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Dissociating Socioeconomic Influences on Maternal Language Input and Child Language Outcomes

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by

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Abstract

Early language development is associated with children's socioeconomic status (SES). Specifically, children from lower SES backgrounds, on average, exhibit slower language development compared to their peers from higher-SES backgrounds. Even though SES is a multidimensional construct, research often relies on a single dimension or a composite measure when studying child language development. In this article, I investigate four dimensions of SES, including maternal education, income-to-needs ratio, financial security, and neighborhood SES. Specifically, I examine whether the quantity and quality of maternal linguistic input mediates the relationships between dimensions of SES and child receptive language skills. Mothers and their 36-40 months old children (n=276 dyads) were video recorded during a 15-minute free play session. Three measures of maternal linguistic input were derived from verbatim transcripts, including one quantitative measure (number of words spoken) and two qualitative measures (lexical diversity and syntactic complexity). Children's concurrent receptive language skills were measured by a standardized measure of children's ability to receive, process, and execute oral instructions of increasing syntactic complexity. Results revealed that maternal education was the strongest predictor of both maternal linguistic input and child receptive language outcomes. Syntactic complexity of input was the only measure that mediated the relationship between maternal education and child receptive language skills. These findings critically identify which early environmental factors are mechanistically related

to SES disparities in children's language development and provide implications for interventions to reduce these disparities.

Key words: syntactic complexity, language outcomes, socioeconomic status, SES.

Introduction

Despite over fifty years of research on socioeconomic status (SES) and its association with children's language development, we still do not fully understand the underlying mechanism of adult language input, and how it relates SES to child language abilities. The early literature suggested that children who come from low SES families on average hear 30 million fewer words in the first four years of their lives when compared to their peers from high SES families (Hart & Risley, 1995; Hoff, Laursen & Tardiff, 2002; Rowe, 2008). These findings are often referred to as the "30-million-word gap," which presumably leads to disparities in language development. Although the general association between SES and language input has been frequently replicated (Fernald, Marchman & Weisleder, 2013; Pace, Luo, Hirsh-Pasek, & Golinkoff, 2017), there is also often as much, if not more, variation within SES strata as across it (Schwab & Lew-Williams, 2016; Gilkerson et al., 2017). This suggests that a unitary measure of SES, combining factors such educational, financial, and material resources, may not appropriately capture the variety of environmental factors that influence language input (Rowe, 2017). Hence, disparities in language development might be much more intricate than an omnibus SES measure is able to reveal.

Definition and Measurement of Socioeconomic Status

SES is a complex measure that encompasses an individual's financial and educational resources, and his/her social standing in relation to others in the society. It is challenging to precisely assess a family's financial and social resources, therefore, most

studies on SES effects on child development treat SES as a unidimensional measure. Social scientists often combine different components of SES into a single composite or focus on a singular aspect of SES. Education and occupation are commonly used as a proxy for SES in developmental studies (Duncan & Magnuson, 2012). Many early studies on SES and development incorporated Hollingshead's Four Factor Index, which is calculated by the sum of family's education and occupational prestige (Hollingshead, 1975; Hoff et al., 2002). Some researchers do not directly measure SES but derive occupational and social status from measures that are associated with SES such as home ownership, family structure, or low-income assistance programs (Pace et al., 2017). Another approach to deriving family's socioeconomic standing is through direct questions about participant's perceived social status (Duncan & Magnuson, 2012). Nonetheless, maternal education, occupation, and family income, or combination of the three, are the most commonly used measures of SES. There is no consensus on which variable is the most optimal measure of SES, and the above-mentioned variables are used interchangeably.

Maternal education is often measured as a categorical variable that ranges from some high school education, high school graduate, some college education to college graduate (Pace et al., 2017). Maternal education has been shown to be a strong predictor of overall child development outcomes (Hoff et al., 2002; Hoffman, 2013; Magnuson et al., 2009). Nonetheless, it might not be a clear indicator of SES. For instance, a mother who acquired a college education in a single parent household might still experience poverty related issues. Income-related variables of SES are often measured by family's

income that place family either below or above the federal poverty threshold (FPT, Taylor et al., 2004). Income-to-needs ratio (INR) aims to capture more complex financial circumstances by dividing the total family income by the federal poverty threshold for a particular household size. Financial security encompasses even more complex financial circumstances of the household. This particular measure evaluates family's access to the resources such as proper housing, clothing, furniture, car, food, medical care and recreational activities. INR and financial security are more reflective of a family's financial standing compared to household income alone or FPT measures. For example, a household might be only one dollar over the FPT, which would exclude the family from low-income assistance programs and ultimately put a family in a more financially unstable position than a family under FPT who receives help from the government. Previous investigations have found maternal education to be more strongly related to children's cognitive development than financial measures (Hoff, 2003; Magnuson, 2007). However, there is limited literature that directly compares different components of SES and their relation to child language outcomes.

Effects of Socioeconomic Status on Parenting and Child Development

Moreover, different aspects of SES—educational, financial, material—are distinct constructs that might be linked uniquely to child development. Education is a human capital investment, which yields both financial and personal advantages. It is more stable than income itself and might therefore have more profound effects (Hoff et al., 2002). Research has found that parents who obtain more education are more likely to spend more time with their children and provide a more cognitively enriching environment

(Kalil & Ryan, 2020). Occupational aspect of SES is related to social standing and it is also strongly related to parental education and income. Previous studies revealed that parents with less prestigious employment relied more on authoritative strategies when parenting, while parents with more prestigious occupations used more strategies that enhanced their child's independence (Kohn, 1959). Lastly, income measures refer to the economic resources of the family. The access to resources allows families to provide a richer cognitive environment for children. Research has been conducted, in which income has been manipulated in order to observe change or lack thereof in child development outcomes (Duncan, Magnusen & Votruba-Drzal, 2014). An increase of $1,000 dollars per year showed a positive effect on children's development, particularly in low-income families. However, parental income measures are unstable and prone to variation during childhood due to changes in career, policy, and other life events (Duncan, 1988).

Furthermore, when considering SES effects, it is critical to examine the contexts in which SES influences child development. The bioecological model attempts to capture social context ranging from proximal (direct interaction between the child and mother, other family members and peers) to distal (education, culture, social policies,) influences on child development (Bronfenbrenner & Morris, 1998). Because SES operates at both individual and community levels, both proximal and distal influences should be taken into account when analyzing the effects of SES on child development. Proximal aspects of SES are more volatile and prone to change across childhood, while distal influences have a larger impact on society as a whole (Duncan & Magnuson, 2012). The majority of studies on SES and child development focus on family-level variables; however, to

capture the complete picture of the problem, neighborhood-level variables should be also considered (Bradley & Corwyn, 2002; Leventhal & Brooks-Gunn, 2000). This oversimplification of SES and the complex household and community factors in which children and parents interact may give rise to inconsistent findings and obscure the truly influential environmental factors (Duncan & Magnuson, 2012).

