From infancy to young adulthood : the Leiden Longitudinal Adoption Study

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Attachment and physiological reactivity to infant crying in young adulthood: Dissociation between experiential and physiological arousal in insecure adoptees

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Abstract

The associations between attachment representations of adopted young adults (*N* = 69; 37 females) and their experiential and physiological arousal to infant crying were examined. Attachment representations were assessed with the Attachment Script Assessment (ASA), and the young adults listened to infant cries, during which ratings of cry perception were collected and physiological reactivity was measured. We found that secure adoptees showed clearer signs of parasympathetic withdrawal than insecure adoptees, indicating more adequate responding to external stressors in secure individuals. Compared to secure adoptees, insecure adoptees displayed a combination of lower perceived urgency and heightened sympathetic arousal, reflecting a deactivating style of emotional reactivity.

Keywords: adoption, adult attachment, Attachment Script Assessment, physiological reactivity, emotional reactivity

Introduction

Central to attachment is children's need for adult support when they struggle with negative feelings. Whereas parental support - e.g., comfort in case of distress - is expected to contribute to secure child attachment and emotional self-regulation, the lack of such support may reduce children's sense of security and may increase the risk of less effective emotion regulation (Cassidy, 2008). Based on their experiences with caregivers in (early) childhood and adolescence, individuals develop emotion regulation patterns that are shaped by the security of the relationship with their main attachment figures to cope with stressful situations without becoming too overwhelmed by negative emotions (Bowlby, 1969/1982; Dykas & Cassidy, 2011). In recent studies, physiological measures have been used to index emotional responding and regulation, potentially broadening our understanding of variation in emotional reactivity as a function of attachment security (e.g., Ablow, Marks, Feldman, & Huffman, 2013; Groh & Roisman, 2009; Oosterman, De Schipper, Fisher, Dozier, & Schuengel, 2010). In the present study we tested whether young adults' attachment representations, as measured with secure base scripts in the Attachment Script Assessment (ASA; Waters & Waters, 2006), were related to their experiential and physiological arousal to emotional stimuli.

The ASA (Waters & Waters, 2006) is a cost-effective alternative to the gold standard of adult attachment assessment, the Berkeley Adult Attachment Interview (AAI; George, Kaplan, & Main, 1996; Hesse, 2008; Main, Goldwyn, & Hesse, 2003). The concept of a secure base script is derived from attachment theory (Waters & Cummings, 2000) and makes use of insights from cognitive science, in particular research on mental models. Similar to the idea of internal working models (Bowlby, 1969/1982), a secure base script is considered a mental representation that is formed based on an individual's history of secure base support (Waters & Rodrigues-Doolabh, 2001). Consistent and coherent support leads to a script that is easily accessible and includes the idea that the primary caregiver will be there for support, especially in times of need. Inconsistent or ineffective support leads to a script that is incomplete and less accessible or includes more negative expectations about significant others (Waters & Waters, 2006).

Attachment and emotional reactivity

Individual variation in young adults' attachment representations as reflected in different styles of emotional responding should become clearest when young adults are confronted with attachment-related stressors (Goldberg, Grusec, & Jenkins, 1999; Kobak, Cole, Ferenz-Gillies, Fleming, & Gamble, 1993). Infant crying is such a stressor; infant cries evoke physiological arousal in adults, both males and females, parents and non-parents (Frodi, Lamb, Leavitt, & Donovan, 1978; Groh & Roisman 2009). Infant cry sounds provide information about the infant's health and level of distress (Gustafson, Wood, & Green, 2000; Murray, 1979), and are produced to elicit caregiving responses (Bowlby, 1969/1982; Murray, 1979; Zeifman, 2001). For example, high-pitched cry sounds are indicative of higher levels of infant distress (Zeskind, Sale, Maio, Huntington, & Weiseman, 1985), and adults are likely to perceive these signals as more urgent and in need of more prompt caregiving behaviors than low-pitched cries (Out, Pieper, Bakermans-Kranenburg, Zeskind, & Van IJzendoorn, 2010). There is also evidence that adults become increasingly sensitized to repeated infant distress signals (e.g., Out et al., 2010). Repeated exposure to cry sounds is therefore considered as more stressful and tends to evoke heightened physiological arousal.

According to Dykas & Cassidy (2011), individuals process social information in a way that is congruent with their attachment-related experiences: secure individuals process it in a positively biased manner, whereas insecure individuals process it in a negatively biased manner. However, if the information is attachment related and emotional components of the information are likely to cause psychological distress, insecure individuals might use an emotional response style characterized by defensive exclusion of the information from further processing (Bowlby, 1980; Dykas & Cassidy, 2011). Thus, dependent on the type of information received (non-threatening versus threatening), insecure individuals will either process information using a strategy marked by hyperactivation or marked by deactivation (Kobak et al., 1993).

