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Associations between observed and reported infant negative affectivity, fear and self-regulation, and early communicative development—Evidence from the FinnBrain Birth Cohort Study

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Abstract

Self-regulation and language are intertwined abilities, but the nature of their relations in early childhood when both skills are still emerging is insufficiently understood. Our knowledge of the relations between early negative affectivity and preverbal and verbal communicative development is still limited. Further, observed and reported temperament capture how aspects of temperament operate in different settings but are rarely used in parallel in studies examining early language. During the period of rapid development, longitudinal studies are needed to identify early risk factors

for delayed communicative development. We studied relations between aspects of emerging self-regulation and negative affectivity using both observations at 8 months and mother-reports at 6 and 12 months, and communicative development measured by gesturing and vocabulary at 14 and vocabulary at 30 months in 183 children. Mother-reported self-regulation was related to a higher use of communicative gestures and observed self-regulation by gaze aversion to poorer receptive and expressive vocabulary at 14 months, but neither was significantly associated with vocabulary at 30 months. We found little evidence for associations between negative affectivity and fear in infancy and communicative development. Our findings highlight different aspects of self-regulation as both potential risk and protective factors for communicative development. Mixed results indicate a need for a more detailed examination of different strategies of self-regulation in different conditions and developmental stages to yield a deeper understanding of the relations between self-regulation in infancy and communicative development.

1 | INTRODUCTION

During the first year of life, infants start to communicate using preverbal gestures and sounds and start to develop a receptive vocabulary. From around the first birthday, communication is enriched by a growing expressive vocabulary. Early communicative skills thus include both preverbal communicative gesturing as well as expressive and receptive vocabulary. It is known that strong communicative skills in infancy predict adaptive outcomes in language skills and academic achievement during childhood and adolescence (Hohm et al., 2007), and even in adulthood (Taanila et al., 2005). Inter-individual variability is also very large at this early stage. Therefore, supporting children's communicative development from the very beginning of life is of importance. Further, it is pivotal to understand the underlying factors influencing communicative development in order to support it comprehensively. Although existing work has pointed to the importance of some factors, such as parental child-directed speech (e.g., Newman, Rowe, & Bernstein, 2016), in support of language development, much less work has focused on the role of early emotionality and self-regulation.

Temperament refers to inter-individual differences in emotional, motor, and attentional reactivity and self-regulation (Rothbart & Bates, 1998). Temperament traits have a biological foundation, but experience, maturation, and environmental factors modify them over the life course (Goldsmith et al., 1987; Rothbart & Bates, 2006). According to Rothbart's psychobiological theory, infant temperament consists of three dimensions: positive emotionality/surgency, negative affectivity, and orienting/regulation (Gartstein & Rothbart, 2003). Extant literature presents relatively consistent and robust findings on positive emotionality/surgency being positively related to language development in infants and

toddlers (Garello et al., 2012; Laake & Bridgett, 2014; Moreno & Robinson, 2005; Prior et al., 2008), and is arguably due to this temperament dimension promoting interaction leading to increased communication opportunities (Laake & Bridgett, 2014). However, in striving to prevent weak communicative skills, temperament traits associated with a risk of communicative development problems are also of importance to be aware of, as these may be indicative of a need to stimulate communicative development explicitly.

Negative affectivity is a trait linked with several negative developmental outcomes, such as psychopathology (Buss, 2011; Edwards & Hans, 2015; Pérez-Edgar & Fox, 2005) However, findings regarding negative affectivity and communicative development have been inconsistent. Many studies have reported that high negative affectivity is linked with poorer language development (Bloom & Capatides, 1987; Kubicek & Emde, 2012; Pérez-Pereira, Fernández, Resches, & Luisa Gómez-Taibo, 2016; Salley & Dixon, 2007). In the same vein, low overall affectivity (including both positive and negative affect) has been positively related to language skills in some studies (Bloom & Capatides, 1987; Noel et al., 2008). However, Moreno and Robinson (2005) found that high expression of negative emotions at 8 months of age positively predicted expressive language at 30 months. Furthermore, Nozadi et al. (2015) found that the relations between observationally assessed negative affectivity and language development depended on child age. More specifically, higher levels of anger reactivity at 18 months predicted better expressive language skills at 30 months of age for both genders, whereas poorer expressive language was predicted by concurrent higher anger reactivity for boys. This led the authors to conclude that the same temperament dimension may have differential associations with language development depending on child age. Moreno and Robinson (2005) argue that, similar to positive emotionality, displays of negative affectivity may also serve as support for interaction and create learning opportunities since displaying negative emotions often initiates interaction with an adult. In addition to expressions of frustration and arousal, negative emotions, such as anger, can also be signs of eagerness to reach a goal, which gives the child motivation to communicate the need for assistance in achieving the goal (Moreno & Robinson, 2005). Regardless of the possible positive associations between the tendency for negative affectivity and language skills, Bloom and Capatides (1987) argue that negative affectivity taxes the attentional resources available for language learning, and therefore a more neutral emotional state is more optimal for language learning. Finally, it has been hypothesized that anger expressions in early toddlerhood, when verbal expression is still limited, may be an adaptive communicative strategy (Robinson & Acevedo, 2001), whereas high anger expressions in later toddlerhood, when regulatory abilities are more developed, may be indicative of weaker regulatory abilities (Nozadi et al., 2015).

Separately from other negative emotions, the associations between fear and language have been less frequently studied in infancy and toddlerhood, with the direction of findings being inconsistent across studies. Some suggest that high fear is associated with poorer language skills starting at 15 months of age (Kubicek & Emde, 2012), whereas others have found positive relations between the two domains during the first year (Peterson et al., 2017). Robinson and Acevedo (2001), on the other hand, report that high fear at 6–9 months was inversely related to language skills at 2 years in infants with low reliance on the mother in the assessment situation, whereas fearful infants with high reliance on the mother tended to have stronger language skills. Theories about the mechanisms underlying the relation between fear and language development are similar to those regarding anger and general negative affectivity. Namely, negative relations are explained using the competition for resources-theory, thus, the infants with higher need to regulate fear have less resources for acquiring language skills (Kubicek & Emde, 2012). Positive relations, in turn, are suggested to result from fear creating a need to communicate distress to the caregiver and consequently resulting in the caregiver scaffolding communicative development (Peterson et al., 2017). To conclude, the existing studies

report mixed results regarding both negative emotionality and fear and communicative development in infancy and toddlerhood. Hence, more research is needed in this age group. In line with other research showing that better early self-regulation predicts adaptive development (McClelland et al., 2007; Trentacosta & Shaw, 2009; Ursache et al., 2013; Valiente et al., 2003), the orienting/regulation temperament trait or other closely related concepts of emerging self-regulation, such as attentional orienting (Nigg, 2017), are typically positively associated with language development. These associations have, however, been scarcely studied in infancy, and the few existing studies have predominantly utilized parent reports of self-regulation. For example, Gartstein et al. (2008) found that orienting persistence and perceptual sensitivity, which are specific aspects of regulation, in 6- to 12-month-olds positively predicted emerging language in the form of vocalizations. Additionally, Dixon and Smith (2000) found attentional control, also an aspect of early regulation skills, to positively predict both expressive and receptive language in infancy/toddlerhood. Parent reports typically assess general self-regulation, including several strategies in a variety of situations over a longer period of time. In an experimental design focusing strictly on attention rather than overall self-regulation, Vouloumanos and Curtin (2014) found that attention to verbal stimuli at 12 months positively predicted expressive speech at 18 months, whereas overall attentiveness did not. It is believed that, similar to affectivity, good capacity for self-regulation increases chances for interaction with others (Gartstein et al., 2008). More effective emotion regulation and the ability to focus attention on others may encourage interaction and lead to more occasions for learning communicative behaviors. Hence, it may be important to specify the type of self-regulation studied, as the attentional strategies differ in the degree they involve turning to another person for support, and consequently, more social regulatory strategies may have stronger associations with communicative development compared to strategies such as gaze aversion. This has been done in very few studies, and we have not come across any previous studies where, for example, gaze aversion, which is the earliest form of self-regulation (Rothbart et al., 2011), and communicative development have been studied.

Especially later in childhood, self-regulation is thought to have a bidirectional relationship with language skills (Bohlmann et al., 2015). Namely, language is a tool for self-regulation and, thereby, stronger language predicts more advanced self-regulation, but good self-regulatory capacity also provides better prerequisites for language development (Bohlmann et al., 2015). Bohlmann et al. (2015) hypothesize that language as a tool for self-regulation may become increasingly important during the preschool years when vocabulary grows substantially, whereas the influence of self-regulation on language learning may be stronger in infancy and early childhood, when vocabulary is still limited. Gartstein et al. (2008) argue, however, that even in infancy, emerging vocalizations may serve as a regulatory strategy to call for adult attention when needed. Also worth noting when discussing relations between negative affectivity and communicative development is that the infant's preferred strategy for self-regulation when experiencing negative emotions may influence the association between negative affectivity/fear and communicative skills. More specifically, avoidant regulation behaviors such as gaze aversion, in instances where it means looking away from the communication partner, may reduce exposure to communication stimuli. This points to the need to study negative emotionality and self-regulation together in the same condition, which has, to our knowledge, not been done previously.

