Autonomic Reactivity of Children to Separation and Reunion With Foster Parents

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ABSTRACT

Objective: To determine whether foster children showed different autonomic nervous system activity on separation and reunion than control children. Autonomic nervous system activity in foster children was examined in relation to time in placement and disinhibited attachment. **Method:** The sample included 60 foster and 50 control children between 2 and 7 years of age who participated with their caregivers in a modified Strange Situation. Heart rate, respiratory sinus arrhythmia (RSA), and pre-ejection period were monitored continuously. Foster caregivers reported disinhibited symptoms on the Disturbances of Attachment Interview. **Results:** The Strange Situation elicited less RSA reactivity in foster children. Differences in RSA, heart rate, and pre-ejection period responses on the specific separation and reunion episodes were not significant. RSA responses on separation from the stranger and on reunion with the foster caregiver were partly explained by time in placement and disinhibited attachment. **Conclusions:** Early experiences of relationship disruptions in foster children as well as short placements may have an impact on children's adaptation to environmental and relational challenges. Stable placement may facilitate adaptive affect regulation, except for children with disinhibited symptoms. *J. Am. Acad. Child Adolesc. Psychiatry,* 2007;46(9):1196–1203. **Key Words:** autonomic nervous system, disinhibited attachment, children in foster care.

Social experiences and, in particular, attachment experiences may determine children's ability to evaluate and adapt appropriately to environmental changes (Schore, 2001). Field (1994) showed that primary caregivers function as regulators of children's affective states. Early relational traumas, such as neglect, abuse, separation, and loss, have been identified as sources of prolonged and intense negative arousal, which may impair the affective regulatory systems in the brain, including the autonomic nervous system (ANS; Schore, 2001). Scheeringa et al. (2004) showed that traumatized children had decreased heart period and, in combination with less positive parental discipline, decreased respiratory sinus arrhythmia (RSA) in reaction to a trauma stimulus. The present study examines whether foster children, many of whom have experienced relational traumas, showed different ANS activity on separation and reunion with the foster caregiver compared to control children with their caregivers.

An influential framework for linking the developing ANS to affect regulation and social behavior was developed by Porges (2004). His polyvagal theory described three phylogenetic stages of neural development that are associated with distinct affective processes and behaviors. The first stage includes a vegetative, unmyelinated vagal system that is associated with immobilization (e.g., freezing behavior). The second stage involves the sympathetic nervous system or mobilization system, facilitating fight-flight behavior by, for example, increasing blood pressure and heart rate (HR). The evolutionary most recent adaptation includes the myelinated vagal system (third stage), which emerges from the nucleus ambiguus. The vagal system fosters homeostasis by functioning as a brake on the stimulation of the heart by the sympathetic nervous system (Porges et al., 1996). This function of the vagal system is adaptive when environmental demands are low. However,

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when there are environmental challenges, the vagal system downregulates homeostatic processes to increase cardiac output, which facilitates engagement with the environment. Porges (2004) suggested that adaptive development of the vagal system is compromised if children are exposed to environmental challenges that are excessive in intensity or duration. "Natural cues to danger" (Bowlby, 1969/1997), such as being left alone or with a stranger, as well as cues to safety, namely, access to the attachment figure, require adaptation by the regulatory processes operative within the parent–child relationship, including the ANS (Fox and Card, 1999; Hofer, 2006).

Regulation of ANS activity in parent–child relationships have been studied by using separation-reunion paradigms based on the Strange Situation (Ainsworth et al., 1978). Most studies included measures of HR, which is influenced by both the sympathetic and parasympathetic branches of the ANS. Separation from the caregiver elicited HR increases in infants (Spangler and Grossmann, 1993). Other studies examined different types of attachment relationships and found HR increases to separation in avoidant (Sroufe and Waters, 1977) and disorganized attachment (Willemsen-Swinkels et al., 2000) relationships, although Zelenko et al. (2005) found no significant differences between the attachment groups during separation from the caregiver.

