Development and Psychopathology (2025), 1–13
doi:10.1017/S0954579425100291

CAMBRIDGE UNIVERSITY PRESS

Regular Article

How negative affect moderates the effect of mindful parenting on child externalizing behavior: Frontal alpha asymmetry as environmental sensitivity factor

Rabia R. Chhangur[1], Bea R.H. Van den Bergh[2], Jessie Hillekens[1] and Marion I. van den Heuvel[3]

[1]Department of Developmental Psychology, Tilburg University, Tilburg, The Netherlands, [2]Research Group Health Psychology and Leuven Brain Institute, KU Leuven, Leuven, Belgium and [3]Tranzo Scientific Center for Care and Wellbeing, Tilburg University, Tilburg, The Netherlands

Abstract

The development of externalizing behavior in young children is shaped by the complex interaction of temperament, neural mechanisms, and environmental factors. This study explored how child frontal alpha asymmetry (FAA) and child negative affect jointly moderate the relationship between mindful parenting and child externalizing behavior. The sample, drawn from families in the Netherlands, included reports from 128 mothers and 103 partners on mindful parenting, and on children's negative affect and externalizing behavior. FAA was measured in 95 four-year-old children during an EEG session while they watched an animated video. Results indicated that children with high negative affect and greater left-sided FAA displayed the most externalizing behavior when maternal mindful parenting was low, but the least when mindful parenting was high. In contrast, no significant effects were found for children with lower negative affect or in partner-reported data. These findings suggest that children with both high negative affect and greater left-sided FAA are more sensitive to the quality of mindful parenting, particularly from mothers, aligning with the environmental sensitivity framework. Future research should replicate these findings, ideally in a larger sample, and further examine the long-term, cumulative impact of FAA and negative affect on the development of behavioral problems.

Keywords: environmental sensitivity; externalizing behavior; frontal alpha asymmetry; mindful parenting; negative affect

(Received 11 November 2024; revised 28 May 2025; accepted 29 May 2025)

Introduction

Externalizing behaviors, such as aggression, oppositional behavior, and disobedience, are part of normal child development, but can become problematic when elevated, predicting later emotional distress and academic or social impairments (Campbell et al., 2000; Gilliom & Shaw, 2004; Mesman et al., 2001; Scott et al., 2001). Parenting is a significant predictor of these behaviors (Duncombe et al., 2012; Lengua, 2006; Wiggers & Paas, 2022). While negative parenting strategies, such as harsh discipline and inconsistent responses, exacerbate externalizing behaviors (Gershoff, 2002; Harmon-Jones & Allen, 1997), positive parenting strategies, including warmth, acceptance, and emotional engagement, have been shown to reduce such behaviors (Dishion et al., 2008; Gardner et al., 2007). Although extensive research has examined various positive parenting strategies—such as sensitive parenting, parental warmth, and context-sensitive parenting practices—less focus has been placed on the role of mindful parenting in reducing externalizing behaviors. Mindful parenting is defined as the capacity to be present, emotionally regulated, and non-judgmental in interactions with children (Kabat-Zinn, 2003), and helps parents regulate their emotions, avoid reactive parenting, and foster constructive responses during challenging situations. Mindful parenting might be especially relevant in families where children exhibit high externalizing behaviors, because cycles of coercive interactions and heightened stress often develop (DuPaul et al., 2022; Pettit & Bates, 1989; Rothbaum & Weisz, 1994; Yan et al., 2021). Mindful parenting might disrupt these negative cycles by supporting better emotion regulation, and hence reduce externalizing behaviors (Bögels et al., 2008). Studies have shown that mindful parenting is associated with fewer externalizing problems, improved social skills, better emotion regulation, and overall well-being (Burgdorf et al., 2019; Evans et al., 2020; Liu et al., 2021; Turpyn & Chaplin, 2016; Zhang et al., 2019). However, it remains unclear whether all children are equally sensitive to these parenting strategies. Understanding individual differences in sensitivity is essential, as not all children may benefit equally from positive parenting approaches.

The *Diathesis-Stress Model* (Monroe & Simons, 1991; Zuckerman, 1999) offers one perspective, suggesting that certain vulnerability factors increase individuals' susceptibility to negative outcomes under adverse conditions. However, this model does not address whether these vulnerabilities might also confer advantages in supportive environments, raising questions about whether more sensitive children may respond differently to positive parenting

Corresponding author: Rabia R. Chhangur; Email: r.r.chhangur@tilburguniversity.edu
Cite this article: Chhangur, R. R., Van den Bergh, B. R. H., Hillekens, J., & van den Heuvel, M. I. (2025). How negative affect moderates the effect of mindful parenting on child externalizing behavior: Frontal alpha asymmetry as environmental sensitivity factor. *Development and Psychopathology*, 1–13, https://doi.org/10.1017/S0954579425100291

strategies. To better understand these differences, the *Environmental Sensitivity Framework* (Pluess, 2015) proposes that some individuals are inherently more sensitive to environmental influences than others. This framework integrates several influential models, including Differential Susceptibility, Vantage Sensitivity, Biological Sensitivity to Context, and the Sensory Processing Sensitivity model. The *Differential Susceptibility Model* (Belsky & Pluess, 2009) highlights that sensitive individuals are more reactive to both negative and positive environments, benefiting more from supportive conditions but also being more adversely affected by negative ones. In contrast, the *Vantage Sensitivity Model* (Pluess & Belsky, 2013) highlights that some individuals are particularly responsive to positive experiences, gaining more from favorable circumstances. The *Biological Sensitivity to Context Model* (Boyce & Ellis, 2005) adds a physiological perspective, suggesting that biological factors, such as stress reactivity, shape how sensitive an individual is to environmental influences. Finally, the *Sensory Processing Sensitivity Model* (Aron et al., 2012) highlights heightened sensory processing as a key aspect of environmental sensitivity, with highly sensitive individuals experiencing and responding more intensely to their environment. Together, these models highlight that children differ in their sensitivity to environmental influences, including parenting strategies like mindful parenting. While some may be more receptive to the benefits of such positive approaches, others may be less affected.

One factor that might make children more sensitive to environmental influences is negative affect. Negative affect—characterized by emotional traits such as fear, sadness, and anger—is increasingly recognized as a key factor within developmental psychology and psychopathology, particularly within the Diathesis-Stress Model (Monroe & Simons, 1991; Zuckerman, 1999) and broader environmental sensitivity frameworks (Pluess, 2015). Traditionally viewed as a vulnerability factor, negative affect heightens an individual's sensitivity to environmental influences, making children more susceptible to adverse experiences. Yet, contemporary research also highlights a more nuanced role: children who exhibit higher negative affect may possess a heightened sensitivity not only to negative stimuli but also to positive environments, thus potentially benefiting more profoundly from supportive contexts (Hartman et al., 2023). The critical role of negative affect becomes especially evident during early childhood, a developmental period characterized by rapid emotional and neurological changes (Kochanska et al., 2007; Rothbart, 2011; Zhang et al., 2022; van Zeijl et al., 2007). Meta-analytic evidence indeed indicates that from approximately the second year of life onward, children with elevated negative affect demonstrate increased vulnerability to negative parenting behaviors, such as inconsistent discipline, emotional unavailability, or harsh discipline, often resulting in heightened risk for behavioral and emotional difficulties (Slagt et al., 2016). However, this heightened sensitivity might simultaneously open developmental pathways through which children may become more receptive to beneficial influences, such as warmth, support, and responsive caregiving (Compas et al., 2017; Ugarte et al., 2023). For example, Parent et al. (2016) found that mindful parenting significantly reduced externalizing behaviors among preschoolers exhibiting high negative affect, demonstrating its protective and stabilizing potential. Such findings underscore the dual nature of negative affect, which may exacerbate vulnerability under adverse conditions but simultaneously amplify receptivity to positive parenting practices when these conditions are supportive. Thus, negative affect functions not merely as a static vulnerability but as a dynamic trait capable of moderating developmental outcomes.

This adaptive potential of negative affect may be partly attributed to neuroplasticity—the brain's enduring ability to reorganize neural pathways in response to environmental input—and to children's continued responsiveness to the quality of caregiving they receive throughout development. Neuroplasticity allows children's emotional reactivity to remain malleable well beyond early childhood, facilitating positive adaptations through supportive caregiving experiences such as mindful parenting (Masten & Cicchetti, 2016). Therefore, rather than exclusively conceptualizing negative affect as a risk factor, current perspectives emphasize its role as a context-dependent trait that, under mindful and emotionally attuned parenting, may foster resilience and positive developmental outcomes (Bögels et al., 2014; Duncan et al., 2009). Building upon this understanding, a potential neurobiological mechanism facilitating its adaptivity is frontal alpha asymmetry (FAA)—a neural indicator of individual differences in emotional and motivational processing, based on the balance of activity between the brain's left and right frontal regions (Fortier et al., 2014). While negative affective tendencies often appear stable after the second year, FAA-related brain plasticity could support adaptive changes in emotional regulation when moderated by positive postnatal experiences, such as mindful parenting. This highlights the dynamic interaction between early neural predispositions and later environmental inputs in shaping emotional development.

FAA is typically assessed using electroencephalography (EEG) to measure alpha power. Although it is termed 'frontal' asymmetry, FAA predominantly reflects asymmetry in the prefrontal cortex, particularly in the dorsolateral prefrontal cortex, which is involved in emotion regulation and executive functioning (Davidson, 2004; Grimshaw & Carmel, 2014). In EEG, lower alpha power reflects greater underlying neural activity in the respective brain region (Anaya et al., 2021; Howarth et al., 2016; Marshall et al., 2002; Marshall & Fox, 2007; Vincent et al., 2021). FAA scores are calculated as the difference between right and left alpha activity over the frontal regions, as measured with electroencephalography (FAA = right alpha power minus left alpha power). FAA scores are interpretated along a continuum, with *positive scores* indicating *greater left-sided FAA* and *negative scores* indicating *greater right-sided FAA* (Smith et al., 2017; van de Ven et al., 2020). Greater left-sided FAA is typically associated with approach motivation, positive affect, and social engagement, whereas greater right-sided FAA is linked to withdrawal tendencies and negative affect (Davidson & Fox, 1982; Davidson, 1992; Harmon-Jones et al., 2010; Sutton & Davidson, 1997). However, these associations are context-dependent and not inherently adaptive or maladaptive. For instance, excessive left-sided FAA has been associated with heighted reactivity to both positive and negative influences, suggesting that FAA's influence may vary depending on broader social and emotional contexts (Ellis et al., 2017; Hale et al., 2009; Harmon-Jones & Gable, 2018; Harmon-Jones et al., 2010; Keune et al., 2012).