The Effects of Socioeconomic Status on Child Language Outcomes

Differences of language skills between children from low-SES and high-SES emerge as early as when they are 18 months old (Fernald et al., 2013). By 24 months, a 6-month gap has been observed between the two groups in vocabulary knowledge and language processing abilities (Marchman & Fernald, 2008). By the age of 3 years old, when lower-SES children enter programs like Head Start, they are already behind on lexical development compared to their middle-SES peers (Levine et al., 2020). SES differences relate not only to vocabulary, but also to children's syntax. Snow (1999) measured the mean length of utterances (MLUs) of 3- to 5-year-old children, which indexes their level of grammatical development, with longer utterances indicating more advanced syntax. Children from low-income families were on average one year behind their peers from more affluent socioeconomic backgrounds in syntactic development. Vasilyeva et al. (2008) further showed that by 26 months, there were significant SES differences in children's usage of complex syntax structures. SES differences in syntax development have been also observed by Huttenlocher et al. (2010) in a longitudinal study from 14 to 46 months; while SES was stable across this time period, disparities in syntax widened with children's age. Both vocabulary and syntax SES-related differences

emerge as early as the particular skill can be observed and measured (Levine et al., 2020). Research has also shown that the earlier in a child's life that they experience poverty, the more profound the effects on cognitive outcomes (Duncan et al., 1988). These early differences might be partially accountable for disparities in educational achievement later in life, because language is not only crucial for human communication, but it allows for learning. Thus, early language delays might impede children's later academic performance.

The Effects of Maternal Language Input on Child Language Outcomes

Hart and Risley (1992), in their seminal article *Meaningful Differences in the Everyday Experience of Young American Children*, found that parents from lower SES backgrounds on average spoke less to their children when compared to parents from higher SES backgrounds. This resulted in a significant SES difference in children's productive vocabulary (number of different words used) at the age of 36 months. Their measurement of SES was based on socioeconomic occupational measures that ranged from "welfare" to "professional class". However, their sample was quite small, including only 42 families, and only seven families representing low-SES index, with limited racial/sociocultural diversity (Hart and Risley, 1992). Therefore, the "30-million-word gap" might be an overestimation and may also stem from cultural and communication style differences.

Despite shortcomings of this study, several other studies have found that the amount of parental language input, and specifically the number of words spoken, predicts vocabulary growth between 14 and 28 months (Hoff, 2003; Hoff-Ginsberg, 1998;

Huttenlocher et al., 1991). The number of words children hear on average enables them to build their vocabulary, which in turn helps them conceptualize and categorize the world around them. It has also a beneficial impact on emotional and behavioral regulation (Roben et al., 2013; Rowe, 2012).

Moreover, qualitative measures of linguistic input encompass both linguistic measures, such as the variability and complexity of parents' speech, as well as social-interactional and conceptual measures (Rowe & Snow, 2020). For example, 3-year-old children's vocabulary is best predicted by the number of different words and the number of rare words used in speech by parents, while 4-year-old children's vocabulary is best predicted by the topic of discussion (Rowe, 2012). Moreover, research has shown that the fluency and connectedness of parent-child conversational exchange at 24 months is predictive of expressive language at 36 months, over and above the number of words spoken (Hirsch-Pasek et al., 2015).

Furthermore, while the quantity of linguistic input is indeed crucial, the quality of input might be even more influential on language acquisition and educational outcomes. Previous research has shown that the quality of input is a much stronger predictor of language outcomes (Cartmill et al., 2013; Hirsh-Pasek et al., 2015; Huttenlocher et al., 2010; Rowe, 2012). In a study by Pan et al. (2005), researchers found that the number of different words parents spoke (i.e., vocabulary diversity) was most predictive of toddler vocabulary growth. Further expanding on this correlation, studies have found that children whose parents use more rare words, also have more complex vocabulary by the time they enter kindergarten (Weizman & Snow, 2001). These findings may suggest a

developmental trajectory whereby quantitative measures are more important for language development in infancy, while qualitative measures become more important as children reach toddlerhood and preschool ages (Rowe, 2018; Rowe & Zuckerman, 2016). Nonetheless, these measures are highly correlated; mothers who talk more on average, also use more diverse vocabulary and build more complex sentence structures.

A study by Huttenlocher and colleagues (2010) also found that caregiver speech mediated the relation between SES and language growth. Their key finding was that earlier child speech predicted vocabulary growth pointing to bidirectionality of this relation. However, earlier child speech was not correlated with syntactic development, which indicates that caregivers' grammatical input is crucial for syntactic development. It has been suggested that the syntactic quality of input is more predictive of later language outcomes compared to the number of words or number of rare words uttered by caregiver (Cartmill et al., 2013; Rowe, 2012). Syntactic input from a caregiver has been directly related to development of syntactic structures in children's language (Huttenlocher et al., 2002), and also has been found to mediate the relationship between SES and children's vocabulary (Hoff, 2003). Given the importance of both quantitative and qualitative measures of input, as well as both lexical and syntactic qualitative measures, the present study examines instances of all of these measures to investigate relationships with SES and child language outcomes.

The Effects of Socioeconomic Status on Maternal Language Input

Debates have sprung up in current literature about the interpretation of the effects of SES on child language outcomes (Sperry, Sperry & Miller, 2018; Golinkoff et al.,

2019). While associations between SES and child language have been observed across many studies, these have resulted in inconsistent conclusions. Variability has been found not only between socioeconomic strata, but also within it. In the study by Rowe, Pan and Ayoub (2005) researchers found that mothers from low SES showed large variability in the amount of speech, as well as the diversity of their speech. Nonetheless, only lexical diversity was correlated with child language growth. In the study by Hirsh-Pasek et al. (2015) the sample consisted of 60 low-income families. Within that sample large variability was found and revealed that language input quality was more predictive of child receptive language outcomes compared to the quantity of child directed speech. These findings point to the idea that quality of maternal language input is one the most significant factors in child language development. The observed differences between SES groups might reflect a general trend, namely high-quality maternal language input is more common in higher SES families. Nonetheless, many families from low SES strata also provide high-quality language environments.

Furthermore, studies have found that aspects of maternal language input mediate the relationship between SES and child language outcomes (Hoff, 2003; Huttenlocher et al., 2010; Romeo et al., 2018). However, all of these studies have used different measures of SES. Therefore, it is conflicting to directly compare findings from research using maternal education to those using yearly income. The use of maternal education is the most commonly used proxy for SES due to strong relationships with child development (Hoff, 2003, 2013; Vernon-Feagans et al., 2020). Mothers who have acquired more education and had more exposure to written texts, show an increased vocabulary and a

more complex sentence structure of their language (Hoff et al., 2018; Rowe, 2008). Maternal education is often correlated with family income, but not necessarily with the SES of the neighborhood. While investigating SES, both proximal and distal influences have to be considered. By better understanding which aspects of SES influence maternal language input, as well as children's language skills, the more prepared we will be to design interventions that enhance language environments for children from lower SES backgrounds.

The Present Study

In my research I will investigate how various dimensions of SES, including educational, financial, and material resources, relate to dimensions of parental language input, including both quantitative and qualitative measures, and how input in turn relates to children's receptive language outcomes.

Hypotheses

In light of the above literature review, my work aims to contribute to the understanding of the complexity of SES beyond its apparent implications. By employing a dimensional approach, I will investigate the impact of different components of SES, such as maternal education, family income-to-needs ratio, financial security, and neighborhood SES on both quantitative and qualitative measures of maternal language input, and in turn their effect on child language measures.

Hypothesis 1: I hypothesize that different components of SES will have different effects on quantitative and qualitative measures of maternal language input. Specifically, I

hypothesize that maternal education will be more strongly related to language input than measures of financial resources.

Hypothesis 2: I hypothesize that different components of maternal linguistic input quality will show different effects on child language receptive measure. Specifically, I hypothesize that syntactic complexity will be more strongly related to child receptive language measure than lexical diversity.

Hypothesis 3: I hypothesize that the quality of maternal linguistic input will mediate the association between the maternal education measure and child receptive language measure.

