Association of attachment disorganization, attachment-related emotion regulation, and cortisol response after standardized psychosocial stress procedure: A pilot study

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Attachment representations are related to maintaining biological homeostasis, including physiological stress and emotional regulation. Therefore, recent research has focused on attachment stress regulation and hypothalamus pituitary adrenal (HPA) axis reactivity. However, the attachment disorganization underlying emotion regulation associated with the HPA axis response has not yet been investigated. In our study, the attachment representation and the HPA-axis reactivity by cortisol level before and after the Trier Social Stress Test were assessed in a sample of 98 healthy non-clinical subjects. As expected, approximately 30% of this sample showed a disorganized attachment representation. The subjects’ unresolved attachment (breakdown of emotional regulation) showed a prolonged cortisol recovery. No differences were found between the attachment patterns in the increase and the delta of the cortisol response. However, the cortisol reactivity differed significantly for the occurrence of emotional regulation. The subjects with a high occurrence of attachment-related emotion regulation showed a higher cortisol response than the subjects with an unresolved attachment and the ones with a low occurrence of attachment-related emotion regulation. Regulating the negative emotions of stressful situations may require more attention as it might lead to an increased activation of the physiological system.

Keywords: Adult attachment, attachment disorganization, cortisol, stress reactivity, psycho-social stress

Highlights:

• Unresolved attachment occurred with a prolonged cortisol recovery
• High attachment-related emotion regulation is followed by higher cortisol response
• Unresolved attachment regulation showed low cortisol response (CR)
• Attachment-related regulation and not classification ensued specific CR

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The attachment system is a biology-based behavioral system responsible for maintaining homeostasis, including the modulation of physiological stress and mental health (Bowlby, 1980). Attachment is connected to the different ways for regulating emotions. Some researchers have argued that the attachment system is in itself an emotion-regulating device (Vrtička, Bondolfi, Sander, & Vuilleumier, 2012). Therefore, recent research has focused on attachment, stress regulation, and its effect on the hypothalamus pituitary adrenal (HPA) axis reactivity in adulthood (e.g. Ditzen et al., 2008; Kidd, Hamer, & Steptoe, 2010; Quirin, Pruessner, & Kuhl, 2008; Rifkin-Graboi, 2010). From an attachment perspective, it can be assumed that a secure attachment buffers physiological reactivity in response to stressors as these individuals can balance exploration and attachment, they are more open in their emotional expressions, and they can use attachment figures as a safe haven (Gander & Buchheim, 2015). In contrast, insecure attachment is related to deficits in the emotion regulation which either deactivate attachment distress (in case of the avoidant/dismissing group) or show a low autonomy and feelings of anger (ambivalent/preoccupied group). Therefore, it may be expected that these individuals show a heightened physiological reactivity in response to attachment-related stressors, topics such as loneliness, rejection, separation, loss, and attachment related fear. The so called disorganized/unresolved group (U) is defined as an ineffective form of stress and emotion regulation in response to e.g. danger, helplessness, failed protection, and isolation. These individuals are not able to reorganize emotions triggered by these experiences. Unresolved individuals become momentarily flooded by their attachment-related emotions that cannot be reorganized emotionally due to maladaptive coping and demonstrates a breakdown of defensive and coping strategies (George & West, 2012; Solomon & George, 2011).

There is a clear link between attachment and emotion regulation (Barbasio & Granieri, 2013; Mikulincer, Shaver, & Pereg, 2003; Scheidt et al., 1999). One study even demonstrated that the occurrence of certain emotion-regulating strategies (during a social evaluative speech task) such as high suppression (avoidance) and high reappraisal (reframing) predict a heightened cortisol reactivity to an acute stressor (Lam, Dickerson, Zoccola, & Zaldivar, 2009). However, so far, no study investigated the frequency of the occurrence of attachment-related emotion regulation, i.e. regulation and resolution of attachment-related emotions as a moderating variable for coping with an acute stress response. Hereby, the attachment-related emotions might, e.g., be fear of helplessness, rejection, or isolation which in disorganized attached individuals lead to a breakdown in defensive, coping, and emotion-regulating strategies.

