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Associations among stress and language and socioemotional development in a low-income sample

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Abstract

Stress has been linked with children's socioemotional problems and lower language scores, particularly among children raised in socioeconomically disadvantaged circumstances. Much of the work examining the relations among stress, language, and socioemotional functioning have relied on assessments of a single dimension of maternal stress. However, stress can stem from different sources, and people may appraise stressors differently. Taking a dimensional approach, this manuscript characterizes stress in multiple ways: as an overall composite; across the constructs of psychological appraisal vs. environmental stressors; and the independent contributions of a variety assessments. Data are from 548 mother–infant dyads ($M = 13.14$ months, $SD = 2.11$) who served as the control group for a poverty reduction clinical trial. Mothers completed questionnaires regarding the different types of stresses they may have experienced, as well as their children's language and socioemotional development. Results indicate that, collectively, higher maternal report of stress is associated with lower reports of children's socioemotional and language development. In addition, maternal psychological appraisals of stress were associated with both socioemotional and language development, whereas reports of environmental stressors were only associated with socioemotional development. Together, these findings suggest that maternal reports of stress are associated with lower maternal report of child development among low-income children.

Introduction

The experience of childhood poverty, one form of early adversity, has been linked with lower scores on measures of socioemotional and language development (Evans & English, 2002; Farah et al., 2006; McLoyd, 1998; Noble et al., 2007). There is much interest in understanding the mechanisms by which early material deprivation may shape child socioemotional and language development. Dimensional models of adversity hypothesize a number of mechanisms by which early adversity may impact the developing child, including learning and stress (McLaughlin & Sheridan, 2016; McLaughlin et al., 2014; Sheridan & McLaughlin, 2014). Here, we employ a dimensional approach to examine how different theoretically driven stress constructs may be associated with language and socioemotional development in the first year of life in a low-income sample.

Dimensionality in stress research

Perhaps one of the most difficult issues researchers must grapple with in understanding the associations between adversity, stress, and child development is the scattershot use of theory and methods in the existing literature. Indeed, with over 100 named hypotheses

and theories of how stress impacts people (see Harris, 2020 for review), interpreting the broader literature can be challenging.

In addition to the multitude of theoretical approaches, there are vast differences in what constitutes an assessment of "stress" in the literature. Accounts of the stress process vary widely from simpler stimulus-response models to more complex stimulus-evaluation-coping-response models and more (for review see Lazarus, 1993 and Monroe, 2008). It is generally accepted that stress is caused by a stimulus (also known as a stressor) and involves a response to this stimulus (a stress response). Missing from more simplistic models of stress are the reciprocal relations among the organism, the environment, and the psychological or cognitive appraisals of a stress-related stimulus, all of which highlight how stress involves adaptation (Monroe, 2008).

The vast array of stress models make the measurement of stress, particularly via questionnaire, difficult. In particular, different stress measures assess different aspects of the stress process. For instance, some measures of stress quantify the experience of stressors in the environment (e.g., checklists of adverse experiences or life events), while others aim to quantify the psychological experiences of stress (e.g., perceptions of stress). Even more problematic, many assessments of stress blur theoretical boundaries by, for example, measuring both the presence of an environmental stressor as well as an individual's psychological appraisal (e.g., "have you experienced a life stress and how stressful was it;" Monroe, 2008). Such variations in the assessment of "stress" can make it difficult to compare literatures and illuminate which dimensions of stress may impact different developmental processes.

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An additional complication stems from the fact that stressors come in various types and degrees and vary from household to household. Examples of stressors include neighborhood violence, chaos in the home, parenting a new child, and/or limited availability of economic resources – all of which may have different psychological impacts on an individual. In addition, individual differences exist in how people perceive and respond to different stressors. Further, stressors are not evenly distributed across people. Indeed, some groups of individuals experience many more stressors than others. In particular, individuals living in poverty are highly likely to be experiencing economic stress, but also are more likely to experience stress from a variety of different sources as compared with socioeconomically advantaged individuals (Algren et al., 2018; Attar et al., 2010; Blair & Raver, 2016; Evans, 2004; Evans & English, 2002; Evans & Kim, 2010; Hackman et al., 2010; McLoyd, 1990; Senn et al., 2014). Indeed, burgeoning theory also suggests that individuals can adapt to the chronic experience of various stressors (Ellis et al., 2020). As such, experience of stressors may not be consistently associated with cognitive appraisals of these stressors.

