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RESEARCH ARTICLE

Expressive language in infancy and toddlerhood: The roles of child temperament and maternal parenting behaviors

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Abstract

Prompt, appropriate, and contingent maternal behaviors play a role in early language acquisition, as do individual differences in children's temperament. However, little work has investigated the combined influence of maternal psychosocial and child biological factors on expressive language development. The purpose of this study was to evaluate the concurrent and longitudinal contributions of responsive/intrusive parenting and child temperament to multiple expressive language outcomes at 10 and 24 months of age. Participants included 407 mothers and children (209 girls). Mothers completed questionnaires about their infant's temperament and language, and maternal parenting was coded during mother–child interaction tasks. Dependent variables included (1) gestures at 10 months, (2) vocabulary at 24 months, (3) mean length of utterance at 24 months, and (4) sentence complexity at 24 months. After controlling for child sex and maternal education, child temperament was associated with language outcomes at 10 and 24 months, whereas intrusive, but not responsive, parenting related to only 24 month language outcomes. Longitudinally, infant negative affectivity predicted sentence complexity in toddlerhood. These findings elucidate the presence of both psychological and biological predictors as they differentially influence various aspects of expressive language development across the first two postnatal years.

KEYWORDS
expressive language, infancy, parenting, temperament, toddlerhood

1 | INTRODUCTION

Early childhood represents a period of rapid communicative and linguistic development. Indeed, language is thought to serve as an essential tool through which children can begin to modulate their own thoughts/actions and mentally represent increasingly complex problems (Vygotsky, 1978; Zelazo et al., 2003). Not surprisingly then, both communicative gestures and orally productive speech (i.e., expressive language) play a central role in children's later social competence, academic achievement, and cognitive development. For example, gesture use in infancy (i.e., the rate of gesticulation and the diversity of meanings conveyed) is predictive of children's spoken language and social–emotional skills in the preschool years (Rowe & Goldin-Meadow, 2009; Vallotton & Ayoub, 2010). Moreover, Whedon et al. (2018) note that expressive language in toddlerhood is associated with preschool executive functioning, and Hohm et al. (2007) report that infant language is related to children's cognitive performance 10 years later. Given the predictive nature of child language across a host of developmental outcomes, the purpose of the present study was to apply a biopsychosocial perspective to identifying factors that affect expressive language development in infancy and toddlerhood. That said, much of the developmental literature has narrowly focused on single indicators of expressive language, namely, vocabulary or gesturing. For this reason, our study evaluated not only these two core facets of productive language but also two underresearched yet equally important metrics of expressive language: mean length of utterance (MLU) and sentence complexity.

Language develops in the context of social interactions (Kuhl, 2007). As such, caregiving behaviors significantly influence linguistic development across early childhood. For instance, Goldstein and Schwade (2008) report that after receiving contingent verbal feedback from their mother, infants restructured the phonological pattern of their babbling to mirror that of their mothers. Maternal behaviors that are sensitive to infants' cues foster engaging and reciprocal parent–child interactions that promote language learning (Tamis-LeMonda et al., 2001). In other words, mothers who are more responsive to the focus of their child's attention and/or vocalizations increase opportunities to engage in conversational turn-taking and provide children with relevant linguistic information (Carpenter et al., 1998; Tomasello & Farrar, 1986). Maternal responsiveness is related to an array of child expressive language outcomes both concurrently and longitudinally, including communicative gestures, vocabulary, combinatorial speech, and use of decontextualized language (Leigh et al., 2011; Paavola et al., 2006; Tamis-Lemonda et al., 2001).

In contrast, mothers who frequently exhibit intrusive behaviors (i.e., actions that are directive, prohibitive, or controlling) disrupt moments of shared attentional focus with their child, which may adversely impact language development (Tomasello & Farrar, 1986). Although the impact of intrusive parenting has received comparatively less attention in studies of language acquisition, maternal intrusiveness has been reported to be negatively correlated with child expressive vocabulary size (Keown et al., 2001; Tomasello & Farrar, 1986) and with the rate of expressive vocabulary growth (Pungello et al., 2009). Taken together, maternal behaviors play a substantial role in shaping the environments through which children acquire and produce language early in life.

Nonetheless, social interaction is by definition a communicative exchange between two partners which means that the way children elicit, process, and respond to linguistic input may operate in tandem with maternal factors to influence development. One interpretation is that biologically based child characteristics (i.e., temperament; Rothbart & Derryberry, 1981) may influence language acquisition directly via the availability of resources required to process/respond to linguistic input and indirectly via the quantity/quality of parent–child interactions (Salley & Dixon, 2007). Indeed, a growing body of literature reports that temperament influences language development via individual differences in children's self-regulatory and reactivity capacities.