Empirical research supports this context-dependency. Lopez-Duran et al. (2012) found that FAA moderated the relationship between stressful life events and internalizing symptoms in children at familial risk for depression. Specifically, greater right frontal activation was observed in high-risk children during emotional tasks, while greater left frontal activation appeared to buffer the negative effects of stress, reducing the risk of developing internalizing symptoms (Lopez-Duran et al., 2012). Similarly, Mulligan et al. (2022) demonstrated that FAA in response to a stressor moderated the relationship between parenting hassles and

https://doi.org/10.1017/S0954579425100291 Published online by Cambridge University Press

child externalizing problems. Greater left-sided FAA during a frustration-inducing task was associated with increased externalizing behaviors in children experiencing higher levels of parenting hassles, while this association was absent in children with right-sided FAA. These findings highlight stress-induced FAA as a neural marker of susceptibility to environmental stressors. FAA has thus gained attention as a neural indicator of environmental sensitivity, suggesting that individual differences in FAA patterns may moderate how children respond to environmental influences (van de Ven et al., 2020). Importantly, while meta-analytic and review evidence indicate no consistent direct link between FAA and externalizing behavior (Peltola et al., 2014; Reznik & Allen, 2018), research suggests that FAA moderates environmental effects, aligning with both the Diathesis-Stress Model and the Environmental Sensitivity Framework. For instance, children with high negative affect and greater left-sided FAA exhibit heightened reactivity to adverse environments, consistent with the Diathesis-Stress Model (Liu et al., 2021). Conversely, these same children may show greater developmental benefits when exposed to positive parenting, aligning with the Environmental Sensitivity Framework (Fortier et al., 2014; Mulligan et al., 2022). In conclusion, FAA's role is inherently context-dependent, emphasizing that understanding its influence requires considering both neural patterns and environmental conditions. This perspective aligns with theoretical models that recognize variability in susceptibility to environmental experiences, highlighting FAA's relevance in developmental psychopathology research.

This present study examines whether child frontal alpha asymmetry moderates the associations between negative affect and mindful parenting in predicting externalizing behavior. As a first step, we aimed to replicate the negative association between mindful parenting and child externalizing problems, hypothesizing that higher levels of mindful parenting will be associated with lower levels of externalizing problems in children. To strengthen existing research, we examined both maternal and partner-reported mindful parenting, as research on partner-reported mindfulness remains scarce. Throughout the paper, the term 'partner' is used to ensure inclusivity, as our sample included two same-sex female couples where the non-birthing parent identified as a woman. Second, we hypothesized that child negative affect would moderate the association between mindful parenting and child externalizing problems, such that children with higher negative affect would be more reactive to variations in parenting quality. Finally, a three-way interaction model tests whether children with greater left-sided FAA and high negative affect are most sensitive to levels of mindful parenting, aligning with the Environmental Sensitivity Framework. This approach investigates whether FAA serves as a neurobiological moderator that influences how mindful parenting affects children with temperamental differences in negative affectivity. By testing a three-way interaction, we provide a nuanced understanding of how negative affect and FAA jointly moderate children's sensitivity to environmental influences.

Methods

Participants and study design

Data for this study were drawn from the longitudinal pregnancy cohort study *Prenatal Early Life Stress* (PELS) (e.g., van den Heuvel et al., 2014). Families were recruited between the 9th–15th week of gestation ($n = 178$) or the 16th–23rd week of gestation ($n = 12$) through hospital visits during pregnancy at St Elisabeth Hospital and through four midwife practices in Tilburg and surrounding areas, The Netherlands. The mothers, their partners, and their children were followed during pregnancy and the postpartum period, and they continued to be followed. This study uses data from the follow-up wave when the children were 4 years old. Mothers and their partners (if involved) provided informed consent before participating. Most partners were fathers; two families consisted of two mothers.

Table 1. Sociodemographic information at baseline reported by mothers ($n = 128$) and partners ($n = 103$)

	%	Mean	*SD*	Min	Max
Age child (years)[a]		3.8	0.4	3	4
Age mothers (years)		31.9	3.8	22	43
Age partners (years)		34.1	5.4	22	53
% boys	46.0				
Education mother[a]					
% low	29.7				
% medium	44.5				
% high	25.8				
Education partner[b]					
% low	40.6				
% medium	38.6				
% high	20.8				
House income[c]					
% low	2.3				
% medium	13.8				
% high	77.7				
% European descent mother	98.5				
% European descent partner	98.1				
% married/living with partner	100.0				

Note. [a]Mean age at EEG recording; [b]low = completed high school or general vocational training; medium = completed higher vocational training; high = completed university or postgraduate qualification; [c]low = ≤ €2.100; medium = € 2.200–€ 3.600; high = > €3.600.

In total, 190 pregnant women and their families were included in the cohort. Families dropped out for various reasons, including loss to follow-up, only wanting to participate during infancy, moving away, or their child having a (severe) handicap or passing away. At the 4-year follow-up, around the child's 4th birthday, 128 mothers and 103 partners completed questionnaires. Of these, 107 children visited the lab with their parent(s), and EEG data were obtained from 100 children. One child was excluded due to cortical visual impairment, and four others were excluded due to non-compliance with task instructions (e.g., not paying attention or talking too much during the task), resulting in a final sample of 95 cases with usable EEG data.

At study enrollment, 46% of the children were boys; 29.7% of mothers (and 40.6% of partners) had no more than a high school education; 16.1% of families had a low to medium income (≤ €3,600 monthly); and 1,5% of mothers and 1,9% of partners were of non-European descent (e.g., Moroccan, Turkish) (see Table 1).

Procedure

When the children were 4 years old, they participated in a 2-hour session in the lab that included behavioral testing and EEG

https://doi.org/10.1017/S0954579425100291 Published online by Cambridge University Press

measurements. The visit took place at the Baby Lab at Tilburg University, The Netherlands. For the current study, the EEG resting-state measurement was used. Both mothers and their partners completed three questionnaires at home about their child's behavior and development, as well as their own emotions and parenting skills. These questionnaires were answered online via Qualtrics software. The original study was approved by the medical ethics committee of St Elisabeth Hospital, Tilburg, The Netherlands, and was conducted in full compliance with the Helsinki Declaration. The 4-year follow-up was approved by the Ethical Review Board of Tilburg University, The Netherlands.

Measures

Mindful parenting

Mindful parenting was assessed using the validated Dutch version of the Interpersonal Mindfulness in Parenting Scale (IM-P-NL) (de Bruin et al., 2014). The IM-P-NL consists of 29 items, such as "I respond patiently to my child, even when I am frustrated" (1 = *never true*, 5 = *always true)*. We calculated total IM-P-NL sum scores, with higher scores reflecting more mindfulness in parenting. Cronbach's alpha was $\alpha = 0.85$ for mothers and $\alpha = 0.84$ for partners.

Child negative affect

To measure negative affect, mothers and their partners completed the Child Behavior Questionnaire – Very Short Form (Putnam & Rothbart, 2006), each providing ratings of their child's negative affect. We used the "negative affect/emotionality subscale", which consists of 12 items assessing the frequency of negative feelings and difficulty being soothed, using a 7-point Likert scale (1 = *extremely untrue of your child* to 7 = *extremely true of your child*). Higher scores indicate a more negative affect. Example items include: "Has temper tantrums when (s)he doesn't get what (s)he wants" and "Gets mad when even mildly criticized." Internal consistency was modest ($\alpha = .67$ for mothers and $\alpha = .68$ for partners), but within an acceptable range for research in young children.

Child externalizing behavior

Externalizing behavior was assessed based on reports from mothers and partners using the Child Behavior Checklist (CBCL 1.5-5) (Achenbach, 1991), which includes 100 items across several subscales. The Externalizing domain is an aggregate measure of behavioral problems, including Attention Problems and Aggressive Behavior, measured on a 3-point Likert scale (1 = *not true* to 3 = *very true*). Higher scores reflect more externalizing behavior. Example items include: "Can't stand waiting, wants everything now" and "Destroys things belonging to his/her family or other children." Cronbach's alphas were $\alpha = 0.87$ for both mothers and partners.

Child frontal alpha asymmetry (FAA)

To assess frontal alpha asymmetry, resting EEG was recorded using a 64-electrode array with BioSemi ActiveTwo amplifiers and a sampling rate of 512 Hz. Electrodes were placed according to the international 10–20 system, referenced using the standard BioSemi CMS-DRL configuration. Additional electrodes were placed on the left and right mastoids. Resting-state EEG was recorded while the child passively watched a silent animation video from a popular Dutch television program ("Het Zandkasteel") at a viewing distance of about 60 cm. The video lasted up to 3 minutes but was stopped earlier if the child became distracted. All recordings were reviewed to exclude datasets in which children moved excessively or spoke during most of the task. The remaining EEG datasets were processed using Brain Vision Analyzer 2 (Brain Products, Munich, Germany). A 50 Hz notch filter and a 0.1–30 Hz bandpass were applied. Ocular and muscle artifacts were removed using Independent Components Analysis, with components corresponding to blinks and eye movements identified and excluded. Data from two frontal electrodes—F3 (left frontal) and F4 (right frontal)—were extracted and segmented into two-second epochs with 50% overlap. Epochs were automatically rejected if they met any of the following criteria: voltage changes exceeding 200 μV within 200 ms, voltage steps greater than 75 μV, or activity below 0.2 μV for more than 100 ms. The remaining segments were subjected to Fast Fourier Transform to obtain spectral power. Mean alpha power was computed in the 6–9 Hz frequency range at electrodes F3 and F4, which is appropriate for children of this age due to developmental shifts in the alpha rhythm (Marshall et al., 2002; Marshall & Fox, 2004). Power values tend to be positively skewed and were therefore log-transformed (Allen et al., 2004). FAA was calculated using a normalized asymmetry formula: (F4log− F3 log) / (F4log + F3log). This approach, used in prior developmental studies (Vincent et al., 2021; van de Ven et al., 2020), accounts for individual differences in overall alpha power magnitude and yields a relative index of asymmetry. An FAA score of zero reflects symmetrical activity across hemispheres, positive scores indicate greater left-sided FAA (approach orientation), and negative scores indicate greater right-sided FAA (withdrawal orientation).