Methods

Participants

The data utilized for this study have been collected at the University of Washington by Dr. Liliana J. Lengua and her colleagues (as described in Lengua, Moran, & Zalewski, 2015). The complete sample included 306 child-mother dyads that were recruited from university-hospital birth register, daycares, preschools, health clinics, libraries and charitable agencies in proximity to King County, Washington. Families participated in four assessments that occurred at 9-month intervals beginning when the child was 3 years old. Sample distribution included 29% of the participants at or near poverty, 27% below the local median income, 25% above the local median income up to $100,000, and 18% of the upper income that exceeded $100,000 (Klein et al., 2018). 50% of the children participants were girls, 64% were European Americans, 10 % Latino or Hispanic, 9% African Americans, 3% Asian Americans, 2% Native Americans, 12% of children were of other or combination of racial and ethnic backgrounds (Lengua et al., 2015). Mothers' educational background varied, with 3% obtaining some high school education, 6% obtaining high school diploma, 34% obtaining some college education, technical school or professional school, 30% obtaining college diploma, and 27% with post-graduate education. Families were required to have reasonable proficiency in English (self-determined) to participate, and children with developmental disabilities were excluded.

Procedures

At each time point, mother-child dyads participated in a 2-hour assessment including child cognitive testing, parent surveys, and a video-taped parent-child interaction. The parent-child interaction was a 25-minute session that was split in four parts: 7-minutes structured play in which the child is not allowed to play with a visible shelf of highly desirable toys, 7-minutes unstructured play in which the child can play with any toys, 7-minutes LEGO task in which parents must help children build a difficult figure, and 3-minutes cleanup. In my study, I analyzed structured and unstructured sections of the video recording from the first time point, when children were 36-40 months old, in addition to assessments of the child's language ability, and parent surveys about SES, family resources, and family functioning.

Measures

Components of SES

Five components of SES and/or SES-related resources were determined from parent report surveys collected at the first data point. (1) Maternal education was rated on an 8-point scale ranging from less than 8th grade to advanced degree. (2) Family income-needs ratio was computed as the ratio of the total family income divided by the federal poverty threshold for that size family. (3) Financial security was computed by taking the mean of seven questions about family's accessibility to proper housing, clothing, furniture, car, food, medical care and recreational activities in the past 3 months rated on a 5-point scale ranging from 1 – strongly disagree to 5 – strongly agree. (4) Neighborhood SES that encompasses health and environment, education and

socioeconomic domain, was examined using the Child Opportunity Index (COI) database by geocoding participants' residential addresses.

Maternal Linguistic Input

Measures of maternal linguistic input were derived from video recordings of the structured and unstructured play sections of the parent-child interaction from the first data point. Transcription of the videos was conducted by the group of research assistants from the Stress and Development Lab from Harvard University. The process of transcription took seven months. I have spent approximately 640 hours transcribing the video recordings of mother-child interactions. Videos were transcribed verbatim at the utterance level using Codes for the Human Analysis of Transcripts (CHAT) format of the Child Language Data Exchange System (CHILDES; MacWhinney, 2000). Utterances are defined by grammatical closure, terminal intonation contour, pause, or speaker change. Dyad-level measures of input quantity and quality was calculated in the Child Language Analyses (CLAN) program. Input quantity measures included the number of utterances. Input quality measures encompassed lexical diversity (VOCD), and syntactic complexity (mean length of utterance in morphemes). All measures were normalized per minute to accommodate slight differences in video length.

Child Receptive Language Outcome

Child receptive language skills were measured by the Comprehension of Instructions subtest of the NEPSY ("A Developmental NEuroPSYchological Assessment"), which assesses children's ability to receive, process and execute oral instructions of increasing syntactic complexity. For each item, the child points to appropriate stimuli in response to

oral instructions given by the experimenter. Age-normed standard scores will be used as the outcome measure. Please see Appendix A for the instructions and the questionnaire used to collect responses.

Covariates

Covariates in the study include maternal depression (score on the Center for Epidemiologic Studies Depression Scale, CES-D), child's birth order, and child's sex.

Attrition

Due to low quality of video recordings or usage of non-English languages, 30 video recordings were removed from the dataset, rendering 276 video recordings total. Moreover, due to missing or not matching participants' address information, only 222 out of 276 addresses were geocoded and used in this study.

Results

Descriptive information and bivariate correlations among key variables in this study are shown in Table 1. and Table 2. The collected verbatim transcription of mother-child interaction showed that the mean of words per minute was at 71.78 words (SD=18.97), grammatical complexity had a mean of 4.82 (SD=.77) MLU in morphemes, lexical diversity had a mean of 53.01 (SD=6.65) and age standardized measure of child receptive outcomes had at mean of 10.28 points (SD=2.87).

SES Differences in Child Receptive Language Scores

The first part of my analysis aimed to evaluate the effects of different components of SES on child receptive language outcomes (See Figure 1., *c* path). I hypothesized that maternal education would be more strongly related to child receptive outcomes than measures of financial resources. I estimated multiple regression models predicting child receptive language outcomes with all four SES measures (mother's education, income-to-needs, financial security, and neighborhood SES) entered simultaneously. The model predicting child language outcomes with all of the predictors was significant ($F(4, 232) = 13.390$, $p < .001$), with the four SES predictors collectively accounting for 18.8% of variance in the child receptive outcomes. Investigating the unique contribution of each predictor, maternal education was the only significant predictor, with higher maternal education associated with child language outcomes (β=.299, $t = 4.414$, SE=.082, p<.001). Results from this regression modeling can be found Table 3. I then conducted a stepwise regression to remove insignificant predictors. The model with the greatest R^2 (.157)

included only maternal education (F(1,211)=39.372, p<.001). These results can be found in Table 4. This suggests that children whose mothers attained more years of education, on average, score significantly higher on measures of receptive language use.

SES Differences in Maternal Linguistic Input

The second part of my study was focused on investigating various components of SES and its impact on quantitative and qualitative measures of maternal language input (see Figure 1. *a* path). I hypothesized that maternal education would be more strongly related to language input than measures of financial resources. To test this hypothesis, I estimated multiple regression models predicting each of the three input measures (words uttered, vocabulary diversity, and grammatical complexity) with all four SES measures (mother's education, income-to-needs, financial security, and neighborhood SES) entered simultaneously.

The model predicting grammatical complexity was significant ($F(4, 215) = 5.322$, $p < .001$), with the four SES predictors collectively accounting for 7.3% of variance in the mean utterance length of maternal language input. Investigating the unique contribution of each predictor, maternal education was the only significant predictor, with higher maternal education associated with greater grammatical complexity of the maternal language input (β=.281, t = 3.752, SE=.023, p<.001). These results can be seen in Table 5. I then conducted stepwise regressions to remove insignificant predictors. The model with the greatest R^2 (.074) included only maternal education (F(1,218)=18.391, p<.001). See Table 6 for the results of the stepwise regression model.

This suggests that mothers who attained more years of education on average use more grammatically complex structures when communicating with their children.

To further investigate the effects of SES on maternal language input, I also employed stepwise regression models on lexical diversity and words uttered per minute. For vocabulary diversity, the best fitting model included mother's education ($F(1, 218) = 5.458$, $p < .05$), which explained 2.4% of the variance in lexical diversity. Maternal education was a significant predictor (β=.156, $t = 2.336$, SE=.173, p<.05), with higher education associated with more lexical diversity as shown in Table 7. For words uttered per minute, none of the SES variables produced a model with significant variance explained.