In addition to the inconsistencies and paucity of research regarding negative affectivity and self-regulation as predictors of infant language development, there are several gaps in the literature that limit our understanding of the topic. First, some studies report temperament dimensions to be related to receptive language skills (Morales et al., 2000), whereas others have found relations with expressive language only (Laake & Bridgett, 2014). This distinction is important to make since, for example, weak early receptive vocabulary is a stronger risk factor for problems with later reading acquisition compared to expressive vocabulary (Psyridou et al., 2018). Although several studies assess

infant temperament in relation to later language, language assessments are often carried out during the latter half of the second year of life or later. It has been argued that since rank-order stability in language skills is typically reached by the age of two or 3 years, it is particularly important to study the influence of personality and environmental factors on the very earliest language development where inter-individual variability is still high (Laake & Bridgett, 2018). Additionally, the findings suggesting that the same temperament trait may relate differently to language development at different stages of infancy/toddlerhood (Nozadi et al., 2015) highlight the need for longitudinal studies over this developmental period. This also puts more emphasis on the early forms of communication, such as gesturing, which is very scarcely studied. Previous research has found that infant temperament is related to gesturing to a much higher degree than to early receptive language skills. More specifically, higher infant orienting/regulation and positive emotionality predicted higher use of gestures at 12 months of age (Ollas et al., 2020). We also know that gestures typically appear before the first words are uttered and predict later verbal language development (Iverson & Goldin-Meadow, 2005). This underscores the need to further explore this dimension of communication when studying relations between temperament and infant communicative development, which is done in the present study.

Third, the majority of existing studies have used parent reports as the method of temperament assessment, and only a few have utilized observed temperament assessment. In the few studies that have employed both parent-report and laboratory observations of temperament, results have differed somewhat between the assessment modalities. For example, in the study by Kubicek and Emde (2012) parents reported that late talkers showed more anger, whereas no differences were found in laboratory-assessed anger proneness. However, higher fear in late talkers was detected using both observation and parent reports (Kubicek & Emde, 2012). Mixed findings in studies employing both approaches to temperament assessment are notable, as parent reports are sometimes argued to be less objective and under the influence of factors such as parent personality, sensitivity, attitudes, own childhood experiences, and psychiatric symptoms (Durbin et al., 2007; Durbin & Wilson, 2012; Leerkes & Crockenberg, 2003). However, parent reports also have some advantages; for instance, a familiar person assessing child characteristics over a longer period of time across a wider range of situations (Rothbart & Bates, 2006). Laboratory assessments, on the other hand, offer the opportunity for more objective assessment in a standardized setting designed to elicit specific emotions and reactions, but the novel situations with their short durance may limit ecological validity (Durbin et al., 2007) and influence child reactivity (Stifter et al., 2008). As both assessment methods have their strengths and weaknesses and possibly tap into different aspects of temperament, it is recommended to use them in combination (Stifter et al., 2008). The current study uses both mother-reports of temperament at 6 and 12 months of age and observational temperament assessment at 8 months of age, which gives more comprehensive information.

To summarize, although several studies have reported associations between aspects of temperament and language development, literature is lacking consensus especially regarding temperament traits that are possible risk factors for early communicative development. Results differ regarding negative affectivity as a predictor of language outcomes early in life with both positive and negative associations reported. Findings are inconsistent and somewhat dependent on the mode of assessment. The knowledge of the relations between emerging self-regulation and communicative development is also limited and has predominantly been acquired using parent reports. There is also controversy regarding which dimensions of language development seem to be more strongly related to child temperament, and relations between temperament and preverbal communicative skills have been overlooked. Furthermore, the significance of child age in determining the relationship between temperament and communicative development is still poorly understood. In the current study, we address these gaps by focusing on infant negative affectivity and aspects of emerging self-regulation during

the first year of life, assessed using observations and parent-reports, as predictors of early communicative development.

More specifically, the aim of the study is to investigate the relations between negative affectivity and emerging self-regulation and communicative development, both preverbal gestural communication and expressive and receptive language skills at 14 and 30 months of age. We address the limitations of most existing studies by using both observations at 8 months and mother-reports at 6 and 12 months of age when assessing temperament. In light of the mixed findings reported previously, we expected negative affect and fear to be associated with communicative outcomes, but we did not set a specific direction for our hypothesis. Based on prior research, including our study on a different Finnish sample (Ollas et al., 2020), our hypotheses were that higher emerging self-regulation, measured as higher mother-reported emerging regulatory ability and longer observed duration of attention, would be positively related to communicative skills, especially expressive communication. However, the hypothesis for self-regulation by gaze aversion was based on prior research on other aspects of self-regulation only, since there was no research on this specific regulation aspect and communicative development available, and thus, the research question was partially exploratory.

In order to control for confounding variables, factors known to potentially relate to language development were chosen as covariates in the analyses. These variables were maternal postpartum psychological distress, child gender, gestational age at birth, maternal education level, and number of siblings (Berglund et al., 2005; Briggs-Gowan et al., 1996; Durbin & Wilson, 2012; Harrison & McLeod, 2010; Hoff & Tian, 2005; Prior et al., 2008; Reck et al., 2018; Sohr-Preston & Scaramella, 2006; Zerbeto et al., 2015).

2 | METHOD

2.1 | Participants

The participants were 183 families from the FinnBrain Birth Cohort Study. The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, with written informed consent obtained from a parent or guardian for each child before any assessment or data collection. All procedures involving human subjects in this study were approved by the Joint Ethics Committee of the University of Turku and the Hospital District of Southwest Finland. The study sample was selected from those families who participated in the laboratory visits for temperament observation and had returned the CDI-questionnaire on communicative development at least at 14 months. These families belonged primarily to the Focus cohort of the FinnBrain Birth Cohort Study, which is a subsample recruited initially for a case-control follow-up of mothers with high and low reports of prenatal stress and in which the families take part in more extensive multidisciplinary assessments during infancy and early childhood (Karlsson et al., 2018). Families from the current sample did not differ significantly from the entire cohort concerning maternal age (t (6412) = −0.029, p = 0.98), psychological distress (EPDS: t (2435) = 1.43, p = 0.15, SCL-90: t (2432) = 1.18, p = 0.24) or family income (χ^2 (8) = 4.91, p = 0.77). The parents in the current sample, however, tended to have a higher education level (χ^2 (2) = 32.0, p = 0.00). The demographic characteristics of the families in the current sample are presented in Table 1. Monolingualism was defined according to the criterion that the child is exposed to the mother tongue more than 80% of the time. Most typically, the national languages of Finland, Finnish and Swedish, are used in bilingual families. The bi- and monolingual groups did not differ significantly from each other on any of the communication measures according to independent samples t-tests, hence all participants were included in the study. The Finnish version of the

TABLE 1 Demographic characteristics of the sample ($N = 183$)

	Mean, (*SD*) or %, range
Gender, girl	46%
Primiparous	62%
One sibling	29%
≥2 siblings	9%
Gestational age at delivery	40.0 (1.39), 35.7–42.3
Monolingual family	72.4%
Bilingual family	7.5%
Data missing regarding bilingualism	20.1%
Maternal educational level	
University degree	40.4%
Polytechnic degree	36.6%
Vocational training/9-year compulsory school (one case)	12.0%
High school	9.3%
Maternal age at delivery	30.9 (4.0), 21–44
Paternal age at delivery	32.1 (4.9), 23–48

CDI-questionnaire was filled out by all families except five—these five families used the Swedish version of the measure. Since the maximum scores in the Finnish and Swedish versions of the questionnaire are not equal, the percentage of the total score for each individual was used in the analyses.

2.2 | Procedures

Families were recruited in maternal welfare clinics at gestational week 12. Background information regarding the families was collected using questionnaires at gestational week 14 and supplemented with information from later data points when needed. The questionnaire data on maternal anxiety was collected at 3 and 6 months postpartum, and on depressive symptoms at 3, 6, and 12 months postpartum. Mother-reports on infant temperament were collected at 6 and 12 months of age, and postal or electronic questionnaires regarding child communicative development were sent to the families when the child was 14 and 30 months old. Additionally, information regarding child gender and gestational age at birth from the maternity ward was retrieved from the Finnish National Birth Register (www.thl.fi). At 8 months, the families were invited to a laboratory visit at the FinnBrain research site in Turku, where experimental temperament observations were carried out by trained psychologists or advanced psychology master's students.

2.3 | Measures

2.3.1 | Temperament

Observed Temperament. Temperament observations were conducted at 8 months of age using the Laboratory Temperament Assessment Battery Prelocomotor version (Lab-TAB; Goldsmith & Rothbart, 1999), which is a standardized battery for assessing child temperament as a reaction to

different stimuli (Planalp et al., 2017). Aspects of infant negative affectivity were assessed using two episodes, Gentle Arm Restraint by Parent (Overall negative affectivity) and Masks (Fear). Likewise, aspects of infant emerging self-regulation were assessed using two episodes, Blocks (Duration of attention) and Gentle Arm Restraint by Parent (Gaze aversion). The Lab-TAB episodes were presented to all infants/dyads in the same order. In each observation episode, an assessment of caregiver behavior/interference was additionally calculated for each temperament episode (0 = very inefficient parent behavior, does not follow instructions, 1 = parent mildly deviates from instructions, and 2 = parent behaves as instructed) and controlled for in all the analyses with the respective temperament outcome. Coding was carried out by trained graduate and postgraduate students (2–4 coders depending on the episode). Inter-rater reliability was performed on 10% of the full sample participating in the visits.

Fear was assessed during the episode Masks, which is a fear-eliciting episode where the infant is presented with four different masks in order of increasing intensity and likelihood of eliciting a fear response. The episode lasted for 1−1.5 min, or 1,5−2 min with instructions from the experimenter included. Each of the four masks was presented separately to the child for 10 s, and these presentations were coded into two 5 s epochs each. The following behaviors as a response to the presentation of each mask were coded: escape behaviors (0–3), facial fear (0–3), bodily fear (0–3), and distress vocalizations (0–5) ($r = 0.45$–0.78). We used the sum score for total fear, consisting of the standardized scores for the fear responses. The episode showed good inter-rater reliability (Cohen's kappa 0.73–0.83).