Covariates

Potential covariates included in this study were child sex, family income, ethnicity, and maternal and partner educational level. These variables were selected based on their well-established theoretical and empirical associations with externalizing problems and child behavioral functioning, as demonstrated in previous research (Bradley & Corwyn, 2002; Crick & Zahn-Waxler, 2003; Dearing et al., 2006). Child sex was obtained from birth records, while family income, maternal and partner education, and ethnicity were reported by mothers and partners during pregnancy. Educational level was categorized as high (university or postgraduate qualification), medium (high vocational training), and low (vocational training or less). Ethnicity was classified as either European or non-European decent. Family income was categorized as follows: low (≤ €2,100), medium (€2,200–€3,600), and high (> €3,600). Based on exploratory analyses, we selected family income as a covariate in the two-way interaction analysis of partners, as it was significantly correlated with partner-reported negative affect, $\rho(127) = -.25$, $p = .015$. Pearson correlations were used for continuous variables, and Spearman correlations were applied for ordinal variables, such as family income. Other potential covariates were inspected but not included in analyses since they were not significantly correlated with the study variables.

Analytic procedure

Multiple Regression Analyses were conducted in Mplus version 8.2 (Muthén & Muthén, 1998–2017). In the initial two-way interaction model, we included the main effects of mindful parenting and child negative affect, as well as the interaction term Mindful parenting × Child negative affect for both mothers and their partners. To extend this analysis, a three-way interaction model was

https://doi.org/10.1017/S0954579425100291 Published online by Cambridge University Press

Table 2. Statical measures and correlations between mother mindful parenting, partner mindful parenting, child frontal asymmetry and child externalizing behavior reported by mothers (n = 128) and partners (n = 103)

Variables	1	2	3	4	5	6	7
1. Mindful parenting mother	–						
2. Mindful parenting partner	.13	–					
3. Child negative affect by mother	−.28**	.09	–				
4. Child negative affect by partner	−.02	−.28**	.45***	–			
5. Child frontal alpha asymmetry[a]	.01	−.03	−.01	−.06	–		
6. Child externalizing behavior by mother[b]	−.21*	−.17	.23**	.33***	−.01	–	
7. Child externalizing behavior by partner[c]	−.12	−.20	.33***	.45***	−.00	.62***	–
M	116.0	114.4	36.8	37.2	0.0	10.4	12.0
SD	9.9	10.5	9.6	9.1	0.4	6.4	7.2

Note.[a]Higher frontal alpha asymmetry scores indicate relative greater left frontal brain activity; [b]The prevalence of externalizing scores in clinical range is 4.7%; [c]The prevalence of externalizing scores in clinical range is 6.9%. *$p < .05$ **$p < .01$ ***$p \leq .001$.

implemented, incorporating additional variables: Child FAA, Mindful parenting × Child FAA, Child negative affect × Child FAA, and the three-way interaction term Mindful parenting × Child negative affect × Child FAA. Variables were centered to reduce multicollinearity and enhance interpretability by making the main effects more meaningful and easier to interpret in the context of interaction terms (Lacobucci et al., 2017). Model fit is considered good if the root mean square error of approximation (RMSEA) is < .08 and mediocre if < .10. Comparative fit index (CFI) values should be > .90 (Hu & Bentler, 1999). Wald Chi-Square was used to assess whether individual regression coefficients (slopes) of variables/groups in the same linear regression model were significantly different from each other (Liao, 2004). Data were collected from 128 mothers, 103 partners, and 95 children with usable EEG data. To handle missing data, Full Information Maximum Likelihood (FIML) in Mplus was applied, allowing all available data to contribute to the analyses without the need for imputing missing values (Enders & Bandalos, 2001). FIML estimates model parameters using all observed data, reducing bias and maintaining statistical power. Consequently, analyses were conducted using the full maternal ($n = 128$), partner ($n = 103$) and EEG ($n = 95$) samples. involving mothers included data from 128 participants, partner analyses were based on 103 participants, and EEG analyses included the 95 children with usable data.

Results

Descriptive statistics and correlations

Means, standard deviations and correlations among model variables are illustrated in Table 2. Child FAA was not significantly correlated with any measurement, whereas mother- and partner-reported child negative affect was significantly correlated with each other ($r = .45$, $p < .001$), with mother-reported externalizing behavior ($r = .23$, $p < .01$ and $r = .33$, $p = .001$, respectively), and with partner-reported externalizing behavior ($r = .33$, $p = .001$ and $r = .45$ $p < .001$, respectively). Also, mother- and partner-reported child externalizing behavior was significantly correlated ($r = .62$, $p < .001$).

To assess whether combining mother and father reports into unified latent factors was methodologically sound, we conducted a follow-up analysis in Mplus. However, the model showed significant estimation issues—non-convergence, negative residual variances, and poor fit (CFI = 0.129, TLI = 0.000, RMSEA = 0.211, SRMR = 0.157)—likely due to low or negative correlations between parent reports (mindful parenting: $r = -0.20$, $p = .059$; negative affect: $r = -0.28$, $p = .001$; externalizing behavior: $r = -0.08$, $p = .007$). These findings indicated insufficient shared variance to support unified latent constructs. Given these constraints, we conducted separate analyses for mothers and fathers, ensuring valid model estimation and better reflecting the distinct contributions of each parent.

Mindful parenting × Child temperament effects

The interactions between mindful parenting and child temperament are illustrated in Tables 3 (mothers) and 4 (partners). The two-way interaction proved significant for mothers ($\beta = -.186$, $p = .03$; χ^2 [$df = 3$, $n = 128$] = 14.41, CFI = 1.00, RMSEA < .001), but not for partners ($\beta = -.044$, $p = .63$; χ^2 [$df = 4$, $n = 103$] = 23.83, CFI = 1.00, RMSEA < .001).This indicates that the relationship between mother-reported mindful parenting and externalizing behavior was moderated by child negative affect (see Figure 1). A Wald chi-squared test showed that children with high negative affect (+1 *SD*) exhibited significantly more externalizing behavior than those with low negative affect (−1 *SD*) (Wald χ^2 (1) = 7.39, $p = 0.007$), in cases of low mindful parenting. Furthermore, only for children with high negative affect did mindful parenting make a difference, as high levels of mindful parenting reduced their externalizing problems. (Wald χ^2 (1) = 12.65, $p = 0.002$). All other groups did not show significant differences. It is important to note that the groupings presented in the Figures were created solely to enhance clarity and interpretability. These groupings do not affect the statistical outcomes of the study, as Mplus compares estimates at specific values rather than forming discrete groups. In the partners' analysis, a main effect of negative effect was found ($\beta = .452$, $p < .001$), indicating that those children who scored higher on negative affect exhibited more externalizing problems.

Mindful parenting × Child temperament × Child FAA effects

To assess whether including child frontal alpha asymmetry (FAA) improved overall model fit, we compared a two-way interaction model (mindful parenting × negative affect) with a more complex three-way interaction model (mindful parenting × negative affect × FAA) for both mothers and partners. In the maternal model, the

https://doi.org/10.1017/S0954579425100291 Published online by Cambridge University Press

Table 3. Interactions between mindful parenting, child negative affect and child fontal asymmetry and on externalizing problem behavior rated by mothers (n = 128)

Variables	β	(*SD*)	χ^2 (*df*)	CFI0	RMSEA
Two-way interaction model					
Intercept	1.569	(0.13)	14.41 (3)	1.000	<.001
Mother mindful parenting	−.138	(0.09)			
Child negative affect	.163	(0.09)			
Mother mindful parenting × Child negative affect	−.186	(0.09)*			
Three-way interaction model					
Intercept	1.591	(0.09)	28.01 (7)	.93	.04
Mother mindful parenting	−.145	(0.09)			
Child negative affect	.169	(0.09)			
Child FAA	−.044	(0.09)			
Mother mindful parenting × Child negative affect	−.148	(0.09)			
Mother mindful parenting × Child FAA	−.142	(0.09)			
Child negative affect × Child FAA	−.098	(0.09)			
Mother mindful parenting × Child negative affect × Child FAA	−.314	(0.09)***			

Note. β = standardized slope coefficient; *SD* = standard deviation; *df* = degree of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; FAA = Frontal Alpha Asymmetry; *p < .05 **p < .01 ***p < .001.

