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What's parenting got to do with it: emotional autonomy and brain and behavioral responses to emotional conflict in children and adolescents

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Abstract

Healthy parenting may be protective against the development of emotional psychopathology, particularly for children reared in stressful environments. Little is known, however, about the brain and behavioral mechanisms underlying this association, particularly during childhood and adolescence, when emotional disorders frequently emerge. Here, we demonstrate that psychological control, a parenting strategy known to limit socioemotional development in children, is associated with altered brain and behavioral responses to emotional conflict in 27 at-risk (urban, lower income) youth, ages 9–16. In particular, youth reporting higher parental psychological control demonstrated lower activity in the left anterior insula, a brain area involved in emotion conflict processing, and submitted faster but less accurate behavioral responses—possibly reflecting an avoidant pattern. Effects were not replicated for parental *care*, and did not generalize to an analogous *nonemotional* conflict task. We also find evidence that behavioral responses to emotional conflict bridge the previously reported link between parental overcontrol and anxiety in children. Effects of psychological control may reflect a parenting style that limits opportunities to practice self-regulation when faced with emotionally charged situations. Results support the notion that parenting strategies that facilitate appropriate amounts of socioemotional competence and autonomy in children may be protective against social and emotional difficulties.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

1 | INTRODUCTION

Considerable research demonstrates the positive impact of a healthy parent–child relationship on child development. Indeed, healthy parenting predicts greater cognitive functioning (Kok et al., 2014), improved emotion regulation (Manzeske & Stright, 2009), and increased brain gray matter volume in children (Kok et al., 2015). Recent studies have shown that healthy parenting during childhood may be protective against the development of emotional psychopathology (Lima et al., 2014; Lima, Mello, & Mari, 2010). Thus, parenting represents an important proximal environmental factor that shapes long-term outcomes in children, and may be an important target for intervention.

One important dimension of parenting is *care*, characterized by warmth and affection on one end, and indifference and rejection on the other. Another dimension is *psychological control*, characterized by overprotection and intrusion on one end, and encouragement of independence and autonomy on the other (Barber, 1996). Once basic needs of the child are met, surplus of control can be over-solicitous. A further distinction within the concept of control is management of a child's *psychological* and emotional experiences or expressions, as opposed to *behavioral* control, which indicates parental awareness and supervision of a child's behavior (by, for e.g., rules and restrictions; L.D. Steinberg, 1990). A parent with a high level of psychological control might, for example, discredit the way the child tries to solve problems, and seize control when the child tries to initiate his or her own ideas. Behavioral control, in contrast, refers to parental monitoring and limit setting (L.D. Steinberg, 1990). Whereas behavioral control alters risk for deviant peer affiliation or risk-taking behavior in adolescence (Mason, Cauce, Gonzales, & Hiraga, 1996), psychological control is more likely to alter the course of emotional and psychological adjustment.

The present investigation is focused on the influence of parental psychological control on brain and behavioral substrates for emotion processing in their children. Although parental overcontrol may protect children from challenging social situations and peer rejection in the short term, it may also limit the development of a child's social and emotional autonomy (Galambos & Ehrenberg, 1997). Indeed, prior research suggests that higher parental psychological control is associated with poorer self-esteem and self-regulation, and a lower ability to adjust to new situations, even without constant parental supervision (Burt, Simons, & Simons, 2006). Amount of psychological control during adolescence and late childhood may be critical, as this is a time when developmental gains in social and emotional independence are occurring (L.D. Steinberg, 1990). Indeed, there is a dramatic shift in social affiliation from being family- to peer-oriented during the transition into adolescence, a time when social interactions become more complex and emotionally charged (L. Steinberg & Morris, 2001). High levels of parental psychological control may therefore limit a child's ability to self-regulate when faced with challenging new emotional situations, particularly among their peers.

Despite the strong link between parenting styles and socioemotional outcomes in children, surprisingly little is known about underlying brain and behavioral mechanisms. Early caregiving contexts may sensitize the social-affective circuitry of the brain, thereby laying the foundation for determining what a child attends to, responds to, and values, when placed

