Received: 11 November 2022 | Revised: 5 July 2023 | Accepted: 8 January 2024

DOI: 10.1002/icd.2493

REPORT

WILEY

# Investigating the association between socioeconomic status and language skills in children with autism spectrum disorder or other developmental delays

Meredith Pecukonis[1] | Julia Levinson[2] | Andrea Chu[2] | Sarabeth Broder-Fingert[3,4] | Emily Feinberg[2,3] | Howard Cabral[2] | Helen Tager-Flusberg[1]

[1]Department of Psychological & Brain Sciences, Boston University, Boston, Massachusetts, USA

[2]Boston University School of Public Health, Boston, Massachusetts, USA

[3]Boston University School of Medicine, Boston, Massachusetts, USA

[4]Boston Medical Center, Boston, Massachusetts, USA

**Correspondence**
Meredith Pecukonis, Department of Psychological & Brain Sciences, Boston University, Boston, MA, USA.
Email: mpecukon@bu.edu

**Present addresses**
Julia Levinson, University of California Berkeley, Berkeley, California, USA; Andrea Chu and Emily Feinberg, Brown University, Providence, Rhode Island, USA; and Sarabeth Broder-Fingert, Department of Pediatrics and Eunice Kennedy Shriver Center at UMASS Chan School of Medicine, Worcester, Massachusetts, USA.

**Funding information**
National Institute on Deafness and Other Communication Disorders, Grant/Award Number: F31DC019562; Maternal and Child Health Bureau, Grant/Award Numbers: T32HS022242, T32HS10038; National Institute of Mental Health, Grant/Award Numbers: R01MH104355-02S1, K23MH109673, R01MH104355

**Handling Editor:** Emily Farran

## Abstract

Numerous studies have reported that socioeconomic status (SES) predicts language skills in typically developing children. However, this association has been less systematically studied in children with developmental disabilities, such as autism spectrum disorder (ASD) or other developmental delays (DD). In the present study, we examined the association between SES, operationalized as maternal education attainment and health insurance status, and receptive and expressive language skills in a sample of children from lower SES, racial/ethnic minority families at increased 'clinical risk' for ASD based on early screening. Neither maternal education attainment nor health insurance status were significantly associated with children's language skills. Expressive and receptive language skills were significantly higher in children with DD compared to children with ASD. Findings differ from previously published work, highlighting the importance of study replication. Further research is needed to understand why the association between SES and children's language skills might vary across samples.

  

**Highlights**

- Examined association between socioeconomic status (SES) and language skills in children at 'clinical risk' for autism based on early screening.
- Found no associations between measures of SES and children's language skills.
- Results differ from previously published work, highlighting the importance of replicating studies with lower SES, racial/ethnic minority families.

**KEYWORDS**
autism spectrum disorder, developmental delay, language, language delay, maternal education, socioeconomic status

## 1 | INTRODUCTION

In their pioneering study, Hart and Risley found that by 3 years of age, the vocabulary size of children from higher socioeconomic status (SES) families was two times larger than the vocabulary size of children from lower SES families (Hart & Risley, 1995). Since then, dozens of studies have reported a significant, positive association between SES and language skills in typically developing (TD) children, demonstrating that the environment plays an important role in language development (Hoff, 2006; Letourneau et al., 2013; Pace et al., 2017). While SES is a multidimensional construct, two measures of SES, maternal education attainment and family income, play a particularly important role in language development, even though they appear to impact language development through distinct mechanisms (Duncan & Magnuson, 2003). While the precise mechanisms underlying the association between SES and language are unknown, current research suggests that SES influences children's language development by way of more proximal environmental factors, such as parenting behaviours or household characteristics (Hoff et al., 2012). Studying how children's language skills are related to proximal environmental factors is important, as it helps identify potential targets for interventions that seek to strengthen children's language development. However, we believe that it is equally as important to study the association between children's language skills and distal environmental factors, such as SES, for two reasons. First, focusing on distal factors as opposed to proximal factors may help to shift the blame away from lower SES parents and onto broader, systemic issues that contribute to socioeconomic disparities, such as inequitable access to higher education and healthcare (Kuchirko, 2019). Second, distal environmental factors can be more efficiently targeted through broader changes to institutions and public policies that promote children's language development.

Despite the importance of this research topic, the association between SES and language has remained understudied in children with developmental disabilities, such as autism spectrum disorder (ASD). ASD is characterized by difficulties with social communication and interaction, as well as restricted and repetitive behaviours and interests (APA, 2013). Although language deficits are no longer a core diagnostic feature of ASD, the majority of children with ASD experience challenges using and/or understanding spoken language (DiStefano & Kasari, 2016). Given this fact, researchers have devoted substantial resources towards identifying the early predictors of children's language skills. The majority of studies have focused on identifying the neurobiological and cognitive predictors of language skills in children with ASD (Groen et al., 2008; Tager-Flusberg, 2018), while fewer studies have explored how the environment might also shape language development in ASD. Studies that have explored the environment's role in language development in ASD have focused on more proximal environmental factors, such as the quantity and quality of parent language use at home (Bottema-Beutel & Kim, 2021; Edmunds, Kover, & Stone, 2019), while distal environmental factors, such as SES, have received less attention in the literature.

To date, only three studies have explicitly investigated the association between SES and language skills in children with ASD. Choi et al. (2020) and Swanson et al. (2019) assessed the association between maternal education attainment, a commonly used measure of SES, and language skills in young children (<24 months old) at elevated likelihood for receiving an ASD diagnosis. Both studies reported that maternal education attainment was a positive predictor of children's verbal developmental quotient scores on the Mullen scales of early learning (MSEL), demonstrating that the association between SES and language is also present in samples of young children with ASD. However, neither of these studies explored whether this association might differ for receptive language versus expressive language.

Olson et al. (2021) addressed this limitation by showing that maternal education attainment was a positive predictor of both receptive and expressive language skills in a sample of slightly older children with ASD (15 to 64 months old). This positive association was present across two measures of children's language skills—the MSEL and the Vineland adaptive behaviour scales (VABS). Olson and colleagues also studied the association between children's language skills and family income-to-needs ratio, which is another commonly used measure of SES. Interestingly, family income-to-needs ratio was only related to children's expressive language skills, as measured by the MSEL but not the VABS (Olson et al., 2021). Taken together, these findings suggest that maternal education attainment as a measure of SES may play a particularly important role in language development for children with ASD. A few studies have reported non-significant associations between maternal education attainment and language skills in children with ASD, although the primary aim of these studies was not to investigate the association between SES and language (Markfeld et al., 2023; Romeo et al., 2022). Researchers proposed that these non-significant findings may be the result of sample characteristics.

Other work has sought to characterize the relation between SES and language skills in children with other developmental disabilities, such as those with developmental delays (DD). Children with DD experience delays in one or more domains of development, including speech/language, cognition, motor, and social/emotional domains, relative to their same-aged peers. While many children with ASD experience delays in one or more of these domains of development, we define children with DD as those who have delays that cannot be explained by ASD. While some children with DD go on to be diagnosed with another developmental disorder later in life, such as developmental language disorder, other children with DD begin to meet developmental milestones at a more typical rate and thus no longer meet diagnostic criteria for DD or another developmental disorder. Maternal education attainment seems to play a small, yet significant, role in predicting whether or not children will experience delays in their language and cognitive development (Henrichs et al., 2011; Hillemeier et al., 2011; Horwitz et al., 2003). Annual household income, another measure of SES, also seems to play an important role in language development for children with DD. Dai et al. (2018) found that in a sample of children with developmental disabilities, which included both children with ASD and children with DD, annual household income was a positive predictor of children's expressive language skills, as measured by the MSEL, but not their receptive language skills. However, this study did not explore whether this association varied based on diagnostic outcome of ASD or DD, nor did it examine the association between maternal education attainment and children's language skills.