Variations in stress theory, measurement of types of stressors and ensuing psychological responses, and distribution of stressors across people have together led to an uneven approach to characterizing stress in the literature, ranging from relying on a single stress measure (e.g., a questionnaire on perceived stress or stress hormone levels following a stress task) to multivariate assessments (e.g., multiple questionnaires and/or additions of point-in-time measurements of stress physiology) to cumulative indices of stress (e.g., aggregating stress or stressors over longer periods of time or measuring cumulative stress hormone output). Complicating the picture further, many projects examining the impacts of stress on child development collect multiple indices of stress (e.g., perceived stress, household chaos, and life events), and the analytical treatment of these multiple indicators varies.

Various measures of stress have been linked with lower scores on measures of child language and socioemotional development, particularly among children raised in socioeconomically disadvantaged circumstances. However, the extent to which stress, regardless of its source, operates more generally on these outcomes, as opposed to how individual sources of stress and stressors operate differentially, is less clear. Furthermore, it is unclear whether environmental stressors and caregivers' psychological assessment of those stressors have differential effects on child development. Understanding how these different ways of stress quantification are associated with children's socioemotional and language development is of great interest, given the potential to provide valuable insights for future research and subsequent evidence-based interventions.

Associations among poverty, stress, and socioemotional development

A growing body of research has documented that increased stress in childhood is associated with worse socioemotional development, particularly in low-income samples (e.g., Evans & English, 2002). Within the literature, the term "socioemotional development" has been used broadly to represent a variety of underlying skills, including a child's experience, expression, and management of emotions; their ability to establish positive and rewarding relationships with others; and their ability to actively explore their environment and learn (Cohen et al., 2005). Socioemotional development in infants can be characterized by both competencies and

problem behaviors (Briggs-Gowan et al., 2004). In infants, problem behaviors have been postulated to encompass externalizing problems, internalizing problems, and dysregulation (Carter et al., 2003). Externalizing behaviors include high activity, impulsivity, aggression, and defiance. Internalizing problems include depression, social withdrawal, anxiety, separation distress, and extreme inhibition/shyness. Dysregulation includes problems in sleeping and eating, problems regulating negative emotional states with respect to reactivity and regulation, and unusual sensory sensitivities. Here we focus on early problems with an emphasis on behaviors seen as precursors to psychiatric problems, including internalizing and externalizing problems (Carter et al., 2003; Karabekiroglu et al., 2010). However, few studies have examined the impact of both the overall role of stress (as measured across multiple types of stress) as well as the contributions of environmental stress and psychological appraisals of stress on socioemotional problems in the first few years of life. One study found that increased internalizing and externalizing symptoms at age 5 were predicted by both maternal cumulative life stress as well as individual stressful life events and parenting hassles (Crnic et al., 2005).

The consideration of both cumulative stress as well as the presence of stressors and psychological appraisals of stress may be particularly important among children reared in low-income families, who are at increased risk for both stress exposure and socioemotional problems (McLoyd, 1990). Notable stressors that predict internalizing and externalizing problems in older children include stressors present in the environment like economic stress (McConnell et al., 2011; McLoyd, 1990; Mistry et al., 2002), neighborhood safety (Giurgescu et al., 2015; Henderson et al., 2016; Sharkey et al., 2012), and household chaos (Evans et al., 2005; Raver et al., 2015; D. Wang et al., 2020) as well as maternal psychological appraisals of stress such as parenting stress (Trentacosta et al., 2008; D. Wang et al., 2020). However, the extent to which these conditions are associated with socioemotional development in infancy has received little attention.

Associations among poverty, stress, and language development

In addition to its association with socioemotional development, increased stress has also been linked to lower language skill in children as young as two years old (Magill-Evans & Harrison, 2010; Noel et al., 2008). A handful of studies have considered the contributions of environmental stressors (e.g., Huizink et al., 2003; Ribeiro et al., 2015). For example, higher household chaos (Lecheile et al., 2020; Vernon-Feagans et al., 2012) and lower neighborhood quality and safety (Barbarin et al., 2006; Marco & Vernon-Feagans, 2013) have been linked with decreased language ability among preschool-aged children. While consistent evidence also suggests that socioeconomic status is predictive of language abilities, and that this relation is detectible as early as the second year of life (e.g., Noble et al., 2015), to our knowledge no studies have considered the specific role of stress stemming from lack of economic resources as it relates to infants' language development. Increased psychological assessments of stress like parenting-specific stress have also been shown to correlate with reduced language performance in some studies (e.g., Magill-Evans & Harrison, 2010), but not in others (Lehr et al., 2016).