Maternal Language Input and Child Receptive Language Outcomes

My third research question aimed to uncover whether quantity and quality of maternal linguistic input was associated with child receptive language outcomes (See Figure 1., *b* path). I hypothesized that syntactic complexity will be more strongly related to child receptive language measure than lexical diversity, and that both qualitative measures would predict receptive language better than the quantitative measure of words uttered. To test these hypotheses multiple linear regression was used. Results revealed that 17.3 % of variance in child receptive language outcomes can be accounted for by the three predictors, collectively ($F(3,259)=18.074$, p<.001). Further analysis of the model suggests that grammatical complexity was positively associated with child receptive language outcomes (β=.403, $t = 6.164$, SE=.231, p<.001), and lexical diversity was also

positively associated with child receptive language outcomes (β=.167, t= 2.870, SE=.024, p<.005). However, words per minute was negatively associated with child receptive language outcomes (β= -.032, t= -3.424, SE=.009, p<.001). Results from this analysis are shown in Table 8. This suggests that grammatical complexity has the strongest relationship with child receptive language outcomes, and only qualitative measures of input positively predicted the child language outcomes.

Grammatical Complexity of Maternal Language Input Mediates the Relation Between Maternal Education and Child Receptive Language Outcomes

My final analysis aimed to uncover whether maternal language input mediates the correlation between SES and child receptive language outcomes. Only maternal education and grammatical complexity were explored based on the above regression results. The relationship between maternal education and child receptive language scores was partially mediated by grammatical complexity of maternal language input. As Figure 1. illustrates, the standardized regression coefficient between maternal education and grammatical complexity of maternal language input (*a* path ß=0.27) was statistically significant, as was the standardized regression coefficient between grammatical complexity of maternal language input and child receptive language scores (*b* path ß=0.24). A bootstrapped mediation model revealed a standardized indirect effect of .066, with a 95% bias-corrected confidence interval from .027-.117. The direct effect remained significant (*c'* path ß=0.38) though the ratio of the indirect to total effects of .164

indicated that maternal grammatical complexity explained approximately 16.4% of the effect of maternal education on children's receptive language scores.

After discovering that grammatical complexity of maternal linguistic input significantly mediated relationships between maternal education and child receptive outcomes and, I explored models controlling for multiple covariates such as maternal depression, single parenting, child's sex and child's birth order. Only the child's birth order was significantly related to both the quality of maternal language input and child receptive outcomes (*a* path ß=0.22; *b* path ß=0.23; *c'* path ß=0.31). Controlling for birth order, the standardized indirect effect was reduced to .06, and the bootstrapped standardized indirect effect was .05, with a 95% from .0138, .0998. Thus, the indirect effect was still statistically significant.

Discussion

The goal of the present study was to identify the pathways by which SES influences child language outcomes. In my study, I was able to demonstrate a robust effect of maternal education on language input and child receptive language outcomes. My analysis also revealed that the grammatical complexity of maternal speech partially mediated the correlation between maternal education and child language outcomes. Identification of the mediating variable does not fully explain the association between maternal education and child language outcomes, but it provides one pathway that contributes to the association.

Outcomes and Implications

Using a data set with substantial variability in both caregiver's socioeconomic status and child language outcomes, I found SES-related differences in maternal language input and child receptive language outcomes at 36-40 months. Maternal education was the most strongly correlated SES variable when predicting child language outcomes. Maternal education predicted the quality of maternal language input such as grammatical complexity and lexical diversity. However, maternal education was not correlated with quantitative measure of words per minute. Mothers who on average attained more education used more complex language and diverse vocabulary.

Moreover, I examined how quantity (words per minute) and quality (grammatical complexity and lexical diversity) of maternal linguistic input are related to child receptive language outcomes. I found that the quality of maternal linguistic input positively

predicted child receptive outcomes, specifically grammatical complexity had the strongest effect on child receptive outcomes. I also found an unexpected negative relation between words uttered per minute and child receptive language outcomes.

Lastly, I have also discovered that the grammatical complexity of maternal linguistic input partially mediated the relation between maternal education and child receptive outcomes, suggesting that the quality of maternal language input partially accounts for variability in the relationship between maternal education and child receptive outcomes.

SES-Related Differences in Child Receptive Outcomes and Maternal Linguistic Input

These analyses built upon and extended several prior studies investigating the influences of SES on child language development. Maternal education is a strong predictor of both child language outcomes and maternal linguistic input (Hoff, 2003). A study by Guryan, Hurst and Kearney (2008) linked parental education with increased parent-child interactions, which might lead to positive developmental outcomes. Previous studies have found that parenting knowledge about child development has a positive effect on parent-child communication (Rowe, 2008; Rowe et al., 2016; Rowe & Leech, 2019). Also, mothers who have more education are more likely to seek professional help and read written texts about child development (Rowe, 2017). Overall, mothers who acquired more education might be more aware of parenting strategies and ways to foster language development in general.

Furthermore, mothers with more education have more exposure to written texts in the academic environment, which in turn could have improved the grammatical complexity of their speech. Similar effects of maternal education on grammatical complexity were found within bilingual mothers. Specifically, education in a particular language was correlated with the syntactic complexity only in the language mother received formal education, which in turn related to child language development (Hoff et al., 2018; Hurtado, Marchman & Fernald, 2008).

In my study, I have also investigated the effects of income-to-needs ratio and financial security on child receptive outcomes and maternal language input. I observed only a correlation between the financial security and grammatical complexity of maternal linguistic input, as well as child receptive outcomes. However, grammatical complexity did not mediate the relation between financial security and child receptive outcomes. This could indicate that financial resources do not directly impact maternal linguistic input. Financial resources may fluctuate more compared to education, which once acquired remains stable. Therefore, education or lack thereof might have more profound influence on language regardless of financial circumstances.

Furthermore, the key to understanding how SES impacts maternal language input and child language outcomes may lie in structural constraints that lower-SES parents face, which are not typically captured in traditional SES measures. For example, a recent study by Ellwood-Lowe, Foushee and Srinivasan (2020) found that regardless of parental income, parents who were asked to reflect on recent financial scarcity spoke less on average to their 3-year-old children when compared to parents in the control group.

Therefore, it is crucial to investigate the role of parental stress related to financial resources on both the language input and child language outcomes.

In order to investigate broader aspects of SES, I have examined the role of the neighborhood SES on maternal language input and in turn on child receptive outcomes. Results showed a correlation between state-normed neighborhood SES and child receptive outcomes, but there was no effect observed on maternal language input. No mediation was found. Nonetheless, neighborhood SES impacts a wide range of resources such as access to education, healthcare and employment. Neighborhood SES does not have an effect on maternal linguistic quality and quantity, but it still has an effect on child receptive outcomes.

My study has revealed an important mechanism between maternal education and maternal linguistic input, which in turn has an effect on child receptive outcomes, but it does not aim to discredit how various SES-related measures impact child language development. This study implies that when studying the effects of SES on language development, it is crucial to discriminate between educational, occupational, financial and community related SES measures. SES should not be studied using a composite measure of SES neither relying on one measure as a proxy for SES. Due to its complexity and various effects on child's language development, many components of SES should be included in studies and measured separately.