In summary, studies within the existing literature suggest that SES, as measured by maternal education attainment, is positively associated with receptive and expressive language skills in children with ASD or DD (Choi et al., 2020; Henrichs et al., 2011; Hillemeier et al., 2011; Horwitz et al., 2003; Olson et al., 2021; Swanson et al., 2019). Measures of family income (e.g., income-to-needs ratio, annual household income) appear to be positively associated with children's expressive language skills only (Dai et al., 2018; Olson et al., 2021). Despite the importance of these findings, sample characteristics in these studies limit the generalizability of findings to the broader population for two reasons. First, all of these studies utilized samples of predominately higher SES families, as most mothers attained education beyond the high school level. Second, the majority of participants in these samples were White. Unfortunately, children from lower SES, racial/ethnic minority families are often excluded from research samples (Steinbrenner et al., 2022), which has led to a biased scientific literature that primarily represents the experiences of children from higher SES, White families. Failure to include those from marginalized groups in research is likely contributing to the systemic inequities that we observe in diagnosis, service use and access, mental and physical health, and overall well-being (Aylward et al., 2021; Broder-Fingert et al., 2020; Gallegos et al., 2021).

The present study aimed to address these limitations by examining the association between SES and receptive and expressive language skills in a sample of children from lower SES, racial/ethnic minority families who were identified to be at increased 'clinical risk' for ASD based on early screening. SES was operationalized as maternal education attainment and health insurance status (public vs. private), which was used as a proxy for family income. The present study also aimed to determine whether the association between SES and children's language skills differed depending on diagnostic outcome of ASD or DD. Based on the findings of the studies mentioned above, we hypothesized that for both children with ASD and children with DD, maternal education attainment would be positively associated with children's receptive and expressive language skills, while health insurance status would be positively associated with children's expressive language skills only.

## 2 | MATERIALS AND METHODS

### 2.1 | Participants

The children who participated in this study were enrolled in a larger, multi-site study investigating the effectiveness of a Family Navigation intervention which aimed to increase the likelihood of obtaining an ASD diagnosis among young children at increased clinical risk for ASD based on early screening (Feinberg et al., 2021). Participants 15 to 27 months of age were recruited into the larger study, which took place across 11 urban primary care practices or clinics in Massachusetts, Connecticut, and Pennsylvania. Parents/legal guardians completed the Modified Checklist for Autism in Toddlers, Revised with Follow-up (M-CHAT-R/F) screener at their child's 18- and 24-month health supervision visits. The M-CHAT-R/F is a 20 item parent-report screening tool used to assess early signs of ASD but has also been shown to reliably detect other developmental delays and disorders (Robins et al., 2014; Stenberg et al., 2020). Children who screened positive on the M-CHAT-R/F were referred to enrol in the larger study. To ensure consistency in screening, research staff readministered the M-CHAT-R/F with all families at the time of enrolment. If a child screened negative after re-administration of the M-CHAT-R/F, research staff shared this information with the child's primary care clinician, who was allowed to override negative M-CHAT-R/F screening results based on clinical concern; these children were also invited to enrol in the study. Children who had a previous diagnosis of ASD or who were in custody of child protective services at the time of enrolment were excluded from the larger study.

The present study included participants who: (1) demonstrated increased clinical risk for ASD based on their M-CHAT-R/F scores and/or clinician concern, (2) received a diagnostic evaluation at their final study visit, and (3) completed one or both of our language measures of interest—the Mullen scales of early learning and the Vineland adaptive behaviour scales. The final sample for the present study consisted of $N = 99$ children in the ASD group (77 males, 22 females) and $N = 78$ children in the DD group (47 males, 31 females). The ASD group was composed of participants who received a diagnosis of ASD after diagnostic evaluation. The DD group was composed of participants who did not receive a diagnosis of ASD but were identified as having one or more developmental delays after diagnostic evaluation. All diagnoses were made by a developmental behavioural paediatrician or psychologist based on best clinical judgement, which was determined using information about the child's developmental history and formal in-person testing using a battery of standardized assessments that included the Autism Diagnostic Observation Schedule-Second Edition (ADOS-2; Lord et al., 2012) and the Mullen scales of early learning (MSEL; Mullen, 1995). Primary care sites administered additional clinical assessments to help with differential diagnosis, as needed. While the majority of participants in the DD group were diagnosed with Developmental Delay ($N = 43$), Global Developmental Delay ($N = 16$), or Language/Speech Delay ($N = 5$), a subset of children was diagnosed with a language disorder, including Expressive Language Disorder ($N = 5$), Mixed Receptive Expressive Language Disorder ($N = 5$), and Developmental Disorder of Speech or Language ($N = 3$). $N = 1$ participant was diagnosed with a behavioural disorder; this participant was also included in the DD group. Results did not change when the participants with language/speech delay or language disorders were excluded from analyses (see Supplementary Material).

## 2.2 | Measures

### 2.2.1 | Maternal education attainment

While we acknowledge that SES is a multidimensional construct, the present study operationalized SES as years of maternal education attainment and health insurance status. We defined maternal education attainment as the highest education level attained by the child's mother. This information was collected via a parent-report demographics form. Education attainment categories were converted into years of education based on Rowe (2008). Less than high school degree was represented as 10 years of education, high school degree or GED was represented as 12 years of education, some college or Associate's degree was represented as 14 years of education, Bachelor's degree was represented as 16 years of education, and some graduate school or graduate degree was represented as 18 years of education. For $N = 4$ participants, the highest education level attained by the child's legal guardian was used in place of maternal education level.

### 2.2.2 | Health insurance status

Health insurance status was determined using information collected via a parent-report demographics form. Parents were asked 'What type of health insurance does your child have?' and were given the following options to select from—public insurance (Medicaid), private insurance (Blue Cross Blue Shield, Anthem, Cigna, etc.), or other. Health insurance status was used as a proxy for family income, as parents were not asked to provide information about their annual household income due to the design of the larger, multi-site study.

### 2.2.3 | Receptive language and expressive language

Children's receptive language (RL) and expressive language (EL) skills were assessed using two measures—the Mullen scales of early learning (MSEL; Mullen, 1995) and the Vineland adaptive behaviour scales, Comprehensive Parent/Caregiver Form-Third Edition (VABS; Sparrow et al., 2016). The MSEL is a standardized behavioural assessment used to assess children up to 68 months of age on five scales of development. Four of the MSEL scales were administered in the present study—Receptive Language, Expressive Language, Visual Reception, and Fine Motor. The VABS is a parent-report form that gathers information about the adaptive behaviour of individuals across the lifespan. The Communication domain of the VABS assesses both Receptive Language/Communication and Expressive Language/Communication subdomains. Previous work has documented that scores on these two language measures are highly correlated in children with ASD and children with DD (Weismer et al., 2010; also see Table 1).