Task orientation/attentiveness was assessed using the Blocks episode, where the infant is given a set of blocks to play with and manipulate during a 3-min episode with minimal involvement from the caregiver. The whole episode, including instructions from the experimenter, lasted for approximately 4 min and was coded in 10-s epochs divided into three sets of one minute each. The following behaviors were coded[1]: intensity of facial interest (0–2) and duration of looking (0–3), from which a standardized sum score was calculated (intercorrelation $r = 0.30$). The episode showed adequate inter-rater reliability (Cohen's $K = 0.72$–0.79).

Finally, overall negative affectivity and emergent self-regulation were assessed using the Arm Restraint episode. In this episode, the infant is presented with an interesting toy, and after the infant has started to play with the toy, the mother grabs and gently holds the infant's arms for two 30-s trials, preventing the infant from reaching the toy. Both 30-s trials are coded in 5-s epochs. The total duration of the episode was 2 min, or 3 min including instructions from the experimenter. The following behaviors were coded: intensity of facial anger (0–3), intensity of facial sadness (0–3) and intensity of distress vocalizations (0–5). A negative affect sum score was calculated based on these three indicators ($r = 0.48$–0.84). Inter-rater reliability was adequate (Cohen's $K = 0.62$–0.79). The Arm Restraint episode was also used for assessing self-regulation by gaze aversion, which is one of the earliest forms of self-regulation evident in infancy (Rothbart et al., 2011). Gaze aversion was coded as seconds looking away from the toy, either around the room or at the parent, during the episodes. We used a sum score of total gaze aversion in seconds during each 5-s epoch (0–5). The epochs were the same as for the assessment of negative affectivity. The reliability of the measure was adequate (inter-rater $r = 0.78$–0.95). Gaze aversion was not divided into social and non-social as the assessment situation was not originally designed for this purpose and hence not optimal for this, with the parent sitting behind the child and not always with the eyes visible on the videotape.

Reported Temperament. The Infant Behavior Questionnaire—Revised (IBQ-R) (Gartstein & Rothbart, 2003) was used for parent reports of infant temperament. The Finnish version of the instrument has been used in several studies and its reliability and predictive validity have been at

[1]One of the indicators, manipulation, was left out of the sum score because it showed very low inter-individual variability between the infants.

least at the same level as other translations (Gaias et al., 2012; Komsi et al., 2006). The questionnaire was completed by the mother twice, when the infants were aged 6 and 12 months. The IBQ-R is a parent-report of infant temperament where the parent rates the occurrence of certain infant behaviors and reactions in different everyday situations during the past week on a seven-point scale from *never* to *always*. Three broader factor scores, Surgency/Extraversion (Cronbach's $\alpha = 0.89–0.91$), Negative Affectivity ($\alpha = 0.85–0.87$), and Orienting/Regulation ($\alpha = 0.82–0.84$) are obtained (Gartstein & Rothbart, 2003). Negative Affectivity contains subscales Sadness ($\alpha = 0.74–0.78$), Distress to limitations ($\alpha = 0.68–0.74$), Fear ($\alpha = 0.80–0.81$), and Falling reactivity ($\alpha = 0.73–0.75$). Orienting/Regulation is an indicator of emerging self-regulation composed of subscales Low intensity pleasure ($\alpha = 0.75–0.78$), Cuddliness ($\alpha = 0.71–0.76$), Duration of orienting ($\alpha = 0.80–0.84$), and Soothability ($\alpha = 0.79$) (Gartstein & Rothbart, 2003). To match the observed temperament assessments, in this study we used the factors Negative Affectivity and Orienting/Regulation, as well as the specific Fear-subscale form the IBQ-R-questionnaires to match the observed Fear episode.

2.3.2 | Communicative development

Communicative development was assessed using the Finnish and Swedish versions of the MacArthur-Bates Communication Development Inventories—Words and gestures for infants (CDI-I) (Eriksson & Berglund, 2002; Fenson, 1994; Lyytinen, 1999) at 14 months and the CDI—Words and sentences for toddlers (CDI-T) at 30 months (Eriksson & Berglund, 2002; Fenson, 1994; Lyytinen, 1999). The CDI, including the currently used translations, has been shown to be a valid parent-report for assessing early communication and language development (Eriksson & Berglund, 2002; Fenson, 1994; Lyytinen, 1999). We used the sum scores for actions and gestures, receptive vocabulary and expressive vocabulary at 14 months, and for expressive vocabulary at 30 months. The CDI is a checklist of different communicative behaviors and words. The actions and gestures section involves lists of the first communicative gestures, games and routines, actions with objects, pretending to be a parent, and imitating other adult actions. For the communicative gestures, the parent checks whether the infant uses the gesture often, sometimes or not at all. For the remaining actions and gestures, the use is assessed on a yes/no-basis. We used the sum score for the total use of gestures. Regarding vocabulary, the instrument contains words in different semantic categories, and the parent fills out whether the infant understands or understands and uses a certain word in the 14-month version, giving separate sum scores for receptive and expressive vocabulary, and understands *and* uses in the 30-month version, resulting in one sum score for expressive vocabulary (Fenson, 1994; Lyytinen, 1999).

2.3.3 | Covariates

Maternal postpartum psychological distress is associated with both less adaptive communicative outcomes and maternal rating of child behavior (Briggs-Gowan et al., 1996; Durbin & Wilson, 2012; Reck et al., 2018; Sohr-Preston & Scaramella, 2006). For the purpose of controlling for this type of distress, the Edinburg Postnatal Depression Scale (EPDS) at 12 months postpartum (Cox et al., 1987) and the anxiety subscale of the Symptom Checklist—90 (SCL-90, Derogatis, Lipman, & Covi, 1973) at 6 months postpartum were used. For one participant, who had not completed the 6-month SCL-90-questionnaire, the score from the same questionnaire at 3 months postpartum was used. The sum scores for EPDS and SCL-90 were standardized and summed into a postnatal psychological distress composite score, which was used as a continuous covariate in analyses.

In addition, since also previously reported to relate to language development, child gender, gestational age at birth, maternal education level, and number of siblings were used as covariates in all models (Berglund et al., 2005; Harrison & McLeod, 2010; Hoff & Tian, 2005; Prior et al., 2008; Reck et al., 2018; Sohr-Preston & Scaramella, 2006; Zerbeto et al., 2015). Maternal educational level was self-reported during the first trimester of pregnancy. Educational level was coded as a categorical variable with four categories: high school-level, vocational training, polytechnic degree, or university degree. One mother had completed only the 9-year compulsory education and was added to the vocational training group. Information regarding the number of siblings was reported by the mother when the child was 12 months, and the information was completed by the same data from the 3-month postpartum assessment in instances where the 12-month answer was missing and used as a continuous variable in analyses.

2.4 | Data analysis

The data was analyzed using IBM SPSS 25. Missing data was imputed using multiple imputation (10 imputations) using the MCMC protocol. Data was missing for the variables: maternal postnatal psychological distress, 6- and 12-month reported temperament measures, use of communicative gestures, 30-month vocabulary, and maternal educational level. Data was missing in 19.7% of cases for 30-month vocabulary, 11.5%–12% of cases for 12-month reported temperament, and less than 10% of cases for the other measures. According to Little's MCAR test, data was missing at random (chi-square = 104.39, $DF = 133$, $p = 0.97$).

Gesture use was normally distributed, whereas expressive and receptive vocabularies at 14 months and vocabulary at 30 months were not. The 14-month receptive vocabulary score and the 30-month vocabulary score were improved by square root transformation. The transformed 30-month vocabulary score was not normally distributed according to the tests (D (183) = 0.08, $p = 0.005$, skewness = −0.39) but was still regarded as resembling a normal distribution to a degree that allows use of parametric tests and regression analyses (see Lumley et al., 2002). Further, as not many children produce a high number of words around their first birthday, the expressive vocabulary sum score at 14 months was expectedly skewed toward zero and could not be improved by transformation. Hence, we used a categorical version of the variable with groups of low, intermediate, and high expressive vocabulary. The low-vocabulary group represented the children with no words in use at 14 months ($n = 29$), and the large expressive vocabulary group consisted of a same sized group of infants with the highest scores on expressive vocabulary ($n = 30$), and the remaining infants ($n = 124$) were assigned to the intermediate-level group. The data did not contain any outliers extreme enough to require actions.

First, the Pearson correlation coefficient was used for analyzing zero-order correlations between variables. Standard linear regression analysis with manual stepwise entering of variables using the general linear model command was used for analyzing the effects of temperament traits on gestures and receptive vocabulary at 14 months and expressive vocabulary at 30 months. Correspondingly, the influence of temperament traits on expressive vocabulary groups (small, intermediate, and large vocabulary) was analyzed using multinomial logistic regression analysis. The first step of each model included the covariates (child gender, maternal educational level, gestational age at birth, number of siblings, and maternal postpartum psychological distress score), and the second step included the temperament trait in focus. Temperament traits were entered in individual models to avoid collinearity. Additionally, negative affectivity was included in the regression model with observed emerging self-regulation by gaze aversion in order to test whether gaze aversion had an independent effect or was dependent on the level of negative affectivity during the episode. Finally, the p-values in the regression

models were corrected for multiple comparisons per each hypothesis using the Benjamini-Hochberg procedure with an alpha level $p < 0.05$.

3 | RESULTS

Descriptive statistics for the Lab-TAB, IBQ-R, and CDI are displayed in Table 2.

3.1 | Zero-order associations between measures

3.1.1 | Communicative outcomes

Zero-order Pearson correlations between measures are displayed in Table 3. The correlations between communicative measures at 14 and 30 months were moderate to strong, both concurrently and longitudinally.