Table 4. Interactions between mindful parenting, child negative affect and child fontal asymmetry and on externalizing problem behavior rated by partners (n = 103)

Variables	β	(*SD*)	χ^2 (*df*)	CFI0	RMSEA
Two-way interaction model					
Intercept	2.012	(0.67)	23.83 (4)	1.000	<.001
Partner mindful parenting	−.087	(0.09)			
Child negative affect	.452	(0.08)***			
Partner mindful parenting × Child negative affect	−.044	(0.09)			
Three-way interaction model					
Intercept	.1.706	(0.09)	30.43 (7)	.92	.08
Partner mindful parenting	−.108	(0.09)			
Child negative affect	.481	(0.08)**			
Child FAA	.077	(0.09)			
Partner mindful parenting × Child negative affect	−.067	(0.09)			
Partner mindful parenting × Child FAA	−.080	(0.10)			
Child negative affect × Child FAA	−.091	(0.10)			
Partner mindful parenting × Child negative affect × Child FAA	.149	(0.09)			

Note. β = standardized slope coefficient; *SD* = standard deviation; *df* = degree of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; FAA = Frontal Alpha Asymmetry; *p < .05 **p < .01 ***p < .001.

two-way interaction model demonstrated good fit ($\chi^2[df = 3, n = 128] = 14.41$, CFI = 1.00, RMSEA < .001), while the three-way interaction model showed acceptable fit ($\chi^2[df = 7, n = 128] = 28.01$, CFI = .93, RMSEA = .04). Although the χ^2 difference test indicated that the inclusion of the three-way interaction significantly improved model fit ($\Delta\chi^2[df = 4] = 13.60, p = .009$), we acknowledge that such tests are more appropriate within structural equation modeling frameworks. Therefore, we also conducted a hierarchical regression analysis to examine whether the three-way model added explanatory power over the two-way model. This analysis revealed a significant increase in explained variance, $\Delta R^2 = .07$, $F(4, 120) = 2.96$, $p = .023$. Moreover, model comparison using the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) supported the inclusion of the three-way interaction, with lower AIC (4715.60 vs. 4433.53), BIC (4791.33 vs. 4491.03), and sample-size adjusted BIC (4709.08 vs. 4427.77) values for the three-way model compared to the two-way model. These results suggest that, despite its greater complexity, the three-way model provided a better balance between fit and parsimony. Furthermore, the three-way model explained more variance in externalizing behavior

https://doi.org/10.1017/S0954579425100291 Published online by Cambridge University Press

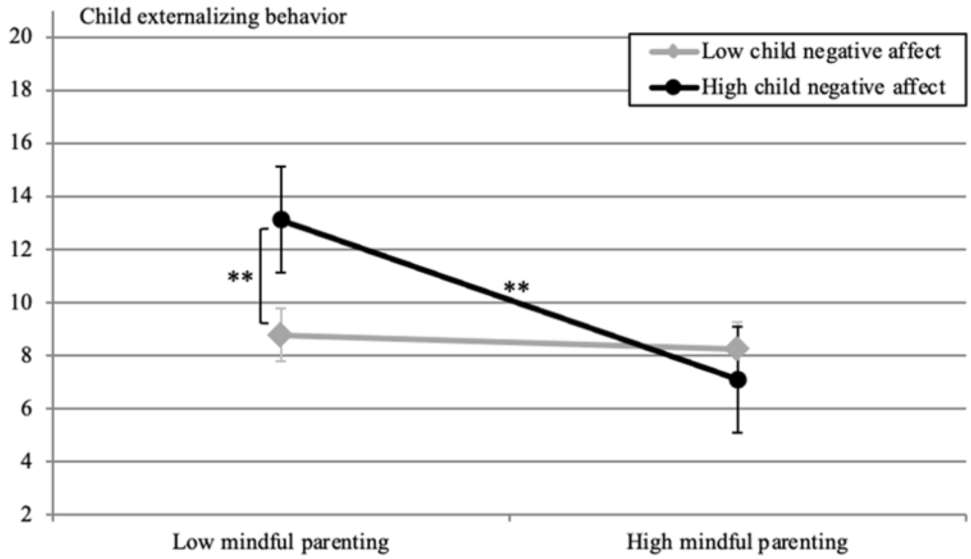

Figure 1. Mother-reported externalizing behavior for low mindful and high mindful parenting (−1 *SD* versus + 1 *SD*) and children with low or high negative affect (−1 *SD* versus + 1 *SD*); **p* < .05 ***p* < .01 ****p* < .001. *Note*. Groupings were created solely to improve clarity and interpretability, without affecting statistical outcomes.

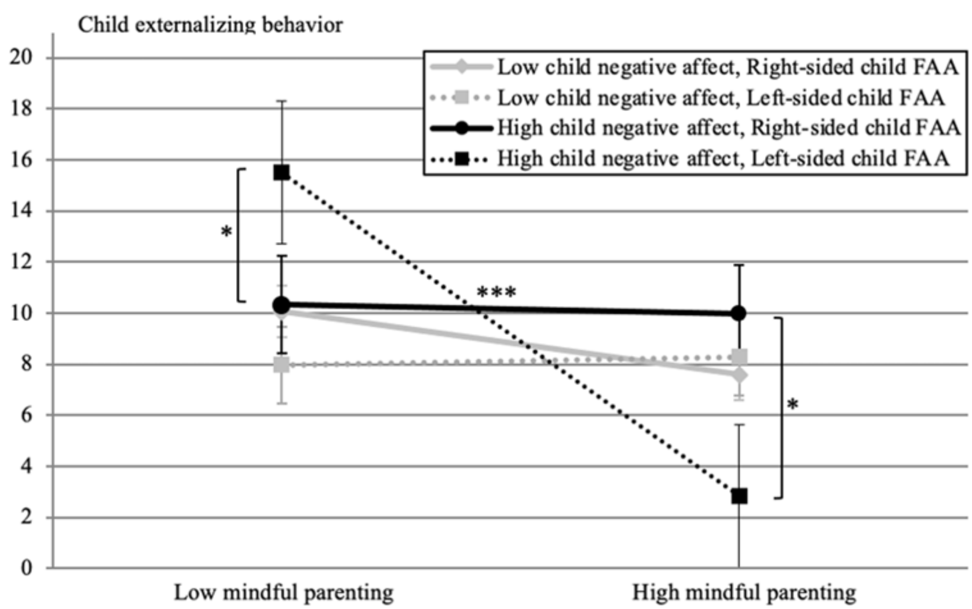

Figure 2. Mother-reported externalizing behavior for low mindful parenting and high mindful (−1 *SD* versus + 1 *SD*), children with low or high negative affect (−1 *SD* versus + 1 *SD*) and children with left- or right-sided frontal alpha asymmetry (+1 *SD* versus −1 *SD*); **p* < .05 ***p* < .01 ****p* < .001. *Note*. Groupings were created solely to improve clarity and interpretability, without affecting statistical outcomes.

($R^2 = .29$) than the two-way model ($R^2 = .22$), further supporting the added explanatory value of FAA as a moderator. Together, these findings indicate that the inclusion of FAA significantly contributed to the explanatory power of the maternal model, justifying the added model complexity. In the partner model, the three-way interaction model demonstrated poorer fit ($\chi^2[df = 7,\ n = 103] = 30.43$, CFI = .92, RMSEA = .08) than the corresponding two-way interaction model ($\chi^2[df = 4,\ n = 103] = 23.83$, CFI = 1.00, RMSEA < .001), indicating that adding FAA did not improve model fit for partner-reported data. This pattern was further supported by model comparison criteria: the two-way interaction model showed lower values on the Akaike Information Criterion (AIC = 3591.48 vs. 3840.66), Bayesian Information Criterion (BIC = 3649.29 vs. 3916.58), and sample-size adjusted BIC (3586.02 vs. 3834.33) compared to the three-way interaction model. To further examine the added value of FAA, we conducted a hierarchical regression analysis comparing the two- and three-way interaction models. This analysis revealed a modest increase in explained variance ($\Delta R^2 = .07$); however, the change did not reach statistical significance, $F(4, 95) = 2.34$, $p = .060$. These results suggest that the additional complexity introduced by FAA did not meaningfully improve model performance or explanatory power in the partner model. The three-way interaction proved significant in predicting mother-reported externalizing behavior ($\beta = -.314$, $p = < .001$), but not partner-reported externalizing behavior ($\beta = .149$, $p = .11$). A subsequent z-test confirmed that the difference in interaction effects between maternal and partner reports was statistically significant (Z = −3.64, $p < .001$), indicating that the moderation effect was specific to maternal reports. This indicates that the relationship between mother-reported mindful parenting and externalizing behavior was moderated by child negative affect and child FAA (see Figure 2). A Wald chi-squared showed that children with high negative affect (+1 *SD*) and greater left-sided FAA (+1 *SD*) exhibited more externalizing behavior under low mindful parenting and less under high mindful parenting (Wald χ^2 (1) = 22.07, $p < 0.001$), compared to those with high negative affect and greater right-sided

https://doi.org/10.1017/S0954579425100291 Published online by Cambridge University Press

FAA exposed to low (Wald χ^2 (1) = 5.15, $p = 0.02$) or high mindful parenting (Wald χ^2 (1) = 5.18, $p = 0.02$). Planned comparisons showed that there were no further significant differences between groups. As a reminder, the groupings in the Figures were included solely to enhance their clarity and interpretability, without affecting the statistical outcomes. The interactions remained significant when family income was included as a covariate, in both the two-way interaction ($\beta = -.195$, $p = .02$; χ^2 [$df = 4$, $n = 128$] = 15.97, CFI = 1.00, RMSEA < .001) and three-way interaction ($\beta = -.314$, $p = .02$; χ^2 [$df = 8$, $n = 128$] = 15.97, CFI = .92, RMSEA = .04), as an additional check based on exploratory analysis, which had already identified family income as a relevant variable in the partner data.

Sensitivity analyses

To evaluate the robustness and interpretation of the three-way interaction, we conducted two additional analyses, both of which supported our main findings. First, we calculated the Proportion of Interaction (PoI; Roisman et al., 2012), which yielded a value of 0.63—slightly above the typical differential susceptibility range of 0.40 to 0.60—suggesting that children with high negative affect and greater left-sided FAA experienced relatively stronger benefits under high mindful parenting than adverse effects under low parenting. A PoI around 0.50 reflects Differential Susceptibility, whereas values near 0.00 or 1.00 indicate Diathesis-Stress or Vantage Sensitivity patterns, respectively (Del Giudice, 2017; Roisman et al., 2012). Second, we applied a person-oriented approach using K-means clustering to identify distinct neuro-affective profiles. In line with the framework of Bergman and Magnusson (1997), this approach focuses on patterns of individual differences rather than average effects. The analysis confirmed that children with high negative affect and left-sided FAA were particularly responsive to variations in parenting quality. Together, these complementary procedures strengthen the interpretation of the three-way interaction. Full methodological details and visualizations are available in the Supplementary Material (see Supplementary Figure S1 and S2).