independently in challenging socioemotional contexts. Thus, the emotional climate of the parent–child relationship, shaped in large part by parenting style, can then generalize to other social situations (Darling & Steinberg, 1993). Neurobehavioral functioning may represent an important mediating factor in the link between caregiving context and socioemotional outcomes. Consistent with this, studies have documented the impact of adverse caregiving experiences, including violence exposure, abuse, and neglect, on brain and behavioral functioning in childhood, adolescence, and beyond (e.g., Marusak, Martin, Etkin, & Thomason, 2015; McLaughlin, Sheridan, & Lambert, 2014; Tottenham et al., 2011; van der Werff et al., 2013). One recent study explored the relation between parenting behavior from the perspective of the child and neural response during socioemotional processing in adolescents, ages 13–16. In this study, Romund and colleagues (2016) found that adolescents who reported higher maternal care demonstrated lower amygdala response to fearful adult faces. Null effects were found for parental psychological control in the three a priori brain areas interrogated (amygdala, hippocampus, fusiform gyrus). These results provide initial support for the notion that perceived parenting behavior is reflected in function in brain circuits critical for socioemotional processing. However, parental psychological control is thought to impede development of emotion regulation ability, and therefore, effects of parental psychological control may be more apparent when children are confronted with situations that require engagement of emotion regulation mechanisms (Cui, Morris, Criss, Houlberg, & Silk, 2014). Discovery of how parenting styles influence brain and behavioral responses during socioemotional processing and regulation in children should inform future research and interventional efforts aimed at promoting healthy development.

Here, we test how children’s perceptions of parental psychological control influences brain and behavioral responses to socioemotional conflict in children and adolescents. We predict that perception of higher parental psychological control will be associated with slower and less accurate behavioral responses when confronted with conflict between emotionally charged stimuli. This is based on the notion that children with parents who exert high levels of psychological control may have fewer opportunities to practice self-regulation and/or expect others to resolve emotional conflict for them. We predict that these behavioral changes will be accompanied by altered neural activity in regions involved in emotion conflict processing, including amygdala, anterior insula (AI), and dorsal (dACC) and rostral anterior cingulate cortex (rACC; Egner, Etkin, Gale, & Hirsch, 2008; Etkin, Egner, Peraza, Kandel, & Hirsch, 2006). Second, we test whether differences in behavior and/or within key emotion conflict processing brain regions will be similarly related to parental *care*, or vary by level of care (i.e., care $\times$ control interaction). Likewise, we test whether effects of parental psychological control on neurobehavioral responses will be specific to conflict between emotionally charged stimuli, or will generalize to *nonemotional* conflict. Finally, we test whether brain and/or behavioral responses to emotional conflict correspond with internalizing (i.e., anxiety and depression) and externalizing behavior problems, based on prior studies linking parental psychological control to increased levels of anxiety, depression, and externalizing behavior problems in children (Barber, Olsen, & Shagle, 1994; Nanda, Kotchick, & Grover, 2012).

Notably, we test these predictions in a low-resource, diverse urban community where sociodemographic risk and stress are high. These participants are at increased risk for emotional psychopathology and developmental problems (Kessler et al., 2010; Lowe, Galea, Uddin, & Koenen, 2014), but were not selected on that basis. Rather, we use a neurobehavioral approach to examine parenting as a proximal environmental factor that could buffer against negative emotional consequences, particularly for children reared in high-stress environments. Therefore, this study is of additional importance as it strives to understand how parenting characteristics may play a role in fostering healthy development in at-risk children and adolescents.

2 | MATERIALS AND METHODS

2.1 | Participants

This functional magnetic resonance imaging (fMRI) study reports on 27 children and adolescents (ages 9–16). Recruitment was focused in an at-risk community (Detroit, Michigan), using local advertisements and mental health service providers, to evaluate underlying neurobehavioral correlates of parenting in a sample with varied risk of emotional psychopathology. Exclusionary criteria included: English as a second language, lower than a 2nd grade reading level, history of brain injury, neurological or movement disorders, or presence of MRI contraindications. One participant was left-handed. Demographic data are provided in Table 1. Of note, 57% of participants reported annual incomes < \$40,000 and 51% were African American. In addition, 52% of parents in this study reported un-partnered marital status (single or divorced). Demographic variables (i.e., IQ, gender, race, household income, parental marital status) were not related to children's perceptions of parental psychological control. One participant reported taking psychotropic medications (atomoxetine and sertraline). Follow-up analyses excluding this participant yielded no changes to observed results.

The study was approved by the Institutional Review Board of Wayne State University. Parental informed written consent and child/adolescent assent were obtained prior to study participation.

2.2 | Measures

2.2.1 | Parenting—The Parental Bonding Instrument – Brief Current Version (PBI-BC; Klimidis, Minas, & Ata, 1992) was used to investigate children's perceptions of parental behaviors. The PBI-BC inquires about father and mother parenting, with a focus on two constructs: (1) care (warmth vs. indifference), e.g., “seems emotionally cold to me” (reverse coded), and (2) control (overprotection/autonomy restriction vs. independence/autonomy fostering), e.g., “treats me like a baby and tries to protect me from everything”. Higher scores indicate higher levels of care/control. Notably, the control dimension of the PBI-BC is conceptualized as an index of psychological (e.g., autonomy granting) rather than behavioral control (e.g., parental monitoring; Parker, Tupling, & Brown, 1979; Smorti, Guarnieri, & Ingoglia, 2014). Additional description of the PBI-BC is provided in the Supporting Information. Two of the 27 included participants did not report on father's parenting and one did not report on mother's parenting, and were thus not included in the respective analyses.