3.1.2 | Temperament traits

Correlations between observed and mother-reported temperament traits are displayed in Table 3. First, there was a modest negative association between observed emerging self-regulation and observed

TABLE 2 Descriptive statistics for the measures used in the study

Measure (theoretical range)	*M* (*SD*) original data	*M* (*SD*) imputed data	Range
Observed temperament (Lab-TAB)			
Negative affectivity	4.4 (1.9)	4.4 (1.9)	0.5–8.3
Fear	3.5 (2.1)	3.5 (2.1)	0–10
Task orientation/attentiveness	3.7 (0.5)	3.7 (0.5)	2.1–4.7
Emerging self-regulation	21.0 (9.9)	21.0 (9.9)	0–50
Mother-reported temperament (IBQ-R)			
At 6 months (0–7)			
Negative affectivity	2.9 (0.8)	2.9 (0.8)	1.4–5.0
Fear	2.4 (1.1)	2.4 (1.1)	1.0–5.7
Emerging self-regulation	5.3 (0.6)	5.3 (0.6)	3.4–6.6
At 12 months (0–7)			
Negative affectivity	3.2 (0.7)	3.3 (0.7)	1.6–5.5
Fear	3.0 (1.2)	3.0 (1.3)	1.0–6.3
Emerging self-regulation	5.1 (0.6)	5.1 (0.6)	3.4–6.3
Communicative development (CDI) (0%–100%)			
Gesture use 14 months	55.0 (12.1)	55.1 (12.3)	9.0–87.9
Expressive vocabulary 14 months	3.3 (4.2)	3.3 (4.2)	0–26
Receptive vocabulary 14 months	37.5 (20.1)	37.5 (20.1)	1.8–91.3
Expressive vocabulary 30 months	71.2 (25.4)	71.1 (25.2)	4.6–100

TABLE 3 Zero-order correlations between measures in the study

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Receptive vocabulary															
2. Gesture use	0.51**														
3. Vocabulary 30 months	0.46**	0.40**													
Observed temperament 8 months															
4. Fear	0.05	0.15*	0.11												
5. Negative affectivity	0.11	0.03	0.05	0.04											
6. Emerging self-regulation	−0.16*	−0.07	−0.10	−0.08	−0.17*										
7. Task orientation/ attentiveness	−0.07	−0.05	−0.08	−0.04	0.11	−0.12									
Reported temperament 6 months															
8. Fear	0.06	0.08	0.09	0.07	0.08	−0.01	−0.01								
9. Negative affectivity	0.01	−0.03	0.04	0.13	0.09	−0.06	−0.01	0.55**							
10. Emerging self-regulation	0.19*	0.17*	0.05	−0.11	−0.02	−0.16*	−0.05	0.05	−0.12						
Reported temperament 12 months															
11. Fear	0.06	0.04	0.08	0.11	0.04	0.05	−0.03	0.41**	0.27**	0.00					
12. Negative affectivity	0.01	0.01	0.05	0.06	−0.01	0.02	−0.11	0.26**	0.53**	−0.06	0.59**				
13. Emerging self-regulation	0.16*	0.32**	0.06	−0.06	0.09	−0.12	0.03	0.02	−0.11	0.54**	0.04	−0.10			
14. Postnatal psychological distress	−0.16*	−0.14	−0.11	0.05	0.04	−0.07	−0.02	0.05	0.23**	−0.09	0.14	0.36**	−0.16*		
15. Gestational age	0.19*	0.18*	0.15	0.07	0.08	−0.09	0.10	0.09	0.15	−0.04	−0.00	−0.01	0.09	−0.04	
16. Number of siblings	−0.11	0.10	−0.18*	0.04	−0.07	−0.12	0.06	0.07	−0.01	0.00	0.11	0.06	0.06	−0.09	−0.08

*$p < 0.05$, **$p < 0.01$.

negative affectivity, but other observed temperament traits at 8 months were not significantly interrelated. Mother-reported fear, negative affectivity, and emerging self-regulation at 6 months in general showed moderate to high correlations with the corresponding traits at 12 months of age. Reported emerging self-regulation at 6 months was modestly negatively correlated with observed emerging self-regulation at 8 months. Other observed and mother-reported temperament traits did not correlate significantly.

3.1.3 | Covariates, temperament, and communicative development

Maternal postpartum psychological distress showed a modest negative correlation with receptive vocabulary at 14 months. Gestational age at delivery was modestly positively associated with both 14-month communicative outcomes, receptive vocabulary, and gesture use. The number of siblings was negatively associated with the 30-month vocabulary. In turn, postpartum psychological distress was positively correlated with reported negative affectivity at both 6 and 12 months, but not with observed negative affectivity. Maternal distress also had a modest negative correlation with 12-month emerging self-regulation.

3.1.4 | Bivariate associations between observed and reported temperament and communicative development

The associations between temperament and communicative development are also shown in Table 3. Observed fear showed a modest positive correlation with gesture use at 14 months. Observed self-regulation correlated negatively with receptive vocabulary at 14 months. Mother-reported self-regulation at both 6 and 12 months of age correlated positively with gesture use and receptive vocabulary at 14 months of age but not with vocabulary at 30 months of age. Other observed or reported temperament traits were not related to communicative development outcomes.

3.2 | The Regression Analyses for observed temperament at 8 Months and communicative development at 14 and 30 months

Regression analyses for observed temperament and communicative development measures are reported in Tables 4 and 5.

3.2.1 | Gesture use at 14 months

None of the observed temperament traits negative affectivity, fear, emerging self-regulation, nor task orientation/attentiveness significantly predicted gesture use at 14 months (see Table S1 in the Supplement).

3.2.2 | Receptive vocabulary at 14 Months (Table 4)

Use of gaze aversion in a distress-provoking situation negatively predicted receptive vocabulary at 14 months, indicating higher emerging self-regulation by gaze aversion was related to lower receptive

TABLE 4 Summary of regression analyses for observed temperament at 8 Months and receptive vocabulary at 14 Months

	B (95% CI)	*SE B*	*p*	Partial eta sqared	Adjusted R^2
Covariates					0.06
Intercept	−2.26 (−9.16–4.65)	3.52	0.52	0.00	
Child gender	0.05 (−0.43–0.52)	0.24	0.85	0.00	
Number of siblings	−0.17 (−0.54–0.19)	0.19	0.36	0.01	
Gestational age	0.21 (0.04–0.38)	0.09	**0.02**	0.03	
Maternal education level (reference: University degree)					
High school	−1.02 (−1.90 to −0.15)	0.45	**0.02**	0.03	
Vocational training	−0.13 (−0.90–0.63)	0.39	0.73	0.00	
Polytechnic degree	−0.12 (−0.65–0.42)	0.27	0.67	0.00	
Maternal postnatal psychological distress	−0.15 (−0.27 to −0.02)	0.06	**0.02**	0.03	
Observed temperament traits					
Negative affectivity	0.06 (−0.04–0.15)	0.05	0.25	0.01	0.06
Fear	0.04 (−0.26–0.33)	0.15	0.81	0.00	0.06
Emerging self-regulation	−0.03 (−0.05 to −0.00)	0.01	**0.02**	0.03	0.08
Task orientation/attentiveness	−0.11 (−0.41 - 0.19)	0.15	0.49	0.00	0.14

Note: Adjusted R^2 reported for the whole model. The same covariates were used in all models, but in the interest of saving space only temperament traits were reported in models. Significant *p*-values are bolded.

vocabulary scores. Correcting for multiple comparisons led to this finding being marginally above the significance level (Benjamini-Hochberg *p*-value = 0.06). There were no significant associations between observed negative affectivity, fear or task orientation/attentiveness, and receptive vocabulary at this age.

3.2.3 | Expressive vocabulary at 14 Months (Table 5)

Emerging self-regulation by gaze aversion was also associated with expressive vocabulary, as infants higher in self-regulation more likely belonged to the no-words group and the intermediate expressive vocabulary group when compared to the high expressive vocabulary group. After correcting for multiple comparisons, the *p*-values were just above the significance level (Benjamini-Hochberg *p*-values = 0.06 and 0.08). Additionally, negative affectivity significantly explained expressive vocabulary at 14 months, with infants higher in negative affectivity being more likely to belong to the high expressive vocabulary group than to the intermediate group. After adjusting for multiple comparisons, the *p*-value for the comparison of high versus intermediate vocabulary groups was no longer significant (Benjamini-Hochberg *p*-value = 0.52). *Fear* or task orientation/attentiveness did not relate significantly to vocabulary group membership.

3.2.4 | Vocabulary at 30 months

Emerging self-regulation by gaze aversion at 8 months was no longer significantly associated with the 30-month vocabulary. Neither were there any other significant associations between negative affectivity, fear, or task orientation/attentiveness and vocabulary at 30 months (see Table S2 in the Supplement).