Regarding the self-regulatory aspect of temperament, both orienting attention in infancy and effortful control in early childhood are related to measures of child language production (Colombo et al., 2004; Slomkowski et al., 1992). With respect to temperamental reactivity, studies illustrate relations between higher surgency (e.g., smiling and laughter) and expressive vocabulary in infancy (Laake & Bridgett, 2014) and toddlerhood (Slomkowski et al., 1992). However, the link between negative affectivity (e.g., displays of distress) and language acquisition in childhood is generally less conclusive. Many researchers report a negative association between negative affect and expressive language, perhaps because children with more negative temperament styles allocate more resources to regulating their affectivity as opposed to processing linguistic information and/or producing speech (Dixon & Smith, 2000; Salley & Dixon, 2007). Spinelli et al. (2018) find a positive association between negative affect and expressive language, however, arguing that greater expressions of negativity may elicit more face-to-face interactions with caregivers, which promote expressive language development.

Finally, there is also evidence of a longitudinal link between temperament and language whereby individual differences in infant temperament predict later expressive language abilities. That is, greater expression of both joy and anger in infancy, in addition to infant audio/visual attention, predict expressive language outcomes in early childhood (Moreno & Robinson, 2005; Salley et al., 2013; Vouloumanos & Curtin, 2014). Taken together, temperamental traits appear to play an important role in shaping not only children's interactions with social partners but also the attentional and regulatory processes needed to comprehend language-relevant information to eventually produce speech.

In the current literature, few studies have jointly examined both maternal caregiving and child temperament with respect to expressive language acquisition at multiple developmental timepoints; rather, previous research has largely focused on either child or maternal factors, or on concurrent relations only. It is also unclear from the existing literature whether parenting behavior still relates to children's expressive language outcomes after accounting for early emerging, child-centric factors. Thus, additional research is warranted to disentangle the influence of child temperament from parenting factors on various measures of expressive language. Our study investigated the individual contributions of psychosocial (i.e., maternal responsiveness and intrusiveness) and biological factors (i.e., child surgency, negative affect, orienting/effortful control) on multiple expressive language metrics in children's first and second postnatal years (i.e., gesturing in infancy and vocabulary, MLU, and sentence complexity in toddlerhood). Our first aim was to examine the influence of child temperament on expressive language outcomes concurrently at 10 and at 24 months of age. We hypothesized that child surgency and orienting/effortful control would positively relate to child expressive language, whereas negative affectivity would be negatively associated with expressive language. Next, our second aim sought to examine whether maternal parenting relates to child expressive language outcomes concurrently at 10 and at 24 months of age after accounting for child centric factors (i.e., temperament). We predicted that maternal responsiveness would positively relate to children's communicative and verbal language scores, whereas maternal intrusiveness would negatively relate to children's expressive language outcomes. Our third and final aim was to evaluate the longitudinal relations between biopsychosocial factors in infancy and expressive language outcomes in toddlerhood. We predicted that 10-month (3a) child temperament and (3b) maternal caregiving would predict 24-month expressive language in a similar fashion as described above.

2 | METHOD

2.1 | Participants

Participants included 407 mothers and children (209 girls, 51.4%) who were recruited as participants in a longitudinal study examining emotion and cognition. In this study, children were recruited and visited the lab when they were infants (at 5 and 10 months) and at various developmental timepoints in childhood (at 2, 3, 4, 6, and 9 years of age). Although our primary focus is on the development of gesturing in infancy and orally productive language in toddlerhood, language was originally assessed in this longitudinal study to control for verbal intelligence in analyses examining cognition–emotion relations. Mother–child dyads were recruited equally by two research locations in the southeastern region (Blacksburg, VA; Greensboro, NC) in the United States using mailing lists, advertisements, flyers, and word of mouth. Familial racial composition reflected the demographics of the geographic region (78% White, 14% Black, 7% other race, 1% Asian). Maternal education was diverse, with 23% advanced degrees, 43% college graduates, 6% technical school graduates, 27% high school graduates, and 2% not completing high school. Mothers were an average age of 31 years (SD = 5.61) at the time of their child's 10 month visit.

Of the 410 children originally enrolled in this study at 5 months of age, three children and their mothers did not contribute any data at either the 10 month or the 24 month visit. A total of 151 children did not complete an assessment of 10 month communicative gesturing because (a) of attrition from the 5 month visit ($n = 28$), (b) they were a member of an early cohort that did not collect language data at this age ($n = 106$), or (c) their caregiver did not complete the language measure ($n = 17$). Of the remaining 259 children with gesturing data, 14 children were missing additional measures (n = 6 missing maternal education, n = 8 did not complete the mother–child interaction task due to families only providing questionnaire data at 10 months with no lab visit [n = 5] or child fussiness [n = 3]). No significant differences in infant temperament or maternal caregiving were detected when comparing children whose caregivers did or did not complete the 10 month language questionnaire ($ps > .05$). However, mothers who did not report 10 month expressive gesturing reported lower educational attainment on average, χ^2 (2, $N = 298$) = 9.12, $p = .003$.

