazo, P. R., & King, S. (2004). Stress during pregnancy affects general intellectual and language functioning in human toddlers. *Pediatric Research, 56*(3), 400–410. https://doi.org/10.1203/01.PDR.0000136281.34035.44

LENA Foundation. (2022, November 30). Developmental snapshot. LENA. https://www.lena.org/developmental-snapshot/

Lewis, A. J., Austin, E., Knapp, R., Vaiano, T., & Galbally, M. (2015). Perinatal maternal mental health, fetal programming and child development. *Healthcare, 3*(4), 1212–1227. https://doi.org/10.3390/healthcare3041212

Masarik, A. S., & Conger, R. D. (2017). Stress and child development: A review of the family stress model. *Current Opinion in Psychology, 13*, 85–90. https://doi.org/10.1016/j.copsyc.2016.05.008

Muntingh, A. D., van der Feltz-Cornelis, C. M., van Marwijk, H. W., Spinhoven, P., Penninx, B. W., & van Balkom, A. J. (2011). Is the Beck Anxiety Inventory a good tool to assess the severity of anxiety? A primary care study in the Netherlands study of depression and anxiety (NESDA). *BMC Family Practice, 12*, 66. https://doi.org/10.1186/1471-2296-12-66

Newland, R. P., Crnic, K. A., Cox, M. J., & Mills-Koonce, W. R. (2013). The family model stress and maternal psychological symptoms: Mediated pathways from economic hardship to parenting. *Journal of Family Psychology, 27*(1), 96. https://doi.org/10.1037/a0031112

Oh, H., Park, K., Yoon, S., Kim, Y., Lee, S. H., Choi, Y. Y., & Choi, K. H. (2018). Clinical utility of Beck Anxiety Inventory in clinical and nonclinical Korean samples. *Frontiers in Psychiatry, 9*, 666. https://doi.org/10.3389/fpsyt.2018.00666

O'Leary, N., Jairaj, C., Molloy, E. J., McAuliffe, F. M., Nixon, E., & O'Keane, V. (2019). Antenatal depression and the impact on infant cognitive, language and motor development at six and twelve months postpartum. *Early Human Development, 134*, 41–46. https://doi.org/10.1016/j.earlhumdev.2019.05.021

Paulhus, D. L. (2017). Socially desirable responding on self-reports. In *Encyclopedia of Personality and Individual Differences*. Springer, 1–5.

Reznick, J. S., & Goldfield, B. A. (1992). Rapid change in lexical development in comprehension and production. *Developmental Psychology, 28*(3), 406–413. https://doi.org/10.1037/0012-1649.28.3.406

Rogers, A., Obst, S., Teague, S. J., Rossen, L., Spry, E. A., Macdonald, J. A., Olsson, C. A., Skouteris, H., Kothe, E., & Hutchinson, D. (2020). Association between maternal perinatal depression and anxiety and child and adolescent development: a meta-analysis. *JAMA Pediatrics, 174*(11), 1082–1092. https://doi.org/10.1001/jamapediatrics.2020.2554

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 is associated with language-related brain function. *Psychological Science, 29*, 700–710. https://doi.org/10.1177/0956797617742725

Rung, R. (2024, June). What is the Beck Anxiety Inventory (BAI)? *Healthline*. https://www.healthline.com/health/anxiety/beck-anxiety-inventory#basics

Straughen, J. K., Misra, D. P., Divine, G., Shah, R., Perez, G., VanHorn, S., Onbreyt, V., Dygulska, B., Schmitt, R., Lederman, S., Narula, P., & Salafia, C. M. (2017). The association between placental histopathology and autism spectrum disorder. *Placenta, 57*, 183–188. https://doi.org/10.1016/j.placenta.2017.07.006

U.S. Department of Health and Human Services. (2010, September). Speech and language developmental milestones. *National Institute on Deafness and Other Communication Disorders*. https://www.nidcd.nih.gov/health/speech-and-language

Villar, J., Gunier, R. B., Tshivuila-Matala, C. O. O., Rauch, S. A., Nosten, F., Ochieng, R., Restrepo-Méndez, M. C., McGready, R., Barros, F. C., Fernandes, M., Carrara, V. I., Victora, C. G., Munim, S., Craik, R., Barsosio, H. C., Carvalho, M., Berkley, J. A., Cheikh Ismail, L., Norris, S. A., . . . Kennedy, S. H. (2021). Fetal cranial growth trajectories are associated with growth and neurodevelopment at 2 years of age: INTERBIO-21st Fetal Study. *Nature Medicine, 27*(4), 647–652. https://doi.org/10.1038/s41591-021-01280-2