The Role of Quantity and Quality of Maternal Language Input

The quantity of maternal input was not correlated with any of the SES measures. Regressing child receptive outcomes on quantity and quality of maternal input revealed

that input quality measured by words per minute negatively predicted child receptive language outcomes (β=-.213, t = -3.333, SE=.010, p<001). This finding might be a result of the experimental design, in which during the first half of the experiment children were asked not to play with the toys on the shelf and later in the second half they were informed by the researcher that it is permitted to play with the toys on the shelf. Therefore, mothers who attained less education used more words per minute to behaviorally regulate children compared to mothers who acquired more education. Most studies that have found positive associations between SES and the number of words instead measured language input in free play with no instructions or need for behavioral regulation. Moreover, the quantity of maternal input might not play a significant role when a child is around 3 years old, as in this study. These results are consistent with the previous findings that quantity of input is most important during the first two years of life (Rowe, 2012).

On the other hand, quality of language becomes more important around the third year of life. Accordingly, my study has revealed that grammatical complexity of maternal input was not only correlated with maternal education, income-to-needs ratio and neighborhood SES, but it has also mediated the relation between maternal education and child receptive outcomes. Previous studies have also found a similar pattern, in which quality of input was more predictive of language outcomes in children around 30 months old (Rowe & Snow, 2020; Rowe & Zuckerman, 2016). Grammatical complexity and lexical diversity are correlated; therefore, it is harder to discern their specific impact on child language outcomes. In my study, both grammatical complexity and lexical diversity

accounted for variance in child receptive outcomes. However, grammatical complexity (β=.395, t = 6.082, SE=.241, p<001) showed stronger effect on child receptive outcomes than lexical diversity (β=.167, t = 2.862, SE=.025, p<005). This finding could be also related to the child's age, indicating that lexical diversity is not as crucial around 36 months old, and might play a more essential role during earlier developmental stages (Rowe, 2012).

Limitations

In the light of the above findings, it is important to note that there are several limitations to the current study. Mothers in the study approximated the U.S. population on mother's education level, however, my sample included a larger proportion of mothers who acquired a graduate degree compared to the U.S population. This sample also did not include mothers who received less than high school education. Moreover, this study is reflective of monolingual English-speaking households in the Seattle Metro Area, WA, where data were collected. Future research should focus on more diverse populations from both urban and rural areas, as well as bilingual households of immigrant populations.

Second, I examined maternal language input using three variables – words per minute, lexical diversity and grammatical complexity derived from in-vivo transcriptions. Literature shows that these variables are predictive of child language outcomes, but an increasing amount of research also examines additional variables such as conversational turn taking and maternal usage of decontextualized language. These variables are

currently a rich area of research in the context of child language development and therefore should be considered in future research.

Lastly, the nature of controlled observation could have a confounding influence. Mothers and children were fully aware of being watched; therefore, the linguistic input might have been higher than average due to the Hawthorne effect. Some researchers suggested that even though SES is related to parent-child communication, SES differences were not observed in parent-researcher interaction (Rowe, 2008). Moreover, this study was not originally aimed to investigate child language outcomes. Due to the nature of secondary research design some aspects of this study might have confounded the results such as the already mentioned design of study (i.e., restricted play session). Additionally, the child language outcome measure was not a complete measure of child language abilities. It focused on syntactic complexity and children's comprehension skills. Therefore, it is possible that lexical diversity may also mediate the relation between maternal education and other measures of child language skills, such as the child's expressive language skills. Expanding on this study, I plan on investigating the quantitative and qualitative aspects of child language outcomes and how they change over time.

Future Research and Direction

The present study aimed to separate the components of SES measure and their effects on maternal language input and child receptive outcomes. Maternal education was found to be a significant predictor of the variation in lexical diversity and grammatical complexity, as well as child language outcomes. Nonetheless, all of the measures of SES

were correlated with child language outcomes. This indicates that even though different components of SES do not impact maternal input, other SES-related variables may affect child language development through various other pathways that might not be directly related to maternal language input. In my study, I discovered one pathway in which grammatical complexity of the maternal input partially mediates the relationship between maternal education and child language outcomes. Present evidence should encourage researchers who study the SES-related differences in language development to include multiple SES measures, as well as various aspects of maternal language input and child speech to study their specific pathways.

Socioeconomic status creates large divides in educational outcomes for children across the United States. It is crucial to understand what drives this correlation. Maternal education has been often used and associated with the child language and educational outcomes, but closer investigation of this variable is also needed. Maternal education in the United States might be a proxy for socioeconomic status that does not directly relate to language skills. It is possible that mothers who acquire a higher level of education are also able to afford more expensive childcare, which in turn might provide more advanced care and resources for children. Therefore, future studies should also investigate the language environment of childcare centers and its effects on child language outcomes.

Moreover, I hope that my findings contribute to the applied research in child language development. My study among many others emphasizes the importance of the quality over the quantity of maternal language input. Future studies should focus on ways in which we can enhance the grammatical complexity of input regardless of mother's

educational level. Early interventions including educational resources for mothers to improve their language skills, as well as access to educational resources for children in less advantageous areas could help close the achievement gap between low and high SES families in the US.

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Tables

Table 1. Sample Descriptive Statistics

Descriptive Statistics

	Mean	Std. Deviation	N
Mother's Education	15.20	2.43	276
Income-to-Needs	2.93	1.90	276
Financial Security	3.69	.90	274
Neighborhood SES	59.48	28.42	222
Words per Minute	71.78	18.97	276
Grammatical Complexity	4.82	.77	276
Lexical Diversity	53.01	6.65	276
Child Receptive Outcomes	10.28	2.87	276

Table 2. Correlations

Bivariate Correlations of Key Variables

	1	2	3	4	5	6	7	8
1. Mother's Education	—							
2. Income-to-Needs	.474**	—						
3. Financial Security	.255**	.398*	—					
4. Neighborhood SES	.217**	.272*	.085	—				
5. Words per Minute	.098	.042	.099	.038	—			
6. Grammatical Complexity	.278**	.126*	.050	.167*	.463**	—		
7. Lexical Diversity	.131*	.091	.014	.101	.164**	.234**	—	
8. Child Language Outcomes	.395**	.330*	.154**	.185**	-.003	.335**	.224**	—

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3. Multiple Regression: SES and Child Receptive Language Outcomes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.433[a]	.188	.174	2.610

a. Predictors: (Constant), Neighborhood SES, Financial Security, Mother's Education, Income-to Needs Ratio

b. Dependent Variable: Child Receptive Language Outcomes

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	364.892	4	91.223	13.390	.000[b]
	Residual	1580.578	232	6.813		
	Total	1945.470	236			

a. Dependent Variable: Child Receptive Language Outcomes

b. Predictors: (Constant), Neighborhood SES, Financial Security, Mother's Education, Income-to Needs Ratio

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	3.556	1.264		2.812	.005	1.065	6.046
	Mother's Education in Years	.361	.082	.299	4.414	.000	.200	.522
	Income-to-Needs Ratio	.252	.111	.165	2.281	.023	.034	.470
	Financial Security	.018	.200	.006	.090	.929	-.377	.412
	Neighborhood SES	.008	.006	.075	1.205	.230	-.005	.020

a. Dependent Variable: Child Receptive Language Outcomes

Table 4. Stepwise Regression: SES and Child Receptive Language Outcomes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.397[a]	.157	.153	2.517

a. Predictors: (Constant), Mother's Education in Years

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	249.448	1	249.448	39.372	.000[b]
	Residual	1336.843	211	6.336		
	Total	1586.291	212			

a. Dependent Variable: GO1 Comprehension of Instructions Standard

b. Predictors: (Constant), Mother's Education in Years

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.624	1.081		3.353	.001
	Mother's Education in Years	.438	.070	.397	6.275	.000

a. Dependent Variable: GO1 Comprehension of Instructions Standard

Excluded Variables

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	Financial Security	-.049[b]	-.743	.458	-.051	.923
	Income to Needs	.129[b]	1.797	.074	.123	.767
	Social and economic domain, state-normed	.110[b]	1.706	.089	.117	.951

a. Dependent Variable: GO1 Comprehension of Instructions Standard

b. Predictors in the Model: (Constant), Mother's Education in Years

Table 5. Multiple Regression: SES and MLU

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.300[a]	.090	.073	.71726

a. Predictors: (Constant), Neighborhood SES state-normed, Financial Security, Mother's Education in Years, Income to Needs