Of the originally enrolled 410 children, 86 children did not have expressive language data available either because of attrition from the 10 month visit (n = 63) or because their caregiver did not complete the language measures (n = 23). Of the remaining 324 children with expressive language data, 32 children were missing other measures (n = 2 missing temperament data, n = 7 missing maternal education data, n = 23 did not complete the mother–child interaction task due to families only providing questionnaire data at 24 months with no lab visit [n = 19] or child fussiness [n = 4]). No significant differences in toddler temperament, maternal caregiving, or maternal education emerged as a function of whether caregivers did or did not complete the 24 month language questionnaire ($ps > .05$). Finally, of the 292 children with complete 24 month data, 16 of these children were missing 10 month data (i.e., $n = 13$ missing temperament data and $n = 3$ did not complete the mother-child interaction task [these three families only provided questionnaire data]).

2.2 | Procedure

Data were collected at both research locations using identical research procedures. Research assistants at both institutions were trained by the Principal Investigator (last author). To ensure identical protocol administration was maintained between the research sites, the Blacksburg team periodically viewed video recordings collected by the Greensboro team. The Blacksburg team coded all mother behavioral data collected by both labs.

When mothers and children arrived in the lab, research assistants explained the lab procedures and obtained informed consent. Mothers were mailed parent-report forms for demographics, infant language, and infant temperament in advance that they completed and brought with them to the lab. In addition to a battery of cognitive and self-regulation tasks not reported here, maternal parenting was assessed during a parent–infant interaction task, and the session was recorded for later behavioral coding. Study procedures were approved by the Virginia Tech and University of North Carolina at Greensboro Institutional Review Boards.

2.3 | Measures

2.3.1 | Child expressive language

Mothers completed versions of the MacArthur–Bates Communicative Development Inventory (MCDI; Fenson et al., 2007) to assess child expressive language.

Ten months—MacArthur–Bates Communicative Development Inventory: Words and Gestures

The MacArthur–Bates Communicative Development Inventory: Words and Gestures (MCDI-WG) is normed for infants ages 8–18 months and assesses infants' early production of language using a vocabulary and gesture checklist (Fenson et al., 2007). Due to floor effects and limited variability on the expressive vocabulary checklists, the total communicative gestures score was used for the current study. The communicative gestures subscale of the MCDI-WG comprises 12 items assessing an infant's nonverbal communicative and intentional behaviors, including reaching, pointing, and nodding (Fenson et al., 2007). The MCDI-WG reports "very high" internal consistency and excellent test–retest reliability (Fenson et al., 2007).

Twenty-four months—MacArthur–Bates Communicative Development Inventory: Words and Sentences

The MacArthur–Bates Communicative Development Inventory: Words and Sentences (MCDI-WS) is normed for toddlers ages 16–30 months and evaluates later facets of language production, including expressive vocabulary, grammar, and syntax. The first section of the MCDI-WS evaluates the words children use with a 680-word vocabulary checklist. The second section evaluates sentences and grammar, from which the MLU is computed. Lastly, parents report on their child's sentence complexity by selecting phrases that best reflect their child's current speech (Fenson et al., 2007). The three variables of interest derived from the MCDI-WS were expressive vocabulary raw score, MLU raw score, and sentence complexity raw score. As described above, the MCDI reports excellent metrics of reliability, internal consistency, and validity (Fenson et al., 2007).

2.3.2 | Maternal caregiving behaviors

Mothers and children were observed interacting during two tasks where mothers were instructed to play with their child as they would at home. Maternal *responsiveness* reflected the ability to attentively respond to her child's arousal, interests, and abilities. Maternal *intrusiveness* was characterized by behaviors such as negative affect, overstimulation, or increasing the pace of an activity, which reflected an interaction being predominantly mother centered rather than child centered. Both maternal behaviors were coded on a 4-point scale (1 = *no evidence*, 4 = *high evidence*), adapted from Calkins et al. (2004) and reported in detail in Bernier et al. (2016). Behaviors were coded in 30-s epochs, which were averaged to create a mean score for each maternal behavior.

Ten months—Dyadic toys task

Mothers and infants played together for 2 min with two age-appropriate toys that were simple in nature; the infant sat in a highchair and the mother was seated in front of her infant (adapted from Calkins et al., 2004). Epochs were co-coded by an independent observer for at least 31% of the dyads. The intraclass correlation coefficient (ICC) was .80 for maternal responsiveness and .75 for maternal intrusiveness.

Twenty-four months—Dyadic puzzles task

Mothers and toddlers played together with three age-appropriate puzzles for 6 min, sitting on adjacent sides of a table (Smith et al., 2004). Epochs were co-coded by an independent observer for at least 22% of the dyads. The ICC was .92 for maternal responsiveness and .95 for maternal intrusiveness.