Discussion

In this study, we examined whether child negative affect and child FAA moderated the effect of mindful parenting on externalizing behavior in 4-year-olds. We hypothesized that children with high negative affect would be more vulnerable to low mindful parenting, leading to more externalizing problems, consistent with the diathesis-stress model. We also explored whether child negative affect and greater left-sided FAA interacted, amplifying or modulating the effects of mindful parenting.

The results showed that high negative affect combined with low mindful parenting predicted higher levels of mother-reported externalizing behavior (not partners'), supporting the diathesis-stress framework (Monroe & Simons, 1991; Zuckerman, 1999). Notably, the prevalence of externalizing scores in the clinical range, as reported by mothers and partners, was relatively low at 4.7% and 4.4%, respectively (Tick et al., 2007). While low mindful parenting involves emotional disengagement rather than the punitive control characteristic of harsh parenting, both negatively impact children by failing to provide emotional support, which can lead to increased externalizing behaviors and strained parent-child relationships, particularly when there is high negative affect. This effect may arise because mindful parenting helps children regulate emotions by constructively addressing negative feelings, thereby reducing the risk of externalizing behaviors (Eisenberg et al., 2005). Consequently, children with high negative affect are more prone to externalizing behaviors under low mindful parenting. This is consistent with Slagt et al.'s (2016) meta-analysis, which identified negative affect as a vulnerability factor after 12 months of age. These findings also align with Hartman and Belsky's (2023) application of the broader theory of prenatal programming (Barker, 1990, 2004; Hanson & Gluckman, 2015) to the environmental sensitivity framework. Their work suggests that early—including prenatal—environmental cues may shape children's sensitivity to later caregiving contexts. This is consistent with our results showing that neural sensitivity (FAA) and temperament interact to predict differential responses to parenting.

To conceptually extend our findings and situate them within broader prenatal programming theories (Barker, 1990, 2004; Hanson & Gluckman, 2015), we draw on additional insights from the PELS cohort (e.g., van den Heuvel et al., 2014), which was also used in the current study. In doing so, we build on Hartman and Belsky's (2023) application of these theories to the development of environmental sensitivity, illustrating how early environmental influences may contribute to individual differences in child sensitivity. A key strength of the PELS cohort is its longitudinal design, which offers valuable opportunities to identify early indicators of environmental sensitivity across development. In line with prenatal programming theories, preliminary results from the PELS cohort indicate that early maternal stress and lower prenatal attachment affect are associated with heightened negative affect in infancy (van den Heuvel et al., 2015). Specifically, our data suggest that infants exposed to elevated prenatal stress levels demonstrated greater emotional reactivity and reduced regulatory capacity in early development, aligning with patterns described in a recent review (Van den Bergh et al., 2024). Importantly, such early vulnerability marker may also reflect adaptive sensitivity, potentially laying the groundwork for heightened environmental responsiveness later in childhood. This developmental process may be moderated by neurobiological mechanisms such as child FAA, underscoring the dynamic interplay between early neural predispositions and postnatal environmental factors in influencing emotional development.

Building on these findings, we further examined whether the interaction between negative affect and mindful parenting was moderated by child FAA, consistent with the environmental sensitivity framework. The three-way interaction between mindful parenting, child negative affect, and child FAA aligns with the environmental sensitivity framework, (Pluess, 2015), suggesting that children with high negative affect and greater left-sided FAA are particularly responsive to the quality of mindful parenting as reported by mothers. These children exhibited greater externalizing behavior when mindful parenting was low but fewer externalizing problems when mindful parenting was high. Sensitivity analyses supported this interpretation: while the Wald chi-squared comparisons clarified differences across FAA levels, a Proportion of Interaction (PoI) value of 0.63 indicated heightened sensitivity to both adverse and supportive environments, consistent with a differential susceptibility pattern. This finding also aligns with the integrated model proposed by Ellis et al. (2022), which posits that caregiving experiences interact with individual neurobiological and temperamental factors to influence behavioral outcome. Specifically, the combination of high negative affect and greater left-sided FAA in this study mirrors their model, illustrating how differences in environmental sensitivity may arise from neural and affective mechanisms that influence children's responses to both adversity and support (Ellis et al., 2022).

https://doi.org/10.1017/S0954579425100291 Published online by Cambridge University Press

Research suggests that mothers and fathers emphasize different aspects of their child's behavior (Brown et al., 2011; Solmeyer & Feinberg, 2011), which may influence how externalizing behaviors are reported. Although no significant differences in mindful parenting levels were found between mothers and partners, prior research suggests that mothers, as more common primary caregivers, may be more attuned to subtle shifts in emotional regulation, while partners may observe externalizing behaviors in different contexts, such as play or structured activities. Additionally, mothers may engage more actively in emotion regulation strategies, shaping how mindful parenting affects child behavior. Although the overall level of mindful parenting appeared similar between parents, the mechanisms through which it influences children may differ. Future research should further investigate how different caregiving roles may moderate the effects of mindful parenting on child behavior. It might also be that we had insufficient power to detect partner effects (see under limitations). Larger samples are therefore also needed to determine whether the absence of effects in the partner-reported data reflects methodological constraints, genuine differences in parental influences, or whether the significant effects observed in the mother-reported data represent a reliable finding rather than a false positive. Notably, in the present study, this pattern was specific to maternal reports, as confirmed by a statistically significant difference in the interaction effects across reporters. To further support and interpret our main findings, we conducted an exploratory, person-centered analysis using K-means clustering to identify meaningful neuro-affective profiles. This approach was used to examine whether combinations of negative affect and frontal alpha asymmetry (FAA) reflect distinct patterns of environmental sensitivity. Interpreting these profiles within the Fast–Slow–Defense (FSD) model (Del Giudice & Haltigan, 2023) offers insight into the possible adaptive significance of these individual differences. The resulting four clusters mapped onto FSD strategies. Cluster 1 (high negative affect, left-sided FAA) showed heightened sensitivity to mindful parenting quality, consistent with a Slow-Defense strategy marked by vigilance and responsivity. Clusters 2 and 3 (low negative affect with left- and right-sided FAA) exhibited relatively stable externalizing behavior across parenting levels, resembling a Slow strategy associated with emotional regulation and resilience. Cluster 4 (high negative affect, right-sided FAA) reflected a Fast strategy, characterized by reactivity and impulsivity, which may be adaptive in unpredictable environments but may also increase externalizing behavior in low-quality caregiving contexts. Together, these exploratory results complement our variable-centered analyses, illustrating that environmental sensitivity may manifest in distinct neuro-affective profiles that align with broader evolutionary strategies. These findings underscore the value of integrating dimensional and categorical approaches to better understand how children's responses to parenting differ based on underlying biological and temperamental characteristics. These findings underscore that children's sensitivity to parenting may vary depending on neurobiological and temperamental characteristics, and raise important questions about how specific neuro-affective profiles influence emotional engagement. Traditionally, greater left-sided FAA has been associated with approach motivation and positive emotions, while greater right-sided FAA is linked to withdrawal motivation and negative emotions (Harmon-Jones & Gable, 2018; Harmon-Jones et al., 2010). This suggests the possibility of a third group in our study—children with negative affect but also greater left-sided FAA. These children may exhibit an approach motivation toward both positive and negative emotions, rather than simply withdrawing from negative ones. They may engage with negative emotions, possibly driven by curiosity, anger, or a desire to resolve distress, explaining their heightened sensitivity to low levels of mindful parenting. In contrast, in environments with high-quality mindful parenting, their approach motivation allows them to engage with positive influences, leading to greater benefits from nurturing interactions. Neurobiological mechanisms, including the plasticity of the prefrontal cortex and the regulation of the hypothalamic-pituitary-adrenal axis, may underlie flexible emotional responsivity (McEwen & Gianaros, 2011). Such mechanisms not only increase vulnerability in negative contexts but also enhance adaptive growth in positive ones. Therefore, children with negative affect and greater left-sided frontal alpha asymmetry (FAA) may be particularly poised for adaptive outcomes when exposed to high-quality, mindful parenting. This pattern, known as *motivated engagement* with both positive and negative stimuli, positions them as highly sensitive but not easily classified within a simple positive-negative dichotomy (Coan & Allen, 2004). This interpretation highlights a nuanced view of emotional regulation, where FAA indicates how flexible and adaptive one's emotional engagement can be, depending on the situation. It reinforces the understanding that emotional engagement is context-dependent rather than simply positive or negative, emphasizing that neurobiological and contextual factors jointly influence emotional outcomes. This context-dependent perspective on emotional regulation aligns with recent research on environmental sensitivity, which recognizes that sensitivity exists on a continuum. This suggests that children may vary in their responsiveness to both positive and negative environmental influences (Zhang et al., 2023). In this context, the variability in how children with different emotional and neural profiles (like negative affect and greater left-sided FAA) respond to mindful parenting could be seen as part of a broader spectrum of environmental sensitivity. Instead of categorizing children as simply 'vulnerable' or 'sensitive', this continuum suggests that all children are sensitive to some degree, but the degree and direction of their sensitivity may depend on individual traits and environmental contexts (Pluess, 2015). This approach aligns with recent research advocating for a more gradient-based understanding of developmental environmental sensitivity, which considers that contextual influences do not produce uniform effects across individuals, but instead manifest differently across a spectrum of environmental sensitivity (Belsky et al., 2022; Zhang et al., 2023). This perspective offers a more nuanced view of child development and could explain why some children benefit more than others from high-quality parenting or are more affected by its absence. This current study into child environmental sensitivity fits well with this emerging continuum model, which acknowledges gradual variation rather than sharp distinctions between 'types' of children.