Most studies on the HPA axis and attachment did not include disorganized attachment. However, Pierrehumbert et al. (2012) for the first time examined the interplay of disorganized attachment representation and HPA axis reactivity.
under stress in a mixed clinical and healthy sample \((N = 74)\) using the Adult Attachment Interview (AAI, George, Kaplan, & Main, 1985). Another study group used the Trier Social Stress Test (TSST, Kirschbaum, Pirke, & Hellhammer, 1993), an established stress paradigm for activating the HPA axis. Surprisingly, subjects with dismissing attachment \((n = 18; 24\%)\) showed the highest cortisol increase and delta (peak minus baseline) compared to the flattened response of disorganized attached subjects \((n = 16; 22\%)\). However, the authors stated as limitations of the study a lack of rigorous control regarding influencing factors such as contraceptives and small sample size. In addition, there was an underrepresentation of disorganized attachment \((n = 2; 7\%)\) in their healthy group. In representative healthy samples the proportion of disorganized attachment is about 15–30\% (Bakermans-Kranenburg & van IJzendoorn, 2009). Since the unresolved attachment (U) category refers to a group of individuals unable to contain and reorganize their emotions, including features such as danger, helplessness, failed protection, and isolation. Unresolved individuals momentarily become flooded by their attachment-related emotions which cannot be reorganized (George & West, 2012). Therefore, our study focused on stress, attachment disorganization, and, additionally, on the underlying attachment-related emotion regulation in a large healthy sample.

To analyze organized/disorganized attachment on a deeper level by focusing on the occurrence of attachment-related emotions and their regulation or resolution, the Adult Attachment Projective Picture System as a valid representational measure (AAP, George & West, 2001, 2012) using attachment-related pictures and the evaluation of stories to the pictures which are evaluated in several experimental, clinical, and non-clinical studies (e.g. Buchheim et al., 2009; Buchheim & George, 2012; Fizke, Buchheim, & Juen, 2013; Juen, Arnold, Meissner, Nolte, & Buchheim, 2013) is employed.

The AAP procedure can identify the occurrence of emotion-regulating processes with respect to attachment-related emotions such as e.g. danger, suicide, helplessness, loss of a significant other, rejection, isolation, and abuse. The designation of the attachment category, however, does not provide specific information about occurrence, severity, and quality of emotion regulation or dysregulation. Therefore in this study, an additional rating system was used to assess attachment-related emotions and the high or low occurrence of their regulating processes (see more details in the Methods Section).

In the present study, cortisol reactivity was compared between high versus low occurrence of attachment-related emotion regulation as well as between organized and disorganized attachment groups after the TSST in a large healthy sample. Three hypotheses were tested:

1. Following Bakermans-Kranenburg and van IJzendoorn (2009), we expected that about 15–30\% of the healthy subjects would show a disorganized attachment representation.
2. Lam et al. (2009) showed that a high occurrence of suppression (avoidance) and of reappraisal (reframing) predict a heightened cortisol reactivity to an acute stressor. Therefore, we expected that subjects with a high occurrence of emotion regulation in response to attachment-related emotions would show a higher cortisol reactivity after the TSST than individuals with a low occurrence of emotion regulation.

3. Since the disorganized/unresolved attachment (U) group is not able to reorganize emotions and momentarily becomes flooded by attachment-related emotions (George & West, 2012) as well as following the results by Pierrehumbert et al. (2012), we hypothesized that disorganized subjects would show a flattened cortisol increase compared to organized subjects during the TSST.

Method

Subjects

The sample was comprised of 98 subjects recruited from among students of the University of Technology, Dresden. Since age and gender influence cortisol reactivity (Kudielka, Hellhammer, & Kirschbaum, 2007), the subjects were recruited within a specific age range of 19–29 years (M = 23.33, SD = 2.47) with an even distribution of gender (n = 49 men and 49 women). The subjects were screened for interfering variables via telephone interviews. None of the subjects were on any medication, and the women were not taking any contraceptive pills. The subjects were non-smokers, had a Body Mass Index (BMI) between 18 and 27, and did not report any chronic illnesses that would be considered an influence on the HPA axis. Furthermore, the Structured Clinical Interview (SCID) (First, Spitzer, Gibbon, & Williams, 1997; Wittchen, Zaudig, & Fydrich, 1997) for the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) was used to ascertain that no psychological or psychiatric illness was present (APA, 2000). The women’s menstruation cycle was standardized, testing only during the luteal phase.