Additionally, missing from the broader literature is a detailed account of how different parts of the stress process impact language development. For example, perceived stress, which measures parents' appraisal of general day-to-day stress, has been associated

with language ability at age two in some studies (D'Souza et al., 2019), but demonstrates mixed or nonsignificant links in others (Lehr et al., 2016; Lin et al., 2017). One possible explanation for these mixed results may stem from the fact that different stressors contribute to perceived stress differently across families. An alternative hypothesis may be that the influences of perceived stress vary based on the age of child or composition of the research sample. A substantial body of work also suggests that stress associated with the experience of poverty may lead parents to provide fewer opportunities for supportive cognitive stimulation (Bradley & Corwyn, 2002; Bradley et al., 2001), with negative repercussions for early neural development (e.g., neural pruning; Rosen et al., 2018; Sheridan & McLaughlin, 2016) and language outcomes (Miller et al., 2021; Miller et al., 2018).

The present study

The goal of the present study is to use a multidimensional assessment of stress to examine the collective and independent associations among different maternal reports of environmental stressors, psychological appraisals of stress, and infant socioemotional development and language milestones, among a sample of infants born into poverty. We will attempt to examine these relations in a series of four steps. First, we will examine relations among 5 different measures of stress (perceived stress, household chaos, parenting stress, economic stress, and neighborhood safety). We hypothesize that all stressors will load together on one composite, given that stress is likely to co-occur within families and that the reporter is the same for all measures (mothers). Second, we will examine whether stress, measured through the composite(s) created in the first analytic step, is related to maternal report of infant socioemotional problems and language milestones in 12-month-old infants being raised in low socioeconomic circumstances. Based on existing literature, we hypothesize that stress will be related to lower language scores and increases in socioemotional problems. Third, we will examine whether there are differential contributions of maternal reports of psychological *appraisals* of stress (e.g., do you feel nervous or stressed) versus experiencing environmental *stressors* (e.g., do you live in an unsafe neighborhood). By examining the contributions of stress across separate theoretical constructs, we aim to broaden the perspective of how stress may impact the developing child. Finally, we will conduct exploratory analyses to examine the extent to which individual measures in five domains (perceived stress, household chaos, parenting stress, economic stress, and neighborhood safety) are associated with socioemotional and linguistic outcomes.

Method

Participants

Participants were drawn from the 600 mother-infant dyads in the comparison group of Baby's First Years, the first randomized control trial of poverty reduction in early childhood in the United States (see Table 1 for sample characteristics). Briefly, in the larger study, mothers were recruited in hospital postpartum wards in four U.S. metropolitan areas (New York City, the greater New Orleans metropolitan area, the greater Omaha metropolitan area, and the Twin Cities of Minneapolis and St. Paul). Shortly after giving birth, mothers were randomized to receive either a large monthly cash gift or a nominal monthly cash gift for the first 40 months of their children's lives. Here we limit analyses to mothers in the low-cash

Table 1. Sample descriptive statistics at baseline data collection

	Mean	SD	N
Child is female	0.50	N/A	600
Child weight at birth (pounds)	7.13	1.08	599
Child gestational age (weeks)	39.09	1.25	596
Mother age at birth (years)	26.80	5.82	600
Mother education (years)	11.88	2.83	593
Mother race/ethnicity: white, non-Hispanic	0.11	N/A	600
Mother race/ethnicity: Black, non-Hispanic	0.40	N/A	600
Mother race/ethnicity: multiple, non-Hispanic	0.04	N/A	600
Mother race/ethnicity: other or unknown	0.05	N/A	600
Mother race/ethnicity: Hispanic	0.41	N/A	600
Household combined income	22,466	21,360	562
Household net worth	−1,981	28,640	531

gift group only. (For more information concerning the larger study design see www.babysfirstyears.com and Noble et al., 2021).

To be eligible, mothers' self-reported income in the prior calendar year had to fall below the federal national poverty threshold for their family size. Additional study inclusion criteria were (1) the mother was of legal age for informed consent (age 18 or older in NY, MN, and LA; 19 or older in NE); (2) the infant was admitted to the newborn nursery (not an intensive care unit); (3) the mother was residing in the state of recruitment; (4) the mother indicated that she is not "highly likely" to move to a different state or country in the next 12 months; (5) the infant was discharged in the custody of the mother; and (6) the mother spoke English or Spanish.