Limitations

Despite the strengths of this study, including the use of temperamental and neural mechanisms and the inclusion of both parents, some limitations should be acknowledged. Although the sample size was relatively small, it remains notable within child psychobiology research, where high attrition rates are common. Additional analyses confirmed effects in the mother-reported data, yet the moderate overall sample size may still limit generalizability. Likewise, the lower statistical power in the partner-reported analyses suggests that null effects should be interpreted with caution.

https://doi.org/10.1017/S0954579425100291 Published online by Cambridge University Press

To test the robustness of our findings, we varied covariate inclusion, with interaction effects remaining consistent across models. A post-hoc power analysis using G*Power 3.1 (Faul et al., 2009) for a regression with 12 predictors indicated sufficient power for mother-reported data ($n = 128$; $1 - \beta = 0.81$) for detecting moderate effects, though smaller effects ($f^2 \leq 0.02$) may have gone undetected. Excluding covariates (seven predictors) increased power for small effects ($f^2 = 0.02$, power $= 1.0$) but reduced it for very small effects ($f^2 = 0.01$, power $= 0.58$). Thus, while the study had adequate power for moderate to large effects, caution is warranted regarding subtle interactions.

While the results suggest that some children are more sensitive to the effects of high and low levels of mindful parenting, these findings should not be interpreted as evidence of long-term effects. Many children may show immediate responses to parenting interventions, but fewer exhibit lasting behavioral changes, which are central to environmental sensitivity theories (Belsky et al., 2007; Belsky & Pluess, 2009, 2013; Ellis et al., 2011). Additionally, FAA may be related to negative affect without defining either as a fixed "trait," opening the possibility of exploring FAA's connection to other behavioral outcomes beyond just negative affect or externalizing problems. Future research should investigate how FAA interacts with a variety of behavioral measures to better understand its role in child development, moving beyond specific emotional or behavioral domains. This broader approach could provide a clearer view of how FAA influences individual differences in responses to environmental influences (Belsky et al., 2022).

Another potential empirical limitation of this study lies in the conceptualization of parenting effects. Unlike the bipolar approach recommended by Belsky and Pluess (2009), which spans from highly negative to highly positive parenting behaviors, this study focused exclusively on positive parenting, particularly mindful parenting, and only varied between low and high levels of this construct. This distinction is important because children who demonstrate the highest or lowest environmental sensitivity to positive parenting may not exhibit the same sensitivity to negative parenting. For example, in a rigorous study by Zhang et al. (2022), a bipolar measure of parenting was used to examine the interaction between temperament and parenting. They found that while more and less supportive parenting predicted fewer and more externalizing problems, respectively, this relationship was stronger for children with more difficult temperaments as infants, supporting a weak environmental sensitivity model. This suggests that including a broader range of parenting behaviors, both negative and positive, may offer a more comprehensive understanding of child outcomes.

Additionally, reliance on parental reports poses another limitation. It is possible that the findings could have differed if observational measures of parenting and child behavior had been available, as these are often considered more objective and can capture nuances that self-reports might miss.

Conclusion

This study emphasizes the role of child frontal alpha asymmetry (FAA) and negative affect in moderating the effects of mindful parenting on children's externalizing behaviors. Children with high negative affect and greater left-sided FAA were found to be especially sensitive to both high and low levels of mindful parenting. These findings align with the environmental sensitivity framework and suggest that sensitivity to environmental factors exists along a continuum, rather than being tied to specific emotional or behavioral domains. This research highlights the importance of moving beyond a domain-specific approach, emphasizing a gradient-based understanding of child sensitivity across various environmental contexts. By recognizing that children's responses to parenting can vary across a wide range of influences, future studies can explore how FAA and child temperament interact in shaping individual developmental outcomes across multiple behavioral dimensions. This broader perspective will offer a more nuanced understanding of how children adapt to their environments, fostering a more integrated view of development.

Supplementary material. For supplementary material/s referred to in this article, please visit https://doi.org/10.1017/S0954579425100291.

Data availability statement. Data supporting the findings of this are available upon reasonable request from the corresponding author.

Acknowledgement. We would like to thank the children and families who participated in this project, as well as the clinical and community-based healthcare providers who supported participant recruitment and data collection. We also thank the reviewers for their thoughtful comments and suggestions on earlier versions of this manuscript.

Funding statement. This research was funded by the European Science Foundation's EuroSTRESS Program, the Netherlands Organisation for Scientific Research, and supported by grants from the European Commission (FP7), FWO - Vlaanderen, and COST Action CA22114.

Competing interests. The authors report no conflicts of interest.

Ethical standards. This study is approved by the Medical Ethical Committee of St Elisabeth Hospital, Tilburg, and Tilburg University's Ethical Review Board for the 4-year follow-up.

Permission to reproduce material. Not applicable.

References

Achenbach, T. M. (1991). *Manual for the child behaviour check-list/4-18 and 1991 profile*. Department of Psychiatry, University of Vermont.

Allen, J. J., Coan, J. A., & Nazarian, M. (2004). Issues and assumptions on the road from raw signals to metrics of frontal EEG asymmetry in emotion. *Biological Psychology*, *67*(1-2), 183–218. https://doi.org/10.1016/j.biopsycho.2004.03.007

Anaya, B., Ostlund, B., LoBue, V., Buss, K., & Pérez-Edgar, K. (2021). Psychometric properties of infant electroencephalography: Developmental stability, reliability, and construct validity of frontal alpha asymmetry and delta-beta coupling. *Developmental Psychobiology*, *63*(6), e22178. https://doi.org/10.1002/dev.22178

Aron, E. N., Aron, A., & Jagiellowicz, J. (2012). Sensory processing sensitivity: A review in the light of the evolution of biological responsivity. *Personality and Social Psychology Review*, *16*(3), 262–282. https://doi.org/10.1177/1088868311434213

Barker, D. (2004). The developmental origins of chronic adult disease. *Acta Paediatrica*, *93*(s446), 26–33. https://doi.org/10.1111/j.1651-2227.2004.tb00236.x

Barker, D. J. (1990). The fetal and infant origins of adult disease. *British Medical Journal*, *301*(6761), 1111. https://doi.org/10.1136/bmj.301.6761.1111

Belsky, J., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). For better and for worse: Differential susceptibility to environmental influences. *Current Directions in Psychological Science*, *16*(6), 300–304. https://doi.org/10.1111/j.1467-8721.2007.00525.x

Belsky, J., & Pluess, M. (2009). Beyond diathesis stress: Differential susceptibility to environmental influences. *Psychological Bulletin*, *135*(6), 885–908. https://doi.org/10.1037/a0017376

Belsky, J., & Pluess, M. (2013). Beyond risk, resilience, and dysregulation: Phenotypic plasticity and human development. *Development and*

Psychopathology, *25*(4), 1243–1261. https://doi.org/10.1017/S095457941300059X

Belsky, J., Zhang, X., & Sayler, K. (2022). Differential susceptibility 2.0: Are the same children affected by different experiences and exposures? *Development and Psychopathology*, *34*(3), 1025–1033. https://doi.org/10.1017/S0954579420002205

Bergman, L. R., & Magnusson, D. (1997). A person-oriented approach in research on developmental psychopathology. *Development and Psychopathology*, *9*(2), 291–319. https://doi.org/10.1017/s095457949700206x

Bögels, S., Hoogstad, B., van Dun, L., de Schutter, S., & Restifo, K. (2008). Mindfulness training for adolescents with externalizing disorders and their parents. *Behavioural and Cognitive Psychotherapy*, *36*(2), 193–209. https://doi.org/10.1017/S1352465808004190

Bögels, S. M., Hellemans, J., van Deursen, S., Römer, M., & van der Meulen, R. (2014). Mindful parenting in mental health care: Effects on parental and child psychopathology, parental stress, parenting, coparenting, and marital functioning. *Mindfulness*, *5*(5), 536–551. https://doi.org/10.1007/s12671-013-0209-7

Boyce, W. T., & Ellis, B. J. (2005). Biological sensitivity to context: I. An evolutionary-developmental theory of the origins and functions of stress reactivity. *Development and Psychopathology*, *17*(2), 271–301. https://doi.org/10.1017/s0954579405050145

Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual Review of Psychology*, *53*(1), 371–399. https://doi.org/10.1146/annurev.psych.53.100901.135233

Brown, G. L., McBride, B. A., Bost, K. K., & Shin, N. (2011). Parental involvement, child temperament, and parents' work hours: Differential relations for mothers and fathers. *Journal of Applied Developmental Psychology*, *32*(6), 313–322. https://doi.org/10.1016/j.appdev.2011.08.004

Burgdorf, V., Szabó, M., & Abbott, M. J. (2019). The effect of mindfulness interventions for parents on parenting stress and youth psychological outcomes: A systematic review and meta-analysis. *Frontiers in Psychology*, *10*, 1336. https://doi.org/10.3389/fpsyg.2019.01336

Campbell, S. B., Shaw, D. S., & Gilliom, M. (2000). Early externalizing behavior problems: Toddlers and preschoolers at risk for later maladjustment. *Development and Psychopathology*, *12*(3), 467–488. https://doi.org/10.1017/s0954579400003114

Coan, J. A., & Allen, J. J. (2004). Frontal EEG asymmetry as a moderator and mediator of emotion. *Biological Psychology*, *67*(1-2), 7–49. https://doi.org/10.1016/j.biopsycho.2004.03.002

Compas, B. E., Jaser, S. S., Bettis, A. H., Watson, K. H., Gruhn, M. A., Dunbar, J. P., Williams, E., & Thigpen, J. C. (2017). Coping, emotion regulation, and psychopathology in childhood and adolescence: A meta-analysis and narrative review. *Psychological Bulletin*, *143*(9), 939–991. https://doi.org/10.1037/bul0000110

Crick, N. R., & Zahn-Waxler, C. (2003). The development of psychopathology in females and males: Current progress and future challenges. *Development and Psychopathology*, *15*(3), 719–742.