Suggesting that parenting dimensions are distinct, child's report of maternal care was not associated with maternal control, $r(26) = 0.022$, $p = .92$. A similar null effect was observed between paternal care and control, $r(25) = -0.18$, $p = .38$. There was a positive association between perceived maternal control and paternal control, $r(24) = 0.54$, $p = .007$, but the association between maternal care and paternal care did not reach significance, $r(24) = 0.352$, $p = .09$. Thus, effects of maternal and paternal measures on brain and behavior were assessed separately.

2.2.2 | Anxiety symptomology—Child self-report of anxiety symptomology was evaluated using the Screen for Child Anxiety-Related Emotional Disorders (SCR; Birmaher et al., 1997). In addition to a total anxiety score, the SCR consists of five subscales: panic/somatic, generalized anxiety, separation anxiety, social anxiety, and school avoidance. See Supporting Information for further detail on the SCR. Although diagnostic testing was not performed here, SCR total and subscale scores have differentiated youth with anxiety disorders from those without (or with non-anxiety psychiatric disorders) in both clinical and community samples (Birmaher et al., 1997; Desousa, Salum, Isolan, & Manfro, 2013). In all, 22% ($n = 8$) of youth in this sample exceeded an optimal threshold determined for differentiating anxious from non-anxious children in community samples (>22 points; Desousa et al., 2013), suggesting that our sample varied in risk of emotional psychopathology.

2.2.3 | Depressive symptomology—Child self-report of depression symptomology was evaluated using the Children's Depression Inventory – Short Form (CDI-S; Allgaier et al., 2012). See Supporting Information for further detail on the CDI-S. Altogether, 37% ($n = 10$) of youth in this sample exceeded an optimal threshold determined for differentiating depressed from non-depressed children in community samples (≥ 3 points; Allgaier et al., 2012).

2.2.4 | Externalizing problem behaviors—Parents reported on their child's externalizing problem behaviors using the Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1991). See Supporting Information for further detail on the CBCL. In all, 11% ($n = 3$) of youth in this sample scored at or above the borderline clinical range for externalizing problems (≥ 60).

2.2.5 | IQ—IQ was estimated using the Kaufman Brief Intelligence Test (KBIT v.2; Kaufman & Kaufman, 2004).

2.2.6 | Pubertal development—Pubertal development was assessed using the self-reported Tanner stages questionnaire (Marshall & Tanner, 1968). Following prior work (Forbes et al., 2009), participants were categorized as pre/early (Tanner stages 1–2) or mid/late pubertal (stages 3–5).

2.2.7 | Emotional and nonemotional conflict fMRI tasks—Participants performed two analogous versions of a face categorization conflict task during fMRI scanning (Figure 1). Task order was counterbalanced across participants. The task-relevant stimuli in both versions of the task consisted of images of male and female faces with either fearful or

happy expressions. In the first, emotional conflict task, participants identified the face affect while trying to ignore an overlying emotion word (“FEAR” or “HAPPY”). Emotional conflict was created when the emotion word was incongruent with the face affect. In the second, nonemotional conflict (control) task, participants identified the gender of the face while trying to ignore an overlying gender word (“MALE” or “FEMALE”). Nonemotional conflict was created when the gender word was incongruent with the face gender. Thus, identical faces served as task-relevant stimuli in both conditions, but the source of conflict varied (emotional vs. nonemotional). The original task (Egner et al., 2008) utilized adult face stimuli. We have adapted this task for children (Marusak et al., 2015) utilizing an established set of child and adolescent emotion face stimuli (Egger et al., 2011), thus modeling peer interactions while minimizing authoritative relations inherent in adult face stimuli (Marusak, Carre, & Thomason, 2013).

Stimuli were displayed for 1000 ms, with a varying interstimulus interval of 2000–4000 ms (average = 3000 ms), in a pseudorandom order, counterbalanced across trial types for expression, word, response button, and gender. Each task consisted of 163 trials (82 incongruent, 81 congruent), for a total duration of 12 min 46 s per task.

2.3 | fMRI data acquisition, preprocessing, motion, and analysis

Information about fMRI data acquisition, preprocessing, motion, and analysis is provided in the Supporting Information. In brief, fMRI data were acquired during both emotional and nonemotional tasks. Preprocessing and analysis steps followed procedures described in prior work using the emotion conflict task (Etkin et al., 2006; Marusak et al., 2015). For each task (emotional, nonemotional) our main contrast of interest was incongruent–congruent trials (I–C), which isolated neural responses to conflict.