Following screening for eligibility, participants completed a baseline interview and were randomized to receive a $20 monthly cash gift ($240 annually) for the first 40 months of their infants' lives ($N = 600$). As a part of the baseline interview, mothers reported on demographic factors including maternal education, race, ethnicity, and infant sex.

When infants were approximately one year old ($M = 13.14$ months, $SD = 2.11$) 548 mother–infant dyads completed an age-1 interview (91% response rate; complete survey instruments available at www.babysfirstyears.com). As described below, here we examine associations across age-1 maternal reports of stress, infant socioemotional problems, and infant language development. Interviews were initially conducted in-person, with questions read to the participant by an interviewer. However, due to the COVID-19 pandemic, interviews were transitioned from in-person ($N = 343$) to over the phone ($N = 205$) during the age-1 data collection period. As such, method of survey administration was included as a covariate in all analyses.

Measures of stress

Measures of stress were selected by identifying pre-registered constructs that measured perceptions and experience with potent stressors in the Baby's First Years Project. All stress measures were administered during the age-1 visit.

Perceived stress

Perceived maternal stress was assessed using the perceived stress scale (PSS; Cohen et al., 1994; Cohen & Williamson, 1988). The PSS questionnaire, which assesses the degree to which the

respondent has perceived situations as stressful within the last month. Erroneously, one item was omitted from the survey, leaving a total of 9 items drawn from the larger 10-question questionnaire (see Supplemental Material 1 for administered items). The items were summed with higher scores indicating greater perceived stress and showed acceptable internal consistency ($\alpha = 0.758$). Mothers needed to complete at least six of the nine items for their score to be considered valid.

Household chaos

Household stress was measured through the Confusion, Hubbub, and Order Scale (CHAOS; Matheny et al., 1995). The CHAOS is designed to measure the order, routine, and disorganization of the home environment. Consistent with past work (e.g., Evans et al., 2005), we added items to increase coverage of routines and rituals in the home such as, "We have a regular morning routine at home," and "We eat together as a family once a day." Participants responded to each item as true or false of their home most of the time. Overall, the CHAOS showed acceptable internal consistency after this recode ($\alpha = 0.743$), which is consistent with past studies (Evans et al., 2005). Positively stated items were reverse coded before being summed, and higher scores indicated greater household chaos. Mothers needed to answer at least 11 items to have a valid CHAOS score.

Parenting stress

Parenting stress was assessed through a seven-item index preregistered as a part of the larger Baby's First Years project. Of the seven items, three were drawn from the Aggravation in Parenting Scale (PSID-Child Development Supplement) and four were drawn from the Cleminshaw – Guidubaldi Parent Satisfaction Scale (Guidubaldi & Cleminshaw, 2010). The scale included seven statements related to the rewards and stresses of parenting (e.g., "When it comes to raising kids, I have a lot of confidence in my abilities," "I feel trapped by my responsibilities as a parent"). For each of these items, participants indicated the extent to which they agreed or disagreed with the statement using a five-point Likert scale ranging from "strongly disagree" to "strongly agree" (see Supplemental Material 2 for items). Items were summed with and possible scores ranged from 7 to 35 with higher scores indicating more parenting stress. Mothers needed to answer at least 50% of the items to have a valid score.

Economic Stress. Economic stress was assessed through mothers' self-report on nine questions (Kling et al., 2007). For seven of the questions, mothers responded "yes" or "no" (e.g., "In the past 12 months have you ever missed a rent or mortgage payment?"; See Supplemental Material 3 for full list of questions). "Yes" responses were scored as 0, and "no" responses were scored as 1. For one question, mothers also rated the frequency (i.e., "all of the time," "very frequently," "occasionally," "rarely," "very rarely," "never") with which they worried about being able to meet monthly living expenses. Responses of "occasionally" or less frequent were scored 0, and responses of "very frequently" or "all of the time" were scored 1. Finally, mothers responded to the question, "In the past 12 months, would you say that your household has spent more, less, or about as much as all of your sources of income combined?" Responses of "more" or "about the same" were scored 1 and "less" was scored 0. A total score was created by summing the scores for each of the nine questions. Higher scores indicated higher economic stress. Mothers needed to complete at least five of the nine questions for their score to be considered valid.