2.3.3 | Child temperament

Ten months—Infant Behavior Questionnaire-Revised

The Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003) is a parent-report form that contains statements/questions regarding their infant's temperament that parents report on using a 7-point Likert scale. The IBQ is designed to measure 14 facets of infant temperament between the ages of 3 and 12 months that load onto three factor scales, *Surgency*, *Negative Affectivity*, and *Orienting*. Surgency comprised six subscales, including approach, vocal reactivity, high intensity pleasure, smiling and laughter, activity level, and perceptual sensitivity. Negative Affectivity reflected four subscales, including sadness, distress to limitations, fear, and falling reactivity/rate of recovery from distress. Lastly, Orienting comprised four subscales: low intensity pleasure, cuddliness, duration of orienting, and soothability (Gartstein & Rothbart, 2003). In the current study, internal consistency for the subscales was good to excellent (Surgency: $\alpha = .93$; Negative Affectivity: $\alpha = .81$; Orienting: $\alpha = .84$).

Twenty-four months—Early Childhood Behavior Questionnaire

The Early Childhood Behavior Questionnaire (ECBQ; Putnam et al., 2006) is a parent-report questionnaire designed to measure temperament in toddlers ages 18–36 months using a 7-point Likert scale. The ECBQ assesses 18 unique dimensions of temperament, which load onto three-factors of *Surgency*, *Negative Affectivity*, and *Effortful Control*. Surgency comprised five subscales, including impulsivity, activity level, high-intensity pleasure, sociability, and positive anticipation. Negative Affectivity comprised eight subscales including discomfort, fear, sadness, shyness, perceptual sensitivity, motor activation, non-soothability, and frustration. Lastly, Effortful Control comprised five subscales: inhibitory control, attention shifting, attention focusing, low-intensity pleasure, and cuddliness (Putnam et al., 2006). In the current study, internal consistency for the subscales was good to excellent (Surgency: $\alpha = .90$; Negative Affectivity: $\alpha = .91$; Effortful Control: $\alpha = .88$).

2.4 | Data analytic plan

Results were analyzed with IBM SPSS (Version 26). Correlations between main study variables were first examined. To evaluate the concurrent predictors of expressive language, hierarchical linear regressions were conducted with child characteristics entered in Block 1 and maternal parenting behaviors added in Block 2. Child characteristics were blocked first to evaluate the additive nature of parenting above and beyond child characteristics. To evaluate longitudinal predictors of expressive language, hierarchical linear regressions were conducted with infant and maternal parenting behaviors at 10 months in Block 1, followed by toddler factors at 24 months in Block 2, and maternal parenting behaviors at 24 months in Block 3.

Seven regression models were conducted for both concurrent and longitudinal aims: one for concurrent language at 10 months (gestures), three for concurrent language at 24 months (MLU, sentence complexity, expressive vocabulary), and three for longitudinal language at 24 months (MLU, sentence complexity, expressive vocabulary). Due to the large number of regressions conducted, Bonferroni corrections were applied to all significance levels, which subsequently required *p*-values to be at or below .007 to be interpreted as significant ($.05/7 = .00714$; Curtin & Schulz, 1998). Each model also included covariates of child sex and maternal education, as both of these variables have established connections to language in the literature and were significantly correlated with expressive language in the present study (Bornstein & Cote, 2005; Hoff, 2003a; Ozçalişkan

& Goldin-Meadow, 2010). Maternal education was dichotomized as a function of whether mothers obtained a college degree (0 = *no college education*, 1 = *college education*): an approach established in previous works as sensitive enough to detect group differences in child language (e.g., Gilkerson et al., 2017; Hoff-Ginsberg, 1998). Maternal education served as a proxy for maternal language (Hoff, 2003a).

2.5 | Missing data

Missing cases for primary variables included in our regression models were handled via multiple imputation in SPSS using the fully conditional specification method (MCMC). The number of imputations was set to 10 (Graham et al., 2007) and the results were then aggregated for use in our planned analyses. Across all variables, the percentage of missing cases was 15.8% (11.5% for 10 month temperament, 11.5% for 10 month maternal parenting behavior, 17.8% for 24 month temperament, 36.6% for 10 month communicative gesturing, 22.2% for 24 month maternal parenting behavior, 18.8% for 24 month vocabulary, 19.8% for 24 month MLU, 20.2% for 24 month sentence complexity, and 2.4% for maternal education). Compared to other techniques for handling missing data (e.g., listwise deletion) that have been shown to produce biased estimates under certain circumstances (i.e., when the proportion of missingness is greater than 5% or the data are not missing completely at random [MCAR]), multiple imputation is well-suited to handling missing data when the proportion of missingness is moderate (i.e., 10%–25%; Jakobsen et al., 2017; Widaman, 2006). The observed dataset (using listwise deletion, $n = 292$) and the imputed dataset ($n = 407$) were analyzed separately to compare the results and examine evidence of bias that may have been introduced as a function of imputation. The descriptive statistics and findings were similar between the two datasets (i.e., the direction of the slopes was similar across datasets; Goodman et al., 2021). As such, the results of the hierarchical regression models are presented below using the imputed dataset.

3 | RESULTS

Descriptive statistics and correlations between all study variables using the observed dataset are reported in Table 1. Assumptions of homoscedasticity, normality, and multicollinearity were met prior to conducting the hierarchical regression analyses.