2.4 | Main group-level analysis

Group-level analyses focused on the effects of parental psychological control on brain and behavioral responses to emotional conflict (I–C trials). We assessed maternal and paternal control separately, given the observed variation among measures (see section 2.2.2 above). For behavioral data, partial correlations were used to test for effects of maternal and paternal psychological control on accuracy and reaction time (RT) interference to emotional conflict (I–C), while controlling for age. Higher values for accuracy and RT interference reflect a greater drop-off in accuracy and a greater slowing in response, respectively, to incongruent relative to congruent trials. Age was controlled for in all brain and behavioral analyses, given the relatively wide age range, and that age was associated with parenting and behavioral responses. Specifically, older youth reported less maternal, $r(26) = -0.4$, $p = .049$, and paternal care, $r(25) = -0.64$, $p = .001$, and demonstrated less RT interference to nonemotional conflict, $r(27) = -0.38$, $p = .049$. Of note, pubertal stage was positively correlated with chronological age in this sample, $r(27) = 0.75$, $p = .00006$, and main results remained significant when controlling for pubertal stage rather than age. Behavioral effects were considered significant at a $p < .05$ threshold.

An analogous approach was used for analysis of neuroimaging data. Individual participant contrast maps for emotional conflict (I–C) were submitted to two whole-brain regression

analyses, with maternal or paternal psychological control as regressors of interest, and age as a nuisance regressor. Significant effects of parenting on neural response to emotional conflict were considered within a priori regions of interest (ROIs) known to be involved in emotional conflict processing: (i) amygdala (left, $x = -30$, $y = -6$, $z = -14$; right, $x = 32$, $y = 0$, $z = -12$), (ii) AI (left, $x = -30$, $y = 22$, $z = -2$; right, $x = 40$, $y = 30$, $z = -7$), (iii) dACC ($x = 2$, $y = 32$, $z = 31$), and (iv) rACC ($x = -8$, $y = 43$, $z = 2$), using coordinates derived from prior work using the emotional conflict task (Egner et al., 2008; Etkin et al., 2006). Regional ROIs (8 mm radii spheres) were created around each peak, and significance was assessed within each ROI using a small-volume family-wise error corrected threshold of $p_{FWE} < .05$. All coordinates provided in this report are given in MNI convention. A complementary whole-brain analysis was performed, and effects were considered significant at a whole-brain alpha of 0.05. This was achieved using a combined voxelwise threshold of $p < .001$ and a cluster threshold of > 178 voxels, determined by computing the spatial autocorrelation of the data via AFNI's 3dFWHMx and subsequently performing Monte Carlo simulations (10,000 iterations) using 3dClustSim (compile date 22 July 2016; https://afni.nimh.nih.gov/pub/dist/doc/program_help/3dClustSim.html).

2.5 | Follow-up group-level analyses

To examine the specificity of results to parental *control*, and to brain and behavioral responses to *emotional* conflict, we performed several follow-up analyses. First, we tested for potential associations between maternal/paternal *care* and brain and behavioral responses to emotional conflict, using partial correlation (controlling for age). The same methods and statistical threshold were applied as described above. Potential interactive effects of maternal/paternal care $\times$ control on brain and behavioral responses were also evaluated.

Next, we evaluated whether observed effects of parental psychological control on behavioral and brain responses to emotional conflict generalized to the *nonemotional* conflict task. Specifically, we tested for associations between maternal/paternal psychological control and behavioral and brain responses to nonemotional conflict, using partial correlation (controlling for age). Within-sample Steiger Z tests (Steiger, 1980) were used to test whether effects of parental psychological control on brain/behavior response to *emotional* conflict were significantly different from effects of control on response to *nonemotional* conflict. To estimate parenting–brain correlations during each task, average neural response (I–C) for each participant was extracted from spherical ROI(s) that showed significant effects of parental psychological control.

2.6 | Associations with internalizing and externalizing symptomology

Next, given prior studies linking parental psychological control and internalizing and externalizing symptomology in children (Barber et al., 1994; Nanda et al., 2012), we tested for potential associations among perceived parental control, internalizing/externalizing symptomology (i.e., anxiety, depression, externalizing), and child brain and behavioral responses to emotional conflict, using Pearson Bivariate Correlation in SPSS. We focused on brain and behavioral measures showing significant effects of parental psychological control, using average brain response extracted from spherical ROIs (as described above). For brain or behavioral measures that were also significantly associated with anxiety, PROCESS

software (2.11; Hayes, 2013) implemented in SPSS was then used to test for the mediating effects of neural/behavioral responses in the association between parenting and internalizing/externalizing symptomology. Indirect effects are considered significant when confidence intervals do not overlap zero (Hayes, 2013).