## 2.3 | Procedure

During their initial visit, parent/legal guardian informants completed a series of self-report measures that asked questions about their family, including a demographics form that asked about their child's sex, race, and ethnicity, as well as years of maternal education attainment, health insurance status, language(s) used in the home (i.e., household

**TABLE 1** Spearman's rank correlations among variables of interest.

| | Child age at MSEL | Child age at VABS | MSEL receptive language | MSEL expressive language | VABS receptive language | VABS expressive language | Maternal education attainment |
|---|---|---|---|---|---|---|---|
| Child age at MSEL | 1.00 | – | – | – | – | – | – |
| Child age at VABS | 0.959*** | 1.00 | – | – | – | – | – |
| MSEL receptive language | 0.094 | 0.103 | 1.00 | – | – | – | – |
| MSEL expressive language | 0.106 | 0.058 | 0.845*** | 1.00 | – | – | – |
| VABS receptive language | 0.076 | 0.080 | 0.723*** | 0.774*** | 1.00 | – | – |
| VABS expressive language | 0.038 | 0.035 | 0.760*** | 0.827*** | 0.878*** | 1.00 | – |
| Maternal education attainment | −0.014 | −0.102 | 0.009 | 0.002 | 0.030 | 0.042 | 1.00 |

***$p < 0.001$.

language exposure), child care status, and frequency of Early Intervention services for speech/language. At a separate study visit, children completed the ADOS-2 with a research reliable developmental behavioural paediatrician or psychologist to determine their final diagnosis. Within the entire sample, the age at time of final diagnosis ranged from 18 to 40 months with an average diagnosis occurring at 24.81 months. Because the MSEL and VABS were added as part of a research supplement to the larger multi-site study, they were administered during the last research visit for some families, or at a separate follow-up visit if families had already finished the study and needed to be reconsented. This visit occurred 12.46 months after the first study visit, on average, although the length of time between the first and last study visit ranged from 4 to 41 months across participants. Measures were administered in the language that children were exposed to most often at home, which was determined based on information provided by the parent/legal guardian. When a fluent assessor was not available, a translator was used. All procedures performed in this study were carried out in accordance with the ethical standards of the Declaration of Helsinki as revised in 2000 and the Institutional Review Board at Boston University Medical Center (No. H-33008). Informed consent was obtained from the parent(s) and/or legal guardian(s) of all children who participated in this study. Families were compensated for participating in the larger multi-site study.

## 2.4 | Data analysis plan

Analyses were conducted in SPSS (version 27.0) and Mplus (version 8.5). We first conducted Mann–Whitney *u*-tests and chi-square tests to examine group differences in MSEL and VABS raw scores, years of maternal education attainment, health insurance status, and other demographic variables of interest. To address our first research aim, we constructed a structural equation model that included years of maternal education attainment, health insurance status (0 = public, 1 = private), and group (0 = ASD, 1 = DD) as exogenous variables. MSEL RL raw scores, MSEL EL raw scores, VABS RL raw scores, and VABS EL raw scores were included as endogenous variables. We decided to use raw scores instead of standard scores in our analyses to capture the full range of language skills across all participants in our sample. Because we used raw scores, child age in months at the time of MSEL and VABS administration were included as covariates in the model. Child sex (0 = male, 1 = female) was also included as a covariate in the model, as previous work has suggested that MSEL scores may differ by sex (Carter et al., 2007). Exogenous variables were allowed to covary with each other, as were endogenous variables. To address our second research aim, we added two interaction terms as exogenous variables to our model—group by maternal education attainment and group by health insurance status. Previous work has demonstrated that when children with ASD are assessed in the language that they are most proficient in, as was done for the majority of children in the present study (93.8%), language skills do not differ depending on whether children come from monolingual or multilingual households (Dai et al., 2018; Siyambalapitiya et al., 2021; also see Gilhuber, Raulston, & Galley, 2023 for review). Therefore, we did not include household language exposure (monolingual vs. multilingual) as a predictor variable in our planned analyses (although see Supplementary Material).

Robust maximum likelihood estimation was used in all models to account for missing data and data that were not normally distributed. From the larger, multi-site study, $N = 15$ participants ($N = 7$ ASD, $N = 8$ DD) were missing data from the MSEL RL scale and $N = 10$ participants ($N = 3$ ASD, $N = 7$ DD) were missing data from the MSEL EL scale because of experimenter error during assessment administration (e.g., basal and/or ceiling not established). $N = 23$ participants ($N = 13$ ASD, $N = 10$ DD) were missing data from the VABS RL and EL scales because the parent-report form was not completed ($N = 1$) or it was unable to be scored due to missing items ($N = 21$) or incorrect administration ($N = 1$). Proportion of missing MSEL data ($\chi^2 = 3.674$, $p = 0.159$) and VABS data ($\chi^2 = 0.004$, $p = 0.951$) did not significantly differ across groups.

## 3 | RESULTS

### 3.1 | Sample descriptives

Within the entire sample ($N = 177$), 62.7% of participants were Black, 7.9% were White, and 27.1% were some other race (including 'Asian/Pacific Islander', 'more than one race', and 'other' race options). 24.9% of participants identified as Hispanic or Latino. The majority of participants (83.6%) were from households in which English was primarily used. 10.2% were from households in which Spanish was primarily used and 6.2% were from households in which another language was primarily used (including Vietnamese, Haitian Creole, Arabic, Bengali, Portuguese, Amharic, French, Nepali, and American Sign Language). 91.0% of children were from monolingual households, in which only one language was used, and 5.6% of children were from multilingual households, in which two or more languages were used.

51.4% of participants had a mother who attained education at the high school level or below (10.7% less than high school degree, 40.7% high school degree or GED) while 48.6% of participants had a mother who attained education beyond high school (26.0% some college, 9.6% Associate's degree, 9.6% Bachelor's degree, 3.4% some graduate school or Graduate degree). While we did not collect data on annual household income, 91.0% of the sample qualified for public health insurance coverage through Medicaid, which is determined based on annual household income. 8.5% of the sample utilized private insurance and 0.6% utilized both public and private insurance. To qualify for Medicaid coverage during the years in which data was collected (2015–2019), families needed to have an annual household income below 155% of the Federal Poverty Level (FPL) in Massachusetts, 201% in Connecticut, and 162% in Pennsylvania (Kaiser Family Foundation, 2021).

49.2% of informants, who were predominantly mothers (87.0%), reported that they provided full time care for their child at home during the week; an additional 15.3% reported that their child received in-home care from another family member or babysitter. 35.6% of the sample utilized out-of-home care from a family member, babysitter, or child care centre. A subsample of parents (47.5%) provided information about how frequently their child received early intervention (EI) services for speech/language. 23.2% of children did not receive any EI services, 1.1% received EI services once per month, 1.1% received EI services twice per month, 18.6% received EI services once per week, and 3.4% received EI services twice per week. Additional demographic information for the ASD group and the DD group is available in Table 2.

### 3.2 | Group comparisons

The ASD group and DD group did not significantly differ on child age at the time of MSEL administration ($U = 3511.00$, $p = 0.299$) or VABS administration ($U = 2540.00$, $p = 0.160$), maternal age ($U = 3759.00$, $p = 0.851$),