Procedure

The study was approved by the local ethical committee of the Medical Faculty of the Technische Universitaet Dresden, Germany and proceeded in accordance with the ethics guidelines of the Helsinki Declaration (No#EK391122010). The subjects were informed about the aim and the procedure of the study and gave written consent for the participation. In the first testing session the subjects took part in a psychosocial stress test, the Trier Social Stress Test (TSST) (see Figure 1). The cortisol reactivity and the heart rate were measured before, during, and after the TSST to specify the physiological stress reactivity. Saliva probes in cotton tubes were taken to specify the cortisol; the heart rate was measured by a polar watch system. The State-Trait-Anxiety-Inventory (STAI; Laux, Glanzmann, Schaffner, & Spielberger, 1981) was administered before and after the TSST in order to specify the degree and the increase of anxiety state. In the second testing session, the Adult Attachment Projective Picture System (AAP, George, & West, 2001, 2012) was administered to determine the subjects’ adult attachment status as organized versus disorganized and to code the occurrence of attachment-related emotions and their resolution.
Psychological measures

The **STAI** (Laux et al., 1981) assesses state and trait anxiety. Each scale (state and trait) contains 20 items. The items can be evaluated on a five-point Likert scale with a range from 20 to 80. For the trait-anxiety-scale, the reliability coefficients (Cronbach’s Alpha) ranged between .88-.94 whereas for the state-anxiety-scale it ranged between .90-.94 in different published samples (Laux et al., 1981).

The **Adult Attachment Projective Picture System** (AAP; George, & West, 2001, 2012) measures the adult attachment representation based on the analysis of a set of seven standardized drawings of attachment scenes. The subjects are asked to tell a story in response to a picture stimulus that portrays an attachment event such as loneliness, separation, threat, or death. The responses were analyzed using verbatim transcripts to evaluate the mental organization of attachment. Based on the AAP, subjects can be classified into four patterns of attachment representation: Secure attachment (F), insecure-preoccupied (E), insecure-avoidant (Ds) and unresolved (U). Secure (F) and insecure (Ds, E) are the so called organized patterns, while the unresolved attachment (U) is the so called disorganized pattern.

Psychometric properties are excellent (George & West 2001, 2012). AAP inter-rater reliability between independent judges showed agreement of 90% (kappa = .85, p = .000, n = 144). In the present study, the interrater-reliability of the reliably certified judges (A.B., K.P.) was 92% based on 20% of the AAPs for organized-disorganized attachment (kappa = .89, p<.001).

The comparison with the Adult Attachment Interview (AAI; George et al., 1985; Main & Goldwyn, 1984/1998; Main, Goldwyn, & Hesse, 2003), another established measure for assessing the attachment representation (see Buchheim & George, 2012; George & West, 2012), showed a convergent validity of 90% for the four major attachment groups (kappa = .84, p <.000). The convergent agreement for two group classifications was 97% (kappa = .88, p <.000) (George & West, 2012). Furthermore, the disorganized attachment classification in the AAI could be identified by the AAP with high concordance (a concordance rate of 95% for classifying individuals as organized versus unresolved) (Hörz, Mertens, & Buchheim, 2011).
Rating system