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.951	4	2.738	5.322	.000[b]
	Residual	110.608	215	.514		
	Total	121.559	219			

a. Dependent Variable: Mean length of utterance in morphemes

b. Predictors: (Constant), Neighborhood SES state-normed, Financial Security, Mother's Education in Years, Income to Needs

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.441	.355		9.682	.000
	Mother's Education in Years	.085	.023	.281	3.752	.000
	Income to Needs	-.012	.030	-.031	-.401	.689
	Financial Security	-.029	.059	-.035	-.501	.617
	Neighborhood SES	.003	.002	.107	1.586	.114

a. Dependent Variable: Mean length of utterance in morphemes

Table 6. Stepwise Regression: SES and MLU

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.279[a]	.078	.074	.71710

a. Predictors: (Constant), Mother's Education in Years

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.457	1	9.457	18.391	.000[b]
	Residual	112.102	218	.514		
	Total	121.559	219			

a. Dependent Variable: Mean length of utterance in morphemes

b. Predictors: (Constant), Mother's Education in Years

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.473	.307		11.323	.000
	Mother's Education in Years	.085	.020	.279	4.288	.000

a. Dependent Variable: Mean length of utterance in morphemes

Excluded Variables

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Income to Needs	-.020[b]	-.265	.791	-.018	.777
	Financial Security	-.042[b]	-.613	.540	-.042	.926
	Neighborhood SES	.102[b]	1.536	.126	.104	.956

a. Dependent Variable: Mean length of utterance in morphemes

b. Predictors in the Model: (Constant), Mother's Education in Years

Table 7. Stepwise Regression: SES and Lexical Diversity

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.156[a]	.024	.020	6.27206

a. Predictors: (Constant), Mother's Education in Years

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	214.696	1	214.696	5.458	.020[b]
	Residual	8575.846	218	39.339		
	Total	8790.542	219			

a. Dependent Variable: Vocabulary Diversity (VOCD)

b. Predictors: (Constant), Mother's Education in Years

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	46.517	2.682		17.342	.000
	Mother's Education in Years	.405	.173	.156	2.336	.020

a. Dependent Variable: Vocabulary Diversity (VOCD)

Excluded Variables

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Income to Needs	-.020[b]	-.265	.791	-.018	.777
	Financial Security	-.042[b]	-.613	.540	-.042	.926
	Neighborhood SES state-normed	.102[b]	1.536	.126	.104	.956

Table 8. Multiple Regression: Maternal Language Input and Child Receptive Outcomes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.416[a]	.173	.164	2.520

a. Predictors: (Constant), Vocabulary Diversity (VOCD), Tokens per Minute, Mean length of utterance in morphemes

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	344.215	3	114.738	18.074	.000[b]
	Residual	1644.218	259	6.348		
	Total	1988.433	262			

a. Dependent Variable: GO1 Comprehension of Instructions Standard

b. Predictors: (Constant), Vocabulary Diversity (VOCD), Tokens per Minute, Mean length of utterance in morphemes

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.059	1.441		1.429	.154
	Tokens per Minute	-.032	.009	-.220	-3.424	.001
	Mean length of utterance in morphemes	1.426	.231	.403	6.164	.000
	Vocabulary Diversity (VOCD)	.069	.024	.167	2.870	.004

a. Dependent Variable: GO1 Comprehension of Instructions Standard

Figures

Figure 1. Analytical Mediation Model

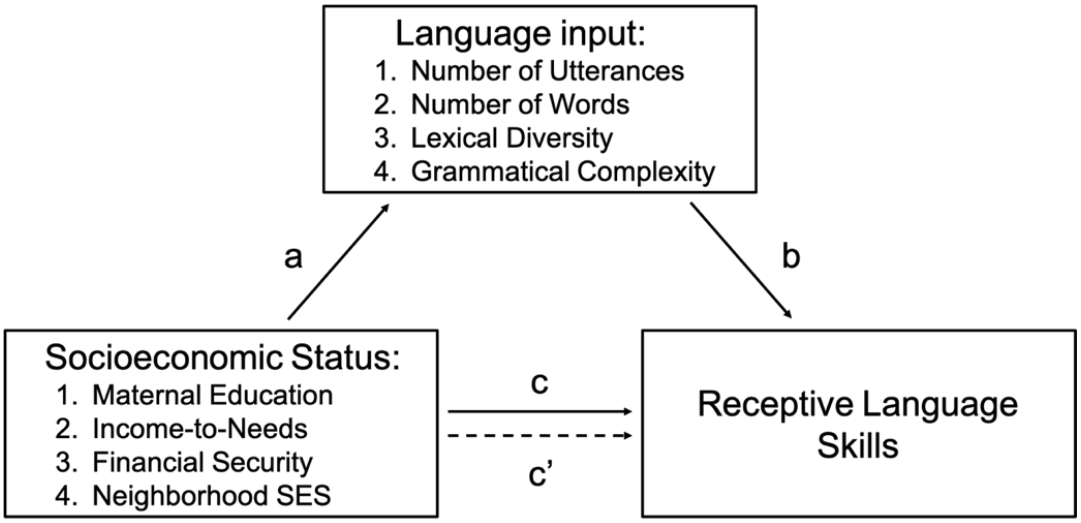


Figure 2. Mediation Model

Model showing the effect of maternal education on child receptive language skills as mediated by grammatical complexity of maternal linguistic input. Solid arrows represent direct paths, whereas the dotted arrow represents the indirect (mediated) path. Asterisks indicate significant paths, ***p < .001).

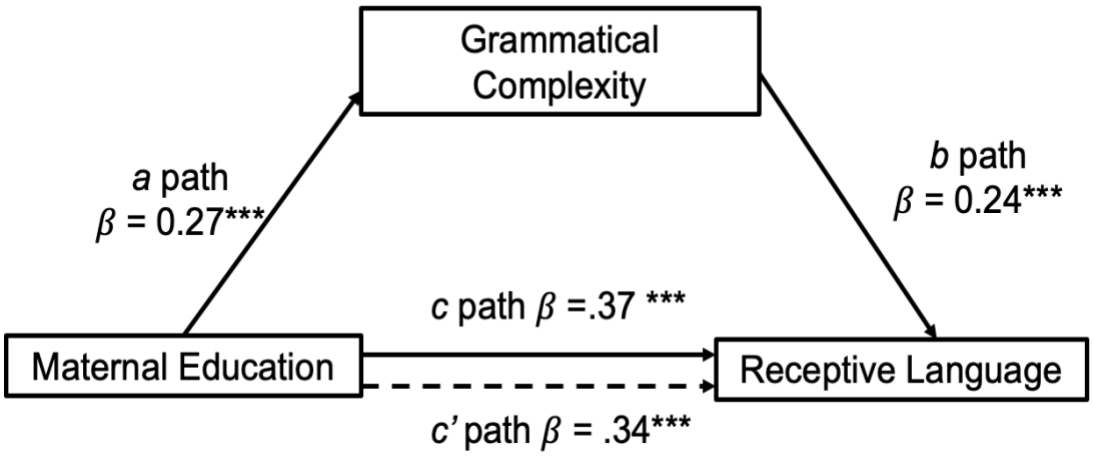


Figure 3. Mediation Model *a*-Path

Relationship between grammatical complexity of maternal language input and mother's education in years.