3.1 | Concurrent predictors of expressive language

For gestures (10 months), the final block with was significant, $F(7, 407) = 11.861$, $p < .001$, and represented a significant F change from the previous block, $F\triangle\ (3, 400) = 5.295$, $p < .001$. This illustrates that adding the maternal factors improved model fit and together, the infant predictors accounted for 15.7% of the overall variance in communicative gestures (see Table 2). Significant predictors included child sex, maternal education, Surgency, and Negative Affectivity.

For expressive vocabulary (24 months), the final block was significant, $F(7, 407) = 11.197$, $p < .001$, and represented a significant F change from the previous block, $F\triangle\ (3, 400) = 9.295$, $p < .001$ (see Table 2), demonstrating the addition of maternal factors significantly improved the overall model fit. The final block accounted for 14.9% of the overall variance in expressive vocabulary, and the significant predictors included child sex, Surgency, Effortful Control, maternal education, and maternal intrusiveness.

For MLU (24 months), the final block was significant, $F(7, 407) = 10.767$, $p < .001$, and represented a significant F change from the previous block, $F\triangle\ (3, 400) = 9.86$, $p < .001$ (see Table 2). The final block accounted for 14.4% of the variance in toddler MLU, and the significant predictors included Effortful Control, maternal education, and maternal intrusiveness.

Finally, for sentence complexity (24 months), the final block was significant, $F(7, 407) = 10.777$, $p < .001$, and represented a significant F change from the previous block, $F\triangle\ (3, 400) = 6.022$, $p < .001$. The final block accounted for 14.4% of the variance in sentence complexity. In the final block, the significant predictors were child sex, Effortful Control, maternal education, and maternal intrusiveness.

3.2 | Longitudinal predictors of expressive language

For expressive vocabulary (24 months), the final block was significant, $F(12, 407) = 6.865$, $p < .001$, and represented a significant F change from the previous block, $F\triangle\ (2, 395) = 7.673$, $p < .001$. The final block accounted for 14.7% of the overall variance in expressive vocabulary (see Table 3). In the final block, significant predictors included child sex, maternal education, Surgency at 24 months, Effortful Control, and maternal intrusiveness at 24 months. None of the 10-month predictors reached significance in the final model after accounting for the 24-month predictors.

For MLU (24 months), the final block was significant, $F(12, 407) = 6.567$, $p < .001$; however, the final block did not demonstrate a significant F change from the previous model after accounting for Bonferroni corrections, $F\triangle(2, 395) = 4.452$, $p = .012$. Thus, the second block is interpreted as the final model. The second block accounted for 12.6% of the overall variance in MLU (see Table 3). In the second block, significant predictors included maternal education and Effortful Control at 24 months. None of the 10-month predictors reached significance in the final model after accounting for the 24-month predictors.

Lastly, for sentence complexity (24 months), the final block was significant, $F(12, 407) = 7.382$, $p < .001$. Despite the final model being significant, it did not represent a significant F change from the second block after accounting for Bonferroni corrections, $F\triangle\ (2, 395) = 3.660$, $p = .027$. Thus, the second block, which accounted for 14.7% of the overall variance in sentence complexity, is interpreted as the final model (see Table 3). In the second block, the significant predictors included child sex, maternal education, negative affectivity at

TABLE 1 Descriptives and Pearson correlation matrix for primary study variables

	M (*SD*)	*N*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. 10-month gestures	10.03 (5.36)	229	–													
2. 24-month expressive vocabulary	306.33 (172.56)	324	.194**	–												
3. 24-month MLU	4.03 (2.47)	324	.051	.614**	–											
4. 24-month complexity	8.94 (9.54)	324	.096	.738**	.694**	–										
5. 10-month surgency	5.26 (0.56)	305	.201**	.080	.030	.013	–									
6. 10-month negative affectivity	3.40 (0.61)	305	.234**	−.101	−.154**	−.208**	.056	–								
7. 10-month orienting	4.70 (0.54)	305	.134*	.084	.045	.058	.514**	−.084	–							
8. 24-month surgency	5.13 (0.59)	323	.194**	.095	−.003	.039	.460**	.115*	.229**	–						
9. 24-month negative affectivity	3.09 (0.56)	323	.150*	−.081	−.153**	−.165**	.158**	.452**	.059	.105	–					
10. 24-month Effortful control	4.44 (0.51)	323	.078	.270**	.274**	.293**	.142*	−.133*	.346**	−.041	.212**	–				
11. 10-month maternal responsiveness	3.43 (0.50)	306	.050	.013	.061	.021	−.179**	−.048	−.068	−.160**	−.182**	.003	–			
12. 10-month maternal intrusiveness	1.34 (0.51)	306	−.041	−.004	−.098	−.057	.161**	.103	.102	.125*	.236**	.003	−.716**	–		
13. 24-month maternal responsiveness	3.32 (0.47)	301	−.066	.170**	.145*	.164**	−.102	−.141*	−.057	−.112	−.231**	.029	.275**	−.145*	–	
14. 24-month maternal intrusiveness	1.40 (0.47)	301	.101	−.245**	−.235**	−.226**	.108	.259**	.024	.042	.331**	−.115*	−.145*	.248**	−.588**	–

*$p < .05$;
**$p < .01$.