Neighborhood Safety. Participants responded to two questions about the perceived safety of their neighborhood. Using a Likert scale (0 = very unsafe to 3 = very safe), mothers responded with their perceived safety of the streets near their home both during the day and at night. These scores were then summed together to create one neighborhood safety variable with a range of 0–6, with higher scores indicating more perceived neighborhood safety, $M = 4.382$, $SD = 1.323$.

Psychological appraisal and experience of stress composites

To further understand the unique contributions of maternal reports of psychological appraisal of stress and the experience of stressors, two composites were created from the five individual stress measures. Two measures – the perceived stress scale and parenting stress – were identified as asking about maternal psychological assessments of stress. Three measures were identified to be mostly comprised of items endorsing the presence and absence of stressors – economic stress, neighborhood safety, and household chaos. Composites were created by z-scoring each questionnaire to place them on the same scale. Next, means of the z-scored individual questionnaires were averaged to create the Psychological and Environmental composites, respectively.

Socioemotional problems

The Brief Infant-Toddler Social Emotional Assessment (BITSEA; Briggs-Gowan et al., 2004) is a clinical screener for social-emotional issues, behavioral problems, and delays in competency in young children. BITSEA measures the occurrence of problem behaviors and parents' concern about their child's development. The scale was previously validated in a clinical sample and is used to screen children 12–36 months old (Briggs-Gowan et al., 2004).

At the age-1 assessment, the Behavior Problems Subscale (31 items) was administered to assess socioemotional development. Mothers completed 23 items about the frequency (0 = not true/rarely, 1 = sometimes true/often, 2 = very true/often) of certain behaviors (e.g., "My child seems nervous, tense, or fearful"). Due to an administrative error, eight items were administered with the wrong response categories. Specifically, mothers were asked to report their level of worry (1 = not at all worried to 4 = very worried) for their child's behavior and development instead of their frequency (0 = not true/rarely, 1 = sometimes true/often, 2 = very true/often) on eight items. To ensure these items were not given increased weight, these items were recoded as follows: "0" not at all worried was recoded to "0" not true/rarely; "1" a little worried was recoded to "1" sometimes true/sometimes, and "3" worried and "4" very worried were recoded to "3" very true/often. This recoding structure allowed for BITSEA Problem scores to remain within the expected range. This administrative error and the associated recoding were consistent for all participants. Overall, the BITSEA showed good internal consistency after this recode ($\alpha = 0.810$).

Language

Child language milestones were assessed using the Communication subscale of the Ages and Stages Questionnaire – Third Edition (ASQ-3; Squires et al., 2009). The ASQ-3 measures children's achievement of developmentally relevant skills and screens for developmental delays across five domains: gross motor skills, fine motor skills, problem-solving ability, communication, and personal and social skills. Depending on the child's date of birth, the 12-month, 14-month, 16-month, or 18-month ASQ-3 was administered.

The Communication subscale of the ASQ-3 includes six items measuring children's developmentally relevant language skills (e.g., "Does your baby make two similar sounds, such as "ba-ba" "da-da" or "ga-ga"?"). For each item, mothers reported whether their infant regularly demonstrated the skill, sometimes demonstrated it, or did not yet demonstrate it. The ASQ-3 questions vary based on age and are standardized in 2-month bins (e.g., 10–11 months, 12–14 months). Age-appropriate versions of the ASQ-3 were administered to each child, and total scores were calculated by summing the item scores. Given that raw scores vary in their clinical significance across age, raw scores were then z-scored using the normed means and standard deviations for the ASQ-3. Higher z-scores indicated greater achievement of developmentally relevant language skills relative to same-aged peers. The ASQ-3 has shown strong concurrent validity ($r = .85$), two-week test-retest reliability ($r = .75–.82$), interobserver reliability ($r = .43–.69$), and internal consistency ($\alpha = .51–.87$; Squires et al., 2009).

Analytic plan

Data were analyzed in a series of four steps.

To test whether stress is associated with socioemotional and language development, we examined whether five measures of stress (perceived, household, economic, neighborhood safety, parenting) may be reduced to one or more composite measures of stress by using exploratory factor analysis (EFA). Significant factor(s) were extracted for further inquiry.