Davidson, R. J. (1992). Emotion and affective style: Hemispheric substrates. *Psychological Science*, *3*(1), 39–43. https://doi.org/10.1111/j.1467-9280.1992.tb00254.x

Davidson, R. J. (2004). What does the prefrontal cortex "do" in affect: Perspectives on frontal EEG asymmetry research. *Biological Psychology*, *67*(1-2), 219–233. https://doi.org/10.1016/j.biopsycho.2004.03.008

Davidson, R. J., & Fox, N. A. (1982). Asymmetrical brain activity discriminates between positive and negative affective stimuli in human infants. *Science*, *218*(4578), 1235–1237. https://doi.org/10.1126/science.7146906

de Bruin, E. I., Zijlstra, B. J., Geurtzen, N., van Zundert, R. M., van de Weijer-Bergsma, E., Hartman, E. E., Nieuwesteeg, A. M., Duncan, L. G., & Bögels, S. M. (2014). Mindful parenting assessed further: Psychometric properties of the Dutch version of the Interpersonal Mindfulness in Parenting Scale (IM-P). *Mindfulness*, *5*(2), 200–212. https://doi.org/10.1007/s12671-012-0168-4

Dearing, E., McCartney, K., & Taylor, B. A. (2006). Within-child associations between family income and externalizing and internalizing problems. *Developmental Psychology*, *42*(2), 237–252. https://doi.org/10.1037/0012-1649.42.2.237

Del Giudice, M. (2017). The evolution of interaction shape in differential susceptibility. *Child Development*, *88*(6), 1897–1912. https://doi.org/10.1111/cdev.12710

Del Giudice, M., & Haltigan, J. D. (2023). An integrative evolutionary framework for psychopathology. *Development and Psychopathology*, *35*(1), 1–11. https://doi.org/10.1017/s0954579421000870

Dishion, T. J., Shaw, D., Connell, A., Gardner, F., Weaver, C., & Wilson, M. (2008). The family check-up with high-risk indigent families: Preventing problem behavior by increasing parents' positive behavior support in early childhood. *Child Development*, *79*(5), 1395–1414. https://doi.org/10.1111/j.1467-8624.2008.01195.x

Duncan, L. G., Coatsworth, J. D., & Greenberg, M. T. (2009). A model of mindful parenting: Implications for parent-child relationships and prevention research. *Clinical Child and Family Psychology Review*, *12*(3), 255–270. https://doi.org/10.1007/s10567-009-0046-3

Duncombe, M. E., Havighurst, S. S., Holland, K. A., & Frankling, E. J. (2012). The contribution of parenting practices and parent emotion factors in children at risk for disruptive behavior disorders. *Child Psychiatry and Human Development*, *43*(5), 715–733. https://doi.org/10.1007/s10578-012-0290-5

DuPaul, G. J., Chunta, A., & Ahn, J. H. (2022). Parenting children with externalizing behavior and ADHD. In A. S. Morris, & J. Mendez Smith (Eds.), *The Cambridge Handbook of Parenting: Interdisciplinary Research and Application* (pp. 403–424). Cambridge University Press. https://doi.org/10.1017/9781108891400.023

Eisenberg, N., Zhou, Q., Spinrad, T. L., Valiente, C., Fabes, R. A., & Liew, J. (2005). Relations among positive parenting, children's effortful control, and externalizing problems: A three-wave longitudinal study. *Child Development*, *76*(5), 1055–1071. https://doi.org/10.1111/j.1467-8624.2005.00897.x

Ellis, A. J., Kinzel, C., Salgari, G. C., & Loo, S. K. (2017). Frontal alpha asymmetry predicts inhibitory processing in youth with attention deficit/hyperactivity disorder. *Neuropsychologia*, *102*, 45–51. https://doi.org/10.1016/j.neuropsychologia.2017.06.003

Ellis, B. J., Boyce, W. T., Belsky, J., Bakermans-Kranenburg, M. J., & van Ijzendoorn, M. H. (2011). Differential susceptibility to the environment: An evolutionary-neurodevelopmental theory. *Development and Psychopathology*, *23*(1), 7–28. https://doi.org/10.1017/s0954579410000611

Ellis, B. J., Sheridan, M. A., Belsky, J., & McLaughlin, K. A. (2022). Why and how does early adversity influence development? Toward an integrated model of dimensions of environmental experience. *Development and Psychopathology*, *34*(2), 447–471. https://doi.org/10.1017/s0954579421001838

Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal*, *8*(3), 430–457. https://doi.org/10.1207/S15328007SEM0803_5

Evans, S., Bhide, S., Quek, J., Nicholson, J. M., Anderson, V., Hazell, P., Mulraney, M., & Sciberras, E. (2020). Mindful parenting behaviors and emotional self-regulation in children with ADHD and controls. *Journal of Pediatric Psychology*, *45*(9), 1074–1083. https://doi.org/10.1093/jpepsy/jsaa073

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Fortier, P., Van Lieshout, R. J., Waxman, J. A., Boyle, M. H., Saigal, S., & Schmidt, L. A. (2014). Are orchids left and dandelions right? Frontal brain activation asymmetry and its sensitivity to developmental context. *Psychological Science*, *25*(8), 1526–1533. https://doi.org/10.1177/0956797614534267

Gardner, F., Shaw, D. S., Dishion, T. J., Burton, J., & Supplee, L. (2007). Randomized prevention trial for early conduct problems: Effects on proactive parenting and links to toddler disruptive behavior. *Journal of Family Psychology*, *21*(3), 398–406. https://doi.org/10.1037/0893-3200.21.3.398

Gershoff, E. T. (2002). Corporal punishment by parents and associated child behaviors and experiences: A meta-analytic and theoretical review. *Psychological Bulletin*, *128*(4), 539–579. https://doi.org/10.1037/0033-2909.128.4.539

Gilliom, M., & Shaw, D. S. (2004). Codevelopment of externalizing and internalizing problems in early childhood. *Development and Psychopathology*, *16*(2), 313–333. https://doi.org/10.1017/S0954579404044530

Grimshaw, G. M., & Carmel, D. (2014). An asymmetric inhibition model of hemispheric differences in emotional processing. *Frontiers in Psychology*, *5*, 489. https://doi.org/10.3389/fpsyg.2014.00489

Hale, T. S., Smalley, S. L., Hanada, G., Macion, J., McCracken, J. T., McGough, J. J., & Loo, S. K. (2009). Atypical alpha asymmetry in adults with ADHD. *Neuropsychologia*, *47*(10), 2082–2088. https://doi.org/10.1016/j.neuropsychologia.2009.03.021

Hanson, M. A., & Gluckman, P. D. (2015). Developmental origins of health and disease – Global public health implications. *Best Practice & Research Clinical Obstetrics & Gynaecology*, *29*(1), 24–31. https://doi.org/10.1016/j.bpobgyn.2014.06.007

Harmon-Jones, E., & Allen, J. J. (1997). Behavioral activation sensitivity and resting frontal EEG asymmetry: Covariation of putative indicators related to risk for mood disorders. *Journal of Abnormal Psychology*, *106*(1), 159–163. https://doi.org/10.1037//0021-843x.106.1.159

Harmon-Jones, E., & Gable, P. A. (2018). On the role of asymmetric frontal cortical activity in approach and withdrawal motivation: An updated review of the evidence. *Psychophysiology*, *55*(1), e12879. https://doi.org/10.1111/psyp.12879

Harmon-Jones, E., Gable, P. A., & Peterson, C. K. (2010). The role of asymmetric frontal cortical activity in emotion-related phenomena: A review and update. *Biological Psychology*, *84*(3), 451–462. https://doi.org/10.1016/j.biopsycho.2009.08.010

Hartman, S., Belsky, J., & Pluess, M. (2023). Prenatal programming of environmental sensitivity. *Translational Psychiatry*, *13*(1), 161. https://doi.org/10.1038/s41398-023-02461-y

Howarth, G. Z., Fettig, N. B., Curby, T. W., & Bell, M. A. (2016). Frontal electroencephalogram asymmetry and temperament across infancy and early childhood: An exploration of stability and bidirectional relations. *Child Development*, *87*(2), 465–476. https://doi.org/10.1111/cdev.12466

Hu, L.t, & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice*, *10*(2), 144–156. https://doi.org/10.1093/clipsy.bpg016

Keune, P. M., van der Heiden, L., Várkuti, B., Konicar, L., Veit, R., & Birbaumer, N. (2012). Prefrontal brain asymmetry and aggression in imprisoned violent offenders. *Neuroscience Letters*, *515*(2), 191–195. https://doi.org/10.1016/j.neulet.2012.03.058

Kochanska, G., Aksan, N., & Joy, M. E. (2007). Children's fearfulness as a moderator of parenting in early socialization: Two longitudinal studies. *Developmental Psychology*, *43*(1), 222–237. https://doi.org/10.1037/0012-1649.43.1.222

Lacobucci, D., Schneider, M. J., Popovich, D. L., & Bakamitsos, G. A. (2017). Mean centering, multicollinearity, and moderators in multiple regression: The reconciliation redux. *Behavior Research Methods*, *49*(1), 403–404. https://doi.org/10.3758/s13428-016-0827-9

Lengua, L. J. (2006). Growth in temperament and parenting as predictors of adjustment during children's transition to adolescence. *Developmental Psychology*, *42*(5), 819–832. https://doi.org/10.1037/0012-1649.42.5.819

Liao, T. F. (2004). Comparing social groups: Wald statistics for testing equality among multiple logit models. *International Journal of Comparative Sociology*, *45*(1-2), 3–16. https://doi.org/10.1177/0020715204048308

Liu, R., Calkins, S. D., & Bell, M. A. (2021). Frontal EEG asymmetry moderates the associations between negative temperament and behavioral problems during childhood. *Development and Psychopathology*, *33*(3), 1016–1025. https://doi.org/10.1017/s0954579420000309

Lopez-Duran, N. L., Nusslock, R., George, C., & Kovacs, M. (2012). Frontal EEG asymmetry moderates the effects of stressful life events on internalizing symptoms in children at familial risk for depression. *Psychophysiology*, *49*(4), 510–521. https://doi.org/10.1111/j.1469-8986.2011.01332.x

Marshall, P. J., Bar-Haim, Y., & Fox, N. A. (2002). Development of the EEG from 5 months to 4 years of age. *Clinical Neurophysiology*, *113*(8), 1199–1208. https://doi.org/10.1016/s1388-2457(02)00163-3

Marshall, P. J., & Fox, N. A. (2004). A comparison of the electroencephalogram between institutionalized and community children in Romania. *Journal of Cognitive Neuroscience*, *16*(8), 1327–1338. https://doi.org/10.1162/0898929042304723

Marshall, P. J., & Fox, N. A. (2007). Infant EEG and ERP in relation to social and emotional development. In M. de Haan (Ed.), *Infant EEG and Event-Related Potentials* (pp. 227–249). Psychology Press.

