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The relation between emotion regulation strategies and physiological stress responses in middle childhood

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Summary The current study sought to examine whether children's spontaneous use of the emotion regulation strategies suppression and reappraisal during a psychosocial stress task was related to their cortisol and alpha-amylase responses to that task.

Salivary cortisol and alpha-amylase responses to a psychosocial stress task were assessed in 158 10-year-old children (83 girls). The children completed a self-report questionnaire measuring use of reappraisal and suppression during the task. Results showed overall increases in cortisol and alpha-amylase in response to the stressor, with higher cortisol reactivity in girls than in boys. With regard to emotion regulation, more use of suppression was related to lower cortisol reactivity in girls, and lower alpha-amylase reactivity and quicker alpha-amylase recovery in all children. The use of reappraisal was not related to the children's cortisol or alpha-amylase responses.

The current study is the first to investigate the relation between the spontaneous use of reappraisal and suppression, and physiological stress responses to a psychosocial stressor in children. Our results indicate that reappraisal and suppression are used and can be measured even in 10-year-olds. At this age reappraisal appears ineffective at down-regulating physiological responses, while suppression was related to lower physiological responses. For cortisol reactivity there was a sex difference in the relation with suppression, indicating the importance of including sex as a moderator variable in research studying stress reactivity and its correlates in this age group.

1. Introduction

In face of a stressor, humans respond with changes in emotions and physiology. Two systems are central to human peripheral physiological stress responses: the autonomic nervous system (ANS), and the hypothalamic-pituitary-adrenocorticol (HPA) axis. The sympathetic branch of the ANS, the sympathetic nervous system (SNS), is a fast responding system involved in initiating the fight/flight response through the release of epinephrine and norepinephrine (Gunnar and Quevedo, 2007). The HPA-axis works through the release of glucocorticoids, a type of steroid hormones, the production of which takes some time. As a result, the HPA-axis responds slower to stressors and takes longer to return to baseline (Gunnar and Quevedo, 2007).

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There are individual differences in the regulation of physiological stress responses (Kudielka et al., 2009; Rohleder and Nater, 2009). Adequate regulation of physiological responses to stress is important, as previous research has indicated that repeated and long-lasting activation of the stress-system is related to adverse effects on the immune system (e.g. Sapolsky, 1998), and to the development of physical and psychological problems (McEwen, 1998; Charmandari et al., 2005). As such, it is important to determine the origins of the differences in physiological stress regulation. Therefore, the current study investigated whether the extent to which people try to regulate their appraisals and emotions in the face of a stressor, for instance by using emotion regulation strategies, might also affect the strength of their physiological responses to stress.

According to classical theories on stress, differences in physiological responding may follow from differences in cognitive appraisals of the stressful situation, and emotional responses associated with those appraisals (Lazarus and Folkman, 1984; Frijda, 1986). A recent paper investigated this notion for the HPA-axis, with a meta-analysis of 54 studies that experimentally manipulated social stress or induced emotions (Denson et al., 2009). Nine judges rated the likelihood that participants experienced certain appraisals and emotions. Results showed that higher appraisal ratings for challenge, threat, novelty, and intensity predicted larger effect sizes in terms of cortisol responses. For the experienced emotions, only surprise showed a positive relation with cortisol responses. The results of this meta-analysis show how appraisals and emotions are related to cortisol reactivity.

Activation of the SNS also appears to be related to experienced emotions. Salivary alpha-amylase (sAA) is considered a non-invasive biomarker of this system (Nater and Rohleder, 2009; but see also Bosch et al., 2011). A recent study showed that levels of sAA were related to participants' self-reported emotional state following the completion of a 'Fear Challenge Course' museum exhibit. Specifically, participants that indicated they were 'negatively aroused' showed significantly elevated levels of sAA, whereas participants that reported to be 'positively aroused' or 'positively calm' showed a significant reduction in sAA levels (Buchanan et al., 2010).

Research relating children's use of specific emotion regulation strategies to their physiological stress responses is limited. Investigating this is nonetheless important, as reactions to stressors in childhood at least partly determine how individuals respond to stressors later in life (Heim and Nemeroff, 2002). Also, both emotion regulation and physiological response systems are developing during childhood. For example, previous research found that children's HPA-axis reactivity to a psychosocial stress task changed from a significant response at age nine, to blunted reactivity at age 11, back to a significant response at age 13 (only in girls) and at age 15 (Gunnar et al., 2009). As a result, findings regarding the relation between emotion regulation strategies and physiological responding for older age groups might not generalize to children. In the current study, we investigated whether individual differences in the way 10-year-old children regulate their emotions is related to their physiological responses to a psychosocial stressor.

There is ongoing debate as to how the concept of emotion regulation should be defined (see e.g. Eisenberg and Spinrad, 2004; Thompson et al., 2008). Gross (1998a) defines it as the processes that influence which emotions a person has, when that person has these emotions, and how these emotions are experienced and expressed. Across the early years of life, children gradually learn how to regulate their emotions. Infants and toddlers greatly rely on the help of adults in regulating their emotion experience and expression. During the preschool years, the understanding emerges that expressed emotions do not need to reflect current emotion experience (Zeman et al., 2006). Between six and ten years of age, children's repertoire of emotion regulation strategies expands rapidly, and shifts from an external, behaviourally oriented approach (e.g. gaze aversion, hiding emotions), towards the use of more cognitively based strategies (e.g. mental distraction, reappraisal; Meerum Terwogt and Stegge, 1995). This availability of both behavioural and cognitive strategies of emotion regulation makes middle childhood a good age at which to study the use of two strategies that have recently gained a lot of attention in the adult literature: *reappraisal* and *suppression* (Gross, 1998b).

Reappraisal is a strategy where the meaning of a situation is reinterpreted in such a way that the emotional impact of the situation is changed. As this strategy is used prior to the activation of emotional response tendencies, it is considered antecedent-focused. Suppression, on the other hand, is a tactic that involves inhibiting the expression of emotions that are already being experienced, and as such it is a response-focused strategy (Gross, 1998b). In adults, reappraisal has been related to the experience and expression of more positive emotions and less negative emotions, better interpersonal functioning, and greater well-being (Gross and John, 2003). Suppression has been associated with less experience and expression of positive emotions, more experience of negative emotions, worse interpersonal functioning, and lower well-being in adults (Gross and John, 2003). In relation to the larger repertoire of emotion regulation strategies that are available in middle childhood, reappraisal is considered a cognitive strategy, whereas suppression is considered a behavioural strategy (Meerum Terwogt and Stegge, 1995). As such, reappraisal could be considered a more mature strategy, and suppression a more immature strategy.

The use of reappraisal and suppression in middle childhood and early adolescence has been researched by Gullone et al. (2010). They found that use of reappraisal seems to be relatively stable across middle childhood and early adolescence, while the use of suppression gradually decreases. In relation to adaptive functioning it has been found that children and adolescents reporting high levels of depressive symptoms used less reappraisal and more suppression than matched controls with low levels of depressive symptoms (Hughes et al., 2011). Also, a school refusal sample of children and adolescents with a primary diagnosis of an anxiety disorder reported fewer use of reappraisal, and more use of suppression than matched controls (Hughes et al., 2010).

Previous research on adults that investigated the relation between the use of these emotion regulation strategies and physiological responses consisted primarily of experimental studies that related the use of reappraisal and/or suppression to SNS activation (e.g. Steptoe and Vögele, 1986; Gross and