Next, the stress factor(s) and covariates were entered a regression with the dependent variable of interest (socioemotional problems or language milestones). To confirm that educational, demographic, age-related, or administration-related differences did not account for our findings, a number of covariates were entered into our models. Covariates included maternal education (five dummy-coded variables for maternal high school degree, some college, associate's degree, bachelor's degree, and unknown education), maternal race (four dummy-coded variables for Black, Multi-racial, Other Race, and Race Unknown), maternal ethnicity (one dummy-coded variable for Hispanic ethnicity), child sex (one dummy-coded variable), child age at interview (in months), and method of administration (one dummy-coded variable, with 1 = interview conducted over the phone).

Third, to examine whether maternal endorsements of environmental stressors and psychological appraisals of stress have differential associations with child development, we conducted a linear regression where the psychological appraisal and environmental composite were entered individually, in place of the stress factor(s) utilized in the prior linear regression models along with covariates.

Finally, to examine whether some measures were more highly associated with socioemotional problems vs. language milestones, a set of exploratory linear regressions were conducted. In these exploratory linear regressions, each stress measure was entered into the model individually, in place of the psychological and environmental composites utilized in the prior linear regression, along with covariates.

Results

Relations among variables of interest

Bivariate correlations among all independent and dependent measures can be found in Table 2.

Dimension reduction of stress variables

To examine whether our five stress measures (perceived, household, parenting economic, and neighborhood safety) may be reduced into one or more stress factors, the five stress measures were analyzed in an exploratory factor analysis using principal factor analysis with Varimax rotation. The analysis yielded a one-factor solution with an Eigenvalue greater than 1 (eigenvalue = 1.407). This factor was labeled 'Stress Composite' due to the high loadings by the following items: perceived stress (loading = 0.666), household chaos (loading = 0.565), parenting stress (loading = 0.532), economic stress (loading = 0.445), and neighborhood safety (loading = −0.405). This Stress Composite factor was extracted for further analysis for a total of 544 participants.

Association with socioemotional problems

First, the Stress Composite Factor and covariates were regressed onto the Problem Scale from the BITSEA. Overall, this model revealed that higher scores on the Stress Composite were significantly associated with more socioemotional problem behaviors ($\beta = 2.913$, $p < .001$, partial $\eta^2 = .144$).

Next, the Psychological and Environmental composites and covariates were regressed onto the Problem Scale from the BITSEA. This model revealed that increases in both Psychological stress ($\beta = 1.991$, $p < .001$, partial $\eta^2 = .067$) and Environmental stress ($\beta = 1.884$, $p < .001$, partial $\eta^2 = .025$) composite were significantly related to higher maternal report of infant problem behaviors.

Finally, an exploratory regression was conducted to see if different measures of stress (as opposed to the Stress Composite) were associated with infant socioemotional problems, after controlling for covariates. This analysis revealed that increased maternal perceived stress ($\beta = .178$, $p < .001$, partial $\eta^2 = .026$) and household chaos ($\beta = .562$, $p < .001$, partial $\eta^2 = .063$) were associated with more socioemotional problems, while parenting stress ($\beta = .053$, $p = .509$, partial $\eta^2 = .001$), economic stress ($\beta = .039$, $p = .788$, partial $\eta^2 < .001$), and neighborhood safety ($\beta = −.111$, $p = .579$, partial $\eta^2 = .001$) were statistically unrelated to socioemotional problems.

Association with language milestones

First, the Stress Composite Factor and covariates were regressed onto the ASQ Communication subscale. Results indicated that higher Stress Composite scores were statistically associated with lower maternal report of infant language milestones ($\beta = -.137$, $p = .004$, partial $\eta^2 = .017$).

Next, the Psychological and Environmental composites and covariates were regressed on the ASQ Communication Subscale. This model revealed that increased Psychological stress was related to lower maternal report of language milestones ($\beta = -.119$, $p = .015$, partial $\eta^2 = .012$), while Environmental stress was not significantly related to infant language milestones ($\beta = -.016$, $p = .834$, partial $\eta^2 < .001$).

Finally, an exploratory regression was conducted to see if different measures of stress (as opposed to the Stress Composite) were associated with language milestones. For this regression, all covariates and the five different measures of stress (perceived stress, household chaos, parenting stress, economic stress, and neighborhood safety) were regressed onto the ASQ subscale. Examination of individual stress types showed no single stress type reached conventional levels of statistical significance (all *p's* > .122).