TABLE 5 Summary of multinomial logistic regression analyses for observed temperament and low, intermediate and high expressive vocabulary at 14 Months

	Intermediate group versus no words-group				Intermediate group versus high expressive vocabulary group				High expressive vocabulary group versus no words-group				Cox & snell
	B	SE B	OR (95% CI)	*p*	B	SE B	Or (95% CI)	*p*	B	SE B	Or (95% CI)	*p*	R^2
Covariates													0.10
Intercept	−4.20	5.95		0.48	7.81	6.49		0.23	−12.02	8.09		0.14	
Child gender (reference: Girl)	−1.19	0.47	0.30 (0.12–0.79)	**0.02**	0.09	0.42	1.09 (0.48–2.47)	0.84	−1.28	0.59	0.28 (0.09–0.89)	**0.03**	
Number of siblings	0.22	0.35	1.24 (0.63–2.45)	0.53	−0.09	0.32	0.91 (0.49–1.71)	0.77	0.31	0.43	1.37 (0.58–3.20)	0.47	
Gestational age	0.17	0.15	1.19 (0.88–1.59)	0.26	−0.16	0.16	0.85 (0.62–1.16)	0.31	0.33	0.20	1.40 (0.94–2.07)	0.10	
Maternal education level (reference: University degree)													
High school	−1.49	0.70	0.23 (0.06–0.89)	**0.03**	1.15	1.10	3.15 (0.36–27.25)	0.30	−2.64	1.21	0.07 (0.01–0.76)	**0.03**	
Vocational training	−0.75	0.66	0.47 (0.13–1.72)	0.26	0.67	0.80	1.94 (0.41–9.35)	0.41	−1.42	0.96	0.24 (0.04–1.60)	0.14	
Polytechnic degree	−0.35	0.53	0.70 (0.25–1.99)	0.51	0.27	0.45	1.30 (0.54–3.14)	0.56	−0.62	0.64	0.54 (0.16–1.88)	0.33	
Maternal postnatal psychological distress	0.08	0.11	1.08 (0.87–1.35)	0.48	0.03	0.12	1.03 (0.82–1.29)	0.82	0.05	0.15	1.06 (0.79–1.41)	0.72	
Observed temperament traits													
Negative affectivity	−0.00	0.09	1.00 (0.84–1.18)	0.97	−0.18	0.09	0.84 (0.71–0.99)	**0.04**	0.18	0.11	1.19 (0.96–1.48)	0.11	0.13
Fear	0.08	0.28	1.08 (0.62–1.88)	0.78	−0.12	0.26	0.88 (0.54–1.45)	0.63	0.20	0.35	1.22 (0.62–2.41)	0.57	0.12
Emerging self-regulation	−0.02	0.02	0.98 (0.94–1.02)	0.29	0.05	0.02	1.05 (1.00–1.10)	**0.04**	−0.07	0.03	0.93 (0.88–0.99)	**0.02**	0.14
Attention	−0.12	0.29	0.89 (0.50–1.58)	0.69	−0.00	0.27	1.00 (0.59–1.71)	0.99	−0.12	0.37	0.89 (0.43–1.82)	0.74	0.12

Note: Cox & Snell R^2 reported for the whole model. The same covariates were used in all models, but in the interest of saving space only temperament traits were reported in models. Reference groups are underlined in the table. Significant *p*-values are bolded.

3.2.5 | Sensitivity analysis with negative affectivity as a covariate

When adding negative affectivity to the models with emerging self-regulation by gaze aversion, results stayed essentially the same (receptive vocabulary at 14 months: $B = -0.03$, $p = 0.04$, use of communicative gestures at 14 months: $B = -0.04$, $p = 0.69$, expressive vocabulary at 14 months: intermediate expressive vocabulary group vs. no words-group: $B = -0.02$, $p = 0.28$, intermediate vs. high: $B = 0.02$, $p = 0.07$, high vs. no words: $B = -0.07$, $p = 0.03$, expressive vocabulary 30 months: $B = -0.03$, $p = 0.11$), leading us to conclude that the relation between gaze aversion and communicative skills was independent from the level of negative affectivity during the episode.

3.3 | The Regression Analyses for Mother-reported Temperament at 6 and 12 Months and Communicative Development at 14 and 30 Months

Summaries of regression analyses on mother-reported temperament and communicative skills are presented in Table 6. None of the temperament traits significantly predicted group membership of low or high expressive vocabulary at 14 months, hence these logistic regressions are reported in the Supplement (Table S3).

3.3.1 | Gesture use at 14 Months (Table 6)

Emerging self-regulation at 6 and 12 months was positively related to gesturing. After adjusting for multiple comparisons, the p-value for 12-month emerging self-regulation remained significant, whereas for 6-month emerging self-regulation it did not (Benjamini-Hochberg p-values = 0.01 and 0.10). Negative affectivity and fear showed no significant associations with gesturing.

TABLE 6 Summary of regression analyses for mother-reported temperament at 6 and 12 Months and use of gestures and receptive vocabulary at 14 Months

	***B* (95% CI)**	***SE B***	***p***	**Partial eta sqared**	**Adjusted R^2**
Use of gestures					
Reported temperament traits					
Negative affectivity 6 months	−0.77 (−3.23–1.69)	1.25	0.54	0.00	0.07
Fear 6 months	0.61 (−0.97–2.20)	0.81	0.45	0.00	0.08
Emerging self-regulation 6 months	3.12 (0.26–5.99)	1.46	**0.03**	0.03	0.10
Negative affectivity 12 months	0.20 (−2.68–3.08)	1.46	0.89	0.00	0.07
Fear 12 months	0.18 (−1.43–1.79)	0.83	0.82	0.00	0.07
Emerging self-regulation 12 months	5.48 (2.51–8.47)	1.52	**0.00**	0.08	0.15
Receptive vocabulary					
Reported temperament traits					
Negative affectivity	0.03 (−0.31–0.36)	0.17	0.88	0.00	0.06
Fear 6 months	0.09 (−0.12–0.30)	0.11	0.42	0.00	0.06
Emerging self-regulation 6 months	0.49 (0.09–0.88)	0.20	**0.02**	0.03	0.09
Negative affectivity 12 months	0.13 (−0.26–0.52)	0.20	0.50	0.00	0.06
Fear 12 months	0.11 (−0.12–0.34)	0.12	0.34	0.01	0.07
Emerging self-regulation 12 months	0.34 (−0.07–0.75)	0.21	0.11	0.02	0.07

Note: Adjusted R^2 reported for the whole model. Significant p-values are bolded.

3.3.2 | Receptive vocabulary at 14 Months (Table 6)

Self-regulation was positively associated with receptive vocabulary when assessed at 6 months, but no longer at 12 months. After adjusting for multiple comparisons, the p-value for 6-month emerging self-regulation was no longer significant (Benjamini-Hochberg p-value = 0.10). Negative affectivity and fear were found to have no significant relation with receptive vocabulary.

3.3.3 | Vocabulary at 30 months

Self-regulation, which was related to communicative skills at 14 months, was no longer associated with vocabulary at 30 months of age (see Table S4 in the Supplement). Neither negative affectivity nor fear showed any relation with vocabulary at this age.

4 | DISCUSSION

Many studies agree that positive emotionality/surgency is positively related to language development, but there is much less conclusive results regarding which temperamental dimensions are potential risk factors for early communicative development. The aim of the study was to investigate the relations between infant negative affectivity and emerging self-regulation and communicative development, as previous results differ regarding these dimensions of temperament in particular. Additionally, of the few studies of relations between temperament and language development in infants, we are not aware of other research groups involving preverbal gesturing as a measure of communicative development, although it is a very important communication modality in this age group. We assessed both preverbal gestural communication at 14 months of age and expressive and receptive language skills at 14 and 30 months of age, and utilized both observations and mother-reports of temperament in our setting. In light of existing literature and our previous results from the first phase of the FinnBrain-study (Ollas et al., 2020), our hypotheses were that dimensions of higher emerging self-regulatory abilities (assessed by mother-reported orienting and regulation and observed attentiveness and gaze aversion in a distress-provoking situation) would be positively related to communicative skills, especially expressive verbal and gestural communication, and that similar relations would be found using both observed and reported temperament in the analyses. Given the mixed previous findings, we did not set any direction for the hypothesis regarding negative affectivity and fear, but hypothesized these traits would be associated with communicative development.

In line with our hypotheses, mother-reported orienting/regulation, an indicator of emerging self-regulation, was positively related to gesturing at 14 months (Dixon & Smith, 2000; Gartstein et al., 2008). Surprisingly, observed attentiveness did not relate significantly to any communicative skill. We found weak support for the hypothesis that higher levels of observed negative affectivity would predict better expressive language, since infants higher in negative affectivity were more likely to belong to the high expressive vocabulary group than to the intermediate group, but this finding did not remain significant after multiple comparisons correction. This was also the only result supporting this hypothesis. Further, we found no significant relations with neither observed nor reported fear and communicative outcomes at 14 and 30 months of age.

4.1 | Self-regulation and communicative development

Regarding self-regulation, the strongest association found was between mother-reported self-regulation at 12 months and communicative gesturing at 14 months of age. There were also associations between

self-regulation and receptive vocabulary, but these did not remain significant after correcting for multiple comparisons. This corresponds well with our previous findings in a different sample (Ollas et al., 2020). We are not aware of any prior studies looking into self-regulation and preverbal gesturing. Suggested mechanisms behind relations between self-regulation and language in previous studies are that better infant emerging self-regulation supports interaction and leads to an increase in chances for communicative learning when the infant can more easily focus on the communicative experiences. Higher emerging self-regulation and orienting can also be interpreted as a higher interest in communication, which may lead to others communicating more with the infant (Dixon & Smith, 2000; Gartstein et al., 2008). Finally, better regulatory ability may have a positive influence by leaving more attentional resources to spend on interpersonal interaction rather than on the regulation of actions and negative affective states (Salley & Dixon, 2007). Although these theories are based on verbal language, it is plausible that the same mechanisms can be applied to preverbal gesturing. The fact that the strongest association in the current study was found between the concurrent self-regulation at 12 months and gesturing at 14 months of age, and not with the verbal language outcomes, was interesting. We had similar findings in another Finnish sample of 12-month-olds where we found aspects of mother-reported self-regulation and positive emotionality to predict infant gesturing over and above verbal language (Ollas et al., 2020). Our findings suggest that gesturing is the communicative skill most influenced by self-regulatory capacity at this early age. As an expressive modality, gesturing typically precedes expressive vocabulary (Iverson & Goldin-Meadow, 2005) and presents larger variability at this age, which may explain why it shows stronger associations with self-regulation compared to expressive vocabulary. Interestingly, whereas the predictive power of early expressive vocabulary is debated (Duff et al., 2015), early gesturing is reported to predict later language development (Kuhn et al., 2014; Rowe & Goldin-Meadow, 2009), making the current findings interesting also from the larger perspective of childhood. More studies are needed to explore whether similar results can be found in other populations as well.