Several studies have shown links between an adult's AAI classification as insecure, either dismissing or preoccupied, and physiological reactivity to attachment-related stressors. Deactivating strategies during the AAI were associated with electrodermal increases (Skin Conductance Level; SCL) in reaction to negative attachment stimuli (Ablow et al., 2013; Dozier & Kobak, 1992; Holland & Roisman, 2010; Roisman, 2007; Roisman, Tsai, & Chiang, 2004), whereas hyperactivation strategies were associated with increases in heart rate (Roisman, 2007). Using the ASA to assess attachment, Groh and Roisman (2009) found that low scores on the ASA were uniquely linked to heightened electrodermal activity (SCL) in individuals listening to infant crying.

Besides electrodermal activity as a measure of sympathetic activity, parasympathetic activity (Respiratory Sinus Arrhythmia; RSA) and its link with attachment is relevant. It has been suggested that secure individuals show clearer signs of parasympathetic withdrawal or vagal tone when confronted with attachment-related stressors, which might be an indicator of more adequate responding to external stressors in these individuals compared to insecure individuals (Joosen et al., 2012; Porges, Doussard-Roosevelt, & Maiti, 1994). However, a replicable pattern of associations between quality of attachment and parasympathetic activity has not been established yet (Dias, Soares, Klein, Cunha, & Roisman, 2011; Hill-Soderlund et al., 2008; Oosterman et al., 2010; Roisman, 2007).

The present study

In our study we tested whether attachment representations were associated with experiential arousal and both sympathetic and parasympathetic reactivity to infant cries in adopted young adults. The adoptees were raised by their biologically unrelated adoptive parent, and as a consequence possible associations are not confounded by genetic influences (Harris, 1998; Haugaard & Hazan, 2003; Rowe, 1993).

Based on the positive experiences with their attachment figures, secure adoptees were expected to show optimal emotional reactivity (Bowlby 1969/1982; Izard & Kobak, 1991), processing the attachment-related information in a relatively open manner (Dykas & Cassidy, 2011). That is, we expected them to show parasympathetic withdrawal during exposure to the cries, and convergence between experiential and physiological arousal, with both experiential and physiological arousal being higher during exposure to the cries versus baseline and recovery, and in later versus previous blocks of cry sounds due to repeated exposure (Out et al., 2010). Insecure adoptees were expected to display less optimal emotional reactivity, characterized by either a hyperactivating or a deactivating strategy (Kobak et al., 1993). In case of hyperactivation, insecure adoptees will display both heightened experiential and physiological arousal in reaction to the infant cries compared to secure adoptees. In case of deactivation, exclusion of the attachment-related information from further processing will result in heightened physiological arousal in the absence of heightened experiential arousal compared to secure adoptees (Diamond, Hicks, & Otter-Henderson, 2006), or flattened experiential and physiological arousal to the infant cries, dependent on how complete the exclusion of information is (Bowlby, 1980).

Method

Participants

In the Leiden Longitudinal Adoption Study 190 internationally adopted children (100 girls) were followed from infancy to the age of 23 years (for details on earlier phases of the study, see Beijersbergen, Bakermans-Kranenburg, Van IJzendoorn, & Juffer, 2008; Jaffari-Bimmel, Juffer, Van IJzendoorn, Bakermans-Kranenburg, & Mooijaart, 2006; Stams, Juffer, & Van IJzendoorn, 2002). The children arrived in the Netherlands before the age of six months (M = 10.28 weeks, SD = 5.42) and were adopted from Sri Lanka (n = 116), South Korea (n = 49), and Colombia (n = 25). The adoptive families were randomly recruited through Dutch adoption agencies. Children's placement in adoptive families was based solely on the parents' position on the waiting list of the adoption agency, and not on characteristics of the parents or children. All parents were Caucasian and came from predominantly middle-class socioeconomic backgrounds. For the current study, 69 adoptees (37 females) were included (see below).

Procedure

In infancy, home visits took place at 5, 6, 9, and 12 months, and mother and child came to the laboratory at 12, 18, and 30 months. During the home visits 50 randomly selected families received a short-term intervention to promote maternal sensitivity (Juffer, Bakermans-Kranenburg, & Van IJzendoorn, 2005). In the follow-up assessments at 7, 14, and 23 years, four major domains of development were investigated: social development, personality development, cognitive development, and behavioral adjustment. The current study uses physiological measurements to examine social-emotional functioning at age 23. At this age, the adoptees came to the laboratory and attachment representations were assessed. In the same laboratory visit, they also completed a computer task with a cry paradigm. During this task, ratings of cry perception were collected, the electrocardiogram (ECG) and thoracic impedance (to obtain a breathing signal) were recorded, and the level of skin conductance was measured. The young adults also completed an intelligence test.

Attrition

The original sample consisted of 160 families. At 7 years, 30 adoptive families from the same population were added to the sample. Compared to the original sample no differences in background variables were found (Stams et al., 2002). In middle childhood, 146 of the 160 adoptive families participated (9% attrition), and in adolescence there was 11% attrition, with 143 of the 160 families participating (Jaffari-Bimmel et al., 2006). At 23 years, 62% of the eligible 190 adoptees participated in the study. At this assessment, long traveling distance, lack of interest, or time constraints were the major reasons for nonparticipation. For the current study, out of the 117 participating adopted young adults, 69 were selected based on their attachment classification (see below).

