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The Adult Attachment Interview: coherence & validation in adolescents

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Chapter 4

Stress Regulation in Adolescents: Physiological Reactivity during the Adult Attachment Interview and Conflict Interaction

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Abstract

The current study examined whether adolescents' attachment representations were associated with differences in emotion regulation during the Adult Attachment Interview (AAI; George, Kaplan, & Main, 1996) and during a mother-adolescent conflict interaction task (FIT; Allen et al., 2003). Participants were 156 14-year-old adolescents. Dismissing adolescents showed less stress reactivity (as recorded with interbeat intervals) during the AAI than secure adolescents. However, during the FIT dismissing adolescents showed more stress. No differences in physiological reactivity were found between individuals with resolved or unresolved loss or trauma during the AAI or FIT. Our results indicate that dismissing adolescents may effectively use a defensive strategy during the AAI, but less so in direct conflict interaction with their attachment figure.

Introduction

According to attachment theory internal working models of attachment influence emotion regulation, both in (early) childhood and in adolescence and adulthood (Cassidy, 1994; Main, Kaplan, & Cassidy, 1985). Physiological parameters provide an excellent opportunity to test this hypothesized link (Spangler & Zimmermann, 1999), but research in this area is still scarce. Using physiological measures, the current study examined whether adolescents' working models of attachment (or attachment representations) are associated with their emotion regulation during two situations in which the attachment system is activated: during the Adult Attachment Interview (AAI; George, Kaplan, & Main, 1996; Hesse, 1999; Main, Goldwyn, & Hesse, 2003) and during a dyadic (mother-adolescent) conflict interaction task (Allen et al., 2003; Kobak, Sudler, & Gamble, 1991; Strodtbeck, 1951).

Emotion regulation patterns can be seen as part of an adaptive strategy with the goal of maintaining the relationship with the attachment figure (Cassidy, 1994). Individuals are suggested to have flexible or inflexible styles of emotion regulation, developed as the result of particular caregiving histories. Infants with secure attachment relationships as well as adults with secure attachment representations are characterized by open, flexible emotional expressions (Bretherton, 1990; Cassidy, 1994). For example, during the AAI secure adults are able to talk coherently about positive as well as negative childhood experiences (Hesse, 1999). Individuals with insecure attachment representations typically show a restricted range of emotions. Dismissing persons are suggested to systematically suppress emotions; they would mask negative affect. Evidence for the nature of this defensive strategy is still limited. Nevertheless the first studies using physiological measures (Dozier & Kobak, 1992; Roisman, Tsai, & Chang, 2004) show that dismissing individuals experience stress although it is not displayed overtly. Preoccupied individuals, in contrast, heighten emotion expression (Main, 1990; Kobak, Holland, Ferenz-Gillies, Fleming, & Gamble, 1993). It has been hypothesized that they show greater negative reactivity than they would actually feel (Cassidy, 1994). Even though these emotion regulation strategies may be adaptive in the relationship with the attachment figure (not being rejected or gaining attention from an unavailable caregiver, respectively) they may be maladaptive in other contexts and have negative psychological and developmental consequences (Cassidy, 1994; Cassidy & Kobak, 1988; Main, 1990).

Internal working models of attachment may also have an impact on the regulation of attention. Dismissing individuals are hypothesized to systematically exclude attachment-relevant information (see Bowlby, 1980; Main, 1999). As a consequence, dismissing persons would usually be unable to give evidence for what they claim was

a perfectly normal or very nice childhood. Preoccupied persons, on the contrary, show a strong focus on attachment relationships and experiences (Hesse, 1999). Moreover, it has been suggested that during information-processing their attention is centered on negative emotions (Spangler & Zimmermann, 1999).

In contrast to individuals with organized attachment classifications, unresolved individuals show a momentary breakdown in their strategy (Hesse, 1999; Lyons-Ruth & Jacobvitz, 1999; Main et al., 2003). Adults are classified as unresolved when they show lapses in the monitoring of reasoning or discourse (or report extreme behavioral reactions) when talking about loss or other trauma (Main et al., 2003). These lapses are suggested to be indicative of a sudden absorption involving traumatic memories (Hesse & Main, 2006; Madigan et al., 2006). It has been proposed that these adults may be impaired in emotion regulation when confronted with traumatic experiences (Spangler & Zimmermann, 1999).

Emotions affect physiological responses (Brownley, Hurwitz, & Schneiderman, 2004; Dawson, Schell, & Filion, 2004; Hagemann, Waldstein, & Thayer, 2003). Physiological responses are a result of the activity of the autonomic nervous system (ANS) (Porges, 1995). This system consists of two subsystems: the parasympathetic nervous system (PNS) and the sympathetic nervous system (SNS). Both originate in the brainstem and influence the regulation of organs such as heart, lungs, and kidneys, as well as sweat glands, and blood vessels. The PNS is involved in growth and restorative processes in the body. The SNS promotes metabolic output as a reaction to challenges from the environment. This branch quickly mobilizes existing reserves of the body when a situation requires a fight-or-flight reaction. To get insight into the activity of the ANS in situations in which emotions are elicited, measures like interbeat interval (IBI), heart rate variability (RMSSD), and skin conductance level (SCL) have been used (Bradley, 2004). IBI is an indicator for the time between two consecutive beats of the heart. When a person is under stressful behavior challenge (or e.g., exercising) his or her heart rate may fasten, therefore, IBI will be shorter. RMSSD may be lower under the same challenge (Brownley et al., 2004). The level of electrodermal activity as indexed by SCL is influenced by increases and decreases in sweat in the eccrine sweat glands (Boucsein, 1992; Dawson et al., 2004). More emotional arousal will result in higher SCL levels (Bradley, 2004). It is important to note that these physiological measures are differentially influenced by the SNS and PNS: IBI is influenced by both (Brownley et al., 2004), while RMSSD is primarily influenced by the PNS (Hagemann et al., 2003), and SCL is influenced by the SNS (Dawson et al., 2004). These measures can provide a window on emotions that may or may not be expressed overtly.