**TABLE 2** Sample descriptives by group.

| | ASD ($N = 99$) | DD ($N = 78$) | *p*-value |
|---|---|---|---|
| Child age at MSEL (months) | | | 0.299 |
| Mean (SD) | 34.61 (4.50) | 33.92 (4.41) | |
| Range | 27–58 | 23–52 | |
| Child age at VABS (months) | | | 0.160 |
| Mean (SD) | 34.53 (5.38) | 33.21 (3.86) | |
| Range | 27–61 | 23–42 | |
| Maternal age (years) | | | 0.851 |
| Mean (SD) | 31.90 (6.49) | 32.06 (7.12) | |
| Range | 20.48–54.91 | 17.69–60.53 | |
| Child MSEL raw scores | | | |
| Receptive language | | | <0.001 |
| Mean (SD) | 17.64 (5.93) | 22.86 (5.67) | |
| Range | 1–31 | 10–33 | |
| Expressive language | | | <0.001 |
| Mean (SD) | 17.58 (6.12) | 22.69 (6.29) | |
| Range | 4–33 | 12–36 | |
| Visual reception | | | 0.221 |
| Mean (SD) | 27.33 (5.92) | 25.56 (7.64) | |
| Range | 11–47 | 0–46 | |
| Fine motor | | | 0.066 |
| Mean (SD) | 28.73 (6.34) | 26.48 (7.06) | |
| Range | 17–42 | 3–38 | |
| Child VABS raw scores | | | |
| Receptive language | | | <0.001 |
| Mean (SD) | 24.73 (14.66) | 39.96 (16.36) | |
| Range | 1–64 | 6–72 | |
| Expressive language | | | <0.001 |
| Mean (SD) | 23.17 (15.63) | 41.37 (19.17) | |
| Range | 2–69 | 10–90 | |
| Maternal education attainment (%) | | | 0.804 |
| Less than high school degree | 10.1% | 11.5% | |
| High school degree or GED | 40.4% | 41.0% | |
| Some college or associate's degree | 36.4% | 34.6% | |
| Bachelor's degree | 11.1% | 7.7% | |
| Some graduate school or graduate degree | 2.0% | 5.1% | |
| Health insurance status (%) | | | 0.504 |
| Public (Medicaid) | 90.9% | 91.0% | |
| Private | 9.1% | 7.7% | |
| Child sex (%) | | | 0.012 |
| Female | 22.2% | 39.7% | |
| Male | 77.8% | 60.3% | |

**TABLE 2** (Continued)

| | ASD ($N = 99$) | DD ($N = 78$) | *p*-value |
|---|---|---|---|
| Child race (%) | | | 0.056 |
| Black | 61.6% | 64.1% | |
| White | 12.1% | 2.6% | |
| Other | 24.2% | 30.8% | |
| Child ethnicity (%) | | | 0.930 |
| Hispanic/Latino | 25.3% | 24.4% | |
| Not Hispanic/Latino | 74.7% | 74.4% | |
| Household language exposure (%) | | | 0.745 |
| Monolingual | 89.9% | 92.3% | |
| Multilingual | 5.1% | 6.4% | |
| Child care status (%) | | | 0.234 |
| In-home care | 60.6% | 69.2% | |
| Out-of-home care | 39.4% | 30.8% | |
| Frequency of EI services (%) | | | 0.076 |
| No EI | 25.3% | 20.5% | |
| EI 1x/month | 1.0% | 1.3% | |
| EI 2x/month | 0.0% | 2.6% | |
| EI 1x/week | 16.2% | 21.8% | |
| EI 2x/week | 6.1% | 0.0% | |

*Note*: Other race category was condensed to include 'Asian/Pacific Islander', 'more than one race', and 'other' race options. $N = 4$ participants were missing data on race ($N = 2$ ASD, $N = 2$ DD), $N = 1$ was missing data on ethnicity ($N = 1$ DD), $N = 6$ were missing data on household language exposure ($N = 5$ ASD, $N = 1$ DD), and $N = 93$ were missing data on early intervention exposure ($N = 51$ ASD, $N = 42$ DD). $N = 1$ participant utilized both public and private health insurance. $N = 15$ participants were missing data on MSEL receptive language ($N = 7$ ASD, $N = 8$ DD), $N = 10$ were missing data on MSEL expressive language ($N = 3$ ASD, $N = 7$ DD), $N = 27$ were missing data on MSEL Visual Reception ($N = 17$ ASD, $N = 10$ DD), $N = 24$ were missing data on MSEL Fine Motor ($N = 15$ ASD, $N = 9$ DD), and $N = 23$ were missing data on VABS receptive language and expressive language ($N = 13$ ASD, $N = 10$ DD). Groups were compared using independent Mann–Whitney *u*-tests and chi-square tests.
EI, early intervention; MSEL, Mullen scales of early learning; VABS, Vineland adaptive behaviour scales.

years of maternal education attainment ($U = 3782.00$, $p = 0.804$), health insurance status ($\chi^2 = 1.370$, $p = 0.504$), child race ($\chi^2 = 5.769$, $p = 0.056$), child ethnicity ($\chi^2 = 0.008$, $p = 0.930$), household language exposure ($\chi^2 = 0.106$, $p = 0.745$), child care status ($\chi^2 = 1.416$, $p = 0.234$), or frequency of EI services for speech/language ($\chi^2 = 8.464$, $p = 0.076$). Groups did significantly differ by child sex, with more males and fewer females in the ASD group compared to the DD group ($\chi^2 = 6.385$, $p = 0.012$). While raw scores varied greatly across individuals within each group (Figure 1), they were significantly higher in the DD group than the ASD group on both language scales of the MSEL (Receptive Language: $U = 4734.50$, $p < 0.001$; Expressive Language: $U = 4957.00$, $p < 0.001$). Raw scores did not significantly differ between groups for the Visual Reception ($U = 2464.50$, $p = 0.221$) and Fine Motor ($U = 2398.00$, $p = 0.066$) scales of the MSEL. Raw scores on both language scales of the VABS were significantly higher in the DD group than the ASD group (Receptive Language: $U = 4432.00$, $p < 0.001$; Expressive Language: $U = 4622.50$, $p < 0.001$).

## 3.3 | Model 1

Our first model assessed the associations between years of maternal education attainment, health insurance status, and group, and the four measures of children's language skills. This model, which also included child age and sex as