Measures

Attachment representations. The Attachment Script Assessment (ASA; Waters & Waters, 2006) was conducted in young adulthood to assess attachment representations. Participants received four prompt word outlines that were developed to evoke the production of attachment-related stories. Both mother/child stories and adult/adult stories were included. Participants were instructed to use the twelve provided words to frame their best possible story, and they were stimulated to elaborate on the story. Stories were audiotaped and literally transcribed. Transcripts were scored based on the presence or absence of a prototypic secure base script; this script suggests that there is a secure base in the story (parent or partner) who helps the main character deal with distress and helps things get back to normal (Waters & Waters, 2006). Stories were coded on a 7-point scale (higher scores indicating more secure attachment) by three coders who were blind to all background information and to the other stories told by the same participant. Intercoder reliability at two stages of the scoring process (at the start and at the end) ranged between .78 and .88 (intraclass correlations, single measure, absolute agreement). Reliability and validity of the ASA measure have been tested in various cross-national studies (Bost et al., 2006; Coppola, Vaughn, Cassibba, & Costantini, 2006; Dykas, Woodhouse, Cassidy, & Waters, 2006; Vaughn et al., 2006; Veríssimo & Salvaterra, 2006), see Bakermans-Kranenburg (2006) for a summary of the findings.

Attachment security scores were categorized into three groups based on the content of the ASA rating scale (Waters & Rodrigues-Doolabh, 2004). According to this scale, stories with scores below 3 contain negative or insecure elements, for example brief, disjointed or inconsistent stories, whereas positive or secure elements are found in stories coded around 4 or higher. In accordance, we used cut-off scores of 3 and 3.75 (Waters & Waters, 2006) to distinguish participants labeled as insecure (n = 18) from those showing some security (n = 47), and those labeled as secure (n = 51), respectively. For the analyses, we decided to focus on the insecure versus the secure group (N = 69).

Cry paradigm. Following a 4-min baseline of neutral images (landscape photographs), three blocks with each three cry sounds were presented through Sennheiser HD202 headphones at a constant volume. Within blocks, cries of 500, 700, and 900 Hz were presented in a random order. In between baseline and the first block of sounds, participants practiced with the cry of 500 Hz to get used to the format of the task. Exposure to cry sounds was followed by a 4-min recovery of neutral images (landscape photographs). Stimulus presentation was controlled by E-prime 2.0 software (Psychology Software Tools, Inc.).

Cry stimuli were obtained by recording the spontaneous crying of a healthy, 2-day-old, normal birth weight, and full-term baby girl, of which a 10-second period was selected. The seven cry expirations within sounds had a mean duration of 1055 msec (range, 545 to 1899 msec) and a mean fundamental frequency peak F0 of 452.6 Hz (range, 425.2 to 515.6 Hz; 500 Hz Cry). To provide cry stimuli with a wide range of fundamental frequencies, the original cry (averaging approximately 500 Hz) was digitally altered to increase the fundamental frequency while holding temporal and other spectral aspects of the cry constant. Two new 10-sec cry stimuli were created by digitally increasing the original cry by approximately 200 and 400 Hz, respectively, resulting in two new cry sounds with an overall peak of F0 = 714.5 Hz (700 Hz Cry) and F0 = 895.8 Hz (900 Hz Cry). The acoustic and temporal structure of the original cry sound is characteristic of the cries of normal, healthy infants (e.g., LaGasse, Neal, & Lester, 2005; Wasz-Höckert, Michelsson, & Lind, 1985). Fundamental frequencies of 700 and 900 Hz (and even higher) are observed in transient pain cries of healthy infants and in infants being separated from their parents (Porter, Porges, & Marshall, 1988; Zeskind & Collins, 1987), as well as in cries of infants with medical and neurological conditions (Soltis, 2004).

The presentation of each stimulus was followed by a rating of the participant's perception of the characteristics of the cry on four rating scales with a 5-point scale: not aroused – aroused, not urgent – urgent, healthy – sick, not aversive – aversive (Zeskind & Lester, 1978). Following Out et al. (2010), who found one component underlying these ratings, we used a composite urgency score of the four questions for each block of cry sounds. Cronbach's alphas ranged from .70 to .76. The cry stimuli as well as the design of this particular paradigm have been used with different samples in previous studies on physiological reactivity to infant crying (Joosen et al., 2012; Out et al., 2010; Riem, Pieper, Out, Bakermans-Kranenburg, & Van IJzendoorn, 2011).

Inter-Beat Interval (IBI), Skin Conductance Level (SCL), and Respiratory Sinus Arrhythmia (RSA). The Ambulatory Monitoring System (VU-AMS5fs, TD-FPP, Vrije Universiteit, Amsterdam, the Netherlands; De Geus, Willemsen, Klaver, & Van Doornen, 1995) was used to measure the electrocardiogram (ECG), thoracic impedance, and level of skin conductance during the cry paradigm (see Bimmel, Van IJzendoorn, Bakermans-Kranenburg, Juffer, & De Geus, 2008, and Beijersbergen et al., 2008 for earlier findings on the use of the VU-AMS device in our sample of adoptees). For the ECG, three disposable pre-gelled Ag-AgCl electrodes (ConMed, New York, USA) were placed below the right collar bone 4 cm to the right of the sternum, 4 cm under the left nipple, and at the lateral right side. For the ICG, four electrodes were attached at the top end of the sternum between the tips of the collarbones, on the spine, at the low end of the sternum where the ribs meet, and again on the spine (at least 3 cm below the previous one). To measure skin conductance, two small Ag-AgCl electrodes, filled with isotonic GEL101 electrode paste, were placed on the middle and index finger of the adoptee's non-dominant hand.