The subjects are judged disorganized/Unresolved (U) when they show emotional dysregulation in their narratives while talking about desperation, fear, abandonment, or other threatening situations. Dysregulation on a narrative level is operationalized 1) by the occurrence of words in the stories representing categories such as failed protection, danger, isolation etc. and 2) by the incapacity to resolve this described danger or threat by using, e.g., internal mentalization processes, a haven of safety, or the capacity to act in a constructive way. Examples for resolution are words or markers representing e.g. protection, thinking, help, comfort, reassurance. This representational failure, evident in the AAP stories, indicates that subjects are overwhelmed by attachment-related emotions associated with danger, fear, abuse, or loss. In order to differentiate the severity and the quality of emotion dysregulation with respect to these attachment-related threats and the subject’s potential resolution, an additional rating system was developed. The word “resolution” is used in the field of attachment to designate an individual’s ability to re-organize attachment dysregulation and threats that have become unleashed when the attachment system is activated. Potentially dysregulating attachment-related emotions and threats are organized and protect the individual from becoming overwhelmed, disorganized, dysregulated, or disoriented (George & Solomon, 1996, 2008; Solomon & George, 1996; Solomon, George, & De Jong, 1995). Attachment resolution means that the internal working model of attachment is re-organized when dysregulation occurs during assessment. We use the designation of “R” in the AAP coding scheme (George & West 2012). Based on the statistical percentiles, three frequencies of resolution occurrence could be identified for the AAP narratives in the following way: low occurrence of emotional regulation processes (a low amount of Resolution markers (R) in the whole AAP interview (1–2 Rs, n = 31), high occurrence of emotional regulation processes (a high amount of Resolution markers (R) (≥3 Rs, n = 33), and failed emotional regulation, i.e. no resolution in minimum one of the seven stories (no Resolution = Unresolved, U, n = 30).

Stress paradigm and endocrine measures

The Trier Social Stress Test (TSST) was implemented for a standardized test of the HPA axis reactivity (for a detailed description and evaluation of the TSST, see Kirschbaum et al., 1993; Kudielka et al., 2007). Based on the standardized protocol, a preparation time (five minutes) for the mock job interview was followed by the mock job interview (5 minutes) and a task of mental arithmetics (five minutes). The collection of the saliva probes is described in Figure 1. The subjects were instructed to gently move a cotton swab around their mouth while chewing on it for one minute. For a quick and hygienic collection, Salivette swabs were used (Sarstedt, Nümbrecht, Germany) which were kept frozen at −20 °C until assay. To produce a clear supernatant of low viscosity, the salvia probes were first centrifuged at 3000 rpm for 5 min. For cortisol analysis 50 μl were removed using an immunoassay with chemiluminescence detection. The lower detection limit of this assay is 0.43 nmol/l. Intra- and inter-assay coefficients of variation were below 8% for low (3 nmol/l) and high (25 nmol/l) cortisol levels, respectively.

Statistical analysis

Analyses of variance (ANOVAs) for repeated measures were performed to reveal possible main or interaction effects in cortisol, momentary anxiety, and heart rate responses to the TSST for the attachment classification. Greenhouse-Geisser correction was applied to account for violations of the sphericity assumption. A response to the TSST was defined as an increase in cortisol levels of 2.5 nmol/l over the baseline (Van Cauter & Refetoff, 1985). Data analyses were performed using SPSS v. 12 (SPSS Inc., Chicago, IL, USA).
Results

Distribution of attachment classifications

According to our first hypothesis the distribution of the attachment representation in the present healthy sample revealed 69.4% percent organized and 30.6% percent disorganized attachment representation.