3 | RESULTS

3.1 | Effects of perceived parental psychological control on behavior and brain responses to emotional conflict

3.1.1 | Behavior—Controlling for age, we found that children reporting higher maternal psychological control showed less slowing of response (i.e., lower RT interference, $t(21) = -0.44$, $p = .034$) but a greater drop off in accuracy (i.e., higher accuracy interference, $t(21) = 0.42$, $p = .045$) to emotional conflict (I–C; see Figure 2). That is, children who report higher maternal control show a speed–accuracy trade-off such that they respond more quickly, but less accurately, when confronted with conflicting emotional stimuli. Similar effects were observed for *paternal* psychological control such that higher control was associated with greater accuracy interference, $t(21) = 0.56$, $p = .005$, but the effect on RT was not significant, $p = .5$. The effects of maternal/paternal control on behavioral response to emotional conflict remained significant when controlling for single parenting, and when removing the single potential outlier in RT interference ($Z > 3$; see Figure 2). Breakdown by trial type (incongruent [I], congruent [C]) showed that effects appear to be driven by an effect of perceived parental control on accuracy and RT during incongruent ($ps = 0.025$ – 0.6) rather than congruent trials ($ps = 0.2$ – 0.6), such that higher psychological control was associated with lower accuracy and faster RTs during incongruent trials.

3.1.2 | Brain response—Controlling for age, we found that children reporting higher maternal psychological control showed lower response to emotional conflict (I–C) in the left AI ($p_{FWE} = 0.036$, $x = -32$, $y = 22$, $z = -6$, $Z = 2.73$, 18 voxels; see Figure 3 top panel). The same effect was observed for paternal psychological control, such that children reporting higher paternal psychological control exhibited lower response to emotional conflict in left AI ($p_{FWE} = 0.007$, $x = -34$, $y = 20$, $z = -8$, $Z = 3.38$, 42 voxels; see Figure 3 lower panel). These effects remained significant when additionally controlling for anxiety, and for RT—given the significant association between higher psychological control and faster RT, and given a significant between-task difference in RT, but not accuracy, such that RT was slower for the emotional relative to the nonemotional task, $t(26) = 3.77$, $p = .001$. A similar effect of RT between tasks was reported in a previous study comparing brain and behavioral responses during emotional vs. non-emotional tasks in adults (Egner et al., 2008). Time spent on task (i.e., visual processing) also did not explain these neural effects, as duration of stimuli presentation was fixed across trials, and there was no direct effect of RT on AI response, $t(27) = 0.162$, $p = .23$. No other ROIs were associated with maternal or paternal psychological control during emotion conflict processing, and no brain areas showed significant effects at the corrected whole-brain level.

3.2 | Specificity of effects to parental psychological control (vs. care or the care × control interaction)

Next, we tested for potential associations between maternal/paternal *care* and behavior and brain responses to emotional conflict. Potential interactive effects of maternal/paternal care × control on behavior and brain responses were also evaluated.

3.2.1 | Behavior—Controlling for age, we found that children reporting higher maternal care demonstrated less RT interference to emotional conflict (i.e., less slowing in response, $r[20] = -0.62$, $p = .002$). However, unlike effects for maternal control, maternal care was not associated with accuracy interference, $p = .36$. Conversely, higher *paternal* care was associated with lower accuracy interference ($r[20] = -0.61$, $p = .003$), but was not associated with RT interference, $p = .5$. The interaction between maternal care and control (care × control), or that between paternal care and control (care × control), was not associated with accuracy or RT to emotional conflict.

3.2.2 | Brain response—There were no significant effects of maternal care, paternal care, or the maternal/paternal care × control interaction on brain response in emotion conflict processing ROIs. Taken together, these data do not support similar significant effects of parental *care* on brain responses to emotional conflict. For completeness, we also tested for whole-brain effects of care and care × control. One effect reached significance at the corrected whole-brain threshold: children reporting higher parental care demonstrated increased neural response in the superior frontal gyrus (Brodmann Area 9) to emotional conflict ($x = -4$, $y = 56$, $z = 32$, $Z = 4.1$, 306 voxels; see Figure S1).

3.3 | Generalization of effects of perceived parental psychological control to nonemotional conflict

Next, we tested whether observed effects of perceived parental psychological control on behavioral and brain responses to emotional conflict generalized to an analogous *nonemotional* conflict task.

3.3.1 | Behavior—Controlling for age, there were no significant associations between maternal/paternal psychological control and accuracy or RT to *nonemotional* conflict, $ps > .04$. Within-sample Steiger's Z test indicated a stronger association between paternal control and both RT and accuracy interference during the emotional, relative to the nonemotional task, $Z = 2.09$, $p = .036$, and $Z = 2.05$, $p = .04$, respectively. There was no difference in tasks with regard to the effects of maternal control on RT/accuracy interference, $p = .06$ and $p = .09$, respectively.