VU-DAMS software packages derived Inter-Beat Interval time series (IBIs) by automatic peak detection of the R-wave. We inspected each ECG recording and corrected it manually when necessary. The software automatically derived average IBI and SCL per segment (i.e., the 4-min. baseline, each individual 10-sec. cry sound, and the 4-min. recovery period), and marked inspirations and expirations from the thoracic impedance signals. RSA was calculated per breathing cycle as the difference between the longest IBI during expiration and the shortest IBI during inspiration and averaged across each labeled period. RSA values for breaths with an invalid RSA were set to zero. IBI, SCL, and RSA values were averaged across the three cry sounds in each block. Change scores were created for each of the three blocks and the recovery by subtracting baseline values from those obtained during the other episodes.

IQ at 23 years. To enable controlling for differences in IQ related verbal fluency, intelligence of the participants was measured with a revised version of the Groningen Intelligence Test that became available in 2004 (GIT 2; Luteijn & Barelds, 2004). Test-retest reliability was above .80 for all subtests. A correlation of $r = .54$ was found between GIT 2 IQ scores and educational level (Luteijn & Barelds, 2004). The abbreviated version used in this study consisted of five subtests: Vocabulary, Matrices, Puzzles, Figures, and Numeracy. Scores for the first two subtests were summed ($r = .39$, $p = .001$) and transformed into a verbal IQ score.

Statistical analyses
A repeated measures ANOVA was conducted to examine the association between attachment security and perceived urgency of the cry sounds, with perceived urgency as outcome measure, three blocks of cry sounds as within-subjects factor, and attachment security as between-subjects factor.

To examine the relation between attachment security and physiological reactivity to the cry sounds, repeated measures ANOVAs were performed with IBI, SCL and RSA change scores as outcome measures, episode (three blocks of cry sounds and recovery) as within-subjects factor, and attachment security as between-subjects factor. Greenhouse-Geisser epsilon was used to correct for violation of sphericity when necessary.

Results

Preliminary analyses
Table 1 presents the descriptives of the physiological variables for the two groups of attachment security (secure versus insecure). The original physiological scores were transformed into change scores, and we checked standardized kurtosis and skewness per episode for both IBI, SCL and RSA. Variables with standardized skewness or kurtosis outside the normal range (numerical values more than three times larger than their standard error) included the first episode of IBI, all episodes of SCL and the last three episodes of RSA. These variables were winsorized preserving the original order (Tabachnik & Fidell, 2001).

The correlations among the physiological measures in all episodes of the cry paradigm are shown in Table 2. Significant correlations were found for different episodes using the same physiological measure and between measures of IBI and RSA, independent of episode.

No associations were found between attachment security status (secure versus insecure) and major background variables such as country of origin, experimental condition of the short-term intervention in infancy, socioeconomic status of the adoptive parents, age on arrival and age at testing in young adulthood (p ranged

Table 1. *Descriptive statistics of two groups of attachment security.*

		Secure			Insecure		
		M	*SD*	*N*	*M*	*SD*	*N*
Urgency	Block 1	2.52	.64	50	2.32	.72	18
	Block 2	2.68	.73	50	2.23	.79	18
	Block 3	2.73	.66	50	2.23	.87	18
IBI	Baseline	841.83	112.06	48	829.84	131.24	18
	Block 1	850.06	108.56	48	846.56	126.42	18
	Block 2	839.99	110.38	48	831.10	117.49	18
	Block 3	828.74	111.17	48	811.94	119.84	18
	Recovery	827.43	109.26	48	809.88	124.57	18
SCL	Baseline	5.58	3.60	48	5.98	4.29	18
	Block 1	6.22	3.95	48	6.67	4.66	18
	Block 2	6.26	3.88	48	6.90	4.69	18
	Block 3	6.29	3.81	48	7.10	5.06	18
	Recovery	6.23	3.76	48	7.43	5.01	18
RSA	Baseline	77.04	35.66	48	64.50	24.96	18
	Block 1	68.38	39.14	47	63.48	38.02	18
	Block 2	68.36	38.34	47	72.33	34.99	18
	Block 3	63.92	33.45	47	73.76	45.55	18
	Recovery	70.91	33.93	48	63.73	24.49	18

Note. Based on scores before transformation and winsorizing.