In attachment research the potential of psychophysiological parameters is increasingly used for enhancing our understanding of emotion regulation in individuals

with different attachment patterns (e.g., Oosterman & Schuengel, 2007; Spangler & Grossmann, 1993; Sroufe & Waters, 1977; Stevenson-Hinde & Marshall, 1999; Zelenko et al., 2005). Only two studies, however, have examined physiological stress regulation during the AAI. Dozier and Kobak (1992) examined whether SCL reactivity during the AAI was associated with attachment representation. They hypothesized that deactivation (a strategy preferred by individuals with a more dismissing representation), as contrasted with hyperactivation (that is more characteristic of preoccupied representations) would be related to SCL because of its relation to behavioral inhibition (Fowles, 1980). Their findings revealed that individuals using deactivating strategies were indeed more stressed during the AAI, especially during questions concerning attachment-relevant memories and questions calling for reflection upon attachment relationships. Roisman et al. (2004) extended this line of research by including cardiovascular reactivity (as measured with IBI, pulse transmission time to the finger, and pulse transmission time to the ear) as well as skin conductance reactivity during the AAI. Convergent with their expectations, deactivation was related to SCL reactivity but not to cardiovascular reactivity (which is suggested to be indicative of behavioral activation, see Fowles, 1980). In conclusion, both studies showed an association between deactivation and increased stress during the AAI as indicated by sympathetic reactivity.

Differences in emotion regulation patterns may not only be evident during the AAI, they may also appear in other situations in which the attachment system is activated, such as in dyadic conflict interactions (Allen et al., 2003; Feeney & Cassidy, 2003). During discussions of disagreements with their parents, adolescents need to establish autonomy while also maintaining relatedness. In such conflict situations, secure individuals are supposed to be better able to balance exploration (e.g., autonomy strivings) and attachment (e.g., relatedness) than insecure individuals (Allen & Land, 1999). Roisman (2007) conducted a study on stress reactivity in adults during a discussion with their romantic partners. This study revealed that deactivation was related to SCL reactivity, while hyperactivation was associated with HR reactivity. Attachment security was related to less SCL reactivity during interactions with romantic partners. Respiratory sinus arrhythmia (RSA, an index of vagal tone, influenced by the parasympathetic branch) was not associated with attachment. No studies have yet investigated the link between attachment and stress reactivity during interactions between parents and their adolescent children.

The relation between attachment representation and patterns of interaction during conflict resolution has been examined before. Allen and Hauser (1996) reported that young adults' coherence of discourse during the AAI could be predicted from their mothers' promoting autonomy and relatedness 11 years earlier. Using Kobak's Q-sort (1993), Allen and colleagues (2003) revealed that dyadic relatedness

shown in conflict interactions between mothers and 16-year-old adolescents was related to adolescent attachment security. Kobak and colleagues (1993) demonstrated that secure adolescents and their mothers were characterized by less dysfunctional anger and less avoidance of problem-solving during conflict interactions. More dysfunctional anger as well as more maternal dominance was displayed in interactions between adolescents with deactivating strategies and their mothers. Secure adolescents appeared to show a balance between their mother's and their own assertiveness.

In the current study we examined physiological reactivity during the AAI and during an interaction task in which mothers and adolescents tried to reach consensus in an area of disagreement. It was expected that dismissing adolescents would experience more stress during the AAI than secure participants because of their hypothesized defensive strategy during the task of reflecting on early attachment experiences. In accordance with previous studies, no differences between preoccupied and secure adolescents were expected. Furthermore, unresolved individuals might show more reactivity during the questions concerning loss and (other) trauma. Regarding the conflict interaction task (FIT), we hypothesized that dismissing as well as preoccupied individuals would be more stressed than adolescents with secure attachment representations. No differences were expected between adolescents with resolved or unresolved states of mind since it seems unlikely that the interaction task on a disagreement would trigger memories of loss or trauma. Finally, it was expected that secure adolescents would show more autonomous-relatedness during conflict interaction than insecure adolescents.

Method

Participants

Participants were 156 14-year-old internationally adopted adolescents, who took part in a longitudinal study which started in infancy (Juffer, Bakermans-Kranenburg, & Van IJzendoorn, 2005; Jaffari-Bimmel, Juffer, Van IJzendoorn, Bakermans-Kranenburg, & Mooijaart, 2006). We report on 152 participants, because in two cases the Adult Attachment Interviews (AAIs) of the adolescents could not be coded due to technical problems and two other AAIs were not classifiable because the respondents did not understand the questions due to (very) low intellectual level (IQs of 58 and 82, respectively).

Sixty-eight boys and 84 girls were involved in the current study (see Table 1). All children were adopted before the age of 6 months (*M* = 10.0 weeks; *SD* = 5.30). They came from Sri Lanka (*n* = 94), South Korea (*n* = 38), and Colombia (*n* = 20). The adoptive families predominantly belonged to middle-class or upper middle-class (Jaffari-Bimmel et al., 2006). Mean age of the adoptive mothers at the time of the birth of the children was 33.1 (*SD* = 3.55, *N* = 142) and of the adoptive fathers 35.0 (*SD* = 3.55, *N* = 141).

Procedure

The adoptive families were randomly recruited through Dutch adoption organizations. When the children were 5, 6, 9, and 12 months old, the families were visited at home. At 12, 18, and 30 months the mothers and children came to the laboratory. At 7 years of age, the families were again visited at home. During these visits mother-child interactions were observed, the child was involved in an intelligence test, and the mothers participated in an interview and completed questionnaires. The current study reports on the data collected at a follow-up at 14 years of age. Adolescents participated in 3.5 hour home visits together with their mothers, except for four families where the fathers participated (because of divorce or death of the mother). Results were similar when these fathers were excluded from the analyses. During the visits the AAI was administered with the adolescents, as well as an intelligence test. The adolescents also completed questionnaires and participated in an interaction task with their mothers. One questionnaire (used as baseline for the physiological measures during the AAI) and the AAI were completed in a separate room, without the mother present. A second questionnaire, used as baseline for the physiological measures during the FIT, was completed in the presence of the mother. During the entire session the adolescents were connected to the VU-AMS recording device (the Vrije Universiteit Ambulatory Monitoring System; AMS 36; Groot, De Geus, & De Vries, 1998; see also Jaffari-Bimmel, Van IJzendoorn, Bakermans-Kranenburg, Juffer, & De Geus, in press). Participants were informed that their heart rate and skin conductance level was monitored in order to examine whether particular aspects of the home visit were more stressful than other aspects.