3.3.2 | Brain response—Controlling for age, there were no significant associations between maternal/paternal psychological control and brain response to nonemotional conflict (I–C) in any ROIs. Steiger's Z tests did not support a significant difference in correlation between neural response and parental control during emotional vs. nonemotional conflict processing in the left AI.

3.4 | Associations with internalizing and externalizing symptomology

Next, we tested for potential associations among perceived parental control, child internalizing/externalizing symptomology, and child brain and behavioral responses to emotional conflict.

3.4.1 | Association between anxiety and perceived parental psychological control—Controlling for age, the association between perceived parental control and total anxiety scores did not reach significance in this sample ($p = .061$ for maternal control, $p = .3$ for paternal control). However, there was a positive association between maternal psychological control and symptoms of social anxiety, $r(21) = 0.5$, $p = .015$, and school avoidance, $r(21) = 0.46$, $p = .028$. A link between parental psychological control and social anxiety symptoms, in particular, has been previously reported in children (Affrunti & Ginsburg, 2012). Perceived parental psychological control was not associated with symptoms of depression and externalizing problem behavior in this sample, $ps > .08$.

3.4.2 | Association between anxiety and neurobehavioral response to emotional conflict—Controlling for age, children with higher total anxiety scores, $r(24) = -0.525$, $p = .006$, as well as higher social anxiety ($r[24] = -0.451$, $p = .021$) and school avoidance ($r[24] = -0.581$, $p = .002$), displayed less RT interference to emotional conflict (I–C). Anxiety was not associated with accuracy interference, $ps > .1$, or with AI response to emotional conflict, $ps > .5$. In addition, depressive symptoms and externalizing behavior problems were not associated with behavioral or neural response in the AI to emotional conflict in this sample, $ps > .09$. Given that both anxiety and parental psychological control were associated with behavioral response to emotional conflict, we tested for potential mediation effects. Mediation analyses indicated a significant indirect effect from maternal psychological control to total anxiety scores via RT interference during emotional conflict ($\beta = 0.8$, $SE = 0.42$, lower limit confidence interval [LLCI] = 0.18, upper limit confidence interval [ULCI] = 1.87), while controlling for age. The indirect effect was also significant for social anxiety ($\beta = 0.14$, $SE = 0.11$, LLCI = 0.006, ULCI = 0.44), and for school avoidance ($\beta = 0.8$, $SE = 0.42$, LLCI = 0.02, ULCI = 0.22; see Figure 4). The direct effects of perceived maternal psychological control on social anxiety and school avoidance became non-significant when added to the respective mediation models, suggesting that RT interference fully mediates the link between perceived parental overcontrol and both social anxiety and school avoidance in children.

4 | DISCUSSION

Healthy parenting has long been known to enhance emotion regulation ability and promote healthy social and emotional development in children. Parenting may thus be an important interventional target that buffers against negative socioemotional outcomes, particularly for children reared in high-stress environments. The present study demonstrates that perceived parental psychological control, a dimension of parenting thought to influence socioemotional development, relates to children's behavior and brain responses to socially relevant emotional stimuli (i.e., affective peer faces). We found that children reporting higher maternal psychological control submit faster but less accurate responses to emotional

conflict. Higher maternal and paternal psychological control were both associated with diminished neural responses in the left AI, a region involved in emotion conflict processing. These neural effects held when additionally controlling for RT, and were not explained by alterations in visual processing, as duration of stimuli presentation was fixed. Importantly, parental care did not have the same effects on behavior and brain responses to emotional conflict. In addition, the observed effects of perceived parental control did not generalize to an analogous *nonemotional* conflict task that also involved viewing emotionally charged stimuli (affective peer faces), but in this case, the source of the conflict (i.e., face gender) was nonemotional. Taken together, our results are consistent with the notion that perceived parental overcontrol may impair a child's ability to regulate responding when faced with emotionally charged situations. Our data also suggest that behavioral responses to emotional conflict bridge the previously reported link between perceived parental psychological control and anxiety in children.

We observed a potential avoidant behavioral pattern (i.e., faster and less accurate) for youth reporting higher maternal psychological control when faced with conflicting emotional stimuli. This is consistent with the idea that this style of parenting may undermine the development of a child's emotional autonomy by limiting opportunities to practice self-regulation when confronted with new but developmentally normative social challenges (Galambos & Ehrenberg, 1997). Development of socioemotional competency may be particularly critical during the transition into adolescence, as this is a time when autonomy-seeking is high and when relationships with peers become more salient, complex, and emotionally charged. Prior studies link higher perceived parental psychological control to shyness and social withdrawal in children, as well as internalizing problems, which also increase in salience beginning in late childhood (Rubin & Coplan, 2010). This pattern of parenting is also associated with poorer emotion regulation ability in young adults (Manzeske & Stright, 2009), indicating that perception of early caregiving experiences can have enduring effects on emotional functioning.