Table 2. *Correlations among physiological measures.*

	IBI.b	IBI.1	IBI.2	IBI.3	IBI.r	SCL.b	SCL.1	SCL.2	SCL.3	SCL.r	RSA.b	RSA.1	RSA.2	RSA.3	RSA.r
IBI.b	-														
IBI.1	.94**	-													
IBI.2	.93**	.95**	-												
IBI.3	.93**	.94**	.96**	-											
IBI.r	.96**	.94**	.93**	.94**	-										
SCL.b	-.14	-.08	-.10	-.08	-.07	-									
SCL.1	-.16	-.10	-.13	-.10	-.09	.99**	-								
SCL.2	-.17	-.10	-.13	-.10	-.10	.98**	.99**	-							
SCL.3	-.15	-.08	-.12	-.09	-.09	.96**	.98**	.99**	-						
SCL.r	-.15	-.08	-.12	-.09	-.09	.95**	.97**	.99**	.99**	-					
RSA.b	.43**	.38**	.40**	.36**	.37**	-.14	-.15	-.15	-.15	-.16	-				
RSA.1	.30*	.35**	.37**	.38**	.29*	-.10	-.11	-.10	-.10	-.10	.72**	-			
RSA.2	.39**	.42**	.41**	.38**	.37**	-.08	-.10	-.09	-.08	-.08	.77**	.67**	-		
RSA.3	.32**	.33**	.34**	.34**	.30*	-.12	-.12	-.11	-.10	-.10	.65**	.66**	.74**	-	
RSA.r	.45**	.42**	.44**	.45**	.46**	-.09	-.10	-.10	-.10	-.10	.85**	.78**	.80**	.73**	-

Note. Based on scores before transformation and winsorizing; b: baseline, 1: block 1, 2: block 2, 3: block 3, r: recovery; N ranges between 64 and 66; * $p < .05$; ** $p < .01$.

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between .37 and .98). Also, verbal IQ of the adoptee was not associated with group assignment (p = .47). The only exception was gender: girls were overrepresented in the secure group (62.7%), χ^2 (1, N = 69) = 6.54, p = .011.

Group differences in perceived urgency

A main effect of episode on perceived urgency was absent (p = .66), but a main effect of attachment security did appear, F(1, 66) = 4.53, p = .037, partial η^2 = .06. Follow-up t-tests per block revealed that differences between secure adoptees and insecure adoptees became larger in later, more stressful blocks: secure adoptees reported significantly higher urgency of the cry sounds in block 2, t (66)= -2.23, p = .013, and block 3, t (66)= -2.51, p = .015. An interaction between blocks and attachment security also emerged, F(2, 66) = 3.16, p = .046, partial η^2 = .05. Significant differences were found in the contrast analyses for the contrasts from block 1 to block 3, F(1, 66) = 5.96, p = .017, partial η^2 = .08. Secure adoptees rated the cry sounds in later blocks as more urgent than in previous blocks, whereas the insecure adoptees did not display this increase in self-rated urgency of the cry sounds over time, see Figure 1.

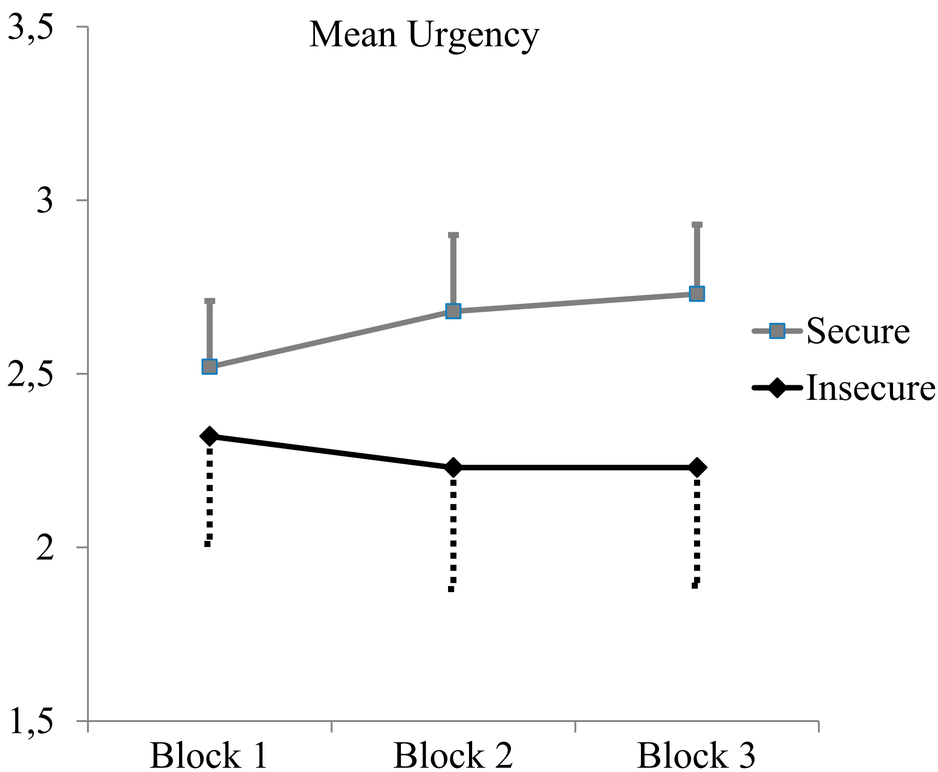

Figure 1. Perceived urgency of cry sounds (M, SE) across blocks for two groups of attachment security.