Table 1

Descriptive Statistics: Demographics and Background Variables

	Secure[a] (*n* = 57)		Dismissing[b] (*n* = 62)		Preoccupied[c] (*n* = 33)		Resolved[d] (*n* = 110)		Unresolved[e] (*n* = 23)		Total[f] (*N*= 152)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Health condition at placement	.36	.14	.36	.14	.38	.11	.36	.14	.37	.13	.37	.13
Age at placement (in weeks)	9.9	5.40	10.6	5.45	8.8	4.77	10.1	5.40	9.3	4.57	10.0	5.30
Age at time of assessment	14.5	0.54	14.3	0.48	14.5	0.62	14.4	0.55	14.4	0.51	14.4	0.53
IQ	100.8	12.74	100.4	13.02	100.5	14.18	100.3	12.94	99.4	11.98	100.6	13.09
SES	10.0	2.60	10.1	2.64	10.0	2.82	9.8	2.79	10.5	2.18	10.0	2.65
Smoking	2.1	1.27	2.1	1.47	2.0	1.30	2.1	1.35	2.0	1.22	2.1	1.35
Number of sports	1.4	0.89	1.4	1.10	1.5	1.16	1.4	1.04	1.7	1.06	1.4	1.03
Number of words during AAI[g]	1907	599.0	1356	529.1	2823	1425.7	1821	998.5	2261	1095.3	1881	992.2
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Sexe (*N* male)	19	33.3	34	54.8	15	45.5	47	42.7	12	52.2	68	44.7
Country of origin												
Sri Lanka	31	54.4	38	61.3	25	75.8	66	60.0	16	69.6	94	60.9
South Korea	18	31.6	15	24.2	5	15.2	31	28.2	2	8.7	38	25
Colombia	8	14	9	14.5	3	9.1	13	11.8	5	21.7	20	13.2

Note. As we only included adolescents who did experience loss or trauma in the resolved and unresolved categories, the total *n* for this subgroup is 133.

[a]Range *n* = 54-57. [b]Range *n* = 61-62. [c]Range *n* = 30-33. [d]Range *n* = 108-110. [e]Range *n* = 22-23. [f]Range *N* = 147-152. [g]Number of words used during responses to AAI questions 6 to 11, except for 9a which is about abuse.

Measures

Adult Attachment Interview

The Adult Attachment Interview (AAI; Main et al., 2003) is an hour-long, semi-structured interview which assesses an individual's current state of mind with respect to attachment. In this interview respondents were asked about their childhood experiences with their adoptive parents and how they thought they were affected by them. Other questions concerned experiences of loss and trauma. Finally, respondents were invited to describe possible changes in the relationship with their adoptive parents since childhood and the current relationship with them. On basis of verbatim transcripts of the AAI the adolescents were judged as having a secure (F), dismissing (Ds), or preoccupied (E) attachment representation. The discourse of secure individuals is coherent. They are able to freely value their experiences and yet stay objective regardless of the nature of their experiences. Individuals with an insecure attachment representation significantly violate Grice's (1975) criteria for coherence. Dismissing individuals typically idealize their parents and claim lack of memory for their childhood. In rare cases they derogate their attachment experiences. Individuals with a preoccupied state of mind are still confused and overwhelmed by their childhood experiences. They are angry towards their parents or their discourse is characterized by vague speech (Main et al., 2003). On top of their main classification, individuals may be classified as unresolved-disorganized (U) when they show lapses in the monitoring of reasoning or discourse in reaction to loss or other traumatic events (Main et al., 2003).

Previous studies provided preliminary evidence for the validity of the AAI in adolescent samples. For example, continuity of attachment from infants' Strange Situation classifications (Ainsworth, Blehar, Waters, & Wall, 1978) to adolescents' AAI classifications has been reported (e.g., Hamilton, 2000; Main, Hesse, & Kaplan, 2005). In addition, adolescent attachment representations as assessed with the AAI were associated with several developmental outcomes in the predicted way (e.g., Adam, Sheldon-Keller, & West, 1996; Mayseless & Scharf, 2007). Although these studies usually involved adolescents with a mean age of 16 years or older, one study reported considerable stability of the AAI classifications when 10-year olds were reassessed 4 years later (Ammaniti, Van IJzendoorn, Speranza, & Tambelli, 2000). In addition, using Kobak's Q-sort (1993), Allen et al. (Allen, Porter, McFarland, Boykin-McElhaney, & Marsh, 2007; Allen, Porter, McFarland, Marsh, & Boykin-McElhaney, 2005) found associations between 14-year olds' attachment representations and mother-adolescent and father-adolescent interactions one year earlier. The validity of the AAI in (early) adolescence thus looks promising.

The AAIs were coded by the first author. For inter-rater reliability, 18 randomly selected interviews were also coded by the second author. Inter-rater agreement was 78% (κ = .64) for three-way classifications (secure, dismissing, and preoccupied) and 83% (κ = .77) for four-way classifications (secure, dismissing, preoccupied, and unresolved). Disagreements between coders were resolved by discussion. Intra-class correlation for the overall unresolved score was r = .89. Finally, a continuous dismissing score was derived by using the maximum score of an individual on the following scales: idealization of mother, idealization of father, derogation of mother, derogation of father, overall derogation of attachment. Intra-class correlation for the dismissing score was r = .71.

Of the 152 adopted adolescents, 57 (37.5%) were secure, 62 (40.8%) dismissing, and 33 (21.7%) preoccupied. Taking the unresolved category into account, the distribution was: 50 (32.9%) secure, 57 (37.5%) dismissing, 19 (12.5%) preoccupied, and 26 (17.1%) unresolved. The distribution of classifications in our sample differed significantly from the normative distribution in non-clinical adolescent samples (Van IJzendoorn & Bakermans-Kranenburg, in press) for the three-way distribution (χ^2 (2, N = 152) = 30.74, p < .01) as well as for the four-way distribution (χ^2 (3, N = 152) = 15.36, p < .01). In the current sample, the insecure categories were overrepresented while the secure category was underrepresented.

In order to test the validity of the AAI in the present sample, we investigated whether emotional investment in others versus self was related to adolescents' AAI classifications. Because dismissing individuals tend to emphasize their independence and dismiss the importance of attachment relationships (Hesse, 1999), they were expected to emotionally invest less in others than non-dismissing individuals who value attachment relationships (secure individuals) or feel emotionally very dependent on others (preoccupied individuals) (see Mikulincer & Shaver, 2007). Our findings confirmed this hypothesis (Beijersbergen, Van IJzendoorn, Bakermans-Kranenburg, & Juffer, 2007), providing additional support for the validity of the AAI when used with adolescents.

Attachment classification was not associated with gender, country of birth, socioeconomic status, health condition or age at adoptive placement, age at time of assessment, number of sports, smoking, or intelligence. A significant association was found between number of words used during the AAI and attachment classification, with preoccupied individuals using the most words, while dismissing individuals gave the shortest answers (F (2, 149) = 33.85, p < .01).

Family Interaction Task (FIT)

Using a revealed differences task (Strodtbeck, 1951) we investigated the patterns of interaction between adolescents and their mothers (Allen et al., 2003; Kobak et al., 1991). Mothers and adolescents were asked to discuss and try to reach consensus on an issue on which they disagreed. Examples of issues are money and grades. Before the discussion started, they listened to a tape (which had been recorded in absence of the mother) on which the adolescent stated his or her opinion about the disagreement, as well as the opinion the adolescent thought the mother had. Then they started the discussion. When they finished talking about the indicated topic before the 10 minutes were over, they were asked to continue the discussion by talking about another topic on which they disagreed.