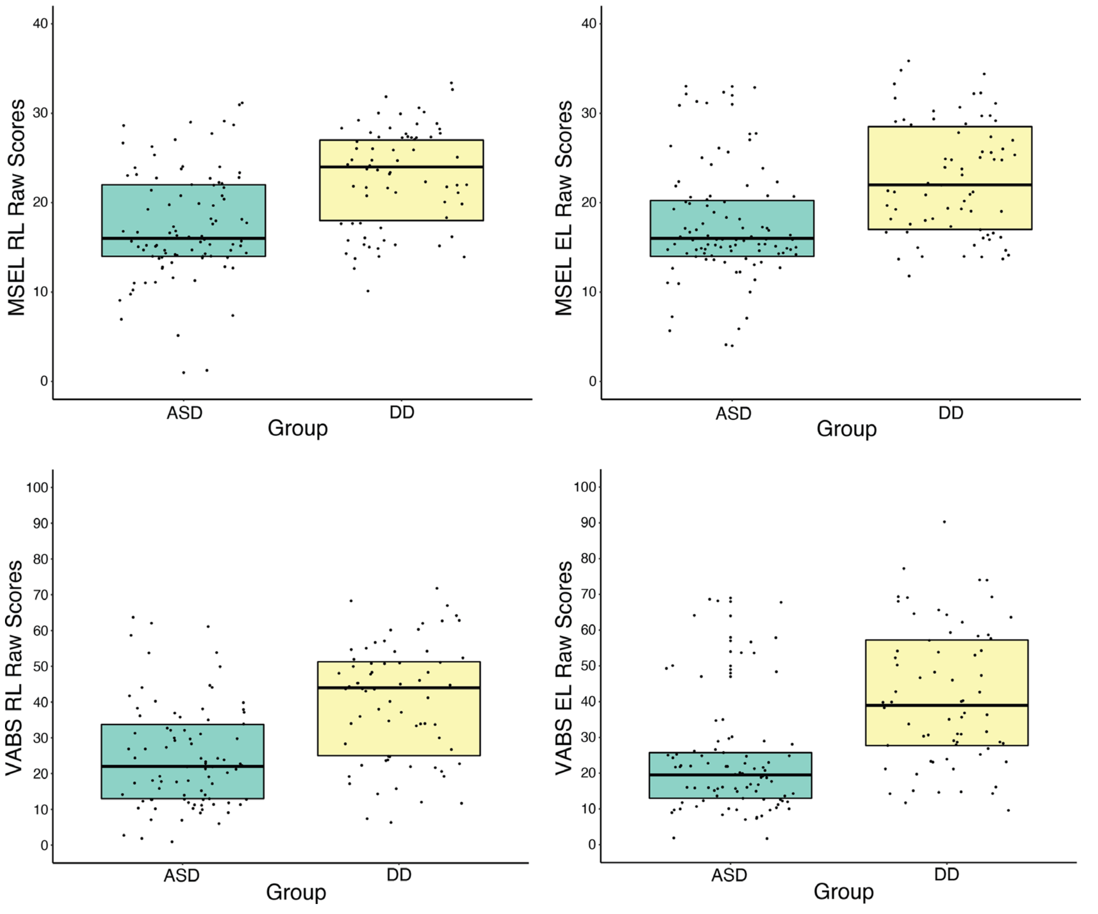


**FIGURE 1** Distribution of receptive language (RL) and expressive language (EL) raw scores on the Mullen scales of early learning (MSEL) and the Vineland adaptive behaviour scales (VABS) in the ASD group (green) and the DD group (yellow). Individual participants are plotted in black. The midline of each boxplot represents the median while the upper and lower limits of each boxplot represent the third and first quartiles, respectively. ASD, autism spectrum disorder; DD, developmental delay.

covariates, indicated adequate fit ($\chi^2 = 9.284$, df $= 4$, $p = 0.054$; RMSEA $= 0.093$; TLI $= 0.935$; CFI $= 0.991$; SRMR $= 0.020$). Group was the only exogenous variable to be significantly and positively associated with children's MSEL RL scores ($B = 4.937$, SE $= 0.953$, $p < 0.001$), MSEL EL scores ($B = 5.681$, SE $= 0.990$, $p < 0.001$), VABS RL scores ($B = 15.745$, SE $= 2.528$, $p < 0.001$), and VABS EL scores ($B = 18.482$, SE $= 2.927$, $p < 0.001$), indicating that as a group, children with DD scored higher on all four language measures when compared to children with ASD. Maternal education attainment was not significantly associated with children's scores on any of the language measures (MSEL RL: $B = 0.263$, SE $= 0.297$, $p = 0.377$; MSEL EL: $B = 0.217$, SE $= 0.302$, $p = 0.472$; VABS RL: $B = 0.741$, SE $= 0.737$, $p = 0.315$; VABS EL: $B = 0.952$, SE $= 0.835$, $p = 0.254$). Similarly, health insurance status was not significantly associated with children's scores on any of the language measures (MSEL RL: $B = -1.963$, SE $= 1.580$, $p = 0.214$; MSEL EL: $B = -0.681$, SE $= 1.894$, $p = 0.719$; VABS RL: $B = -1.637$, SE $= 4.905$, $p = 0.739$; VABS EL: $B = -2.701$, SE $= 4.701$, $p = 0.566$). Overall, this model explained 19.7% of the variance in MSEL RL scores, 19.8% of the variance in MSEL EL scores, 21.6% of the variance in VABS RL scores, and 23.6% of the variance in VABS EL scores. Unstandardized estimates for significant pathways, covariances, and residual variances are summarized in Figure 2.

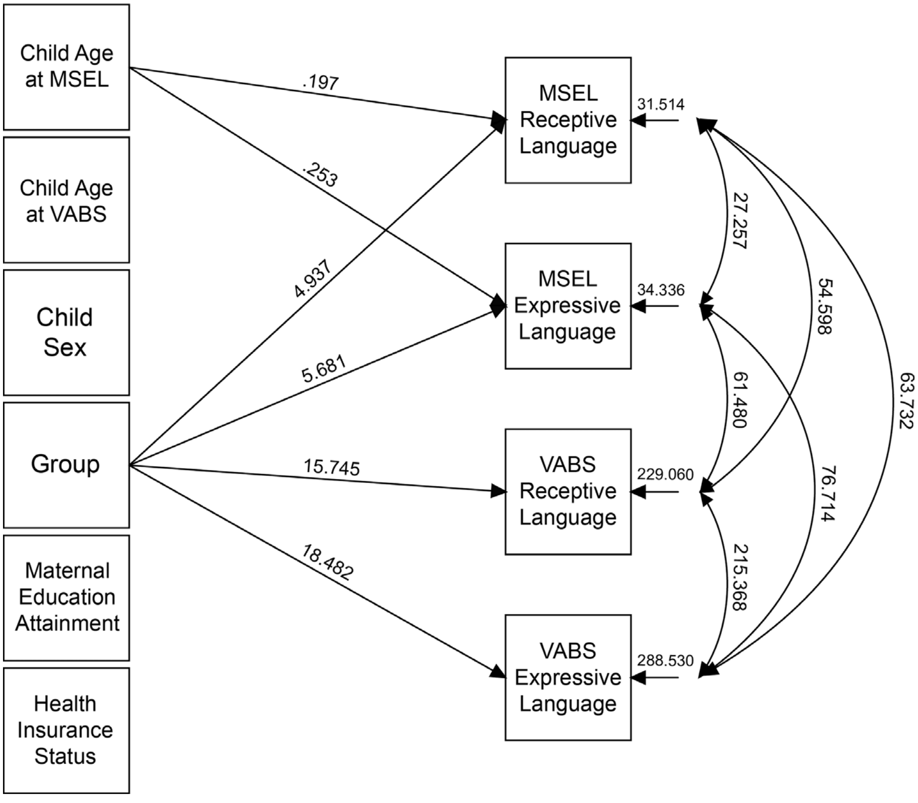


**FIGURE 2** Structural equation model showing significant paths between variables (unstandardized path coefficients), covariances, and residual variances. Covariances between exogenous variables are not shown here but were included in the model. MSEL, Mullen scales of early learning; VABS, Vineland adaptive behaviour scales.

## 3.4 | Model 2

Our second model included two interaction terms as additional exogenous variables to determine whether the associations between our measures of SES and children's language skills differed by group. These interaction terms were group by maternal education attainment and group by health insurance status. While model fit improved slightly with the inclusion of these interaction terms ($\chi^2 = 7.549$, df = 4, $p = 0.110$; RMSEA = 0.076; TLI = 0.944; CFI = 0.994; SRMR = 0.018), group by maternal education attainment (MSEL RL: $B = 0.411$, SE = 0.591, $p = 0.487$; MSEL EL: $B = -0.041$, SE = 0.614, $p = 0.947$; VABS RL: $B = 0.598$, SE = 1.489, $p = 0.688$; VABS EL: $B = 0.087$, SE = 1.704, $p = 0.959$) and group by health insurance status (MSEL RL: $B = -2.814$, SE = 2.930, $p = 0.337$; MSEL EL: $B = -0.703$, SE = 3.798, $p = 0.853$; VABS RL: $B = 0.371$, SE = 9.810, $p = 0.970$; VABS EL: $B = -6.544$, SE = 9.133, $p = 0.474$) were not significantly associated with children's scores on any of the language measures.