Effects of reunion with an attachment figure have been found for HR, although inconsistent, and for RSA. RSA reflects activity of the vagal system. RSA decreases result from withdrawal of vagal influence and therefore indicate increased arousal (see Table 1 for more detailed information about changes in RSA). Stevenson-Hinde and Marshall (1999) showed that HR decreased from separation to reunion, whereas RSA increased on reunion. The effects on RSA and HR were qualified by temperamental inhibition and security of attachment, indicating that RSA did not increase in inhibited children, whereas HR did not decrease in highly inhibited, insecurely attached children. Zelenko et al. (2005) showed no significant effects, whereas the study on attachment in children with pervasive developmental disorders by Willemsen-Swinkels et al. (2000) revealed HR decreases on reunion for children with disorganized attachment. All of these studies included infants between 12 and 14 months of age, except for the study of Stevenson-Hinde and Marshall, which focused on children age 4.5 years. The children in the study of Willemsen-Swinkels et al. were matched based on their mental ages.

TABLE 1
Overview of the Meaning of Indicators of Sympathetic and Parasympathetic Activity

Indicator	Decrease	Increase
RSA[a]	Parasympathetic withdrawal: decreases in parasympathetic influences to the heart (e.g., downregulation homeostatic processes); increases of sympathetic influences to the heart	Parasympathetic activity: increases in parasympathetic influences to the heart (increase digestion); inhibition of sympathetic influences to the heart
PEP	Sympathetic activity: increases in sympathetic influence to the heart (e.g., increase respiration, heart rate, blood pressure)	Sympathetic withdrawal: decreases in sympathetic influence to the heart

Note: RSA = respiratory sinus arrhythmia; PEP = pre-ejection period.

[a] Usually the natural logarithm of RSA is taken (lnRSA) for obtaining distributions suitable for parametric analysis techniques.

The present study examined whether foster children between 2 and 7 years of age showed different ANS reactivity to separation and reunion compared to control children. Differences between the groups were expected because the attachment relationships between children and their foster caregivers may be less well established than between children and parents who have been in a continuous relationship from birth. Larger variation within the foster care group was also expected, due to the differences in duration of foster child-caregiver relationships. Moreover, early experiences of relationship disruption and trauma in foster children may lead to different perceptions and reactions to environmental challenges, which may be reflected in reduced vagal regulation in foster children. Indicators of vagal regulation were derived from changes in RSA, which refers to rhythmic fluctuations in heart period associated with respiration (De Geus and Van Doornen, 1996). The present study also included measures of sympathetic activity, as indexed by pre-ejection period (PEP; Table 1). PEP is a measure of changes in sympathetic effects on inotropic function, which refer to the contractility of the heart (De Geus and Van Doornen, 1996).

Another purpose was to examine individual differences in ANS reactivity in foster children. Because parent–child relationships can develop and become more organized over time, foster children who remained longer in the current placement were supposed to show more evidence of adaptive vagal regulation than foster children with relatively short placements. However, Porges (2004) suggested that dysfunctional vagal regulation also carries forward into difficulties in the activation of the social engagement system, which he proposed as an explanation of the pervasively disordered behavior in social relationships as observed in children with disturbances of attachment. Children showing disorder in developing attachment relationships with their foster caregiver may therefore fail to show the expected link between separation-reunion and vagal regulation, irrespective of the duration of placement.

Early studies on disturbances of attachment identified two subtypes, which correspond to subtypes of reactive attachment disorder, as defined in *DSM-IV-TR* (American Psychiatric Association, 2000). These are the emotionally withdrawn/inhibited type and the indiscriminately social/disinhibited type (e.g., Tizard and Rees, 1975). Children with inhibited symptoms seek little comfort from the caregiver in times of stress, whereas children with disinhibited symptoms indiscriminately seek comfort from unfamiliar adults. Several studies reported elevated frequencies of disinhibited and inhibited symptoms (e.g., Boris et al., 2004; Chisholm, 1998; O'Connor et al., 2000; Zeanah et al., 2002, 2005) in institutionalized and maltreated adoptive or foster children. In a recent review on the status of reactive attachment disorder, it was suggested that the disinhibited pattern may persist over years, whereas the inhibited pattern may diminish when children are placed into more normative caregiving environments (American Academy of Child and Adolescent Psychiatry, 2005). We therefore focused on disinhibited symptoms to gather evidence that children with these symptoms show maladaptive vagal responses, not only to their foster caregiver, irrespective of the duration of placement, but possibly also to the stranger.