The interactions were coded with the autonomy and relatedness coding system of Allen and colleagues (Allen et al., 1994). Adolescents received scores ranging from 0 to 4 on four scales (derived from nine subscales): (a) *exhibiting autonomy* (states reasons clearly for disagreeing, confidence in stating thoughts and opinions) (b) *inhibiting autonomy* (recanting a position, overpersonalizing, pressures to agree) (c) *exhibiting relatedness* (validates/agrees/positively reacts to other person, engaged interaction), and (d) *inhibiting relatedness* (distracting/ignoring, hostile/devaluing statements). The subscale 'recanting a position' was excluded from the inhibiting autonomy scale because it was not associated with the other two subscales as a consequence of lack of variance. Because the inhibiting autonomy and inhibiting relatedness scales were strongly correlated (r = .72, p < .01), they were combined into one scale, *inhibiting autonomy-relatedness*. The scales concerning exhibiting autonomy and exhibiting relatedness were not combined because the correlation between these scales was modest (r = .29, p < .01). The discussions were coded by two different coders who were unaware of other characteristics of the dyads and who were both trained by an expert who received training from dr J.P. Allen. Mean inter-coder reliability between the expert and the two coders was .79 (range: .68 - .92, n = 30). Internal consistency of the three major scales used in the analyses was adequate (exhibiting autonomy α = .82, exhibiting relatedness α = .60, inhibiting autonomy-relatedness α = .82).

Table 2 presents means and standard deviations of the autonomy-relatedness scales. Scale scores were missing for one participant because no parent was present during the session. The autonomy-relatedness scales for one other adolescent could not be scored because of technical problems with the recording.

Table 2

Scores on Autonomy-Relatedness Scales per Attachment Classification

	F (n =56)[a]	Ds (n = 61)[a]	E (n= 33)	nonU (n = 108)[b]	U (n = 23)	Total (N = 150)[c]
Exhib autonom	2.39	2.00	2.35	2.26	2.17	2.22
	(0.69)	(0.75)[c]	(0.84)	(0.78)	(0.71)	(0.76)
Exhib related	1.65	1.64	1.67	1.61	1.79	1.65
	(0.59)	(0.60)	(0.62)	(0.57)	(0.66)	(0.60)
Underm	1.07	0.86	1.03	0.94	1.10	0.98
autonom-related	(0.78)	(0.72)	(0.74)	(0.73)	(0.82)	(0.75)

Note. F = secure. Ds = dismissing. E = preoccupied. NonU = resolved. U = unresolved. Exhib = exhibiting. Autonom = autonomy. Related = relatedness. Underm = undermining. As we only included adolescents who did experience loss or trauma in the resolved and unresolved categories, the total n for this subgroup is 133.

[a]FIT is missing for one participant in this group. [b]FIT is missing for two participants in this group.

[c]*Mean difference dismissing-secure* = 0.39, *SE* = 0.14, $p < .05$.

Physiological measures

The VU-AMS recording device (Groot et al., 1998) was used to measure Interbeat Interval (IBI), Root Mean of the Squared Successive Differences (RMSSD, an index for heart rate variability), and galvanic Skin Conductance Level (SCL). These measures were selected to replicate (IBI and SCL) and extend prior work (RMSSD) by Dozier and Kobak (1992) and Roisman and colleagues (2004). Before placing the electrodes of the VU-AMS device, the adolescents rubbed their skin firmly with alcohol. Then three disposable ECG electrodes were placed on the chest: the first was placed at the jugular notch of the sternum, between the collarbones; the second was placed below the left breast, 4 centimeters (1.5 inch) under the nipple, between two ribs; the last electrode was placed at the right side of the chest between the lower two ribs. The SCL electrodes were placed on the thenar and hypothenar eminences of the palms of the hands. The VU-AMS device continuously recorded IBI. RMSSD was calculated based on the raw IBI data and was sampled every 10 seconds. SCL was sampled every 500 milliseconds. The quality of the signal and attachment of the electrodes were checked by online monitoring of the physiological data.

The VU-AMS device failed to record physiological data during one home visit. SCL recordings were unreliable for one participant, and another participant had unreliable physiological recordings during the AAI. For one adolescent the equipment failed to record physiology after the introduction of the FIT. The corresponding data was excluded from the analyses.

Physiological values during the answers to the following AAI questions were used in the analyses (George et al., 1996): (6) When you were upset when you were little, what did you do, what would happen? Can you think of specific incidents? Physically

hurt? Ill? (7) Could you describe your first separation from your parents? (8) Did you ever feel rejected as a child? What did you do? Do you think your parents realized they were rejecting you? (8a) Were you ever frightened or worried as a child? (9) Were your parents ever threatening with you – maybe for discipline or jokingly? (9a) Some people have memories of some kind of abuse. Did that ever happen to you, or in your family? (10) How do you think your overall experiences have affected your adult personality? (10a) Are there any aspects to your early experiences that you feel were a setback in your development? (11) Why do you think your parents behaved as they did, during your childhood? (13) Did you experience the loss of a parent or other close loved one? and (14) Have you had any other experiences which you would regard as potentially traumatic? These questions were selected because we expected that they would show the largest differences in physiological reactivity between the organized secure and insecure attachment strategies (e.g., questions 6 to 9 and 10 to 11) or between persons with an resolved or unresolved state of mind (e.g., questions 9a, 13, and 14). The last three minutes of the episode in which the adolescents were alone completing a questionnaire was used as baseline for the AAI. Because seven adolescents did not fill in the questionnaire, they could not be included in the analyses.

During the Family Interaction Task, physiological values were recorded for 4.5 minutes starting from the moment the dyad began the discussion. After 4.5 minutes a number of mothers and adolescents drifted away from the original task and began a conversation about non-problem issues, for example about the day at school. The last three minutes of the episode in which the adolescents completed a questionnaire in the presence of the mother was used as baseline for the FIT. Two adolescents did not fill in this questionnaire, and were therefore excluded from the analyses.

Implausible physiological values were deleted (Groot et al, 1998; De Geus, 1996). Physiological reactivity was calculated per AAI question for IBI, RMSSD, and SCL by subtracting means of the AAI baselines from the means during the selected AAI questions. Physiological reactivity during the FIT was computed by subtracting the FIT baseline from the means during the FIT. More reactivity, and thus more stress, is indicated by higher SCL, lower IBI, and lower RMSSD difference scores. Covariates (gender, country of birth, health condition or age at adoptive placement, age at time of assessment, SES, number of sports, smoking, intelligence, and number of words used during the AAI) were only included if they were associated with the dependent as well as the independent variables. Following Keppel and Wickens' (2004) recommendation concerning extreme scores, we included outliers in the analyses. Results remained similar when outliers were changed into the next most extreme scores (Tabachnick & Fidell, 2001).

