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Research report

Differential associations between behavioral and cortisol responses to a stressor in securely versus insecurely attached infants

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HIGHLIGHTS

- Do secure and insecure infants use different regulatory behaviors when stressed?
- Insecure infants fussed less when physiologically stressed.
- Secure infants showed more self-soothing when physiologically stressed.
- 29% explained variance in cortisol by regulatory behaviors in mother's absence.
- Behavior and cortisol are differentially associated in secure and insecure infants.

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ABSTRACT

In this study we examined whether securely versus insecurely attached infants use different regulatory behaviors in absence of their mother and whether these regulatory behaviors are differentially associated with physiological stress responses in secure versus insecure infants. Participants were 193 one-year-olds and their mothers. During three 3-min episodes of separation from the mother in the Strange Situation Procedure (SSP) [1], the following infant regulatory behaviors were observed: crying, fussing, self-soothing, manipulation of toys, and manipulation of the door. Salivary cortisol was measured at baseline and 25, 40, and 60 min after the SSP to measure reactivity and recovery. Additionally, infants were classified as securely or insecurely attached to their mothers.

During the mother's absence, secure infants engaged more in manipulation of the door than insecure infants. Furthermore, in insecure (but not secure) infants less fussing was associated with higher cortisol reactivity, while in secure (but not insecure) infants more self-soothing was associated with higher cortisol reactivity. In total, 29% of the variance in cortisol reactivity was explained by infant regulatory behaviors in the mother's absence. Cortisol recovery was not predicted by infant regulatory behaviors in the mother's absence. To conclude, the results show differential associations between behavioral and cortisol responses to a stressor in secure versus insecure infants. This might indicate that secure and insecure infants apply different behavioral regulatory strategies when physiologically stressed.

1. Introduction

The notion that infant attachment quality is related to later socio-emotional development and mental health is one of attachment theory's most well-known contributions to the field of developmental psychology. For example, securely attached children are considered better able to regulate themselves, i.e. more capable of applying behaviors that modulate their physiological stress [2,3]. However, the specific types of regulatory behaviors that secure versus insecure infants use to regulate their physiological stress are as yet unclear. The purpose of the present study was to first investigate whether securely versus insecurely attached infants use different regulatory behaviors in absence of their mother, and second whether these regulatory behaviors are differentially associated with physiological stress responses in secure versus insecure infants.

By the end of the first year, infants can be classified as securely versus insecurely attached to a caregiver by observing them in the Strange Situation Procedure (SSP) [1]. In the SSP, children are exposed to a series of mild stressors (i.e., confrontation with a stranger and two brief separations from the caregiver), to observe

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whether they can use the caregiver as a 'secure base' in times of uncertainty or stress. When distressed, securely attached infants seek proximity and contact with the attachment figure. The attachment figure can then comfort them and the infants can return to exploration and play. By their attachment behaviors, secure infants apparently elicit external regulation of stress by the attachment figure. Such 'co-regulation' is assumed to protect the infant from excessive levels of distress and to promote the infant's own emergent capacity to regulate arousal [3]. Regulatory capacities gradually evolve into more elaborated and self-initiated processes during the first years of life as a result of increasing control capacities, and are important to cope with developmental challenges. Through a history of co-regulation, secure infants are therefore suggested to develop better self-regulatory capacities, when compared to insecure infants [2]. As yet, it is however unclear what types of specific regulatory behaviors secure and insecure infants use when the attachment figure is not present and whether these regulatory behaviors are differentially associated with physiological stress responses in secure versus insecure infants.

Spangler and Schieche took a first step in examining this question [4]. They suggested two models to explain how behavior can be associated with physiological reactions in secure and insecure attached infants. An *arousal model* implies that stressful events cause a general stress response, resulting both in physiological and behavioral stress responses [5]. Contrarily, in a *coping model*, stressful situations elicit physiological stress responses only when appropriate behavioral coping strategies are not available or effective.