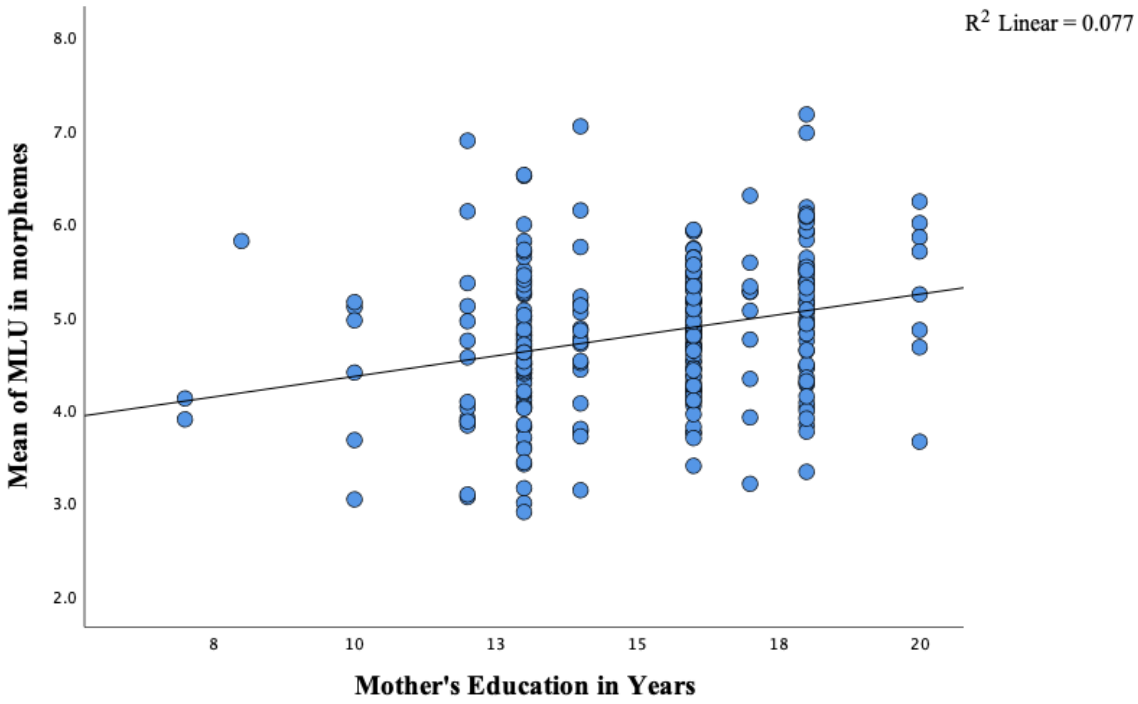


Figure 4. Mediation Model *b*-Path

Relationship between grammatical complexity of maternal language outcome and child receptive language outcomes.

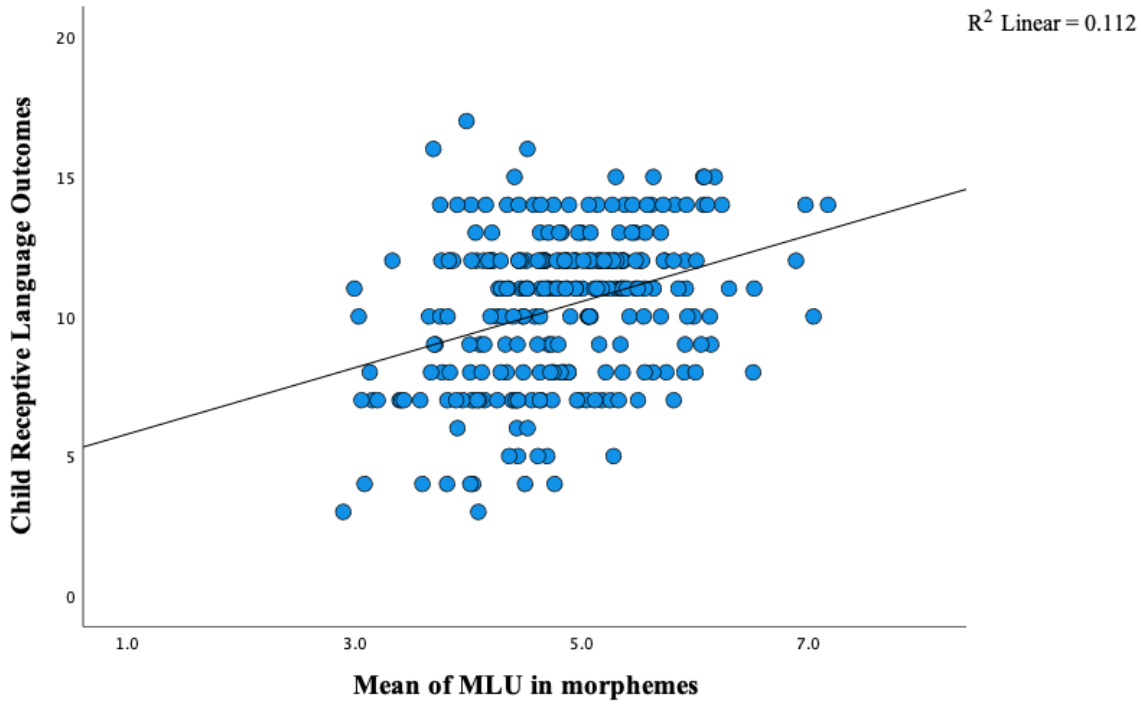
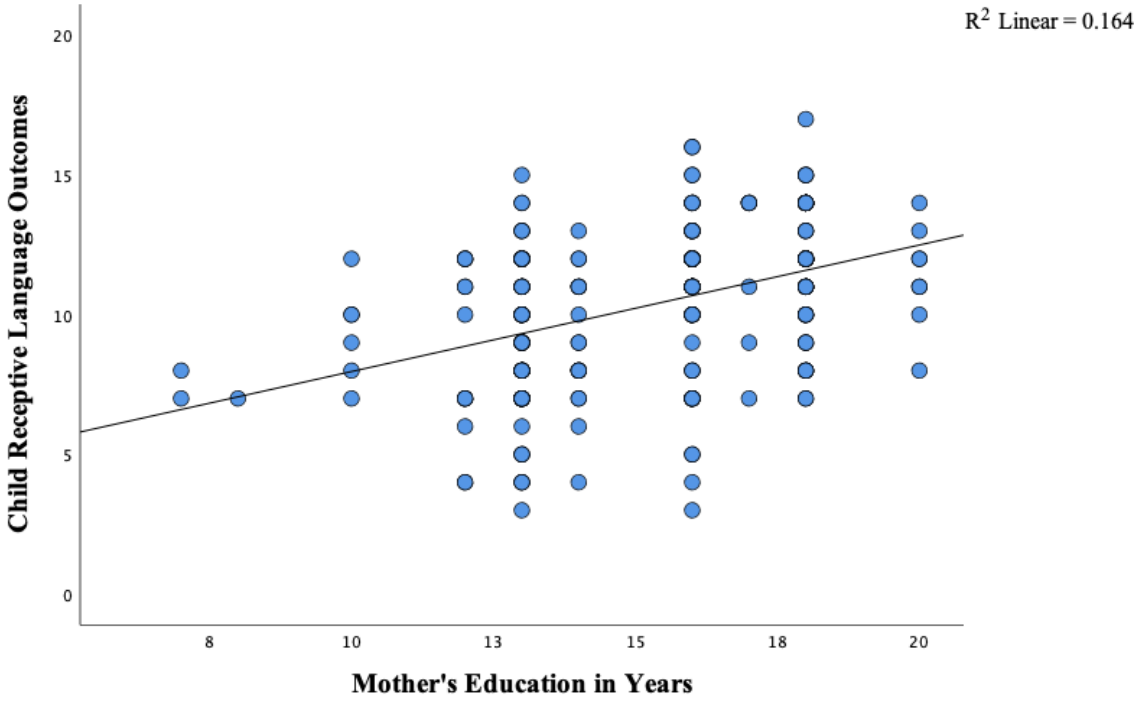