Our neuroimaging data indicate that youth reporting higher perceived parental psychological control show diminished response in the left AI, a region involved in detecting emotional conflict, and emotionally salient stimuli more generally (Dolcos & McCarthy, 2006). The AI is thought to play a pivotal role in not only the detection of emotional conflict, but also engaging control processes to overcome that conflict (Torres-Quesada et al., 2014). The observed pattern of higher parental psychological control and lower AI response when youth are faced with emotional conflict may reflect reduced ability to engage processes that can overcome this conflict. This is fitting with the observed avoidant behavioral pattern, and with the notion that perceived parental psychological overcontrol limits a child's practice of self-regulation strategies in emotionally arousing social contexts.

Effects of perceived parental psychological control on brain, behavioral, and anxiety levels in children is in line with prior research showing that lower parental control (but not care) in childhood predicts better emotion regulation ability (Manzeske & Stright, 2009) and lower anxiety symptomology (Barber, 1996). Interestingly, observed effects of perceived parental psychological control and behavior and brain responses to emotional conflict did not generalize to the *nonemotional* conflict task. This is not surprising, given that psychological

control was associated with altered function of the left AI, an area that has been linked to conflict monitoring exclusively in the emotional domain (Torres-Quesada et al., 2014). Of note, altered functioning of the AI during emotion processing is consistently documented among individuals with internalizing disorders (e.g., meta-analysis by Hamilton et al., 2012), and altered response in emotion conflict neurocircuitry has been documented in anxious and depressed adults (Etkin et al., 2006). Although AI response to emotional conflict did not relate to internalizing symptoms or externalizing problem behaviors in the current study, the observed effects of parenting on shaping this system in early life may increase susceptibility to the development of psychopathology later in life. These longitudinal associations would be important to examine in future research. Alternatively, we may have been underpowered to identify these associations.

Limitations of the study warrant mention. First, the relatively limited sample size and cross-sectional design limits our ability to test whether parenting is protective against the long-term adverse effects of environmental adversity. Nonetheless, this study is one of the first to evaluate neurobehavioral correlates of perceived parental psychological control in youth during socioemotional processing. In addition, genetic or temperamental factors were not considered, despite evidence for differential impact of parenting on children with or without greater sensitivity to social contexts and vulnerability to psychopathology (see Schriber & Guyer, 2016). Future studies with larger sample sizes are needed to test the neural mechanisms underlying the interplay between parenting and individual differences in child's temperament or genetic background. Next, our sample was mostly female and high in sociodemographic risk, and results may thus not be generalizable. Moreover, single parenting—with the mother as the primary caretaker in most (83%) cases—was prominent in this sample (49%), which may partially explain why father's caregiving was associated with accuracy but not RT to emotional conflict in children. Indeed, both maternal and paternal psychological control have been previously associated with child anxiety in other samples (e.g., Luebke, Bump, Fussner, & Rulon, 2014), and here, perceived parental control predicted child social anxiety symptoms. In addition, we focused on child reports of parenting behavior, which may be less objective than observational methods. However, it has been suggested that child reports may be more relevant since it is ultimately the child's perspective of his/her caregiving experience that influences his/her development (Haines, Neumark-Sztainer, Hannan, & Robinson-O'Brien, 2008). Of note, the parenting measure used here has been shown to be stable over a 20-year interval (Wilhelm, Niven, Parker, & Hadzi-Pavlovic, 2005).

4.1 | Conclusion

Here, we unearth potential behavioral mechanisms underlying the link between perceived parenting practices and socioemotional outcomes in children and adolescents. We found that children perceiving higher levels of parental control submit faster but less accurate responses when faced with emotional conflict and show lower engagement of brain regions involved in emotion conflict processing. These effects did not generalize to an analogous *nonemotional* conflict task. These findings are in line with the notion that perceived parental psychological overprotection during the transition into adolescence may limit a child's emotional autonomy and ability to deal with difficult socioemotional interactions. Thus, parenting

strategies that grant autonomy and encourage social and emotional competence in children may be protective against the development of emotional disorders.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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RESEARCH HIGHLIGHTS

- Psychological control is a parenting strategy known to limit social and emotional development in children.
- Here, we demonstrate that parental psychological control is associated with altered brain and behavioral responses to emotional conflict in children and adolescents.
- Effects were not replicated for parental care, and did not generalize to an analogous *nonemotional* conflict task.
- We also find evidence that behavioral responses to emotional conflict bridge the previously reported link between parental overcontrol and anxiety in children.