Table 2. Means, standard deviations, and associations (Pearson's r) among variables of interest

	1.	2.	3.	4.	5.	6.	7.
1. Perceived stress	1						
2. Household chaos	.472***	1					
3. Parenting stress	.399***	.321***	1				
4. Economic stress	.328***	.209***	.207***	1			
5. Neighborhood safety	−.234***	−.195***	−.247***	−.271***	1		
6. Problem behaviors (BITSEA)	.337***	.385***	.194***	.149***	−.119**	1	
7. Communication (ASQ-3)	−.104*	−.138**	−.106*	−.035	.088*	−.020	1
Mean (SD)	10.815 (6.346)	3.420 (3.031)	15.048 (3.521)	2.678 (1.813)	4.382 (1.323)	8.439 (6.219)	.193 (.886)

*<.05.
**<.01.
***<.001.

Discussion

This study provides evidence that stress may be one important mechanism shaping socioemotional and language development for infants experiencing poverty. Specifically, we examined five different measures of stress (perceived stress, economic stress, neighborhood safety, parenting stress, and household chaos) and formed a Stress Composite Factor with higher values indicating more stress. We also examined whether different stress constructs – maternal endorsement of environmental stressors and maternal psychological appraisal of stress – were uniquely associated with child socioemotional problems and language development. We found that higher stress, as measured by this Stress Composite Factor, was associated with more socioemotional problems with a medium effect size and lower reports of language milestones with a small effect size at the end of the first year of life, after controlling for a number of possible confounding factors. When examining the different stress constructs, we found that infant socioemotional development was associated with maternal endorsement of environmental stressors as well as maternal psychological appraisals of stress. In contrast, infant language milestones were significantly associated with maternal psychological appraisals of stress and not significantly associated with maternal endorsement of environmental stressors. Exploratory analyses revealed that some individual sources of stress were more predictive than others for child socioemotional development, but not language development.

One of the goals of the present study was to help identify how different types of stress predict child development both collectively and according to theoretically defined constructs. In particular, we aimed to examine these patterns among children living in poverty, who are more likely to experience stress than their more advantaged peers (Algren et al., 2018; Attar et al., 2010; Blair & Raver, 2016; Evans, 2004; Evans & English, 2002; Evans & Kim, 2010; Hackman et al., 2010; McLoyd, 1990; Senn et al., 2014). Our results found that five different measures of stress – maternal perceived stress, economic stress, neighborhood safety, parenting stress, and household chaos loaded together into a single indicator of stress in our sample. This single factor solution was notable, given the broad nature of the measures entered into the analysis, and given that some of the questionnaires assessed the maternal psychological appraisals of stress while others asked about the presence of environmental stressors. While useful, the meaning of this factor is unclear. One interpretation may be that all sources of stress (or stressors) operate similarly and, thus, the factor is indicative of collective "maternally-reported stress." Alternatively, and perhaps more likely, this factor may also

be reflective of the phenomenon that, for mothers who gave birth while in poverty, experiencing more stress in one area may make one more likely to encounter stress in other areas. Understanding which interpretation best explains the associations in the present manuscript is a promising avenue for future longitudinal and/or causal research.

When we examined the influences of the stress composite, the contributions of different stress constructs, and individual measures of stress on socioemotional problems, our data suggested that the stress composite was associated with significantly more socioemotional problems. Furthermore, we found that increased maternal reports of both environmental stressors as well as psychological appraisals of stress were associated with worse socioemotional and language development. These findings were consistent both with our hypotheses and previous research suggesting that greater exposure to stress is associated with more internalizing and externalizing problems for toddlers from low-income homes (e.g., Trentacosta et al., 2008). Furthermore, exploratory analyses examining individual stress measures revealed that higher maternal perceived stress and higher household chaos predicted greater socioemotional problems at one year of life, whereas parenting stress, neighborhood safety and economic stress did not. These individual assessments of stress are split across different stress constructs, with maternal perceived stress being a psychological appraisal of stress and household chaos being a source of environmental stress. These findings also align with previous research showing associations between greater household chaos and higher internalizing and externalizing problems in both toddlers and school-aged children (Crespo et al., 2019; Z. Wang et al., 2012), even when controlling for other environmental factors (Deater-Deckard et al., 2009). These findings suggest that different sources of stress and stress constructs may be uniquely associated with different aspects of child development. To our knowledge, this is the first study to investigate the collective and independent associations of five different measures of stress, as well as the impact of both environmental stressors and maternal psychological appraisal of stress on socioemotional development, in a sample of low-income 12-month-old infants.