## 3.5 | Exploratory model

To explore whether any of the proximal environmental variables measured in the present study were associated with children's language skills, we constructed an exploratory model that included frequency of EI services for speech/language (0 = no EI, 1 = EI 1x/month, 2 = EI 2x/month, 3 = EI 1x/week, 4 = EI 2x/week) and child care status

(0 = in-home care, 1 = out-of-home care) as additional exogenous variables. This exploratory model also included years of maternal education attainment, health insurance status, and group as exogenous variables, and child age and sex as covariates. This model indicated poorer fit on most indices ($\chi^2 = 10.346$, df = 4, $p = 0.035$; RMSEA = 0.148; TLI = 0.791; CFI = 0.978; SRMR = 0.007). Frequency of EI services (MSEL RL: $B = 0.368$, SE = 0.423, $p = 0.384$; MSEL EL: $B = -0.187$, SE = 0.412, $p = 0.649$; VABS RL: $B = 0.085$, SE = 1.095, $p = 0.938$; VABS EL: $B = -0.518$, SE = 1.061, $p = 0.625$) and child care status (MSEL RL: $B = 2.331$, SE = 1.318, $p = 0.077$; MSEL EL: $B = 0.659$, SE = 1.364, $p = 0.629$; VABS RL: $B = 2.867$, SE = 3.623, $p = 0.429$; VABS EL: $B = 2.790$, SE = 3.634, $p = 0.443$) were not significantly associated with children's scores on any of the language measures. Group was the only exogenous variable significantly associated with all four measures of children's language skills in this exploratory model ($ps \leq 0.002$).

## 4 | DISCUSSION

The aim of the present study was to examine the association between SES, measured by maternal education attainment and health insurance status, and language skills in a sample of children from lower SES, racial/ethnic minority families who were at increased 'clinical risk' for ASD based on early screening. Counter to our hypotheses, results demonstrated that neither maternal education attainment nor health insurance status were significantly associated with children's language skills. These non-significant findings held across both language measures (MSEL and VABS) and both groups of children (ASD and DD). These findings indicate that the significant, positive association between SES and children's language skills that has been previously reported in the literature was not present in the current sample.

Unlike the findings reported in the present study, most studies conducted with TD children have found that SES, as measured by maternal education attainment and family income, is positively associated with children's receptive and expressive language skills (Pace et al., 2017). One explanation for this difference in findings may be that distal environmental factors, such as SES, have less of an influence on language development for children with developmental disabilities like ASD or DD. Neurobiological or cognitive factors may play a more important role in language development for children with ASD or DD. Alternatively, proximal environmental factors may be 'better' predictors of language skills than distal environmental factors in this population. While we attempted to address this hypothesis using our exploratory model, neither of our measures of the proximal environment (i.e., frequency of early intervention services for speech/language, child care status) were associated with children's language skills. Future studies should explore whether other measures of the proximal environment are significantly associated with language skills in children with ASD or DD. Measures of the proximal environment worth investigating include quantity and quality of language used by parents or other caregivers, parental knowledge of and beliefs about child development, parental stress and depression, household chaos, material hardships, and quality of early education or intervention (Rowe, 2018; Rowe & Weisleder, 2020; Sandbank & Yoder, 2016; Swanson, 2020).

This explanation, however, would not explain why our findings differed from results of previous studies that included children with ASD or DD in their samples (Choi et al., 2020; Dai et al., 2018; Henrichs et al., 2011; Hillemeier et al., 2011; Horwitz et al., 2003; Olson et al., 2021; Swanson et al., 2019). These studies found significant, positive associations between SES and children's language skills, demonstrating that distal environmental factors *do* play a role in language development for children with developmental disabilities like ASD or DD. One possible explanation for these different findings across studies is that children in our sample were slightly older than children in previous samples, which may indicate a developmental change in the nature of the association between SES and language. Perhaps SES has less of an influence on the development of language skills in children with ASD or DD during the later years of development when children's more proximal environments begin to change (although see Olson et al., 2021).

To our surprise, current findings did not replicate those reported in Olson et al. (2021), even though we used the same language measures and similarly aged samples. Why might our findings differ from those reported in Olson et al. (2021)? One possibility is that results were influenced by differences in sample characteristics, such as children's language skills, as children in our sample had slightly lower language skills than children in Olson et al.'s sample. The majority of children in our sample were also from lower SES families, while Olson et al.'s sample appeared to include children from a wider range of socioeconomic backgrounds. Therefore, it is possible that SES is a significant predictor of language skills in children with developmental disabilities like ASD or DD, only if their language skills and/or SES lie above a certain threshold.

It is also important to note that these two samples differed on a variety of sociodemographic characteristics, including maternal education attainment, family income, race, ethnicity, age of ASD diagnosis, and languages used at home. Nearly all children in the present sample were from lower SES, racial/ethnic minority families, while a large percentage of children in Olson et al.'s (2021) sample were from higher SES, White families. Thus, certain sociodemographic variables may moderate the association between SES and children's language skills. While the potential sociodemographic moderators of this association are currently unknown, one possibility is that for children living in extreme poverty, like the children in our study, other environmental factors have a stronger influence on language development. For instance, the accumulation of multiple risk factors associated with poverty (e.g., inadequate healthcare and educational resources, food scarcity, exposure to environmental toxins, crime, violence, discrimination, and racism) often leads to chronic stress within families, which can negatively impact children's language development (Evans, 2004; Jensen et al., 2017; Perkins et al., 2013). Exposure to a larger number of risk factors may have a deleterious effect on language development (Stanton-Chapman et al., 2004). Other possible sociodemographic moderators may include languages used at home (Paradis, 2023), immigration status (Mistry et al., 2008), and level of social support from family members, teachers, and peers (Malecki & Demaray, 2006).

## 4.1 | Limitations

The present study had some limitations that may have impacted our findings. First, we had only two measures of SES, maternal education attainment and health insurance status, even though we know that SES is a multidimensional construct (Hoff et al., 2012; Krieger et al., 1997). Unfortunately, the larger, multi-site study did not collect data on family income because this was considered to be sensitive information, and researchers did not want to compromise rapport-building with families by asking for this sensitive information. While we did include health insurance status as a predictor in our analyses as a proxy for family income, we recognize that failing to include a more robust measure of family income, such as annual household income or income-to-needs ratio, is a major limitation of the present study. Future studies should investigate whether other measures of SES are related to language skills in children with ASD or DD. Second, the present study did not include measures of children's proximal environments, apart from frequency of early intervention services and child care status. Future studies should identify other proximal environmental factors that are related to children's language skills, and explore how these proximal environmental factors might interact with SES to shape language development in children with developmental disabilities. Third, it is important to mention that data on SES, children's language skills, and final diagnosis were collected at separate visits, and the amount of time between these visits varied considerably across participants, which may have impacted our findings. Future studies should systematically investigate whether SES is a significant predictor of longitudinal language outcomes, change in language skills, and later literacy achievement, as this will provide important information about the long-term impacts of socioeconomic disparities on child development. Lastly, we recommend that future studies utilize more robust language measures, such as standardized language assessments and natural language sampling, to accurately capture children's strengths in receptive and expressive language.

## 4.2 | Conclusion

In summary, the present study found no association between SES and language skills in children at clinical risk for ASD. Findings differ from what has been previously published in the literature, highlighting the importance of replicating studies in psychological research. Further work is needed to identify potential demographic moderators of the association between SES and children's language skills, as the nature of this association seems to vary across samples. Future research should continue to explore which variables within the proximal and distal environments predict language skills in children with developmental disabilities, such as ASD or DD, so that these variables can be targeted in intervention and public policy. It is particularly important to include children from lower SES, racial/ethnic minority families in these future studies, as excluding these children from studies will lead to even greater biases in the scientific literature.

## AUTHOR CONTRIBUTIONS

**Meredith Pecukonis:** Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; visualization; writing – original draft; writing – review and editing. **Julia Levinson:** Data curation; investigation; project administration; writing – review and editing. **Andrea Chu:** Data curation; funding acquisition; investigation; project administration; validation; writing – review and editing. **Sarabeth Broder-Fingert:** Conceptualization; funding acquisition; investigation; methodology; project administration; resources; supervision; writing – review and editing. **Emily Feinberg:** Conceptualization; funding acquisition; investigation; methodology; project administration; resources; supervision; writing – review and editing. **Howard Cabral:** Formal analysis; methodology; visualization; writing – review and editing. **Helen Tager-Flusberg:** Conceptualization; methodology; supervision; writing – review and editing.