FIGURE 1.

Emotional (top) and nonemotional (bottom) conflict tasks. Two task versions were administered to each participant, counterbalanced for order of presentation. The source of conflict (emotional, nonemotional) varied across tasks, while keeping the face stimuli identical. Participants indicated either the emotion or gender of the face, while ignoring the overlying emotion or gender word. Trials varied the stimuli congruency (congruent, incongruent). Emotional and nonemotional conflict was isolated by contrasting neural and behavioral responses to incongruent–congruent (I–C) trials. The nonemotional task served as the control task, testing whether effects were specific to responses to conflict between emotionally charged stimuli (i.e., emotional conflict). This image was taken from an established set of child emotion-face stimuli of varied ethnicities, ages 10–17 years (Egger et al, 2011). Parent/guardian consent and actor assent was obtained to make the stimuli publicly available for researchers and to be reproduced in scientific publications

FIGURE 2.

Perception of parental psychological control is associated with altered behavioral response to emotional conflict in children and adolescents. Higher values indicate greater reaction time (RT; left) and accuracy (right) interference, i.e., a drop in performance or slowing in response when confronted with conflicting emotional stimuli. Higher maternal control is associated with faster (left) but less accurate (right) responses to emotional conflict (incongruent–congruent trials; I–C). Similar effects on accuracy were observed for paternal psychological control (see text)

FIGURE 3.

Children reporting higher parental psychological control show diminished neural response in left anterior insula (AI). Left AI plays a key role in conflict monitoring, exclusively in the emotional domain, and is thought to recruit processes aimed at overcoming that conflict (Torres-Quesada, Korb, Funes, Lupianez, & Egner, 2014). Diminished neural response is accompanied by faster but less accurate responses to emotional conflict (see Figure 2). Images displayed at $p < .005$, $k > 10$ for display purposes, and significant at small-volume family-wise error corrected threshold of $p_{FWE} < .05$

FIGURE 4.

Reaction time (RT) to emotional conflict mediates the link between perceived parental psychological control and child anxiety symptoms. Similar mediation effects were observed for social anxiety and school avoidance subscales (see text)

TABLE 1

Sample characteristics and demographics

Variable	<i>n</i> = 27
Age, <i>M</i> (<i>SD</i>)	11.96 (2.45)
Gender, <i>n</i> female (%)	22 (81%)
IQ, <i>M</i> (<i>SD</i>)	101 (13.24)
Pubertal development	
Pre/early (Tanner stages 1–2), <i>n</i> (%)	9 (33%)
Mid/late (Tanner stages 3–5), <i>n</i> (%)	18 (67%)
Annual income	
Less than \$40,000, <i>n</i> (%)	17 (63%)
\$40,000–60,000, <i>n</i> (%)	5 (18.5%)
\$60,000–80,000, <i>n</i> (%)	3 (11.1%)
Over \$80,000, <i>n</i> (%)	1 (3.7%)
Not reported, <i>n</i> (%)	1 (3.7%)
Race/Ethnicity	
African American, <i>n</i> (%)	12 (44.4%)
Caucasian, <i>n</i> (%)	7 (25.9%)
Hispanic, <i>n</i> (%)	2 (7.4%)
Mixed race, <i>n</i> (%)	2 (7.4%)
Not reported, <i>n</i> (%)	4 (14.8%)
Marital status	
Married/partnered, <i>n</i> (%)	13 (48%)
Single, <i>n</i> (%)	9 (33%)
Divorced, <i>n</i> (%)	5 (19%)
SCR anxiety symptomology, <i>M</i> (<i>SD</i>)	17.26 (12.35)
CDI depressive symptomology, <i>M</i> (<i>SD</i>)	2.19 (2.57)
CBCL externalizing problem behaviors, <i>M</i> (<i>SD</i>)	45.6 (12.51)
PBI-BC parenting measures	
Maternal care, <i>M</i> (<i>SD</i>)	8.9 (2.4)
Paternal care, <i>M</i> (<i>SD</i>)	7.4 (3.4)
Maternal control, <i>M</i> (<i>SD</i>)	5.5 (2.2)
Paternal control, <i>M</i> (<i>SD</i>)	4.1 (2.9)

Abbreviations: *n*, number; *M*, mean; *SD*, Standard deviation; SCR, Screen for Child Anxiety; Related Emotional Disorders; CDI, Children's Depression Inventory; CBCL, Child Behavior Checklist, PBI-BC, Parental Bonding Instrument – Brief Current; IQ, Intelligence Quotient.