In addition to socioemotional problems, we also found that higher levels of the stress composite significantly predicted lower maternal report of language milestones. This finding was in line with our hypothesis and previous research indicating negative associations between stress and language development. Interestingly, exploratory analyses revealed that no individual stress measure significantly predicted language milestones over and above the influence of other stress measures, but that maternal psychological

appraisals of stress did predict lower language milestone scores while maternal report of environmental stressors did not. This was the first study to our knowledge that considered both the collective and individual influence of stressors commonly experienced by low-income families as well as the contribution of different stress constructs on child language development (Magill-Evans & Harrison, 2010; Noel et al., 2008). Taken together, these findings suggest the possibility that maternal appraisals of psychological stress are more important than the mere presence of stressors for infant language development. While beyond the scope of the present study, one may speculate that a possible mechanism may be that increased maternal psychological appraisals of stress may change the quality or quantity of language or cognitive stimulation in the home and, in turn, impact infant language development. Alternatively, maternal psychological appraisal of stress may lead mothers to rate their infants' language development more poorly.

The present findings are not without their limitations. First, all measures used in our analyses were collected via maternal report, which is subject to reporter effects and bias. Additionally, all assessments were collected concurrently, and associations presented are correlational, rendering it impossible to glean causal inferences. Second, although significant, the effect sizes of our findings were rather small (partial $\eta^2 = .012–.144$), which suggests that any stress-related impacts on socioemotional and linguistic development highlighted in this manuscript are likely one of many different pathways through which language and socioemotional problems develop. Indeed, dimensional theories of adversity suggest that other mechanisms, such as learning, are also likely pathways through which adversity may impact the developing child (McLaughlin & Sheridan, 2016; McLaughlin et al., 2014; Sheridan & McLaughlin, 2014). Third, we observe no individually predictive contributions of economic stress and neighborhood safety. However, given that an enrollment requirement was that families' household income be below the poverty line, it is possible that we had limited variability in these sources of stress due to our recruitment methods. Finally, it is important to note that many of the measures of stress we examined may impact child development through a variety of different mechanisms beyond the extent to which they are stressful. For example, economic stress may lead to differences in access to shelter, heat, cognitive stimulation, or nutritious foods – all of which may affect child development outside of their roles as stressors per se. As such, it is important that future research consider more complex relations between different experiences of stress and child development.

Future work should consider the bidirectional relations between socioemotional and language development. Recent research has demonstrated that language and socioemotional problems may develop in dynamic and interrelated ways (see Chow & Wehby, 2018 for review). Evidence suggests that worse language skills are predictive of a host of socioemotional challenges such as poorer attention (Petersen et al., 2013) and emotional regulation (Rose et al., 2018), as well as increased externalizing behaviors (Menting et al., 2011). A smaller collection of work also suggests that poorer behavioral abilities might complicate children's ability to engage in language-building interactions, thus predicting worse language development (e.g., Petersen et al., 2013).

Future research should also investigate the contributions of other stressors and test potential mechanisms that may explain the current findings. While the present manuscript examined five measures of stress, these are by no means an exhaustive list of the stresses facing families raising children in poverty. Future research should consider a boarder assessment of stress as well as stress

constructs beyond environmental stressors and maternal psychological appraisals, including stress physiology and structural inequality, to better capture the possible pathways stress may shape child development. Additional research is also necessary to determine the mechanisms which explain the current findings. One possibility is that parental stress (Bradley & Corwyn, 2002; Bradley et al., 2001) may drive disparities in child development through less parental engagement in cognitive stimulation (see Dimensional Model of Adversity; McLaughlin & Sheridan, 2016; Miller et al., 2018, 2021; Sheridan & McLaughlin, 2016).

In sum, we provide some of the first evidence that stress is associated with more socioemotional problems and fewer language milestones by the end of the first year of life in a diverse sample of low-income families. The stress measures and constructs examined in this study were especially relevant to the experience of poverty. Although there is abundant literature on the cumulative effects of adversity, little research documents both the collective and independent effects of different stressors as well as how different stress constructs are associated with child language and socioemotional development in infants being raised within the context of poverty. Identifying which aspects of the stress process as well as individual stress measures that are most pertinent to child outcomes is important for interventions and policies aimed at reducing stress, and the experience of stress and stressors, among low-income families.

Author contributions. Emma R. Hart and Jessica F. Sperber contributed equally.

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