## ACKNOWLEDGEMENTS

The authors would like to thank all of the families who participated in this study, and the family navigators, study coordinators, and research staff who played a critical role in study implementation: Manju Abraham, MS, Syneos Health, Jenny Acevedo-Usuga, MS, BCBA, LBA, Behavioral Consulting Associates, Marisol Credle, MA, Yale School of Medicine, Sonia Erlich, MFA, MS, LMHC, Boston Medical Center, Mitsouka Exantus, BA, Boston Medical Center, Ivys Fernandez-Pastrana, JD, Boston Medical Center, Julianna Gardener, MA, Trinity School of Medicine, Nadia Martinez, BA, CommuniCare, Plyce Fuchu, BS, Boston University School of Public Health, Nicole O'Dea, MA, Clark University and Boston Children's Hospital, and Samia Omer, BS, Children's Hospital of Philadelphia.

## FUNDING INFORMATION

This study was funded by the National Institute of Mental Health (grant R01MH104355), NIMH's national ASD Pediatric Early Detection, Engagement, and Service (PEDS) Network. It was conducted in collaboration with the Developmental and Behavioral Pediatrics Research Network (DBPNet). DBPNet is supported by cooperative agreement UA3MC20218 from the Maternal and Child Health Bureau, Health Resources and Services Administration (HRSA), US Department of Health and Human Services. Fellowship funding came from an HRSA Institutional Training Grant (T32HS10038) and an Agency for Healthcare Research and Quality Training in Health Services Research for Vulnerable Populations Grant (T32HS022242). Additional funding was provided by a NIMH Mentored Patient-Oriented Research Career Development Award (K23MH109673, Broder-Fingert) and a NIMH Research Supplement to Promote Diversity In Health-Related Research (R01MH104355-02S1, Chu). Manuscript preparation and revisions were supported by NIDCD (F31DC019562, Pecukonis). The funding sources had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

## PEER REVIEW

The peer review history for this article is available at https://www.webofscience.com/api/gateway/wos/peer-review/10.1002/icd.2493.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## ETHICS STATEMENT

All procedures performed in this study were in accordance with the 1964 Helsinki Declaration and its later amendments. The study was approved by the Institutional Review Board at Boston University Medical Center (No. H-33008). Informed consent was obtained from the parent(s) and/or legal guardian(s) of all children who participated in this study.

## ORCID

*Meredith Pecukonis* https://orcid.org/0000-0002-3161-7607

## REFERENCES

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Association.

Aylward, B. S., Gal-Szabo, D. E., & Taraman, S. (2021). Racial, ethnic, and sociodemographic disparities in diagnosis of children with autism spectrum disorder. *Journal of Developmental and Behavioral Pediatrics*, *42*(8), 682–689.

Bottema-Beutel, K., & Kim, S. Y. (2021). A systematic literature review of autism research on caregiver talk. *Autism Research*, *14*(3), 432–449.

Broder-Fingert, S., Mateo, C., & Zuckerman, K. E. (2020). Structural racism and autism. *Pediatrics*, *146*(3), e2020015420.

Carter, A. S., Black, D. O., Tewani, S., Connolly, C. E., Kadlec, M. B., & Tager-Flusberg, H. (2007). Sex differences in toddlers with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *37*(1), 86–97.

Choi, B., Nelson, C. A., Rowe, M. L., & Tager-Flusberg, H. (2020). Reciprocal influences between parent input and child language skills in dyads involving high-and low-risk infants for autism spectrum disorder. *Autism Research*, *13*(7), 1168–1183.

Dai, Y. G., Burke, J. D., Naigles, L., Eigsti, I. M., & Fein, D. A. (2018). Language abilities in monolingual- and bilingual-exposed children with autism or other developmental disorders. *Research in Autism Spectrum Disorders*, *55*, 38–49.

DiStefano, C., & Kasari, C. (2016). The window to language is still open: Distinguishing between preverbal and minimally verbal children with ASD. *Perspectives of the ASHA Special Interest Groups*, *1*(1), 4–11.

Duncan, G. J., & Magnuson, K. A. (2003). Off with Hollingshead: Socioeconomic resources, parenting, and child development. In M. H. Bornstein (Ed.), *Socioeconomic status, parenting, and child development* (pp. 83–106). Erlbaum Associates.

Edmunds, S. R., Kover, S. T., & Stone, W. L. (2019). The relation between parent verbal responsiveness and child communication in young children with or at risk for autism spectrum disorder: A systematic review and meta-analysis. *Autism Research*, *12*(5), 715–731.

Evans, G. W. (2004). The environment of childhood poverty. *American Psychologist*, *59*(2), 77–92.

Feinberg, E., Augustyn, M., Broder-Fingert, S., Bennett, A., Weitzman, C., Kuhn, J., Hickey, E., Chu, A., Levinson, J., Eilenberg, J. S., Silverstein, M., Cabral, H. J., Patts, G., Diaz-Linhart, Y., Fernandez-Pastrana, I., Rosenberg, J., Miller, J. S., Guevara, J. P., Fenick, A. M., … Blum, N. J. (2021). Effect of family navigation on diagnostic ascertainment among children at risk for autism: A randomized clinical trial from DBPNet. *JAMA Pediatrics*, *175*(3), 243–250.

Gallegos, A., Dudovitz, R., Biely, C., Chung, P. J., Coker, T. R., Barnert, E., Guerrero, A. D., Szilagyi, P. G., & Nelson, B. B. (2021). Racial disparities in developmental delay diagnosis and services received in early childhood. *Academic Pediatrics*, *21*(7), 1230–1238.

Gilhuber, C. S., Raulston, T. J., & Galley, K. (2023). Language and communication skills in multilingual children on the autism spectrum: A systematic review. *Autism*, *27*(6), 1516–1531.

Groen, W. B., Zwiers, M. P., van der Gaag, R. J., & Buitelaar, J. K. (2008). The phenotype and neural correlates of language in autism: An integrative review. *Neuroscience & Biobehavioral Reviews*, *32*(8), 1416–1425.

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*. Paul H Brookes Publishing.

Henrichs, J., Rescorla, L., Schenk, J. J., Schmidt, H. G., Jaddoe, V. W., Hofman, A., Raat, H., Verhulst, F. C., & Tiemeier, H. (2011). Examining continuity of early expressive vocabulary development: The generation R study. *Journal of Speech, Language, and Hearing Research*, *54*(3), 854–869.

Hillemeier, M. M., Morgan, P. L., Farkas, G., & Maczuga, S. A. (2011). Perinatal and socioeconomic risk factors for variable and persistent cognitive delay at 24 and 48 months of age in a national sample. *Maternal and Child Health Journal*, *15*(7), 1001–1010.

Hoff, E. (2006). How social contexts support and shape language development. *Developmental Review*, *26*(1), 55–88.

Hoff, E., Laursen, B., & Bridges, K. (2012). Measurement and model building in studying the influence of socioeconomic status on child development. In L. Mayes & M. Lewis (Eds.),*The Cambridge handbook of environment in human development* (pp. 590–606). Cambridge University Press.

Horwitz, S. M., Irwin, J. R., Briggs-Gowan, M. J., Heenan, J. M. B., Mendoza, J., & Carter, A. S. (2003). Language delay in a community cohort of young children. *Journal of the American Academy of Child & Adolescent Psychiatry*, *42*(8), 932–940.