TABLE 2 Concurrent associations between temperament, parenting, and expressive language at 10 and 24 months

		Communicative gestures		Expressive vocabulary		Mean length utterance		Sentence complexity	
		Beta	*p*	Beta	*p*	Beta	*p*	Beta	*p*
Block 1: Child factors	Sex	.118	.012	.112	.021	.067	.169	.097	.042
	Surgency	.215	<.001	.127	.008	.020	.678	.074	.120
	Negative affectivity	.236	<.001	−.046	.345	−.119	.015	−.141	.004
	Orienting/effortful control	.086	.111	.256	<.001	.244	<.001	.256	<.001
	Model 1 adjusted R^2	.130*		.097*		.087*		.112*	
Block 2: Addition of maternal factors	Sex	.100	.030	.115	.015	.080	.094	.101	.034
	Surgency	.211	<.001	.139	.003	.030	.519	.084	.074
	Negative affectivity	.203	<.001	.052	.304	−.021	.674	−.062	.221
	Orienting/effortful control	.075	.160	.246	<.001	.232	<.001	.247	<.001
	Maternal education	−.189	<.001	.121	.016	.179	<.001	.108	.032
	Maternal responsiveness	.009	.888	.034	.556	−.022	.699	.026	.651
	Maternal intrusiveness	−.046	.480	−.175	.003	−.168	.004	−.133	.024
	Model 2 adjusted R^2	.157*		.149*		.144*		.144*	
	Model 1 to model 2 *F* change	5.295*		9.295*		9.864*		6.022*	

Note: $N = 407$.
*$p < .001$.

10 months, Surgency at 24 months, and Effortful Control at 24 months, accounting for 12.8% of the overall variance in sentence complexity (see Table 3).

3.3 | Post hoc moderation analyses

Language acquisition takes place in the context of reciprocal parent–child exchanges and as such, it is possible that caregiving behavior and child temperament interact in their relation to expressive language. Although not initially hypothesized in this study, we also examined whether children's biologically based characteristics moderate the association between maternal caregiving behavior and expressive language outcomes in infancy and toddlerhood. To examine this potential intersection between concurrent maternal caregiving (intrusiveness and responsiveness) and child temperament (surgency, negative affectivity, and orienting/effortful control), supplemental hierarchical regression analyses were conducted. Prior to analysis, all of the predictors were *z*-scored before being multiplied to generate each temperament × parenting interaction term. Similar to the analytic plan implemented by Letcher et al. (2004), a separate regression analysis was conducted for each temperament × parenting pair across the expressive language outcomes measured. Child temperament and maternal caregiving values were entered in the first block (i.e., the main effects model) and the interaction term was added in the second block (i.e., the full model). Because a large number of regressions were examined, Bonferroni corrections were once again applied to all significance levels, which required *p*-values to be at or below .002 to be interpreted as statistically significant (.05/24 = .0021; Curtin & Schulz, 1998).

Despite two interaction terms emerging as significant at the .05 alpha level (10-month Surgency × maternal responsiveness and 10-month Surgency × maternal intrusiveness), they were not statistically significant after accounting for the Bonferroni corrections. Thus, no evidence of moderation was detected in the current study (for beta weights and model specifications, see Table S1).

4 | DISCUSSION

The purpose of our study was to evaluate the effects of psychosocial and biological factors on expressive language development in infancy and toddlerhood. Based on the developmental literature, we hypothesized that at 10 and 24 months, surgency, orienting/effortful control, and maternal responsiveness would positively relate to language outcomes, whereas negative affectivity and maternal intrusiveness would negatively relate to child language. Overall, our hypotheses were partially supported given that child temperament and maternal parenting behaviors were differentially associated with the various expressive language outcomes at 10 and 24 months.

4.1 | Concurrent predictors of expressive language at 10 months

At 10 months, we found that surgency and negative affectivity, but not orienting, positively related to concurrent communicative gesturing. Situating our findings in the current literature proves difficult, as there is an overwhelming absence of literature examining the association