This study sought to test the following hypotheses: (1) Foster children were expected to show less vagal regulation in a modified Strange Situation than control children, as reflected by smaller RSA decreases from the begin to the end of the procedure as well as by less RSA reactivity across the episodes. Differences in variability between the groups were also examined because foster children may show a broader range of responses. Further, HR and PEP reactivity across the episodes as well as specific effects of HR, PEP, and RSA on separation and reunion were examined. Based on Porges' model, adaptive vagal regulation is supposed to be characterized by RSA decreases on separation and RSA increases on reunion. (2) RSA reactivity was expected to be higher the longer that the children were in the current foster family, but children with disinhibited symptoms were expected to show lower levels of RSA reactivity independent of the time in placement. It was also explored whether time in placement and disinhibited symptoms were related to RSA responses to the specific separation and reunion episodes as well as to PEP responses to separation and reunion. (3) Because children with disinhibited symptoms tend to seek comfort from unfamiliar adults, it was examined whether these children reacted more strongly to the stranger, which may be reflected by increased RSA or PEP reactivity to separation and reunion with the stranger.

METHOD

Participants

The sample included 60 foster children (39 girls) and 50 control children (29 girls). The foster children ranged in age from 26 to 88 months (mean 56.88, SD 16.52). The foster children had been placed between birth and 69 months of age (mean age at placement 12.25 months, SD 16.59). Almost all of the foster children (97%) experienced one or more previous placements (mean 2.31, SD 1.10). The number of previous placements ranged from 0 to 6. Foster children were between 3 and 76 months in the specific foster family (mean 35.33, SD 18.52). Termination of parental rights is rare in the Netherlands, and the official aim of foster placement is almost always toward reunification. Placements are, however, designated as either short term (crisis placement) or long term. The sample was selected for long term (3 months or more), nonkinship placements. Foster children participated with their primary foster parent (54 mothers, 6 fathers).

The control children ranged in age from 36 to 81 months (mean 54.74, SD 9.25) and participated with their primary caregiver (48 mothers, 2 fathers). Of these biological parent–child dyads, 28 were registered by foster care agencies, indicating that the families had also foster children in their home or were intending to provide foster care in the near future. These families as well as the foster parent–child dyads were recruited by foster care agencies in the cities and neighborhoods of Amsterdam, Rotterdam, Utrecht, and Zwolle (the Netherlands). The remaining 22 biological parent–child dyads were recruited by schools and day care centers in Amsterdam and the surrounding area. There were no significant differences in age, sex, and education between these two groups of parents in the control group. Informed consent was obtained from all of the participating families as well as from the biological parents or family guardians of the foster children. There were no differences between the foster and control children with regard to sex and age (independent samples *t* test, $p = .46$ and $p = .70$, respectively).

Procedure

Caregivers and children visited the university laboratory for a separation-reunion procedure based on the Strange Situation (Ainsworth et al., 1978). The modified procedure yields parallel separation and reunion episodes for caregiver and stranger. The following episodes were included: (1) child and caregiver in waiting room; (2) dyad introduced to room, caregiver and child in room for 3 minutes; (3) stranger comes in, talks with caregiver (1.5 minutes), and plays with child (1.5 minutes); (4) caregiver leaves quietly (after 3 minutes), first separation from caregiver for 3 minutes; (5) caregiver returns (after 3 minutes), first reunion with caregiver for 3 minutes; (6) stranger leaves quietly (after 1.5 minutes), first separation from stranger for 3 minutes; (7) caregiver leaves (after 1.5 minutes), second separation from caregiver for 6 minutes; (8) stranger returns (after 1.5 minutes), first reunion with stranger for 3 minutes; (9) stranger leaves (after 3 minutes), second separation from stranger for 4½ minutes; (10) caregiver returns (after 1.5 minutes), second reunion with caregiver for 3 minutes; (11) stranger returns (after 3 minutes), second reunion with stranger for 3 minutes. Physiological measures were conducted during the procedure. Children wore six electrodes on the skin that were connected to a small lightweight device (Vrije Universiteit-Ambulatory Monitoring System 46; see below). Movements were reduced by seating the children behind a table with toys. Before the laboratory visit, foster caregivers were interviewed by telephone about symptoms of attachment disorder. This interview was not administered to the caregivers of the control children because the existence of attachment disorders was not assumed in children raised from birth by the same caregivers (Zeanah et al., 2005).