Jensen, S. K., Berens, A. E., & Nelson, C. A., 3rd. (2017). Effects of poverty on interacting biological systems underlying child development. *The Lancet Child & Adolescent Health*, *1*(3), 225–239.

Kaiser Family Foundation. (2021). *Medicaid income eligibility limits for children ages 1–5, 2000–2021*. https://www.kff.org/medicaid/state-indicator/medicaid-income-eligibility-limits-for-children-ages-1-5/?currentTimeframe=0

Krieger, N., Williams, D. R., & Moss, N. E. (1997). Measuring social class in US public health research: Concepts, methodologies, and guidelines. *Annual Review of Public Health*, *18*(1), 341–378.

Kuchirko, Y. (2019). On differences and deficits: A critique of the theoretical and methodological underpinnings of the word gap. *Journal of Early Childhood Literacy*, *19*(4), 533–562.

Letourneau, N. L., Duffett-Leger, L., Levac, L., Watson, B., & Young-Morris, C. (2013). Socioeconomic status and child development: A meta-analysis. *Journal of Emotional and Behavioral Disorders*, *21*(3), 211–224.

Lord, C., Rutter, M., DiLavore, P., Risi, S., Gotham, K., & Bishop, S. (2012). *Autism diagnostic observation schedule—2nd edition (ADOS-2)*. Western Psychological Corporation.

Malecki, C. K., & Demaray, M. K. (2006). Social support as a buffer in the relationship between socioeconomic status and academic performance. *School Psychology Quarterly*, *21*(4), 375–395.

Markfeld, J. E., Feldman, J. I., Bordman, S. L., Daly, C., Santapuram, P., Humphreys, K. L., Keçeli-Kaysılı, B., Woynaroski, T. G., & Woynaroski, T. G. (2023). Associations between caregiver stress and language outcomes in infants with autistic and non-autistic siblings: An exploratory study. *Journal of Speech, Language, and Hearing Research*, *66*(1), 190–205.

Mistry, R. S., Biesanz, J. C., Chien, N., Howes, C., & Benner, A. D. (2008). Socioeconomic status, parental investments, and the cognitive and behavioral outcomes of low-income children from immigrant and native households. *Early Childhood Research Quarterly*, *23*(2), 193–212.

Mullen, E. M. (1995). *Mullen scales of early learning* (pp. 58–64). AGS.

Olson, L., Kinnear, M., Chen, B., Reynolds, S., Ibarra, C., Wang, T., Linke, A., & Fishman, I. (2021). Socioeconomic factors account for variability in language skills in preschoolers with autism Spectrum disorders. *Journal of Developmental and Behavioral Pediatrics: JDBP*, *42*(2), 101–108.

Pace, A., Luo, R., Hirsh-Pasek, K., & Golinkoff, R. M. (2017). Identifying pathways between socioeconomic status and language development. *Annual Review of Linguistics*, *3*, 285–308.

Paradis, J. (2023). Sources of individual differences in the dual language development of heritage bilinguals. *Journal of Child Language*, *50*, 1–25.

Perkins, S. C., Finegood, E. D., & Swain, J. E. (2013). Poverty and language development: Roles of parenting and stress. *Innovations in Clinical Neuroscience*, *10*(4), 10–19.

Robins, D. L., Casagrande, K., Barton, M., Chen, C. M. A., Dumont-Mathieu, T., & Fein, D. (2014). Validation of the modified checklist for autism in toddlers, revised with follow-up (M-CHAT-R/F). *Pediatrics*, *133*(1), 37–45.

Romeo, R. R., Choi, B., Gabard-Durnam, L. J., Wilkinson, C. L., Levin, A. R., Rowe, M. L., Tager-Flusberg, H., & Nelson, C. A., III. (2022). Parental language input predicts neuroscillatory patterns associated with language development in toddlers at risk of autism. *Journal of Autism and Developmental Disorders*, *52*(6), 2717–2731.

Rowe, M. L. (2008). Child-directed speech: Relation to socioeconomic status, knowledge of child development and child vocabulary skill. *Journal of Child Language*, *35*, 185–205.

Rowe, M. L. (2018). Understanding socioeconomic differences in parents' speech to children. *Child Development Perspectives*, *12*(2), 122–127.

Rowe, M. L., & Weisleder, A. (2020). Language development in context. *Annual Review of Developmental Psychology*, *2*, 201–223.

Sandbank, M., & Yoder, P. (2016). The association between parental mean length of utterance and language outcomes in children with disabilities: A correlational meta-analysis. *American Journal of Speech-Language Pathology*, *25*(2), 240–251.

Siyambalapitiya, S., Paynter, J., Nair, V. K., Reuterskiöld, C., Tucker, M., & Trembath, D. (2021). Longitudinal social and communication outcomes in children with autism raised in bi/multilingual environments. *Journal of Autism and Developmental Disorders*, *52*, 1–10.

Sparrow, S. S., Cicchetti, D. V., & Saulnier, C. A. (2016). *Vineland adaptive behavior scales, third edition (Vineland-3)*. Pearson.

Stanton-Chapman, T. L., Chapman, D. A., Kaiser, A. P., & Hancock, T. B. (2004). Cumulative risk and low-income children's language development. *Topics in Early Childhood Special Education*, *24*(4), 227–237.

Steinbrenner, J. R., McIntyre, N., Rentschler, L. F., Pearson, J. N., Luelmo, P., Jaramillo, M. E., Boyd, B. A., Wong, C., Nowell, S. W., Odom, S. L., & Hume, K. A. (2022). Patterns in reporting and participant inclusion related to race and ethnicity in autism intervention literature: Data from a large-scale systematic review of evidence-based practices. *Autism*, *26*(8), 2026–2040.

Stenberg, N., Schjølberg, S., Shic, F., Volkmar, F., Øyen, A. S., Bresnahan, M., Svendsen, B. K., von Tetzchner, S., Thronæs, N. T., Macari, S., Cicchetti, D. V., Chawarska, K., Suren, P., & Øien, R. A. (2020). Functional outcomes of children identified early in the developmental period as at risk for ASD utilizing the Norwegian mother, father and child cohort study (MoBa). *Journal of Autism and Developmental Disorders*, *51*, 1–11.

Swanson, M. R. (2020). The role of caregiver speech in supporting language development in infants and toddlers with autism spectrum disorder. *Development and Psychopathology*, *32*(4), 1230–1239.

Swanson, M. R., Donovan, K., Paterson, S., Wolff, J. J., Parish-Morris, J., Meera, S. S., Watson, L. R., Estes, A. M., Marrus, N., Elison, J. T., Shen, M. D., McNeilly, H. B., MacIntyre, L., Zwaigenbaum, L., St. John, T., Botteron, K., Dager, S., & Piven. J. (2019). Early language exposure supports later language skills in infants with and without autism. *Autism Research*, *12*(12), 1784–1795.

Tager-Flusberg, H. (2018). Early predictors of language development in autism spectrum disorder. In J. Hickmann, J. Harriet, & E. Veneziano (Eds.), *Sources of variation in first language acquisition: Languages, contexts, and learners* (pp. 391–408). John Benjamins Publishing Company.

Weismer, S. E., Lord, C., & Esler, A. (2010). Early language patterns of toddlers on the autism spectrum compared to toddlers with developmental delay. *Journal of Autism and Developmental Disorders*, *40*(10), 1259–1273.

## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

**How to cite this article:** Pecukonis, M., Levinson, J., Chu, A., Broder-Fingert, S., Feinberg, E., Cabral, H., & Tager-Flusberg, H. (2024). Investigating the association between socioeconomic status and language skills in children with autism spectrum disorder or other developmental delays. *Infant and Child Development*, e2493. https://doi.org/10.1002/icd.2493