Figure 5. Mediation Model *c*-Path

Relationship between child receptive language outcomes and mother's education in years.



Appendix A

Comprehension of Instructions (Ages 3-16)

Read each item at a normal rate of speech. Do not cue the child by stressing particular words.

Record requests for repetitions of items on the Record Form, but do not repeat any items.

If an item makes reference to order (e.g. *first, after, last),* the sequence of the child's response must be in the correct order to be considered correct.

If an item makes reference to "a" bunny or "a" shape (e.g., "a" little bunny, "a" red shape), and the child points to multiple bunnies or multiple shapes that are the correct response (e.g., "Point to a big bunny" and the child points to all the big bunnies on the page), the response should be considered correct.

If the Item specifically says "Point to *one* bunny," then the child is required to point to exactly one bunny and pointing to multiple bunnies should be considered an incorrect response.

For any item containing words that indicate direction, these words make reference to the first shape in that direction (e.g., "the circle below the white cross" means the circle immediately and directly below the white cross).

For Items 21 and 29, correct responses may be provided using either a “classroom” row or a traditional row. The “classroom” row reflects vertical alignment on the page similar to how desks are aligned front to back in a classroom. Traditional row reflects horizontal alignment on the page. A response using either the “class-room” row or traditional row should be considered correct.

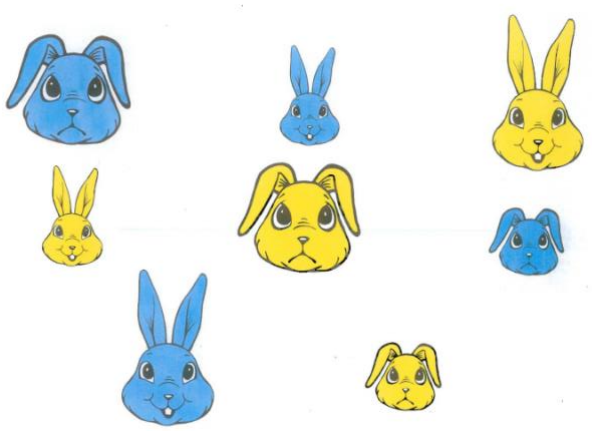
For Item 21, the third shape makes reference to the third shape in the row counting from left to right of the page from the child’s perspective for a traditional row and counting from the top to the bottom of the page from the child’s perspective for a “classroom” row. The third shape counting from right to left of the page and bottom to top of the page from the child’s perspective should be considered incorrect responses.

For Item 29, the first row makes reference to the row at the top of the page from the child’s perspective for a traditional row and the row on the left side of the page from the child’s perspective for a “classroom” row. The second cross on the row on the bottom of the page and the right side of the page from the child’s perspective should be considered incorrect responses.

For item 27, “diagonal” makes reference to the shape that is at a 45° angle from the black and red crosses, which is the red circle and the only correct response. The blue cross should be considered an incorrect response.

For Item 28, the child must provide three distinct responses. The child cannot receive credit for both “a cross” and “the red cross” by only pointing to the red cross. A response consisting of the black circle, the red cross, and a cross that is not red should be considered correct.

Place Stimulus Book flat in front of the child and turn to the age-appropriate start point.



Items 1-13

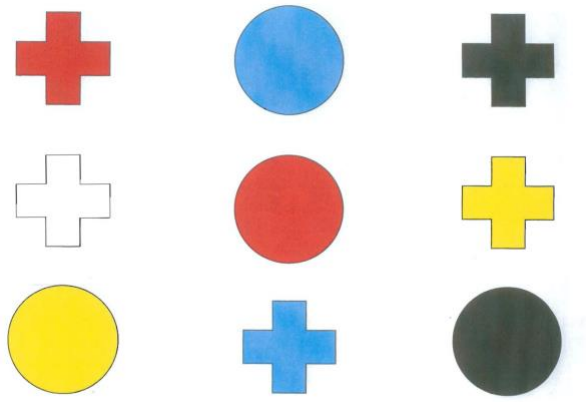
Point to the stimulus for Items 1-13 and say "I will ask you to point to some pictures. Point as soon as I finish talking. Listen very carefully because I can only say it once." If necessary, remind the child to wait for the whole instruction before pointing. Do not repeat any item.

1. Show me a little bunny.
2. Show me a big bunny.
3. Show me a blue bunny.
4. Show me a happy bunny.
5. Show me a sad bunny.
6. Show me a yellow bunny.
7. Show me a bunny that is big and yellow.
8. Show me a bunny that is big and blue.
9. Show me a little sad bunny.
10. Show me a bunny that is little and blue.

11. Show me a little happy bunny.

12. Show me a bunny that is big and blue and happy.

13. Show me a bunny that is little and yellow and sad.



Items 14-33

Say, “Listen Carefully. See these circles and crosses? Point the ones I name. Point to a circle [pause for child to point]. Point to a cross [pause for the child to point].” Correct any errors.

Regardless of the child’s responses to the Prerequisite Items, administer Item 14 and proceed forward until the discontinue rule is met.

Say, “I will ask you to point to some pictures. Listen carefully, because I can only say it once. Wait until I am finished to point.” If necessary, remind the child to wait for the whole instruction before pointing. Do not repeat any item.

14. Point to the white one and a circle.

15. Point to the blue cross and the yellow cross.

16. Point to a shape that is not a circle, but is yellow or black.

17. Point to one that is not a cross and not blue or yellow.

18. Point to a blue circle last and a black cross first.

19. Point to all the crosses and then to a red circle.

20. Point to two red ones, but first to a yellow cross.

21. Point to the black circle and the third shape in the second row.

22. If there is a white circle, touch three crosses and a black circle.

23. Point to a shape followed by another shape of the same color.

24. Point to two shapes that are neither red nor crosses.

25. Point to a shape that is between two crosses and above a circle.

26. Point to a shape that is above one cross and beside another cross.

27. Point to the shape that is diagonal to both the red cross and the black cross.

28. Point to a cross, the black circle, and the red cross.

29. Point to the second cross in the first row, but first to a blue circle.

30. Point to a cross that is to the left of a circle and underneath a cross.

31. Point to a shape adjacent to the yellow circle but not the same shape.

32. Starting on the right, touch every other shape in the top row.

33. Point to a shape that is to the right of a circle but not next to it.