In their research, Spangler and Schieche studied the association between negative emotional expressions (sum of crying, fussing, and sad faces) and cortisol reactivity to the SSP in 12-month-old infants [4]. Cortisol is the end product of the hypothalamic-pituitary-adrenocortical (HPA)-axis, which is activated when confronted with uncertain, unpredictable and stressful situations Ref. [6]. Spangler and Schieche found a positive association between negative emotional expressions and cortisol reactions in insecure infants, but not in secure infants, who showed no association between negative emotional expression and cortisol reactivity [4]. The authors explained this lack of association in secure infants using a coping model, whereas they interpreted the positive behavior-physiology association of insecure infants using an arousal model. According to this reasoning, insecure infants would lack appropriate behavioral coping strategies in the face of maternal separation distress. Negative emotional expressions in this group would be a sign of general stress responses. In contrast, secure infants would show negative emotional expression as a coping strategy, for example to reestablish proximity with the attachment figure, with the consequence that a physiological response does not occur. However, in situations where coping strategies result ineffective, secure infants would also show negative emotional expressions as a sign of a general stress response.

Spangler and Schieche did not examine other types of regulatory behaviors [4]. Also, cortisol recovery was not included, while one may speculate that regulatory behaviors are not only important for regulating the stress response, but also for recovering from stress. Moreover, the groundwork laid by Spangler and Schieche was unfortunately not elaborated by other attachment researchers [4]. More recently, however, the association between affective states and cortisol reactivity in response to another type of stress-inducing procedure, namely the still-face procedure, was studied in very low birth weight (VLBW) and full-term infants [7]. They found a significant negative association between positive as well as negative affect and cortisol reactivity for full-term infants. Thus, the expression of both more positive and more negative affect was related to lower cortisol levels in these infants. By contrast, the associations in the VLBW group were limited. The authors explained their findings by suggesting that less synchrony (i.e., less correlation, either positive or negative) between a behavioral and a physiological response would correspond to a lack of coordination among stress systems, and that the lack of synchrony would represent greater dysregulation [7]. This explanation may also be applicable to a study that showed a greater dissociation between behavioral distress and cortisol reactions after an inoculation in 2-month-olds who were later classified as insecurely attached, as compared to securely attached [8].

The first goal of the present study was to investigate whether secure and insecure infants engage in different regulatory behaviors when separated from the mother. During the episodes of maternal separation within the Strange Situation Procedure (SSP) [1], we observed behaviors that have been suggested to have a regulatory function. Next to crying and fussing, we extended previous research by also including self-soothing, manipulation of toys and manipulation of the door as regulatory behaviors [9]. The second goal of this study was to investigate whether the associations between cortisol responses (reactivity and recovery) and infant regulatory behaviors during the mother's absence are moderated by infant attachment status (secure or insecure). When examining the differential associations, no hypotheses were made as three alternative models existed: (1) the *arousal model* expects a positive association between physiological and behavioral stress responses in both securely and insecurely attached infants [5], (2) the *coping model* expects a positive association between physiological and behavioral stress responses only in insecurely attached infants [4], (3) the model of *synchrony* expects a positive or negative association between physiological and behavioral stress responses only in securely attached infants [7]. Although securely attached children are considered better able to regulate themselves [2,3], the specific types of regulatory behaviors that secure versus insecure infants use to regulate their physiological distress are as yet unclear. The results will provide more knowledge on the normative development of children's regulatory strategies within the secure attachment relationship and the nature of regulation difficulties identified in insecure infants.

2. Methods

2.1. Participants

This study is part of a prospective longitudinal project starting in pregnancy and examining early caregiving factors and their influences on children's development and health across the first years of life. The subjects were healthy infants, whose mothers were recruited during pregnancy through flyers dispersed in midwife practices in and around the Dutch cities of Nijmegen and Arnhem. Inclusion criteria were an uncomplicated and singleton pregnancy without drug use, a clear understanding of the Dutch language, and no current physical and mental health problems. The study was approved by the Faculty Ethical committee and all mothers gave written informed consent before starting. A total of 220 mothers enrolled voluntarily in the study. The final sample was limited to 193 women and their infants, as 8 women were excluded due to medical reasons and 19 discontinued the study during the first three postpartum months because of personal circumstances. No differences in demographics were found between mothers who took part in the study and the 19 women who dropped out.

2.2. Procedure

At 12 months of age (M = 53 weeks and 6 days, SD = 19 days), mother-infant pairs participated in the Strange Situation Procedure (SSP) [1] in the laboratory of the Radboud University, Nijmegen.

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