Although using self-regulation by gaze aversion was partially an exploratory study question as no previous similar studies have been conducted, it was surprising that we found a negative association between observed emerging self-regulation and language outcomes. This pattern of associations, although not significant after correcting for multiple comparisons, was observed in terms of two different language outcomes, receptive and expressive vocabulary, whereas reported self-regulation was most clearly associated with gesturing. The maternal report and observations capture different aspects of self-regulatory ability, which is supported by the fact that observed emergent self-regulation by gaze aversion at 8 months was also modestly negatively correlated with reported emerging self-regulation at 6 months. The aspects of self-regulation beneficial for communicative development may be better reflected in parent-reported self-regulation than in the observations of self-regulatory behaviors. Instead, the frequent use of gaze aversion may reflect a more avoidant regulatory strategy that is independent of parental scaffolding in distress-provoking conditions. Thus, infants using this strategy may regulate through means that are not as beneficial for communicative development. Parallels can be drawn to the finding by Robinson and Acevedo (2001) where high fear was positively related to language when accompanied by high reliance on the mother, but the opposite was true when reliance on the mother was low. The fact that the model did not change when adding negative affectivity indicates that the use of gaze aversion is related to language skills independent of the level of emotional reactivity. Interestingly, the negative relations between gaze a version, a behavioral marker of emotion regulation, were found only with the verbal communication outcomes, not with gesturing. These preliminary results have to be treated with caution, but they point to a need to further confirm the findings and study different aspects of self-regulation at different child age points as these may have individual contributions to the development of communicative skills.

The lack of associations between observed attentiveness and communicative outcomes was also unexpected. Vouloumanos and Curtin (2014) studied associations between experimentally observed attentiveness at 12 months and expressive skills at 18 months and found that attention to linguistic stimuli positively predicted language skills, but overall attentiveness did not. Similarly, it is possible that the method used for observed task orientation/attentiveness assessment used in our setting does not pick up this dimension since the task involves as little interaction and communication as possible and is mainly about visual attention. Conversely, the mother-reported emerging self-regulation factor contains both dimensions of attentiveness and emotional self-regulation across several everyday situations, so it may better tap into dimensions that support interaction and communicative development related to emotion regulation and attentiveness in communication situations. However, we are not aware of other studies employing the same measure of attentiveness as in the current study, so more research is needed to draw conclusions on the patterns observed.

4.2 | Negative affectivity, fear, and communicative development

Previous studies have reported inconsistent findings regarding associations between negative affectivity and language skills, including both positive associations (e.g., Molfese et al., 2010) and negative associations (e.g., Kubicek & Emde, 2012) and no significant main effects at all (Karrass & Braungart-Rieker, 2003; Laake & Bridgett, 2018). Our findings were in line with the latter, as we found no robust evidence for either observed or reported negative affectivity playing a role in language development in our study. However, a finding that did not survive multiple comparison correction, higher negative affectivity in the observed condition significantly associated with infants belonging to the high expressive vocabulary group rather than the intermediate expressive vocabulary group. Furthermore, the regression coefficients, although not statistically significant, between higher negative affectivity and communicative outcomes were positive. Thus, our findings rather hint toward infant negative affectivity having a positive contribution to communicative development instead of being harmful for this development. This interpretation would also be in line with the previous notion that in younger children, specifically anger, has been reported to be positively related to language (Nozadi et al., 2013). Particularly in the observational assessment condition negative affect is a reactive response to being limited from a desired action, which can be interpreted as a way of communicating the distress to the adult when verbal expression is not yet possible (Nozadi et al., 2013; Stifter & Fox, 1990). To summarize, we found no evidence of higher negative affectivity being a risk factor for communicative development.

Previous findings regarding infant fear have also been contradictory, as both positive associations in infancy (Peterson et al., 2017) and negative associations from 15 to 30 months of age (Kubicek & Emde, 2012) have been reported. In our study, the relations did not reach significance, but the coefficients observed in our study were positive. This pattern may reflect the relatively lower power and the possibility that the associations may emerge in larger samples. Further, the associations may be dependent on the context. More specifically, fear expressions in distress-provoking contexts that serve the purpose of initiating interaction with the caregiver may influence communicative development positively (Robinson & Acevedo, 2001). However, since no clear associations were found in the current study, future studies should continue studying negative affectivity as a determinant of language in different contexts.

4.3 | Observed and reported temperament

The use of observed and reported temperament can be seen as both a strength and a weakness in the current study. It is a strength as both methodologies have seldom been used in the same study when

exploring associations between temperament and communicative development. However, unfortunately, the time points for observational and reported assessment did not overlap entirely in our sample, decreasing the degree to which they can be directly compared. Generally, the corresponding observed and reported temperament traits showed low intercorrelations, which is not surprising as it is well known from previous research that correspondence between observational and reported temperament assessment, especially regarding negative emotionality, is not always high (Freund, 2019; Stifter et al., 2008). Thus, the low intercorrelations in the current study are unlikely to result from the 2-month time difference between the first mother-report and the laboratory assessment. Observed and reported temperament traits also displayed differing associations with communicative outcomes. This supports the view that they assess different aspects of the temperament. In a laboratory setting, it is possible to standardize the situations assessed and try to elicit specific, low-frequency emotions and reactions, and the observers are more objective (Durbin et al., 2007). Laboratory assessments are, however, novel situations for the infant, which may lead to lower ecological validity (Durbin et al., 2007) and affect infant reactions, for example, by heightening negative reactivity (Stifter et al., 2008). During observational assessment, the infant and adult are not allowed to interact freely, in contrast to the situations assessed when using parent-reports, which may also shape the infant responses. Since infant self-regulation is dependent on caregiver support (Feldman, 2007) and the expression of dimensions of temperament also depends on caregiver actions and the environment, assessing temperament independently is naturally difficult for parents, and parent-reports inevitably lack objectivity to some extent (Durbin & Wilson, 2012; Leerkes & Crockenberg, 2003). The involvement of interaction aspects in the reported measures may in fact explain their stronger associations with communicative skills. Our findings converge with the prior reports in supporting the view that both assessment modalities may have independent associations with early childhood communicative development (Kubicek & Emde, 2012) and should be utilized simultaneously to understand the relations between temperament and language development.

4.4 | Limitations and directions for future research

There are several strengths in the current study. One is studying relations between temperament and communicative development longitudinally during the first years of life, a time period when the expression of temperament traits comes online and develops (Braungart-Rieker et al., 2010; Caspi & Roberts, 2001; Rothbart et al., 2007), and the first communicative behaviors become observable and then develop at a fast pace (Fenson, 1994). Due to the rapid changes in temperament and communicative development during this time period, this is a particularly interesting time period to explore.

However, there are also important limitations to consider. One is the above-mentioned discussion regarding the use of observed and reported temperament assessment. Furthermore, although being quite large compared to other studies that have considered associations between early temperament and language, the current sample size may still have affected the statistical power and led to smaller, but yet conceptually interesting effects not reaching significance. Second, although both the communication development (Fenson, 1994) and temperament (Gartstein & Rothbart, 2003) assessment instruments have been shown to be reliable and also have advantages as compared to observatory assessments (Gartstein & Marmion, 2008), it is not possible to rule out that the relations between reported temperament and communicative outcomes may be due to rater bias, since ratings of both temperament and communicative skills were made by the same person. Hence, parent perceptions, for example, positive versus negative perceptions of the child, could influence ratings on both instruments. However, the present study used both observed and reported temperament to examine the study

questions, which effectively attenuates this limitation. One additional limitation related to the observational temperament assessment was that no observation technology other than video recording from the front of the infant was used to code gaze aversion in the observational self-regulation task, and it was not possible to add technology at a later stage. Future studies focusing on gaze aversion should routinely use such technologies when available.

Third, since the theory is that temperament traits influence communicative development through influencing the quality and quantity of infant-adult interaction (e.g., Moreno & Robinson, 2005), it would be optimal to involve assessment of parent-child interaction in studies of these relations as well. For example, Karrass and Braungart-Rieker (2003) argue that the influence of negative affectivity may depend on how the parent responds to the emotion. Thus, if they isolate the child in order to help them calm down, interaction is disrupted, but more effective soothing by talking to the child, interaction continues. Hence, knowledge of the quality of mother-infant interaction would be valuable in understanding these relations, and this is included in our plans for future research.

Fourth, it is important to take into consideration that, while measures have been taken to make the current sample as representative as possible for the Finnish sample, there may be cultural differences concerning communication, temperament, and economic factors that this study has not managed to control for, reducing the generalizability to other populations.

5 | CONCLUSION

The results of the current study indicated that higher mother-reported self-regulation was positively associated with preverbal gesturing at 14 months, explaining 15% of the variance. As a preliminary finding, observed self-regulation by gaze aversion at 8 months was linked with poorer receptive and expressive vocabulary. This indicates self-regulation is important to take into consideration as a risk/protective factor for early communicative development, but different aspects of or strategies for self-regulation may have different relations to the different dimensions of communication. No clear associations between negative affectivity or fear and early communicative development were detected in this study. Our findings also support the view that the association between temperament and communicative development depends on the age at which the traits are assessed. More longitudinal research is needed to yield a deeper understanding of these relations and to improve the understanding of the risk factors of early language development.