Intelligence

Intelligence was included because it may affect heart rate: higher IQ has been associated with heart rate deceleration (Lewis & Wilson, 1970; but see Farrington, 1997, for an exception). The adolescents completed the abbreviated Groningen Intelligence Test (GIT; Luteijn & Van der Ploeg, 1983). The following three subsets were included: cipher, enumerate words, and word matrices. Mean IQ score was 100.6 (*SD* = 13.09).

Physical condition and smoking

Physical health and smoking influence heart rate (De Geus, Boomsma, & Snieder, 2003; Farrington, 1997; Vander, Sherman, & Luciano, 2001). We therefore asked participants in which sports they had been active in the previous year. Participants were also asked to rate on a five-point scale how much they smoked (1 = never to 5 = often).

Health condition at placement

Health condition at adoptive placement was used as an index for the health condition of the infant from birth to placement in the family (Stams, Juffer, & Van IJzendoorn, 2002). Information for this index was gathered in the first interview with the parents, which was conducted when the infants were 5 months old. Health condition at placement was calculated by the standardized summation of (a) birth weight, (b) incidence of prematurity, and (c) health problems at placement (reversely coded). Health problems at placement included for example symptoms of malnourishment, dehydration, anaemia or paratyphoid. Higher scores represent better health condition at placement. Mean score was 0.37 (*SD* = 0.13).

Socioeconomic status (SES)

Socioeconomic status of the adoptive families was assessed when the children were 7 years old, combining the educational and vocational background of both parents (for more details see Stams et al., 2002). Scores for SES correspond to socioeconomic strata as follows: 3 to 9 lower class, 9 to 12 middle class, and 12 to 16 upper-class. Adoptive families had a mean SES of 10.0 (*SD* = 2.65).

Data Analysis

First, analyses were conducted for physiological reactivity during the AAI. Linear mixed models were run with attachment representation, question, and the interaction between question and attachment representation as fixed effects. We also tested whether subject should be included as a random effect and which covariance

structure should be used for the error term. For each physiological measure the best fitting models were selected using Akaike's Information Criterion and log likelihood (Fitzmaurice, Laird, & Ware, 2004). Post-hoc tests were conducted to test whether secure individuals significantly differed from dismissing and preoccupied individuals with regard to physiological reactivity during the AAI. Finally, we calculated correlations between the dismissing score and physiological reactivity.

For the analyses concerning unresolved loss, we selected the participants who did report loss or trauma during the AAI (n = 133). Since all adolescents were adopted before the age of 6 months and they were asked about their own memories concerning loss or trauma, all reported experiences concerned post-adoption loss or trauma. Linear mixed model analyses were conducted with the classification unresolved with respect to loss or trauma, question, and the interaction between question and unresolved attachment as fixed effects. Correlations were calculated between the overall unresolved score (for either loss or other trauma) and physiological reactivity.

Next, physiological reactivity during the FIT was examined. We conducted the same analyses (three-way classifications and resolved versus unresolved classifications; dismissing score and unresolved score) as for the AAI data. Finally, reactivity during the selected AAI questions was averaged to compare reactivity during AAI and FIT. We tested whether one task was more stressful than the other, whether persons with different attachment classifications differed in reactivity during both tasks, and whether there was an interaction effect between task and attachment.

Results

Preliminary Analyses

With a MANOVA we tested for significant differences in autonomy-relatedness between adolescents with divergent attachment classifications. The overall effect was not significant (F (6, 290) = 1.60, p = .15). However, since we had a priori hypotheses regarding the different types of adolescents' interactive behaviors and the sphericity assumption held, univariate analyses (that are more powerful than multivariate analyses) were conducted (Keppel & Wickens, 2004). A significant effect was found for exhibiting autonomy (F (2, 147) = 4.56, p < .05). Secure adolescents (EM = 2.39, SE = 0.10) had higher scores on this scale than dismissing adolescents (EM = 2.00, SE = 0.10). Exhibiting autonomy during the FIT was also negatively associated with the AAI dismissing scale (r = -.18, p < .05). No association was found between the

dismissing scale and showing relatedness (r = -.03, p = .69) or inhibiting autonomy-relatedness (r = -.03, p = .68).

Unresolved and not-unresolved adolescents showed no differences in autonomy-relatedness scores (F (3, 127) = 2.42, p = .07). Moreover, none of the correlations between the autonomy-relatedness scales and the unresolved score in the group of adolescents who experienced loss or trauma (n = 131) was significant (exhibiting autonomy r = .06, p = .49; exhibiting relatedness r = .17, p = .06; inhibiting autonomy relatedness r = .16, p = .08).

Physiological Reactivity during the AAI

Means and standard deviations of the raw physiological data during baseline as well as during the AAI-questions are presented in Table 3. Neither secure, dismissing, and preoccupied participants, nor resolved and unresolved participants had significantly different baselines for IBI, RMSSD, or SCL. However, in the group who experienced loss or trauma, country of birth was significantly associated with mean SCL baseline (F (2, 120) = 5.34, p < .01). Adolescents adopted from Korea had higher baseline levels for skin conductance than adolescents from Sri Lanka.

Associations between physiological reactivity during the AAI and background variables

A significant relation was found between IBI reactivity and age at time of the assessment. Furthermore, RMSSD reactivity was related to smoking and gender. SCL reactivity was associated with the following variables: age at adoptive placement, age at time of assessment, country of origin, and number of words used during the AAI.[1]

For the adolescents who experienced loss or other trauma, we found a relation between IBI reactivity and intelligence. In this subgroup, SCL reactivity was associated with age at time of assessment, number of sports and number of words used during the AAI. Because number of words used during the AAI was related to SCL reactivity as well as to the three-way attachment classification, we used this variable as a covariate in all pertinent analyses.

[1] A table presenting all statistics concerning the relations between physiological reactivity and background variables for the total group as well as for the group who experienced loss or trauma is available upon request.