Group differences in physiological reactivity

No significant differences in baseline values were found for IBI and SCL in the comparison of the secure and insecure group (*ps* > .69). For RSA, baseline values of the secure participants (M = 77.04, SD = 35.68) were somewhat larger than those of the insecure participants (M = 64.50, SD = 24.96), but the difference was not significant (t = -1.37, p = .18). Change scores were correlated with baseline values for each physiological measure, and in case of significant correlations, we also conducted the analyses with baseline entered as a covariate. All main effects and interaction effects remained significant after inclusion of the baseline values, therefore the original analyses are reported in this section.

Inter-Beat Interval. For secure and insecure adoptees, we found a (within-subjects) main effect of episode on IBI, $F(3, 64) = 15.34$, $p < .001$, partial η^2 = .19, with decreasing values from block 1 to block 3 (p ranged between < .001 and .005), see Figure 2. No significant main effect of attachment security or an interaction effect between episode and attachment security was found (*ps* > .53).

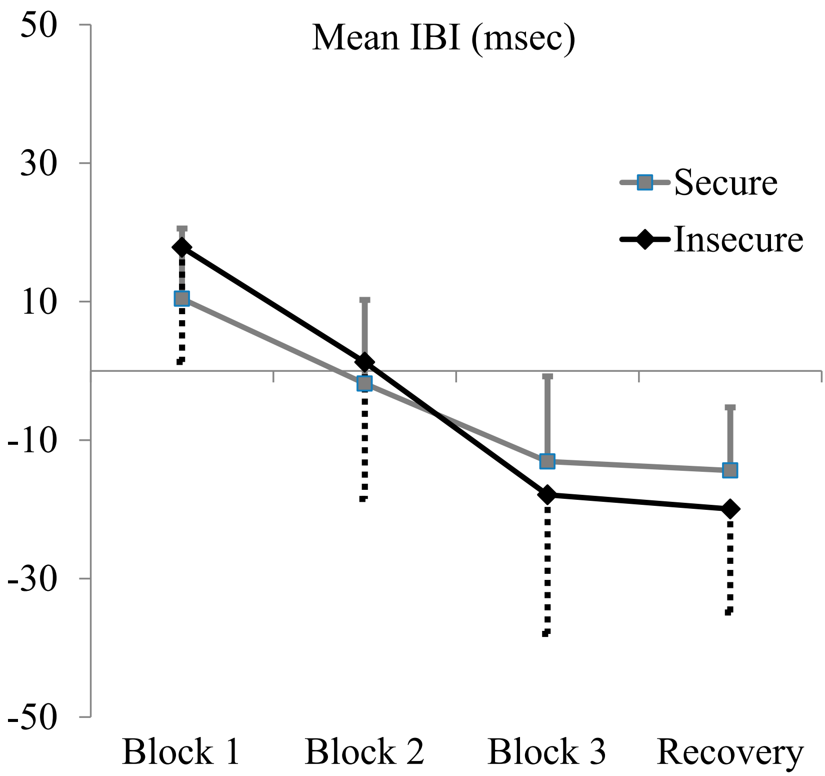

Figure 2. Inter-Beat Interval (*M, SE*) across episodes for two groups of attachment security.

Skin Conductance Level. The outcomes of the repeated measure ANOVA with SCL as outcome measure are presented in Figure 3. We found a main effect of episode, $F(1.55, 64) = 5.02$, $p = .014$, partial $\eta^2 = .07$ (Greenhouse-Geisser correction for sphericity). Although a main effect of attachment security was absent ($p = .20$), a significant interaction between episode and attachment security was found, $F(1.55, 64) = 5.24$, $p = .012$, partial $\eta^2 = .08$ (Greenhouse-Geisser correction for sphericity). Contrast analyses showed a significant difference for the contrast from blocks (1, 2, 3) to recovery, $F(1, 64) = 11{,}15$, $p = .001$, partial $\eta^2 = .15$, with SCL values remaining stable from block 3 to recovery in the secure group versus increasing values in the insecure group. Similar to the approach of a previous study on SCL in these adoptees in adolescence (Beijersbergen et al., 2008), we specifically checked whether SCL reactivity was associated with country of origin of the adoptees. Two dummy variables of country of origin were constructed and added as between-subjects factors in the repeated measure ANOVA. Main effects of both dummy variables were absent (*ps* > .20), suggesting that there was no association between SCL reactivity and country of origin. Both the main effect of episode, $F(1.53, 60) = 5.52$, $p = .01$, partial $\eta^2 = .08$ (Greenhouse-Geisser correction for sphericity), and the interaction between episode and attachment security, $F(1.53, 60) = 7.40$, $p = .003$, partial $\eta^2 = .11$ (Greenhouse-Geisser correction for sphericity), remained significant.