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CONFLICT OF INTEREST

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REFERENCES

Berglund, E., Eriksson, M., & Westerlund, M. (2005). Communicative skills in relation to gender, birth order, childcare and socioeconomic status in 18-month-old children. *Scandinavian Journal of Psychology*, *46*(6), 485–491. https://doi.org/10.1111/j.1467-9450.2005.00480.x

Bloom, L., & Capatides, J. B. (1987). Expression of affect and the emergence of language. *Child Development*, *58*(6), 1513–1522. https://doi.org/10.2307/1130691

Bohlmann, N. L., Maier, M. F., & Palacios, N. (2015). Bidirectionality in self-regulation and expressive vocabulary: Comparisons between monolingual and dual language learners in preschool. *Child Development*, *86*(4), 1094–1111. https://doi.org/10.1111/cdev.12375

Braungart-Rieker, J. M., Hill-Soderlund, A. L., & Karrass, J. (2010). Fear and anger reactivity trajectories from 4 to 16 months: The roles of temperament, regulation, and maternal sensitivity. *Developmental Psychology*, *46*, 791–804. https://doi.org/10.1037/a0019673

Briggs-Gowan, M. J., Carter, A. S., & Schwab-Stone, M. (1996). Discrepancies among mother, child, and teacher reports: Examining the contributions of maternal depression and anxiety. *Journal of Abnormal Child Psychology*, *24*(6), 749–765. https://doi.org/10.1007/BF01664738

Buss, K. A. (2011). Which fearful toddlers should we worry about? Context, fear regulation, and anxiety risk. *Developmental Psychology*, *47*(3), 804–819. https://doi.org/10.1037/a0023227

Caspi, A., & Roberts, B. W. (2001). Personality development across the life course: The argument for change and continuity. *Psychological Inquiry*, *12*(2), 49–66. https://doi.org/10.1207/S15327965PLI1202

Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression - development of the 10-item edinburgh postnatal depression scale. *British Journal of Psychiatry*, *150*(6), 782–786. https://doi.org/10.1192/bjp.150.6.782

Derogatis, L. R., Lipman, R. S., & Covi, L. (1973). SCL-90: An outpatient psychiatric rating scale - preliminary report. *Psychopharmacology Bulletin, 9*(1), 13–28.

Dixon, W. E., & Smith, P. H. (2000). Links between early temperament and language acquisition. *Merrill-Palmer Quarterly*, *46*, 417–440. http://www.jstor.org/stable/23093739

Duff, F. J., Nation, K., Plunkett, K., & Bishop, D. V. M. (2015). Early prediction of language and literacy problems: Is 18 months too early? *PeerJ*, *3*, e1098. https://doi.org/10.7717/PEERJ.1098/SUPP-1

Durbin, C. E., & Wilson, S. (2012). Convergent validity of and bias in maternal reports of child emotion. *Psychological Assessment*, *24*(3), 647–660. https://doi.org/10.1037/a0026607

Durbin, C. E., Hayden, E. P., Klein, D. N., & Olino, T. M. (2007). Stability of laboratory-assessed temperamental emotionality traits from ages 3 to 7. *Emotion*, *7*(2), 388–399. https://doi.org/10.1037/1528-3542.7.2.388

Edwards, R. C., & Hans, S. L. (2015). Infant risk factors associated with internalizing, externalizing, and co-occurring behavior problems in young children. *Developmental Psychology*, *51*(4), 489–499. https://doi.org/10.1037/A0038800

Eriksson, M., & Berglund, E. (2002). Instruments, scoring manual and percentile levels of the Swedish Early Communicative Development Inventory, SECDI (FoU-Rapport 17). Institutionen för pedagogik, didaktik och psykologi.

Feldman, R. (2007). Parent-infant synchrony: Biological foundations and developmental outcomes. *Current Directions in Psychological Science*, *16*(6), 340–345. https://doi.org/10.1111/j.1467-8721.2007.00532.x. http://www.jstor.org/stable/20183232

Fenson, L., Dale, P. S., Reznick, J. S., Bates, E., Thal, D. J., & Pethick, S. J. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development*, *59*, 1–185.

Freund, J. D. (2019). Early temperament in parental report and scientific observation. *Early Child Development and Care*, *189*(14), 2318–2333. https://doi.org/10.1080/03004430.2018.1450252

Gaias, L. M., Räikkönen, K., Komsi, N., Gartstein, M. A., Fisher, P. A., & Putnam, S. P. (2012). Cross-cultural temperamental differences in infants, children, and adults in the United States of America and Finland. *Scandinavian Journal of Psychology*, *53*(2), 119–128. https://doi.org/10.1111/J.1467-9450.2012.00937.X

Garello, V., Viterbori, P., & Usai, M. C. (2012). Temperamental profiles and language development: A replication and an extension. *Infant Behavior and Development*, *35*(1), 71–82. https://doi.org/10.1016/j.infbeh.2011.09.003

Gartstein, M. A., & Marmion, J. (2008). Fear and positive affectivity in infancy: Convergence/discrepancy between parent-report and laboratory-based indicators. *Infant Behavior and Development*, *31*(2), 227–238. https://doi.org/10.1016/j.infbeh.2007.10.012

Gartstein, M. A., & Rothbart, M. K. (2003). Studying infant temperament via the revised infant behavior questionnaire. *Infant Behavior and Development*, *26*(1), 64–86. https://doi.org/10.1016/S0163-6383(02)00169-8

Gartstein, M. A., Crawford, J., & Robertson, C. D. (2008). Early markers of language and attention: Mutual contributions and the impact of parent-infant interactions. *Child Psychiatry and Human Development*, *39*(1), 9–26. https://doi.org/10.1007/s10578-007-0067-4

Goldsmith, H. H., Buss, A. H., Plomin, R., Rothbart, M. K., Thomas, A., Chess, S., Hinde, R. A., & McCall, R. B. (1987). Roundtable: What is temperament? Four approaches. *Child Development*, *58*, 505–529. https://doi.org/10.2307/1130527

Harrison, L. J., & McLeod, S. (2010). Risk and protective factors associated with speech and language impairment in a nationally representative sample of 4- to 5-year-old children. *Journal of Speech, Language, and Hearing Research*, *53*(2), 508–529. https://doi.org/10.1044/1092-4388(2009/08-0086)

Hoff, E., & Tian, C. (2005). Socioeconomic status and cultural influences on language. *Journal of Communication Disorders*, *38*(4), 271–278. https://doi.org/10.1016/j.jcomdis.2005.02.003

Hohm, E., Jennen-Steinmetz, C., Schmidt, M. H., & Laucht, M. (2007). Language development at ten months: Predictive of language outcome and school achievement ten years later? *European Child & Adolescent Psychiatry*, *16*, 149–156. https://doi.org/10.1007/s00787-006-0567-y

Iverson, J. M., & Goldin-Meadow, S. (2005). Gesture paves the way for language development. *Psychological Science*, *16*(5), 367–371. https://doi.org/10.1111/j.0956-7976.2005.01542.x

Karlsson, L., Tolvanen, M., Scheinin, N. M., Uusitupa, H.-M., Korja, R., Ekholm, E., Tuulari, J. J., Pajulo, M., Huotilainen, M., Paunio, T., Karlsson, H., & FinnBrain Birth Cohort Study Group. (2018). Cohort profile: The FinnBrain birth cohort study (FinnBrain). *International Journal of Epidemiology*, *47*(1), 15–16j. https://doi.org/10.1093/ije/dyx173

Karrass, J., & Braungart-Rieker, J. M. (2003). Parenting and temperament as interacting agents in early language development. *Parenting: Science and Practice*, *3*, (3), 235-259. https://doi.org/10.1207/S15327922PAR0303_03

Komsi, N., Räikkönen, K., Pesonen, A. K., Heinonen, K., Keskivaara, P., Järvenpää, A. L., & Strandberg, T. E. (2006). Continuity of temperament from infancy to middle childhood. *Infant Behavior and Development*, *29*(4), 494–508. https://doi.org/10.1016/j.infbeh.2006.05.002

Kubicek, L. F., & Emde, R. N. (2012). Emotional expression and language: A longitudinal study of typically developing earlier and later talkers from 15 to 30 months. *Infant Mental Health Journal*, *33*(6), 553–584. https://doi.org/10.1002/imhj.21360

Kuhn, L. J., Willoughby, M. T., Wilbourn, M. P., Vernon-Feagans, L., & Blair, C. B. (2014). Early communicative gestures prospectively predict language development and executive function in early childhood. *Child Development*, *85*, 1898–1914. https://doi.org/10.1111/cdev.12249

Laake, L. M., & Bridgett, D. J. (2014). Happy babies, chatty toddlers: Infant positive affect facilitates early expressive, but not receptive language. *Infant Behavior and Development*, *37*(1), 29–32. https://doi.org/10.1016/j.infbeh.2013.12.006

Laake, L. M., & Bridgett, D. J. (2018). Early language development in context: Interactions between infant temperament and parenting characteristics. *Early Education & Development*, *29*(5), 730–746. https://doi.org/10.1080/10409289.2018.1436366

Leerkes, E. M., & Crockenberg, S. C. (2003). The impact of maternal characteristics and sensitivity on the concordance between maternal reports and laboratory observations of infant negative emotionality. *Infancy*, *4*, 517–539. https://doi.org/10.1207/S15327078IN0404_07

Lumley, T., Diehr, P., Emerson, S., & Chen, L. (2002). The importance of the normality assumption in large public health data sets. *Annual Review of Public Health*, *23*(1), 151–169. https://doi.org/10.1146/annurev.publheath.23.100901.140546

Lyytinen, P. (1999). Varhaisen kommunikaation ja kielen kehityksen arviointimenetelmä. Jyväskylän yliopiston Lapsitutk- imuskeskus ja Niilo Mäki instituutti. [A method for assessing early communication and language. University of Jyväskylä Child Research Centre and the Niilo Mäki Institute]. Niilo Mäki Säätiö.