Table 3

Raw Physiological Values for the Baseline and AAI-questions

	IBI[a]		RMSSD[b]		SCL[c]	
Question	*M*	*SD*	*M*	*SD*	*M*	*SD*
Baseline	779.85	92.73	54.33	26.72	11.26	7.96
Upset	761.31	94.37	48.76	23.54	11.54	7.95
Separation	761.68	92.78	49.75	24.18	11.52	7.65
Rejection	779.64	99.11	50.69	25.77	11.39	7.44
Frightened	764.80	96.55	50.69	26.44	11.58	7.69
Threatened	776.75	101.40	50.74	26.60	11.62	7.55
Effects	770.32	95.10	50.19	23.93	11.73	7.50
Setback	780.90	105.11	52.98	28.35	11.54	7.47
Why behaved	769.39	96.14	51.24	26.41	11.65	7.49
Abuse	786.45	105.33	52.14	28.26	11.66	7.45
Loss	770.83	98.49	52.39	27.58	11.67	6.97
Other trauma	774.44	98.04	52.82	28.77	11.79	7.26

Note. IBI = Interbeat Interval. RMSSD = Root Mean of the Squared Successive Differences. SCL = Skin Conductance Level.

[a]*N* =150, except for baseline IBI (*N* = 141). [b]*N* ranges between 147 and 149, except for baseline RMSSD, (*N* = 139). [c]*N* = 149, except for baseline SCL (*N* = 142).

Differences between secure, dismissing, and preoccupied adolescents

A linear mixed model for IBI reactivity with a diagonal covariance structure and subject included as a random effect showed that attachment representation, question, and the interaction between question and attachment representation were all significant (F (2, 140) = 3.37, $p < .05$; F (7, 235) = 14.09, $p < .01$; F (14, 235) = 1.77, $p < .05$, respectively[2]). Adolescents appeared to be most reactive during the questions related to being upset and being separated (respectively M = 17.86, SD = 51.64; M = 18.12, SD = 50.79). In contrast, they showed least reactivity during the setback question (M = -2.17, SD = 53.97). Post-hoc tests revealed that dismissing participants showed less IBI reactivity than secure ones (*Mean difference* = -22.60, SE = 8.91, df = 140, $p < .05$) indicating that they were less stressed than secure adolescents (see Figure 1). No differences were found between secure and preoccupied adolescents (*Mean difference* = -6.29, SE = 10.84, df = 140, p = .99). Finally, the interaction between attachment and question revealed that for the questions on separation (t (201) = 2.27, $p < .05$) and threat (t (218) = 2.24, $p < .05$), preoccupied adolescents showed an increase in IBI reactivity (i.e., a decrease in difference score, indicating more stress) while secure individuals displayed a decrease in IBI reactivity.

[2] Corrected for multiple comparisons.

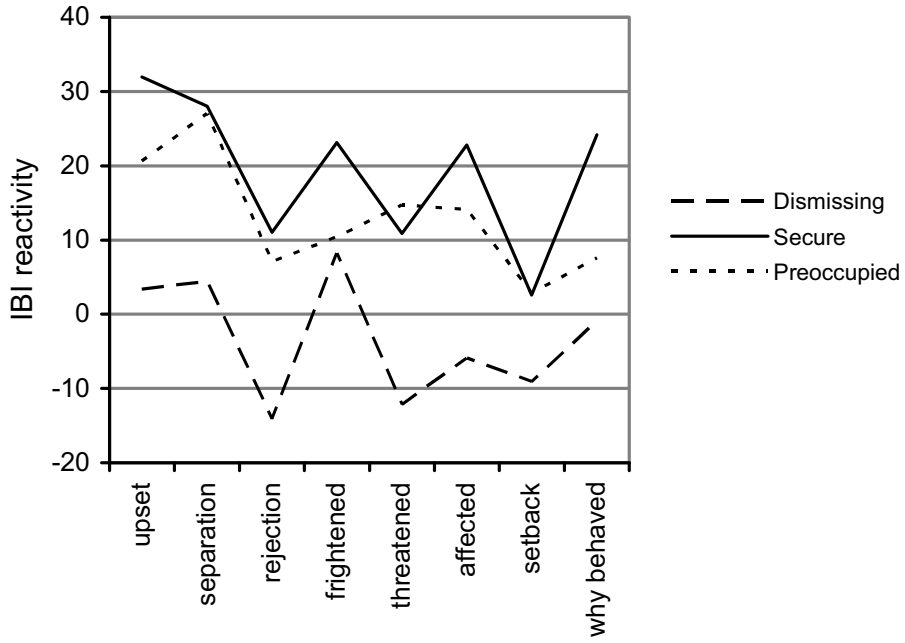

Figure 1
IBI reactivity of secure, dismissing, and preoccupied adolescents during the AAI

Adolescents with secure, dismissing, or preoccupied classifications did not differ significantly from each other on RMSSD reactivity (F (2, 137) = 0.81, p = .45) or SCL reactivity (F (2, 141) = 1.35, p = .26). Participants displayed more SCL reactivity during the question how they were affected by their childhood than during the question on rejection (*Mean difference* = 0.36, *SE* = 0.11, *df* = 585, $p < .05$). When the outliers were changed into the next most extreme scores, the adolescents also showed more SCL reactivity during the frightening and threatening questions than during the rejection question (*Mean difference* = 0.23, *SE* = 0.07, *df* = 912, $p < .05$; *Mean difference* = 0.27, *SE* = 0.09, *df* = 905, $p < .05$). Because the results of the analyses with SCL reactivity did not change whether or not number of words used during the AAI was included, only the statistics of the analyses without number of words as covariate are presented.

Dismissing score

Controlling for background variables which were associated with the physiological measures and the dismissing score, we found that IBI reactivity was associated with the dismissing scale during the questions concerning being upset and when asked for effects of childhood experiences (r = -.18, p < .05; r = -.22, p < .05, respectively). A trend was found for the relation between the dismissing score and the question about separations (r = -.16, p = .06). When the outliers were changed into the next most extreme scores the correlation between the dismissing scale and IBI reactivity during the question about rejection was also significant (r = -.17, p < .05). Adolescents with higher dismissing scores tended to show less reactivity (higher IBI difference scores), indicating less stress during these questions. RMSSD and SCL reactivity were not related to the dismissing scale during any of the selected AAI-questions (RMSSD separate scores for gender: range r -.23 to .19, p = ns; SCL range r -.04 to -.08, p = ns).

Do adolescents with and without unresolved attachment classifications differ in physiological reactivity during the AAI?

The results for SCL reactivity remained the same when number of words was included in the analysis as a covariate, we therefore only report statistics of the linear mixed model for SCL reactivity without number of words. The linear mixed models for IBI, RMSSD, and SCL had a diagonal covariance structure and included subject as a random effect. Question was a significant predictor for IBI (F (2, 158) = 9.69, p < .001): All adolescents showed more IBI reactivity (M = 12.45, SD = 49.09) during the loss question, indicating that this question was more stressful than the questions concerning abuse (M = 6.32, SD = 53.69) and other trauma (M = 9.90, SD = 53.39). In none of the tests unresolved attachment with respect to loss or trauma was a significant predictor of physiological reactivity (IBI, F (1, 127) = 0.42, p = .52; RMSSD, F (1, 120) = 0.42, p = .52; SCL, F (1,123) = 0.03, p = .86). Stress reactivity was neither related to the unresolved loss score.