Warren, E. J., & Font, S. A. (2015). Housing insecurity, maternal stress, and child maltreatment: An application of the family stress model. *Social Service Review, 89*(1), 9–39. https://doi.org/10.1086/680043

Table 1

Descriptives (Demographic Variables)

	% (*n*) or Mean (*SD*)	Min	Max
Mother's age at prenatal visit	32% (5.68)	19	46
Child sex			
Male	46%		
Female	54%		
Mother race			
White	44%		
Black or African American	21%		
Asian	10%		
American Indian/ Alaska Native	1%		
Other	23%		
Missing	1%		
Mother ethnicity			
Hispanic or Latino	40%		
Not Hispanic or Latino	59%		
Missing	1%		
Family income	$184,827 (320,823)	1	$2,563,501
Maternal education	16 (3)	6	22
Child age at LENA snapshot completion	18 (1)	16	21
Patient Health Questionnaire total score	5 (4)	0	17
Total (*N*)	167		

Note. This table shows descriptive statistics for the demographic variables. The total participant count for the current study is 167 children/families, as stated in the last row in the table. Maternal Age is reported in years. Family Income is reported in USD. Maternal Education is reported in years. Child age at LENA (Language Environment Analysis) snapshot completion is reported in months. Family income was log-transformed.

Table 2

Descriptives (IV & DV)

	Mean (*SD*)	Min	Max
Beck Anxiety Inventory total score	9 (7)	0	31
LENA snapshot total score	104 (18)	64	136
Total (*N*)	167		

Note. LENA is representative of Language Environment Analysis.

Table 3

Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12
1. Prenatal anxiety	-	-0.02	-0.17	0.16	-0.09	0.00	-0.05	0.04	-0.08	-0.10	0.11	**0.70**
2. Language development	-0.02	-	0.19	-0.28	0.08	-0.18	-0.14	0.26	0.12	0.25	-0.08	-0.21
3. Mom_White	-0.17	0.19	-	-0.47	-0.30	-0.07	-0.40	0.46	0.19	0.11	-0.27	-0.12
4. Mom_Black	0.16	-0.28	-0.47	-	-0.18	-0.04	0.00	-0.22	-0.22	-0.06	0.11	0.24
5. Mom_Asian	-0.09	0.08	-0.30	-0.18	-	-0.03	-0.23	0.24	0.24	-0.04	-0.05	-0.14
6. Mom_American Indian	0	-0.18	-0.07	0.04	-0.03	-	0.10	0.10	0.10	-0.09	0.09	0.06
7. Mom_ethnicity	-0.05	-0.14	-0.40	0.00	-0.23	0.10	-	**-0.53**	-0.26	-0.02	-0.03	0.05
8. Mom_education	0.04	0.26	0.46	-0.22	0.26	-0.11	**-0.53**	-	0.37	0.14	-0.05	-0.12
9. Family income	-0.08	0.12	0.19	-0.22	0.24	0.10	-0.26	0.37	-	0.06	0.09	-0.15
10. Child sex	-0.10	0.25	0.11	-0.06	-0.04	-0.09	-0.02	0.14	0.06	-	-0.05	-0.10
11. Child age at snapshot	0.11	-0.08	-0.27	0.11	-0.05	0.09	-0.03	-0.05	0.09	-0.05	-	0.14
12. Prenatal depression	0.40	-0.21	-0.12	0.24	-0.14	0.06	0.05	-0.12	-0.15	-0.10	0.14	-

Note. Bolded correlations indicate statistically significant correlations ($p < .05$). Construct names rather than measure names are used in the matrix.

Table 4

Correlation Matrix

	Regression #1		**Regression #2**		**Regression #3**	
	B (SE)	*p*	*B* (SE)	*p*	*B* (SE)	*p*
Covariates	-0.06 (0.19)	0.43	0.03 (0.18)	0.72	0.20 (0.25)	0.06
Demographic	-		*		*	
Controls						
Prenatal Depression	-		-		*	
					-0.25 (0.52)	0.02

Note. Bolded correlations are significant of highly correlated variables. Only correlations relevant to the current study and the overarching literature are included in the matrix. Construct names rather than measure names are used in the table.

* Covariate Included

– Covariate Not Included