McClelland, M. M., Cameron, C. E., Connor, C. M. D., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology*, *43*(4), 947–959. https://doi.org/10.1037/0012-1649.43.4.947

Molfese, V. J., Rudasill, K. M., Beswick, J. L., Jacobi-Vessels, J. L., Ferguson, M. C., & White, J. M. (2010). Infant temperament, maternal personality, and parenting stress as contributors to infant developmental outcomes. *Merrill-Palmer Quarterly*, *56*(1), 49–79. https://doi.org/10.1353/mpq.0.0039

Morales, M., Mundy, P., Delgado, C. E. F., Yale, M., Neal, R., & Schwartz, H. K. (2000). Gaze following, temperament, and language development in 6-month-olds: A replication and extension. *Infant Behavior and Development*, *23*(2), 231–236. https://doi.org/10.1016/S0163-6383(01)00038-8

Moreno, A. J., & Robinson, J. L. (2005). Emotional vitality in infancy as a predictor of cognitive and language abilities in toddlerhood. *Infant and Child Development*, *14*(4), 383–402. https://doi.org/10.1002/icd.406

Newman, R. S., Rowe, M. L., & Bernstein Ratner, N. (2016). Input and uptake at 7 months predicts toddler vocabulary: The role of child-directed speech and infant processing skills in language development. *Journal of Child Language*, *43*(5), 1158–1173. https://doi.org/10.1017/S0305000915000446

Nigg, J. T. (2017). Annual Research Review: On the relations among self-regulation, self-control, executive functioning, effortful control, cognitive control, impulsivity, risk-taking, and inhibition for developmental psychopathology. *Journal of Child Psychology and Psychiatry*, *58*(4), 361–383. https://doi.org/10.1111/JCPP.12675

Noel, M., Peterson, C., & Jesso, B. (2008). The relationship of parenting stress and child temperament to language development among economically disadvantaged preschoolers. *Journal of Child Language*, *35*(4), 823–843. https://doi.org/10.1017/S0305000908008805

Nozadi, S. S., Spinrad, T. L., Eisenberg, N., & Eggum-Wilkens, N. D. (2015). Associations of anger and fear to later self-regulation and problem behavior symptoms. *Journal of Applied Developmental Psychology*, *38*, 60–69. https://doi.org/10.1016/j.appdev.2015.04.005

Nozadi, S. S., Spinrad, T. L., Eisenberg, N., Bolnick, R., Eggum-Wilkens, N. D., Smith, C. L., Gaertner, B., Kupfer, A., & Sallquist, J. (2013). Prediction of toddlers' expressive language from maternal sensitivity and toddlers' anger expressions: A developmental perspective. *Infant Behavior and Development*, *36*(4), 650–661. https://doi.org/10.1016/j.infbeh.2013.06.002

Ollas, D., Rautakoski, P., Nolvi, S., Karlsson, H., & Karlsson, L. (2020). Temperament is associated with the use of communicative gestures in infancy. *Infant and Child Development*, *29*(3), 1–15. https://doi.org/10.1002/icd.2166

Peterson, E. R., Waldie, K. E., Mohal, J., Reese, E., Atatoa Carr, P. E., Grant, C. C., & Morton, S. M. B. (2017). Infant behavior questionnaire–revised very short form: A new factor structure's associations with parenting perceptions and child language outcomes. *Journal of Personality Assessment*, *99*(6), 561–573. https://doi.org/10.1080/00223891.2017.1287709

Planalp, E. M., Hulle, C. V., Gagne, J. R., & Hill Goldsmith, H. (2017). The infant version of the laboratory temperament assessment battery (Lab-TAB): Measurement properties and implications for concepts of temperament. *Frontiers in Psychology*, *8*, 1–17. https://doi.org/10.3389/fpsyg.2017.00846

Prior, M., Bavin, E. L., Cini, E., Reilly, S., Bretherton, L., Wake, M., & Eadie, P. (2008). Influences on communicative development at 24 months of age: Child temperament, behaviour problems, and maternal factors. *Infant Behavior and Development*, *31*(2), 270–279. https://doi.org/10.1016/j.infbeh.2007.11.001

Psyridou, M., Eklund, K., Poikkeus, A. M., & Torppa, M. (2018). Reading outcomes of children with delayed early vocabulary: A follow-up from age 2–16. *Research in Developmental Disabilities*, *78*, 114–124. https://doi.org/10.1016/J.RIDD.2018.05.004

Pérez-Edgar, K., & Fox, N. A. (2005). Temperament and anxiety disorders. *Child and Adolescent Psychiatric Clinics of North America*, *14*(4), 681–706. https://doi.org/10.1016/j.chc.2005.05.008

Pérez-Pereira, M., Fernández, P., Resches, M., & Luisa Gómez-Taibo, M. (2016). Does temperament influence language development? Evidence from preterm and full-term children. *Infant Behavior and Development*, *42*, 11–21. https://doi.org/10.1016/j.infbeh.2015.10.003

Reck, C., Van Den Bergh, B., Tietz, A., Müller, M., Ropeter, A., Zipser, B., & Pauen, S. (2018). Maternal avoidance, anxiety cognitions and interactive behaviour predicts infant development at 12 months in the context of anxiety disorders in the postpartum period. *Infant Behavior and Development*, *50*, 116–131. https://doi.org/10.1016/j.infbeh.2017.11.007

Robinson, J. A. L., & Acevedo, M. C. (2001). Infant reactivity and reliance on mother during emotion challenges: Prediction of cognition and language skills in a low-income sample. *Child Development*, *72*(2), 402–415. https://doi.org/10.1111/1467-8624.00286

Rothbart, M. K., & Bates, J. E. (1998). Temperament. In W. Damon & N. Eisenberg (Eds.), *Handbook of child psychology*. Social, emotional, and personality development (Vol. 3, pp. 105–176). Wiley.

Rothbart, M. K., & Bates, J. E. (2006). Temperament. In W. Damon, R. M. Lerner, & N. Eisenberg (Eds.), *Handbook of child psychology*. Social, emotional, and personality development (Vol. 3, pp. 99–166). Wiley.

Rothbart, M. K., Sheese, B. E., & Posner, M. I. (2007). Executive attention and effortful control: Linking temperament, brain networks, and genes. *Child Development Perspectives*, *1*, 2–7. https://doi.org/10.1111/j.1750-8606.2007.00002.x

Rothbart, M. K., Sheese, B. E., Rueda, M. R., & Posner, M. I. (2011). Developing mechanisms of self-regulation in early life. *Emotion Review*, *3*(2), 207–213. https://doi.org/10.1177/1754073910387943

Rowe, M. L., & Goldin-Meadow, S. (2009). Early gesture selectively predicts later language learning. *Developmental Science*, *12*(1), 182–187. https://doi.org/10.1111/j.1467-7687.2008.00764.x

Salley, B. J., & Dixon, W. E. (2007). Temperamental and joint attentional predictors of language development. *Merrill-Palmer Quarterly*, *53*, 131–154.

Sohr-Preston, S. L., & Scaramella, L. V. (2006). Implications of timing of maternal depressive symptoms for early cognitive and language development. *Clinical Child and Family Psychology Review*, *9*(1), 65–83. https://doi.org/10.1007/s10567-006-0004-2

Stifter, C. A., & Fox, N. A. (1990). Infant reactivity: Physiological correlates of newborn and 5-month temperament. *Developmental Psychology*, *26*(4), 582–588. https://doi.org/10.1037/0012-1649.26.4.582

Stifter, C. A., Willoughby, M. T., & Towe-Goodman, N. (2008). Agree or agree to disagree? Assessing the convergence between parents and observers on infant temperament. *Infant and Child Development*, *17*(4), 407–426. https://doi.org/10.1002/icd.584

Taanila, A., Murray, G. K., Jokelainen, J., Isohanni, M., & Rantakallio, P. (2005). Infant developmental milestones: A 31-year follow-up. *Developmental Medicine and Child Neurology*, *47*(09), 581–586. https://doi.org/10.1017/S0012162205001155

Trentacosta, C. J., & Shaw, D. S. (2009). Emotional self-regulation, peer rejection, and antisocial behavior: Developmental associations from early childhood to early adolescence. *Journal of Applied Developmental Psychology*, *30*(3), 356–365. https://doi.org/10.1016/j.appdev.2008.12.016

Ursache, A., Blair, C., Stifter, C., & Voegtline, K. (2013). Emotional reactivity and regulation in infancy interact to predict executive functioning in early childhood. *Developmental Psychology*, *49*(1), 127–137. https://doi.org/10.1037/a0027728

Valiente, C., Eisenberg, N., Smith, C. L., Reiser, M., Fabes, R. A., Losoya, S., Guthrie, I. K., & Murphy, B. C. (2003). The relations of effortful control and reactive control to children's externalizing problems: A longitudinal assessment. *Journal of Personality*, *71*(6), 1171–1196. https://doi.org/10.1111/1467-6494.7106011

Vouloumanos, A., & Curtin, S. (2014). Foundational tuning: How infants' attention to speech predicts language development. *Cognitive Science*, *38*(8), 1675–1686. https://doi.org/10.1111/cogs.12128

Zerbeto, A. B., Cortelo, F. M., & Filho, É. B. C. (2015). Association between gestational age and birth weight on the language development of Brazilian children: A systematic review. *Jornal de Pediatria*, *91*(4), 326–332. https://doi.org/10.1016/j.jpedp.2015.05.004

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