TABLE 3 Longitudinal predictors of expressive language at 24 months

		Expressive vocabulary		Mean length utterance		Sentence complexity	
		Beta	*p*	Beta	*p*	Beta	*p*
Block 1: Control and 10-month factors	Sex	.157	.001	.117	.016	.136	.005
	Maternal education	.182	<.001	.222	<.001	.149	.003
	10-month surgency	.089	.119	.056	.323	.022	.702
	10-month negative affectivity	−.087	.083	−.107	.033	−.206	<.001
	10-month orienting	.030	.597	.001	.980	.025	.655
	10-month maternal responsiveness	.027	.702	−.007	.914	−.019	.778
	10-month maternal intrusiveness	.052	.455	−.048	.482	−.025	.714
	Model 1 adjusted R^2	.056*		.071*		.081*	
Block 2: Addition of concurrent temperament (24 months)	Sex	.127	.008	.080	.096	.104	.029
	Maternal education	.164	.001	.199	<.001	.127	.010
	10-month surgency	.015	.806	.041	.509	−.038	.527
	10-month negative affectivity	−.080	.147	−.065	.236	−.179	.001
	10-month orienting	−.069	.232	−.094	.104	−.076	.182
	10-month maternal responsiveness	.031	.644	−.013	.852	−.018	.790
	10-month maternal intrusiveness	.045	.501	−.050	.460	−.027	.682
	24-month surgency	.148	.007	.038	.482	.127	.019
	24-month negative affectivity	.034	.553	−.024	.677	−.004	.948
	24-month effortful control	.270	<.001	.267	<.001	.279	<.001
	Model 2 adjusted R^2	.119*		.126*		.147*	
	Model 1 to model 2 *F* change	10.512*		9.404*		11.380*	
Block 3: Addition of concurrent maternal behaviors (24 months)	Sex	.121	.012	.079	.099	.097	.042
	Maternal education	.118	.020	.169	.001	.092	.067
	10-month surgency	.013	.828	.042	.491	−.042	.491
	10-month negative affectivity	−.056	.310	−.045	.412	−.164	.003
	10-month orienting	−.081	.160	−.104	.071	−.083	.146
	10-month maternal responsiveness	.035	.617	.006	.936	−.025	.718
	10-month maternal intrusiveness	.079	.253	−.012	.861	−.012	.858
	24-month surgency	.151	.005	.038	.484	.131	.015
	24-month negative affectivity	.075	.193	.006	.918	.024	.670
	24-month effortful control	.267	<.001	.263	<.001	.279	<.001
	24-month maternal responsiveness	.025	.684	−.022	.713	.044	.468
	24-month maternal intrusiveness	−.189	.002	−.166	.007	−.111	.070
	Model 3 adjusted R^2	.147*		.141*		.158*	
	Model 2 to model 3 *F* change	7.673*		4.452+		3.660+	

Note: $N = 407$.
*$p < .001$;
+$p < .05$.

between negative affectivity and communicative gesturing in infancy. However, Molfese et al. (2010) report that greater expression of negative affectivity at 12 months was positively associated with infants' concurrent expressive vocabulary size. Additionally, positive emotionality during the first postnatal year of life has been linked concurrently to the use of gestures at 12 months of age (Ollas et al., 2020) and longitudinally to expressive vocabulary size at 14 months of age (Laake & Bridgett, 2014). Thus, infants high in temperamental reactivity gesticulate more than their less reactive counterparts, irrespective of the emotional valence of their arousal. One interpretation of our finding is that children with a biological disposition for higher levels of physiological arousal may be more inclined to elicit the attention of others and/or to articulate their wishes or internal state. For example, infants high in surgency may facilitate social interactions via communicative gestures such as pointing at an interesting object, whereas infants high in negative affectivity may communicate their distress by shaking their head "no." Future work is warranted investigating negative affectivity as a predictor of early communication in infancy.

Although affectivity was associated with communicative gestures at 10 months, neither infant orienting nor maternal caregiving emerged as significant predictors. These were unexpected findings, as multiple developmental researchers have reported that the duration of orienting (Bornstein & Sigman, 1986; Colombo et al., 2004) and maternal caregiving (Tamis-Lemonda et al., 2001; Tomasello & Farrar, 1986) are related to productive vocabulary size in infancy. Given that orienting was significantly correlated with communicative gesturing at 10 months, it is possible that this temperamental trait simply did not account for unique variance after controlling for surgency and negativity. However, considerably fewer studies have examined infant factors that relate to expressive gesturing in infancy and as a result, orienting attention and maternal parenting behaviors may not play the same role in facilitating this aspect of emerging expressive language. Instead, researchers report that during parent–child interactions, mothers will often adjust their gesturing similar to how they adjust their speech to match their child's developmental age and communicative needs (Iverson et al., 1999; Özçalışkan & Goldin-Meadow, 2005). Indeed, parental gesture rate is predictive of child gesture rate and even subsequent vocabulary size (Iverson et al., 1999; Rowe, 2000; Rowe et al., 2008). Thus, the quantity and/or quality of maternal gesturing during free play may be a better predictor of infant communicative gesturing than maternal intrusiveness/responsiveness. Replication research measuring numerous maternal factors is therefore needed to further clarify the association between the psychosocial factors and communicative gesturing in infancy.

4.2 | Concurrent predictors of expressive language at 24 months

At 24 months, effortful control was positively related to all three expressive language outcomes (i.e., vocabulary, MLU, and sentence complexity). Our finding replicates previous reports of an association between language and temperamental self-regulation in early childhood (Dixon & Smith, 2000; Slomkowski et al., 1992). Given that language is acquired through social interactions with a mature linguistic partner (Kuhl, 2007), it is not surprising that children's biological predisposition to flexibly shift, maintain, and/or inhibit attention is related to language development (Salley et al., 2013; Vouloumanos & Curtin, 2014). In contrast to our initial prediction, surgency was only related to expressive vocabulary size, whereas negative affectivity was not associated with any 24-month language outcomes. Our finding that surgency is positively linked to productive vocabulary size is consistent with much of the early childhood literature (Dixon & Shore, 1997; Salley & Dixon, 2007; Slomkowski et al., 1992). Given that surgency was related to expressive vocabulary size, but not to the development of morphosyntactic features of language (i.e., MLU, sentence complexity), our study demonstrates that positive emotional reactivity is differentially associated with concurrent expressive language outcomes in toddlerhood.