Evaluation of the stress induction

There were no differences among baseline cortisol levels \((F = 1.251, df = 1, p = .266)\) and heart rate or pre-stress heart rate \((F = 0.122, df = 1, p = .727)\) between the attachment representations. In order to specify the stress induction, the cortisol, heart rate and momentary anxiety before and after the TSST were observed. The TSST was followed by a significant increase in cortisol reactivity \((F = 55.899, df = 1.92, p < .001)\), heart rate \((F = 129.284, df = 1.33, p < .001)\) and in a momentary degree of anxiety across all subjects from the onset of the stress induction to the recovery \((F = 34.916, df = 1.00, p < .001)\). Due to the psychosocial stress, 87% \((N = 86)\) showed a significant cortisol response, 9% \((N = 9)\) presented no response, and only 3% \((N = 3)\) displayed a decrease in the cortisol concentration due to the psychosocial stress.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Total sample</th>
<th>Organized</th>
<th>Disorganized</th>
<th>(F (df))</th>
<th>(p)</th>
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</thead>
<tbody>
<tr>
<td><strong>Cortisol nmol/l; MW (SD)</strong></td>
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<tr>
<td>Baseline (-15min)</td>
<td></td>
<td>6.70 (5.07)(^a)</td>
<td>5.85 (4.29)</td>
<td>55.899 (5,460)</td>
<td>&lt;.001***</td>
</tr>
<tr>
<td>-2min</td>
<td></td>
<td>6.28 (4.58)(^a)</td>
<td>5.19 (3.57)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+2min</td>
<td></td>
<td>10.01 (6.69)(^a)</td>
<td>8.23 (4.75)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+10min</td>
<td></td>
<td>13.97 (9.36)(^a)</td>
<td>10.48 (6.65)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+20min</td>
<td></td>
<td>13.51 (8.59)(^a)</td>
<td>11.13 (7.03)</td>
<td></td>
<td></td>
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<tr>
<td>+30min</td>
<td></td>
<td>10.92 (7.03)(^a)</td>
<td>10.06 (7.37)</td>
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</tr>
<tr>
<td><strong>Heart Rate (bpm); MW (SD)</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (-5min)</td>
<td></td>
<td>81.23 (12.83)(^b)</td>
<td>80.19 (11.48)(^c)</td>
<td>129.284 (2,176)</td>
<td>&lt;.001***</td>
</tr>
<tr>
<td>During TSST (interview)</td>
<td></td>
<td>105.57 (21.32)(^b)</td>
<td>105.06 (23.12)(^c)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery (+15min)</td>
<td></td>
<td>83.88 (15.82)(^b)</td>
<td>81.52 (9.94)(^c)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STAI-State pre</td>
<td></td>
<td>36.49 (7.26)(^d)</td>
<td>37.10 (6.88)(^e)</td>
<td>34.916 (1,94)</td>
<td>&lt;.001***</td>
</tr>
<tr>
<td>STAI-State post</td>
<td></td>
<td>43.10 (10.01)(^d)</td>
<td>(10.64)(^e)</td>
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</tbody>
</table>

Note. \(^a\) \(N = 65\); \(^b\) \(N = 63\); \(^c\) \(N = 27\); \(^d\) \(N = 67\); \(^e\) \(N = 29\).

\***p \leq .001.

Attachment classification and cortisol level

For testing the second hypothesis the cortisol reactivity between the organized vs. disorganized attachment representation was compared in order to specify the attachment-specific stress reactivity (area under the curve with respect to ground: \(AUC_{WG}\)).
One-way ANOVA found no difference in stress reactivity \( (F = 2.230, df = 1, p = .139, d = 0.33) \) and in the delta (peak minus baseline) between the organized and disorganized groups \( (F = 0.960, df = 1, p = .330, d = 0.22; \text{see Figure 2}) \). However, the analyses showed a difference in the recovery process \( (peak \text{minus} \text{recession}, \text{see Pierrehumbert et al., 2012}) \) between subjects with a disorganized attachment representation showing a prolonged salivary cortisol recovery and the subjects with an organized attachment representation \( (F = 7.299, df = 1, p = .008, d = 0.60; \text{means} \text{standard deviation): organized} 2.82 (3.42) \text{vs. disorganized} 0.74 (3.52) \).

### Table 2

**Cortisol reactivity and attachment classification**

<table>
<thead>
<tr>
<th></th>
<th>Total sample ( N = 98 )</th>
<th>Organized (^a)</th>
<th>Disorganized (^b)</th>
<th>( F (df) )</th>
<th>( p )</th>
<th>( d )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cortisol AUCg</strong></td>
<td></td>
<td>52.58 (30.75)</td>
<td>42.99 (23.59)</td>
<td>2.230 (1,92)</td>
<td>.139</td>
<td>0.33</td>
</tr>
<tr>
<td><strong>MW (SD)</strong></td>
<td></td>
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<tr>
<td><strong>Cortisol Delta</strong></td>
<td></td>
<td>8.71 (9.27)</td>
<td>6.81 (7.16)</td>
<td>.960 (1,92)</td>
<td>.330</td>
<td>0.22</td>
</tr>
<tr>
<td><strong>MW (SD)</strong></td>
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<tr>
<td><strong>Cortisol Recovery</strong></td>
<td></td>
<td>2.82 (3.41)</td>
<td>.74 (3.52)</td>
<td>7.299 (1,92)</td>
<td>.008**</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>MW (SD)</strong></td>
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</tbody>
</table>

**Note.** \(^a\) \( N = 65 \); \(^b\) \( N = 29 \).

\( \* p \leq .01 \). \( \* p \leq .05 \) small effect, \( \* \leq 0.80 \) moderate effect.

