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Associations between maternal negative affect and adolescent's neural response to peer evaluation

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ABSTRACT

Parenting is often implicated as a potential source of individual differences in youths' emotional information processing. The present study examined whether parental affect is related to an important aspect of adolescent emotional development, response to peer evaluation. Specifically, we examined relations between maternal negative affect, observed during parent–adolescent discussion of an adolescent-nominated concern with which s/he wants parental support, and adolescent neural responses to peer evaluation in 40 emotionally healthy and depressed adolescents. We focused on a network of ventral brain regions involved in affective processing of social information: the amygdala, anterior insula, nucleus accumbens, and subgenual anterior cingulate, as well as the ventrolateral prefrontal cortex. Maternal negative affect was not associated with adolescent neural response to peer rejection. However, longer durations of maternal negative affect were associated with decreased responsivity to peer acceptance in the amygdala, left anterior insula, subgenual anterior cingulate, and left nucleus accumbens. These findings provide some of the first evidence that maternal negative affect is associated with adolescents' neural processing of social rewards. Findings also suggest that maternal negative affect could contribute to alterations in affective processing, specifically, dampening the saliency and/or reward of peer interactions during adolescence.

1. Introduction

There is emerging evidence that individual differences in neural responsivity to peer evaluation are associated with affective health and disorder (Pfeifer and Blakemore, 2012). Despite behavioral evidence linking parenting with youths' affective responses to peers (Brown et al., 1993), little is known about the extent to which parenting is associated with individual differences in adolescents' neural response to a particularly salient type of emotional information, social evaluation by peers (Nelson et al., 2005; Somerville, 2013). The present study examines relations between one aspect of parenting, maternal negative affect, and neural response to peer rejection and acceptance in emotionally-healthy and depressed adolescents.

1.1. Parental influences on adolescent socioemotional development

Although peers play an increasingly important role during adolescence, parents continue to have a strong

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influence on adolescents' socioemotional development (Stocker et al., 2007). Research has consistently revealed associations between high levels of negative maternal affect and adolescent depressive symptoms (e.g., Schwartz et al., 2012), particularly when mothers express negative affect during discussions that typically elicit parental positive affect, support, or empathy (Dietz et al., 2008; McMakin et al., 2011; Schwartz et al., 2011). As such, examinations of maternal negative affect in typically positive or supportive contexts may be particularly informative in elucidating the effects of parental affect on adolescent social and emotional development.

The mechanisms mediating links between parental affect and adolescents' socioemotional adjustment are still being established; however, theories suggest that high levels of maternal negative affect could alter adolescents' affective responses to peers by increasing their sensitivity to negative affect, diminishing their capacity to experience or maintain positive affect, transmitting maladaptive regulatory behaviors, and altering their experience and/or expectations of social interactions (Eisenberg et al., 1998; Morris et al., 2007; Sheeber et al., 2001). Alterations in emotional reactivity and regulation could thereby sensitize adolescents to social evaluation, impair their ability to regulate distress stemming from negative feedback, or dampen the rewarding aspects of social interactions.

Indeed, behavioral studies have shown that parenting practices are associated with youths' ability to modulate their affective reactions to peer rejection (Yeung and Leadbeater, 2010), confidence in their ability to form and maintain friendships, and perceptions of intimacy and social support within relationships (Ladd and Pettit, 2002; Parker et al., 2006). Furthermore, parental affect during parent–child interactions provides youth with important information about the consequences of their own affective behaviors (Eisenberg et al., 1998). Thus, adolescents who frequently experience parental negative affect may experience, or come to expect, less reward from social interactions. It therefore stands to reason that maternal negative affect during parent–adolescent interaction may influence adolescents' affective responses to peer evaluation by influencing activity in neural regions that underlie affective and social information processing.

Despite immense interest (Belsky and de Haan, 2011), relatively few studies have attempted to link normative variations in parental affect with functional differences in youth's neural response to affective information. A number of studies have, however, examined associations between extreme parental negative affect (e.g., child maltreatment) and children's responses to affective information. These studies provide compelling evidence for the influence of parental negativity on development of affective neural systems (Glaser, 2000) and for alterations in the processing of negative affect (Kaufman and Charney, 2001; Pollak and Tolley-Schell, 2003) and reward-related information (Dillon et al., 2009). However, given the importance of parents on adolescents' emotional adjustment (Morris et al., 2007), it is essential to explore the impact of *normative* variations in parental negative affect on youth's neural response to affectively charged social information (Belsky and de Haan, 2011).

A series of studies by Whittle and colleagues provide preliminary evidence that normative variations in parental affect can influence the development of neural structures that are central for affective and social information processing, including the neural correlates of peer evaluation. Specifically, high parental negativity (e.g., aggressive behavior) during parent–child interactions was associated with smaller amygdala (Yap et al., 2008) and hippocampus (Whittle et al., 2011) volume whereas high parental positive affect was associated with larger orbitofrontal cortex volume (Whittle et al., 2009). Although suggestive of relations between parental negative affect and alterations in adolescents' affective processing, research has yet to identify associations between normative variations in parental negativity and adolescents' neural response to peer evaluation.

1.2. Neural correlates of peer evaluation processing

Given that developmental psychopathology models suggest that increased sensitivity to peer evaluation plays an important role in the rise of anxiety and depression during adolescence (Davey et al., 2008; Nelson et al., 2005; Somerville, 2013), researchers have focused on identifying the neural correlates of peer evaluation. Using virtual interaction paradigms such as the Cyberball (Eisenberger et al., 2003) and Chatroom Task (Guyer et al., 2008), studies consistently find that social exclusion/rejection activates a ventral affective network that includes the amygdala, and anterior insula, as well as the ventro-lateral prefrontal cortex (VLPFC) which is posited to subserve regulation of distress associated with social exclusion/rejection (Guyer et al., 2008; Masten et al., 2009; Sebastian et al., 2011). Whereas social exclusion in adults appears to activate a dorsal portion of the ACC (Eisenberger et al., 2003), extant studies with adolescents often implicate the sgACC in the processing of exclusion (Masten et al., 2009; Sebastian et al., 2010). Fewer studies have examined responsivity to social acceptance but research has begun to show that acceptance activates reward-related brain regions, particularly the NAcc (Davey et al., 2010; Gunther Moor et al., 2010; Guyer et al., 2012) and amygdala (Davey et al., 2011).

There is also emerging evidence for group differences in depressed vs. non-depressed adolescents' in neural responses to peer evaluation. For example, in an earlier analyses the Chatroom Interact task which included a sample that overlaps with the present study, we found that depressed youth showed increased activation to rejection (and not acceptance) relative to controls in the bilateral amygdala, sgACC, left anterior insula, and left NAcc (Silk et al., in press). The present study presents only new analyses focused individual differences in neural responses to peer evaluation. Details about ROIs that were activated by peer acceptance and evaluation can also be found in that study.

1.3. The present study

To examine relations between parental affect and adolescents' neural responses to peer evaluation, we used behavioral observations of maternal negative affect from