Masten, A. S., & Cicchetti, D. (2016). Resilience in development: Progress and transformation. In D. Cicchetti (Ed.), *Developmental Psychopathology: Risk, Resilience, and Intervention* (3rd ed., pp. 271–333). John Wiley & Sons, Inc. https://doi.org/10.1002/9781119125556.devpsy406

McEwen, B. S., & Gianaros, P. J. (2011). Stress- and allostasis-induced brain plasticity. *Annual Review of Medicine*, *62*(1), 431–445. https://doi.org/10.1146/annurev-med-052209-100430

Mesman, J., Bongers, I. L., & Koot, H. M. (2001). Preschool developmental pathways to preadolescent internalizing and externalizing problems. *Journal of Child Psychology and Psychiatry*, *42*(5), 679–689. https://doi.org/10.1017/S0021963001007351

Monroe, S. M., & Simons, A. D. (1991). Diathesis-stress theories in the context of life stress research: Implications for the depressive disorders. *Psychological Bulletin*, *110*(3), 406–425. https://doi.org/10.1037/0033-2909.110.3.406

Mulligan, D. J., Palopoli, A. C., van den Heuvel, M. I., Thomason, M. E., & Trentacosta, C. J. (2022). Frontal alpha asymmetry in response to stressor moderates the relation between parenting hassles and child externalizing problems. *Frontiers in Neuroscience*, *16*, 917300. https://doi.org/10.3389/fnins.2022.917300

Muthén, L. K., & Muthén, B. O. (1998-2017). *Mplus user's guide* (8th ed.). Muthén & Muthén.

Parent, J., McKee, L. G., N.R., J., & Forehand, R. (2016). The association of parent mindfulness with parenting and youth psychopathology across three developmental stages. *Journal of Abnormal Child Psychology*, *44*(1), 191–202. https://doi.org/10.1007/s10802-015-9978-x

Peltola, M. J., Bakermans-Kranenburg, M. J., Alink, L. R. A., Huffmeijer, R., Biro, S., & van IJzendoorn, M. H. (2014). Resting frontal EEG asymmetry in children: Meta-analyses of the effects of psychosocial risk factors and associations with internalizing and externalizing behavior. *Developmental Psychobiology*, *56*(6), 1377–1389. https://doi.org/10.1002/dev.21223

Pettit, G. S., & Bates, J. E. (1989). Family interaction patterns and children's behavior problems from infancy to 4 years. *Developmental Psychology*, *25*(3), 413–420. https://doi.org/10.1037/0012-1649.25.3.413

Pluess, M. (2015). Individual differences in environmental sensitivity. *Child Development Perspectives*, *9*(3), 138–143. https://doi.org/10.1111/cdep.12120

Pluess, M., & Belsky, J. (2013). Vantage sensitivity: Individual differences in response to positive experiences. *Psychological Bulletin*, *139*(4), 901–916. https://doi.org/10.1037/a0030196

Putnam, S. P., & Rothbart, M. K. (2006). Development of short and very short forms of the children's behavior questionnaire. *Journal of Personality Assessment*, *87*(1), 102–112. https://doi.org/10.1207/s15327752jpa8701_09

Reznik, S. J., & Allen, J. J. B. (2018). Frontal asymmetry as a mediator and moderator of emotion: An updated review. *Psychophysiology*, *55*(1), e12965. https://doi.org/10.1111/psyp.12965

Roisman, G. I., Newman, D. A., Fraley, R. C., Haltigan, J. D., Groh, A. M., & Haydon, K. C. (2012). Distinguishing differential susceptibility from diathesis-stress: Recommendations for evaluating interaction effects. *Development and Psychopathology*, *24*(2), 389–409. https://doi.org/10.1017/s0954579412000065

Rothbart, M. K. (2011). *Becoming who we are: Temperament and personality in development*. Guilford Press.

Rothbaum, F., & Weisz, J. R. (1994). Parental caregiving and child externalizing behavior in nonclinical samples: A meta-analysis. *Psychological Bulletin*, *116*(1), 55–74. https://doi.org/10.1037/0033-2909.116.1.55

Scott, S., Knapp, M., Henderson, J., & Maughan, B. (2001). Financial cost of social exclusion: Follow up study of antisocial children into adulthood. *BMJ*, *323*(7306), 191–191. https://doi.org/10.1136/bmj.323.7306.191

Slagt, M., Dubas, J. S., Deković, M., & van Aken, M. A. (2016). Differences in sensitivity to parenting depending on child temperament: A meta-analysis. *Psychological Bulletin*, *142*(10), 1068–1110. https://doi.org/10.1037/bul0000061

Smith, E. E., Reznik, S. J., Stewart, J. L., & Allen, J. J. (2017). Assessing and conceptualizing frontal EEG asymmetry: An updated primer on recording, processing, analyzing, and interpreting frontal alpha asymmetry. *International Journal of Psychophysiology*, *111*, 98–114. https://doi.org/10.1016/j.ijpsycho.2016.11.005

Solmeyer, A. R., & Feinberg, M. E. (2011). Mother and father adjustment during early parenthood: The roles of infant temperament and coparenting relationship quality. *Infant Behavior and Development*, *34*(4), 504–514. https://doi.org/10.1016/j.infbeh.2011.07.006

Sutton, S. K., & Davidson, R. J. (1997). Prefrontal brain asymmetry: A biological substrate of the behavioral approach and inhibition systems. *Psychological Science*, *8*(3), 204–210. https://doi.org/10.1111/j.1467-9280.1997.tb00413.x

Tick, N. T., van der Ende, J., & Verhulst, F. C. (2007). Twenty-year trends in emotional and behavioral problems in Dutch children in a changing society. *Acta Psychiatrica Scandinavica*, *116*(6), 473–482. https://doi.org/10.1111/j.1600-0447.2007.01068.x

Turpyn, C. C., & Chaplin, T. M. (2016). Mindful parenting and parents' emotion expression: Effects on adolescent risk behaviors. *Mindfulness*, *7*(1), 246–254. https://doi.org/10.1007/s12671-015-0440-5

Ugarte, E., Miller, J. G., Weissman, D. G., & Hastings, P. D. (2023). Vagal flexibility to negative emotions moderates the relations between environmental risk and adjustment problems in childhood. *Development and Psychopathology*, *35*(3), 1051–1068. https://doi.org/10.1017/S0954579421000912

van de Ven, M. C. J., van den Heuvel, M. I., Bhogal, A., Lewis, T., & Thomason, M. E. (2020). Impact of maternal childhood trauma on child behavioral problems: The role of child frontal alpha asymmetry. *Developmental Psychobiology*, *62*(2), 154–169. https://doi.org/10.1002/dev.21900

Van den Bergh, B. R. H., Antonelli, M. C., & Stein, D. J. (2024). Current perspectives on perinatal mental health and neurobehavioral development: Focus on regulation, coregulation and self-regulation. *Current Opinion in Psychiatry*, *37*(3), 237–250. https://doi.org/10.1097/yco.0000000000000932

van den Heuvel, M. I., Donkers, F. C. L., Winkler, I., Otte, R. A., & Van den Bergh, B. R. H. (2014). Maternal mindfulness and anxiety during pregnancy affect infants' neural responses to sounds. *Social Cognitive and Affective Neuroscience*, *10*(3), 453–460. https://doi.org/10.1093/scan/nsu075

van den Heuvel, M. I., Johannes, M. A., Henrichs, J., & Van den Bergh, B. R. (2015). Maternal mindfulness during pregnancy and infant socio-emotional development and temperament: The mediating role of maternal anxiety. *Early Human Development*, *91*(2), 103–108. https://doi.org/10.1016/j.earlhumdev.2014.12.003

van Zeijl, J., Mesman, J., Stolk, M. N., Alink, L. R. A., van Ijzendoorn, M. H., Bakermans-Kranenburg, M. J., Juffer, F., & Koot, H. M. (2007). Differential susceptibility to discipline: The moderating effect of child temperament on the association between maternal discipline and early childhood externalizing problems. *Journal of Family Psychology*, *21*(4), 626–636. https://doi.org/10.1037/0893-3200.21.4.626

Vincent, K. M., Xie, W., & Nelson, C. A. (2021). Using different methods for calculating frontal alpha asymmetry to study its development from infancy to 3 years of age in a large longitudinal sample. *Developmental Psychobiology*, *63*(6), e22163. https://doi.org/10.1002/dev.22163

Wiggers, M., & Paas, F. (2022). Harsh physical discipline and externalizing behaviors in children: A systematic review. *International Journal of Environmental Research and Public Health*, *19*(21), 14385. https://doi.org/10.3390/ijerph192114385

Yan, N., Ansari, A., & Peng, P. (2021). Reconsidering the relation between parental functioning and child externalizing behaviors: A meta-analysis on child-driven effects. *Journal of Family Psychology*, *35*(2), 225–235. https://doi.org/10.1037/fam0000805

Zhang, W., Wang, M., & Ying, L. (2019). Parental mindfulness and preschool children's emotion regulation: The role of mindful parenting and secure parent-child attachment. *Mindfulness*, *10*(12), 2481–2491. https://doi.org/10.1007/s12671-019-01120-y

Zhang, X., Sayler, K., Hartman, S., & Belsky, J. (2022). Infant temperament, early-childhood parenting, and early-adolescent development: Testing alternative models of parenting × temperament interaction. *Development and Psychopathology*, *34*(3), 784–795. https://doi.org/10.1017/S0954579420002096

Zhang, X., Widaman, K., & Belsky, J. (2023). Beyond orchids and dandelions: Susceptibility to environmental influences is not bimodal. *Development and Psychopathology*, *35*(1), 191–203. https://doi.org/10.1017/S0954579421000821

Zuckerman, M. (1999). *Vulnerability to psychopathology: A biosocial model.* American Psychological Association. https://doi.org/10.1037/10316-000