Regarding maternal behaviors, maternal intrusiveness was negatively associated with concurrent vocabulary, MLU, and sentence complexity at 24 months. Similar to the findings of Tomasello and Farrar (1986), this suggests that mothers who are more directive and/or prohibitive during parent–child interactions have children with smaller expressive vocabularies who produce shorter and less complex utterances on average. As such, caregiver attempts to redirect toddlers' attention appear to be highly disruptive to speech and sentence construction in early childhood. Despite the low mean values for maternal intrusiveness at each age (see Table 1), significant relations emerged in toddlerhood. This finding demonstrates the powerful role of maternal intrusiveness on 24-month expressive language development. In contrast to our predictions and the developmental literature, maternal responsiveness was not related to any 24-month concurrent expressive language outcomes. This finding was unexpected, as maternal responsiveness has been reported to have a direct effect on toddler expressive vocabulary and combinatorial speech (Leigh et al., 2011; Tamis-LeMonda et al., 2001). Given that maternal responsiveness was positively correlated with vocabulary, MLU, and complexity, it is possible that responsive caregiving was not related to child expressive language because maternal intrusiveness was also accounted for in the model. Alternatively, it could be the case that maternal responsiveness was not significantly associated with language outcomes in our study after controlling for maternal education, a proxy for the amount and diversity of mothers' speech (Hoff, 2003).

4.3 | Longitudinal predictors of expressive language at 24 months

We hypothesized that child temperament and maternal caregiving at 10 months would predict expressive language at 24 months. Although 10-month surgency positively predicted 24-month expressive vocabulary, this effect was no longer significant after including 24-month child temperament. Only infant negative affectivity predicted expressive language (i.e., sentence complexity) in toddlerhood after accounting for concurrent child and maternal factors. Specifically, children who express greater negative affectivity in infancy produce significantly less complex speech in toddlerhood. As previously discussed, infants high in negative emotional expression may better capture the attention of others and in doing so, may elicit more parent–child interactions. However, infant negative affectivity has been shown to negatively influence the amount and lexical diversity of maternal speech, which is an important predictor of early language acquisition (Hoff-Ginsberg, 1991, 1998). Vernon-Feagans et al. (2008) report that highly distressed infants are exposed to less linguistic input and receive relatively less complex maternal language during communicative exchanges. Thus, negative emotionality in infancy may shape the learning conditions through which early language is acquired and eventually produced.

4.4 | Strengths and limitations

Our study has some limitations. First, we were not able to directly control for maternal language, which is frequently implicated in child language development (Huttenlocher et al., 1991). However, we did control for maternal education, which has previously been used in lieu of maternal speech metrics (Hoff, 2003). Second, the primary predictor and outcome variables were maternal report. Despite a lack of objective measures, maternal reports of child language and temperament are considered valid and reliable during this developmental period (Heilmann et al., 2005; Putnam et al., 2006). Lastly, the probability of Type II error was increased due to our use of multiple hierarchical regressions. However, strict Bonferroni corrections were applied to address this concern; results presented here remained significant even after applying stringent statistical corrections. Irrespective of these limitations, our study has numerous strengths, including a large, well-characterized sample collected from two sites with longitudinal data from early infancy through toddlerhood. In addition to the sample characteristics, this is the first study to take a biopsychosocial approach to language development by incorporating metrics of both biologically derived temperament and psychosocial parenting behaviors. This novel design, in tandem with the use of underresearched metrics of language development (i.e., MLU and sentence complexity), is a clear strength.

5 | CONCLUSION

To our knowledge, this is the first study to demonstrate that maternal caregiving behaviors and child temperament differentially influence various aspects of children's expressive language across both the first and second postnatal years. Our findings suggest that temperament, but not parenting, is related to expressive language (i.e., gesturing) in infancy, whereas both temperament and caregiving influence expressive language in toddlerhood. Further, we demonstrate a predictive link between infant negative affectivity and toddler sentence complexity. Although additional research is necessary to uncover causal links and possible bidirectional relations between biopsychosocial factors, these findings indicate that child temperament and maternal parenting should be considered jointly with respect to early childhood language acquisition.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

M.B. and M.A.B. conceptualized the present study. M.A.B. developed the methodology, acquired funding, and carried out the study. M.B. and T.M. performed the analyses/data viualization and wrote the original draft with support from M.A.B and T.O. All authors contributed to the final version of the manuscript. T.O. and M.A.B. performed supervision. M.A.B. designed methodology, performed investigation, provided resources, and acquired funding.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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