### Occurrence of emotional regulation processes

The occurrence of attachment-related emotional regulation processes were compared concerning their cortisol reactivity in the TSST. There was a significant difference in the AUC\(_{ground}\) \( (F = 3.40, df = 2, p = .038, d = 0.07) \). As expected, the main effect was seen when comparing subjects with a high occurrence of emotional regulation processes of the attachment emotions (R-high) to subjects with a low occurrence (R-low) or disorganized attachment (U = Unresolved) (see Table 3, Figure 2). As proposed, subjects with a high occurrence of emotional regulation processes showed a higher cortisol level than the ones with a disorganized attachment as well as the ones with a low occurrence of emotional regulation processes of the attachment emotions.

### Table 3

**Cortisol reactivity and occurrence of emotional regulation processes of attachment emotions**

<table>
<thead>
<tr>
<th></th>
<th>Total sample ( N = 98 )</th>
<th>R-low (^a)</th>
<th>R-high (^b)</th>
<th>Unresolved</th>
<th>( F (df) )</th>
<th>( p )</th>
<th>( \eta^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cortisol AUCg</strong></td>
<td></td>
<td>45.41 (28.57)</td>
<td>60.10 (31.70)</td>
<td>43.00 (23.41) (^c)</td>
<td>3.398 (2,90)</td>
<td>.038*</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>MW (SD)</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Cortisol Delta</strong></td>
<td></td>
<td>7.44 (8.68)</td>
<td>10.37 (9.79)</td>
<td>6.35 (6.98) (^d)</td>
<td>1.853 (2,91)</td>
<td>.163</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>MW (SD)</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Cortisol Recovery</strong></td>
<td></td>
<td>2.67 (3.26)</td>
<td>3.00 (3.65)</td>
<td>.77 (3.46)</td>
<td>3.700 (2,91)</td>
<td>.029*</td>
<td>0.07</td>
</tr>
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<td><strong>MW (SD)</strong></td>
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</table>

**Note.** \(^a\) \( N = 31 \); \(^b\) \( N = 33 \); \(^c\) \( N = 29 \); \(^d\) \( N = 30 \).

\( \* p \leq .05 \). \( \eta^2 = 0.01 \) small effect, \( \eta^2 = 0.06 \) mild effect, \( \eta^2 = 0.14 \) strong effect.
Discussion

In line with the findings of the meta-analysis by Bakermans-Kranenburg and van IJzendoorn (2009), the distribution of the attachment representation in the present healthy sample revealed a 69.4% organized and a 30.6% disorganized attachment representation. In addition, the disorganized attachment pattern showed a prolonged cortisol recovery after the stressor. Furthermore, the cortisol reactivity differed significantly for the occurrence of emotional regulation processes of attachment-related emotions. Subjects with a high effort of emotional regulation processes of attachment threats showed a higher cortisol response than subjects with a failed emotional regulation (U) and the ones with a low occurrence of emotional regulation processes of attachment-related emotions.

Concerning the attachment classification, the findings were partly consistent with Pierrehumbert et al. (2012). The differences between the attachment patterns in the increase and the delta of the cortisol response could not be replicated in the present study. However, as in the clinical sample of Pierrehumbert et al. (2009), there were significant differences between the attachment patterns in the recovery of the cortisol response during the TSST in
the present healthy sample as well. The disorganized attached subjects showed a prolonged recovery compared to the organized attached subjects. Pierrehumbert et al. (2009) proposed that the chronic hyper-activation of the HPA axis in disorganized attached children may cause a desensitization of the endocrine system due to an exhaustion of the stress response system. The hypo-cortisolism and the exhaustion of the HPA axis could not be replicated by the present data.

The prolonged recovery in the present study might be explicable with the theory of allostasis and allostatic load by McEwen (1998).