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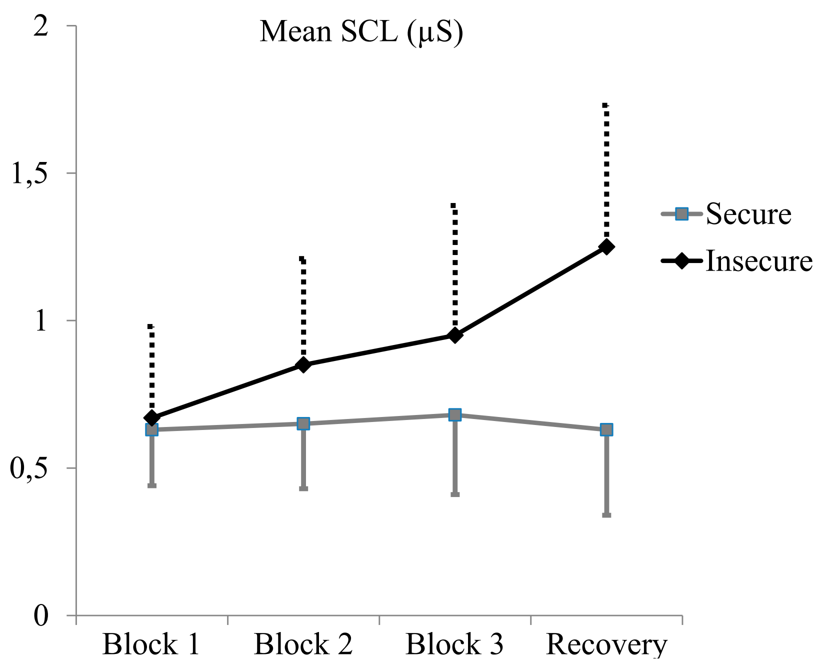

Figure 3. Skin Conductance Level (*M, SE*) across episodes for two groups of attachment security.

Respiratory Sinus Arrhythmia. No main effect of episode or interaction between episode and attachment security was found for RSA (*ps* > .27). However, the main effect of attachment security was significant, $F(1, 62) = 6.31$, $p = .015$, partial $\eta^2 = .09$. Follow-up *t*-tests per episode were performed and significant differences in RSA between secure adoptees and insecure adoptees were found in block 2, $t\ (63) = 2.55$, $p = .013$, and block 3, $t\ (62) = 2.69$, $p = .009$. Group differences were particularly large in block 3 (see Figure 4), which is considered the most stressful episode of the paradigm due to repeated exposure. The overall interaction between episode and attachment security was not significant. Although it should be noted that contrasts are normally not further investigated when the overall effect is absent, we did find a significant contrast from block 3 to recovery, $F(1, 62) = 4.37$, $p = .041$, partial $\eta^2 = .07$. Secure adoptees showed increasing RSA levels from block 3 (M = -14.02, SD = 3.56) to recovery (M = -5.26, SD = 2.18), whereas insecure adoptees showed decreasing RSA values from block 3 (M = 4.52, SD = 5.92) to recovery (M = .59, SD = 3.62).

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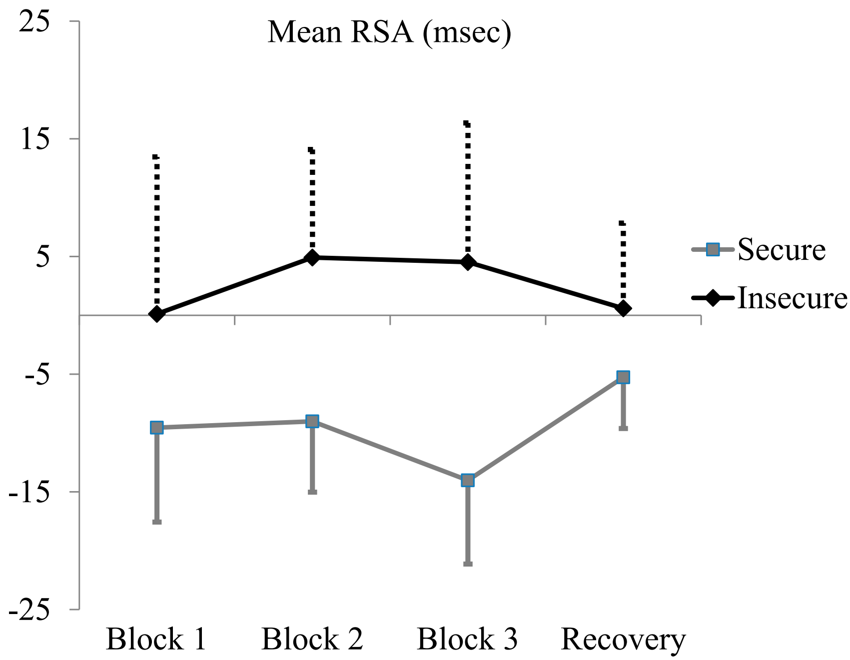

Figure 4. Respiratory Sinus Arrhythmia (*M, SE*) across episodes for two groups of attachment security.