Physiological Reactivity during the FIT

In order to keep the analyses concise and focused, we decided to follow through only on IBI reactivity during the FIT because adolescents with different attachment representations differed in IBI reactivity during the AAI. Mean IBI baseline value was 794.11 (*SD* = 110.46). Boys had higher IBI baseline scores than girls (total group *t* (112) = -3.41, *p* <.01; group with loss/trauma *t* (97) = -2.86, *p* <.01). However, no gender differences were found in IBI reactivity during the FIT (total group, *t* (145) = -0.74, *p* = .46; group with loss/trauma, *t* (127) = -0.92, *p* = .36). During the FIT mean IBI score was 775.63 (*SD* = 104.82).

Secure, dismissing, and preoccupied adolescents

Means of IBI reactivity for the three attachment classifications were 9.43 (*SD* = 46.81) for secure adolescents, 30.90 (*SD* = 58.33) for dismissing adolescents, and 9.87 (*SD* = 52.00) for preoccupied adolescents. The contrast for secure versus dismissing adolescents showed a significant difference (*Difference* = 21.48, *SE* = 9.84, *p* < .05): dismissing adolescents showed more reactivity and were thus more stressed than secure adolescents during the FIT. The dismissing scale was significantly associated with IBI reactivity (*r* = .18, *p* < .05). Adolescents with higher dismissing scores were more stressed (lower scores indicate more stress).

IBI reactivity during the FIT and unresolved loss/trauma

No significant differences were found for IBI reactivity between adolescents with or without an unresolved attachment classification (*F* (1, 127) = 0.87, *p* = .35). In addition, the unresolved score was not correlated to IBI reactivity during the FIT (*r* = -.03, *p* = .76, *n* = 129).

IBI Reactivity during the AAI and during the FIT

A linear mixed model was run with IBI reactivity as dependent variable and task and attachment classification as independent variables. There was no significant main effect for task or attachment (*F* (1, 280) = 1.33, *p* = .25; *F* (2, 280) = .07, *p* = .93, respectively). The interaction between task and attachment was significant (*F* (2, 280) = 6.18, *p* < .01). As can be seen in Figure 2, in comparison with the secure adolescents, dismissing adolescents were more stressed during the FIT whereas they were less stressed during the AAI (*t* (280) = -3.34, *p* < .01).

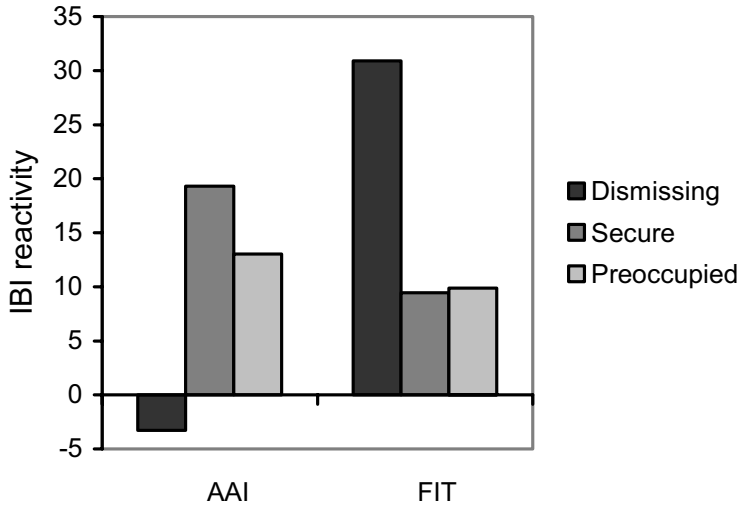

Figure 2
Differences in IBI reactivity during the AAI and during the FIT

Discussion

The current study investigated whether attachment classification was related to physiological reactivity during the AAI (Main et al., 2003) and during a dyadic interaction task (FIT, Allen et al., 2003; Kobak et al., 1991; Strodtbeck, 1951). Using IBI reactivity, dismissing participants showed less stress during the AAI than secure adolescents. However, during the conflict interaction task, involving a discussion with their mother on an issue on which they disagreed, dismissing adolescents showed more stress. Furthermore, in the AAI preoccupied individuals showed elevated stress reactivity while secure individuals displayed decreases in stress reactivity during questions about separation and threat. We found no differences in physiological reactivity between adolescents with a resolved or unresolved state of mind during the AAI or during the FIT. In addition, IBI reactivity was compared during the AAI and during the FIT. It appeared that there were no differences in IBI reactivity between the two tasks, and there was no overall effect for attachment. However, a significant interaction effect revealed that in comparison with secure adolescents, dismissing adolescents were more stressed during the FIT and less stressed during the AAI.

Our study extends previous research with a broader spectrum of physiological measures during the AAI. Moreover, we examined not only associations with secure, dismissing, and preoccupied attachment classifications, but also tested whether

individuals with and without unresolved loss showed different physiological reactivity during the pertinent AAI questions on loss and (other) trauma. We used Main et al.'s classification system (2003) instead of Kobak's Q-sort (1993) (as was done in previous studies). Furthermore, the present study was conducted in the home, whereas prior studies conducted the AAI in a laboratory setting (the latter setting may be more stressful than the home). Fourth, the current study is the first that focused on physiological reactivity shown by persons with different attachment representations during a mother-adolescent conflict interaction task. Finally, our sample consisted of adolescents. The present findings extend previous physiological investigations by using different methodology in a younger sample. The focus on physiology in adult attachment research is relatively new. Further studies are necessary to draw more definite conclusions regarding physiological reactivity in attachment relevant situations, in adolescents as well as in adults.

Dismissing adolescents did not experience more stress during the AAI, whereas they did show more stress than secure adolescents during the FIT. Both tasks place different demands on the participants. During the AAI participants are asked to produce their childhood memories and reflect on them (Hesse, 1999). Our findings suggest that dismissing adolescents are less open to the challenge of the AAI than secure adolescents, and are able to cope with the interview in a somewhat superficial manner. They might therefore experience less stress during the AAI, but it seems impossible to be uninvolved and detached during a direct interaction task with their mother with the goal of reaching consensus in an area of disagreement. We thus propose that the defensive strategy of dismissing adolescents might be effective during the AAI even at an early stage of information processing, and that they are less open to seriously address the questions compared to secure adolescents. This hypothesis has been suggested before. In a study using the Stroop test (Zeijlmans Van Emmichoven, Van IJzendoorn, De Ruiter, & Brosschot, 2003) persons with a secure attachment representation showed slower response latencies than insecure persons. Moreover, clinical subjects with a secure attachment representation had the largest response times to threat words. The authors therefore hypothesized that secure individuals may be more open to this type of threatening information that is carefully processed whereas dismissing individuals exclude this unbalancing information at an early stage.