Allostasis means “maintaining stability (or homeostasis) through change” (Sterling & Eyer, 1988) and describes how, e.g., the cardiovascular system adjusts to resting and active states of the body. The concept of “allostatic load” was proposed to refer to the wear and tear that the body experiences due to repeated cycles of allostasis as well as the inefficient turning on or shutting off of these responses (McEwen, 1998; McEwen & Stellar, 1993).

In the theory of allostasis and allostatic load, McEwen proposed that ‘repeated hits’ such as feelings of prolonged anxiety, insecurity, or chronic stress would lead to an increase in the allostatic load. This load would then lead to an ‘inadequate response’, characterized by a prolonged secretion of glucocorticoids. Due to a delayed recovery phase, the risk for an exhaustion of the HPA axis followed by an inadequate response is higher (McEwen, 1998). The deficiency of the HPA axis response might correspond to a prolonged adrenocortical secretion of the HPA axis (Bevans, Cerbone, & Overstreet, 2005).

In addition, the occurrence of emotional regulation processes of attachment-related emotions and the effort to stay organized led to distinct differences in the cortisol reactivity. The subjects with a high effort of emotional regulation processes showed a higher cortisol response than the subjects with a disorganized attachment and the one with a low occurrence of emotional regulation.

Even though the TSST is not an attachment stressor, the situation of personal evaluation, rejection by personalized negative evaluation by the committee as well as the time and evaluation pressure might threaten the attachment system or initiate emotion-regulating processes. Therefore, the groups of individuals with a different attachment representation might differ in their hormonal stress regulation in every interpersonal situation since the attachment representation influences the behavior, the cognitions, and the emotions in every interpersonal situation. Since the TSST is an interpersonal stressor, the hormonal response might differ due to the attachment representation.

It can be proposed that regulating the negative emotions of stressful situations may require effortful processing and self-control (Richards & Gross, 2000). This additional processing and controlling, in turn, could be responsible for the increased activation of the physiological systems, including the HPA axis. Recent findings and theoretical approaches such as dual process theories support this explanation since certain brain regions associated with cognitive control are activated when emotion regulation takes place (Cunningham & Zelazo, 2007; Evans, 2011; Goldin, McRae, Ramel, & Gross, 2008; Nolte et al., 2013; Van Overwalle & Vandekerckhove, 2013). In addition, the regulation of emotions
may also require enhanced attentional processes, which could lead to increased physiological processes (Butler, Wilhelm, & Gross, 2006). A recent study showed that attachment-related stress reduced the activation in mentalization-related brain regions (Nolte et al., 2013). However, it is still unknown if cognitive control, effort, or attention lead to an increased cortisol reactivity.

To the best of our knowledge, this is the first study regarding the influence of the emotional regulation processes of attachment fear on the HPA-axis reactivity under acute psychosocial stress in healthy subjects. One of the strengths of the study is that a standardized psychosocial stressor was implemented. Furthermore, attachment as well as the dimensions of the emotion-regulating processes were used to reach a more detailed understanding of the association of the disorganized attachment representation, the emotional regulation, and the HPA axis reactivity.

The limiting factors of this study were the small sample size in the cells. Therefore, the power may have been too low for significant differences between the organized and the disorganized attachment representation in regard to the cortisol reactivity. Thus, the results with respect to the occurrence of the emotional regulation processes of attachment fears need to be replicated in a larger sample in order to rule out a cohort effect. Since the recruited subjects were exclusively university students, the effects may be explained by a cohort effect. A general population sample would have been more representative.

For future research, a clinical sample with disorganized attachment would be of interest in order to replicate the effects based on the emotional regulation processes of attachment fear indicators. Furthermore, the reactivity to repeated stress, e.g., habituation would be of interest (Maunder, Lancee, Nolan, Hunter, & Tannenbaum, 2006) as it may be associated to the attachment representation. Jaremka and colleagues (2013) were able to show that attachment anxiety has a psychophysiological cost on the cellular immune response. Therefore, the immunological effect of attachment anxiety on the cortisol reactivity needs to be investigated with attachment-related emotion regulation as a moderator. In addition, the effect of cognitive control, effort as well as attention processes ought to be specified separately concerning their effects on cortisol reactivity.

References


ATTACHMENT DISORGANIZATION, ATTACHMENT-RELATED EMOTION REGULATION, AND CORTISOL RESPONSE


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