Discussion

Insecure adoptees differed significantly from secure adoptees in their ratings of urgency in the more stressful episodes of the infant cry paradigm. In contrast to the secure adoptees who rated the cry sounds in later episodes as increasingly urgent, insecure adoptees rated the cry sounds in later episodes equally urgent as the cry sounds in previous episodes. Secure and insecure adoptees did not significantly differ on IBI, but main effects of attachment security and interaction effects between episode and attachment security appeared for SCL, and RSA. Secure adoptees showed SCL values that remained stable from the most stressful episode of the cry paradigm to recovery, whereas insecure adoptees showed an increase in SCL. Differences in vagal tone were also found, with secure adoptees showing significantly lower RSA values than insecure adoptees, particularly during the most stressful episode of the paradigm. Our findings suggest that secure adoptees have a well-integrated manner of responding to infant distress (i.e., heart-rate increases and RSA withdrawal coupled with heightened perceptions of urgency), whereas a dissociation between experiential and physiological arousal is found in insecure adoptees, who displayed a combination of lower perceived urgency and heightened sympathetic reactivity, without RSA withdrawal.

In support of our hypothesis, we found attachment representations assessed with the ASA to play an important role in emotional reactivity during exposure to attachment-related stressors. In line with previous research on the ASA (Groh & Roisman, 2009), attachment security was associated with electrodermal reactivity (SCL) to infant crying, and associations with IBI were absent. The pattern of heightened electrodermal reactivity found in insecure adoptees can be seen as indicative of heightened sympathetic arousal (Dawson, Schell, & Filion, 2000, p. 210), leading to more inhibition and possibly a less affective response to infant distress (Fowles, 1980).

Our outcomes also provided evidence for parasympathetic differences between secure and insecure adoptees. RSA values were significantly lower in secure adoptees than in insecure adoptees during the most stressful episode of the paradigm, and RSA values also increased into the recovery phase in secure adoptees, in contrast to decreasing values found in insecure adoptees. The secure adoptees showed a clearer pattern of RSA withdrawal when confronted with attachment-related stressors, which has been linked to more adequate responding to infant distress (Porges, 1996; Porges et al., 1994). Our RSA outcomes are in line with findings of Dias and colleagues (2011), who found that insecure women showed poorer vagal tone during the AAI than secure women. Also, Ablow and colleagues (2013) included simple and complex infant cry stimuli as attachment-related stressors and found no RSA decreases in reaction to the cry stimuli in insecure-dismissing women, a pattern of responding that is generally not indicative of efforts to soothe the infant (Beauchaine, 2001; Ham & Tronick, 2006).

The dissociation between experiential and sympathetic arousal found in insecure adoptees suggests that these individuals use a deactivating style of emotional reactivity while processing attachment-related information (Diamond et al., 2006). The lack of RSA withdrawal in insecure individuals (in fact, average reactivity values were positive) is consistent with this deactivating style, as attempts to suppress negative emotions or arousal have been related to increases in RSA (e.g., Butler, Wilhelm, & Gross, 2006). According to Dykas & Cassidy (2011), the presence of a deactivating strategy in persons with insecure attachment representations might indicate that these individuals experience psychological distress while listening to the infant cry sounds, which prevents them from further adequately processing of the information. A negative consequence of being insecure and not recognizing one's own physiological arousal might be that it also prevents individuals from developing more adaptive styles of emotional reactivity in the future (Diamond et al., 2006).

Some limitations of our study should be addressed. Cut-offs were used to distinguish attachment representations, and we included only the participants who clearly showed secure or insecure attachment representations. Due to our selection we had to deal with relatively small group sizes, which may affect the generalizability of our outcomes. However, a similar approach was used by Ablow and colleagues (2013) in order to create the purest contrast between secure and insecure subjects. Moreover, we had no data on physical exercise in the week prior to the assessment, smoking on the morning of the lab session and possible use of medication influencing heart rate. We would have preferred to use these variables as covariates in the analyses on physiological reactivity, although in past studies such covariates did not explain much of the variance in physiological reactivity and it is not evident that they might have influenced the differences found in physiological reactivity between the two groups (e.g., Joosen et al., 2012). Furthermore, the assessment of attachment representations did not temporally precede the assessment of reactivity to infant crying, and therefore no causal inferences could be drawn from our study on concurrent data.

In sum, we examined whether attachment representations were related to experiential arousal and physiological reactivity to infant cries in adopted young adults. The use of a standard infant cry paradigm enabled us to investigate reactions to stimuli representing increasing levels of distress as well as (in-)congruence between experiential and physiological arousal. We found some empirical support for the hypothesis that internal working models of attachment, presumably based on the experiences with primary caregivers, explain individual differences in the way attachment-related information is being processed (Bowlby, 1969/1982; Dykas & Cassidy, 2011). Due to the inclusion of adoptees in the study associations were not confounded by genetic influences. In addition, the concurrent associations found between young adults' attachment representations and their experiential and physiological arousal to infant distress add to the criterion validity of the ASA. Our findings suggest that secure adoptees have an emotionally and physiologically integrated manner of processing infant distress sounds, whereas in insecure adoptees experiential and physiological arousal are dissociated, with a combination of lower perceived urgency but heightened sympathetic reactivity when listening to repeated bouts of infant cry sounds.

Highlights

- Variation in attachment security explains differences in arousal to infant crying
- In secure adoptees experiential and physiological arousal are integrated
- In insecure adoptees experiential and physiological arousal are dissociated
- Insecure adoptees use a deactivating style of emotional reactivity

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