It should be emphasized that this hypothesis of effectively excluding attachment-related memories and experiences at an early stage of information processing may pertain to adolescents only, as prior work on adults did show a different picture. Adolescents are different from adults in that they did not have had much time to work through their attachment experiences, and are in the process of becoming less dependent on their parents (Allen & Land, 1999; Van IJzendoorn & Bakermans-

Kranenburg, in press). Adolescents also differ from adults in that their brain is not yet fully developed (see for a review Blakemore & Choudhury, 2006). Maturation of the frontal cortex continues into adolescence. MRI studies have shown changes in white and gray matter during adolescence which may be indicative of increased axonal myelination and synapse proliferation. These changes may account for the lower capacity of adolescents to control and coordinate their thoughts and behavior (executive function, including selective attention, decision-making, voluntary response inhibition, and working memory) as compared to adults. Adolescents may thus show a different pattern of associations between AAI representations and (physiological) responses because of their transitional life stage (becoming less dependent on their parents) and their less developed cognitive functioning (less mature frontal cortex).

In contrast to their physiological reactivity during the AAI, dismissing adolescents were more stressed than secure adolescents during the FIT. When the dismissing adolescents are in direct interaction with their mother, they may have less opportunity to effectively use defensive processes and they may thus experience more stress than secure adolescents. In the FIT the stakes may be felt to be higher because the discussion pertains to present real-life conflict issues and the mother may play a more demanding or provocative role than an unknown interviewer who is not able to check the validity of any response. This result converges with a study of Roisman (2007) in which deactivation was associated with SCL reactivity during the discussion of a disagreement with the participant's romantic partner.

A second explanation for the higher IBI reactivity of the dismissing adolescents versus the secure adolescents during the FIT may be found in their mothers' contribution during this task. Mothers' interactions during the discussion vary across dyads and may be dependent on the adolescent's behavior. The interactive behavior of mothers of dismissing adolescents might be more stress evoking than that of mothers of their secure counterparts. In fact, during the FIT both dismissing adolescents and their potentially dismissing mothers contribute to the conflict interaction which might exacerbate the tensions in the relationship compared to stress felt during the unilateral AAI narrative.

Preoccupied adolescents differed from adolescents with a secure attachment representation only in their response to the questions on separation and threat during the AAI. During the FIT they did not differ in reactivity from secure adolescents. The strategy of these individuals is to maximize attention to attachment relationships and experiences (Hesse, 1999). The AAI and the FIT thus seem not to challenge preoccupied adolescents like they do dismissing individuals; which fits nicely with the idea that preoccupied persons are used to talk about relationships and emotional experiences. In addition, the FIT provides preoccupied individuals with the undivided attention of their attachment figure. During the AAI questions regarding separation and

threat these individuals may be especially triggered to recall anxious experiences and as a consequence show elevated stress reactivity. Roisman (2007) showed that hyperactivation was associated with more heart rate reactivity during a discussion between romantic partners. However, relationships between adolescents and their parents and between romantic partners have different characteristics. Romantic partners may decide to end the relationship which raises intense feelings of anxiety in preoccupied individuals, whereas even preoccupied adolescents may always feel the strong bond of their parents –whether or not this bond is insecure.

We found differences in cardiac reactivity as opposed to SCL reactivity. Because no difference in RMSSD reactivity (which is an indicator of parasympathetic activation) was found between adolescents with a dismissing or secure attachment representation, we tentatively speculate that differences in IBI reactivity may be mainly due to differences in sympathetic activation (see Roisman, 2007). Activation of the sympathetic branch has been associated with deactivation of attachment before (e.g., Dozier & Kobak, 1992; Roisman, 2007; Roisman et al., 2004). This seems to be in contrast with the result that SCL reactivity was not associated with adolescent attachment; however, the lack of findings for SCL may (partly) be a consequence of the various ethnicities represented in the current sample. SCL is suggested to be influenced by a person's ethnicity: for example, White participants tend to have higher SCL levels than Black participants (Boucsein, 1992). As our sample consisted of adolescents with different ethnic backgrounds, this may have been a problem for our SCL recordings. Although we controlled for possible associations between SCL and country of origin, a more specific measure for ethnicity may be needed as even adolescents from the same country may vary widely in skin color.

The current study is the first that focused on psychophysiological stress reactivity shown by resolved versus unresolved persons during the AAI. The lack of differences between resolved and unresolved adolescents could be due to the way we measured physiological reactivity. Unresolved loss is characterized by a *momentary* breakdown in strategy during discussions of loss, abuse or trauma (Hesse & Main, 2000). We only focused on reactivity during the loss, abuse and trauma questions but experiences of loss and trauma may also be discussed in other parts of the AAI. Moreover, the breakdown in strategy is usually very brief (Hesse, 1999; Hesse & Main, 2000), consequently physiological changes may also have been momentary rather than during the entire response to these questions. Future research should try and connect the moment of breakdown in speech during the AAI with the recordings of physiological reactivity.

Although the adolescents in our sample were adopted, they may not be too different from other adolescents. They were adopted in infancy at a very early age (before 6 months) and were not selected for special needs. Their mean IQ score was

not different from the norm for 14-15 year olds (t (150) = 0.57, p = .57). Moreover, although they had less optimal scores for inhibiting autonomy-relatedness compared to a high school sample (Allen & Hauser, 1996), they exhibited more optimal autonomy behaviors compared to an academic low risk group (Boykin-McElhaney & Allen, 2001).

A limitation of the current study may be that during the baseline periods, adolescents completed a questionnaire, whereas they answered interview questions or were involved in a discussion during the two target tasks. Speaking versus completing a questionnaire may differentially influence physiological activity (e.g., Berntson et al., 1997). However, we were not so much interested in the comparison of physiological response during baseline and these two tests. Our focus pertained to physiological differences in reactivity between adolescents with different attachment representations. We controlled for number of words when necessary, but the findings remained the same.

In sum, the current study is the first to investigate physiological reactivity in adopted adolescents during the Adult Attachment Interview and during a dyadic conflict interaction task. We propose that dismissing adolescents seem to be able to effectively use their defensive strategy during the AAI as they show less stress reactivity than adolescents with a secure attachment representation, but they are more stressed than secure adolescents in direct interaction with their mothers around a conflict issue. Attachment representations thus play an important role in emotion regulation in attachment relevant conflict situations, also during adolescence.