Measures

Psychophysiological Measures. The Vrije Universiteit-Ambulatory Monitoring System 46 was used to continuously record electrocardiograms, basal thorax impedance (Z_0), changes in impedance (dZ), and the first derivative of pulsatile changes in transthoracic impedance (dZ/dt). To yield the impedance cardiogram (ICG), dZ/dt is sampled at 250 Hz (De Geus and Van Doornen, 1996). The VU-AMS Software Programs (2006) were used to extract the physiological parameters.

The software program for ICG derived and displayed an average ICG waveform of 128 samples (512 milliseconds). The following three points were automatically scored and marked on the average dZ/dt waveform: B point or upstroke, $dZ/dt_{(min)}$, and X point or insicura. From these points, the PEP was obtained, which is defined as the time between the onset of ventricular depolarization (Q wave onset) and the onset of left ventricular ejection of blood in the aorta (B point; De Geus et al., 1995). Because of the limited reliability of B-point detection, due to ambiguity in the location of the B point, each dZ/dt waveform was checked and corrected when automated scoring revealed B points that were morphologically inconsistent (Riese et al., 2003). Fewer than 5% of the waveforms were discarded. Interrater reliability of three raters was determined for 2,377 ICG signals of 15 subjects and ranged from 0.88 to 0.94 (intraclass correlation coefficient was 0.90).

The software program for continuous measurement of electrocardiographic R wave–to–R wave intervals and thoracic impedance was used to correct the respiration signal. The respiration signal was obtained from filtered (0.1–0.4 Hz) thoracic impedance signal. The begin and end of inspiration and expiration were detected by an automatic scoring algorithm. RSA was derived by the peak-trough method (Grossman et al., 1990), which combined the respiratory time series and the interbeat intervals (IBIs) to calculate the shortest IBI during HR acceleration in the inspiration phase and the longest IBI during deceleration in the expiration phase (De Geus et al., 1995). RSA was defined as the difference between the longest and the shortest IBIs. The RSA was set on zero or a negative value was obtained, when the longest or shortest IBI was missing for that breath cycle. Scoring of the respiration signal and the IBI was done automatically.

Symptoms of Attachment Disorder. The Disturbances of Attachment Interview (Smyke and Zeanah, 1999, unpublished) is a semistructured interview consisting of 12 items assessing symptoms of inhibited attachment (five items), disinhibited attachment (three items), and secure base distortions (four items). The items were coded 0 if there was no evidence of the symptom, 1 if there was some evidence, and 2 if the symptom was definitely present. The items that assessed secure base distortions were not included in the present study.

First, categorical principal components analysis was used to confirm the distinction between items tapping symptoms of inhibited and disinhibited attachment. Categorical principal components analysis performed optimal scaling of the variables, based on the assumption that the categories were ordinal, using alternating least squares (Gifi, 1990). The initial model was extracted based on two dimensions, explaining 56.9% of the total variance. Analysis of the component loadings revealed that item 4 (responds reciprocally with familiar caregivers) did not load on the two dimensions. Because a three-dimensional solution placed item 4 on a separate dimension, explaining 70.7% of the variance, item 4 was dropped and a two-dimensional solution was chosen. The new two-dimensional solution explained 64.5% of the total variance. The eigenvalue of the two dimensions of 1.60 exceeded the cutoff of 1. Four items (items 1, 2, 3, and 5) loaded 0.43 or higher on the first component, which explained 41.63% of the variance. Three items (items 6, 7, and 8) loaded 0.30 or higher on the second component, which explained 22.83% of the variance. All of the items that primarily loaded on the first dimension reflected inhibited attachment, whereas the items concerning the disinhibited subtype loaded primarily on the second dimension. Item 1, which is considered for both subtypes, loaded primarily on the first dimension and was neutral on the second dimension. Reliability analyses applied to the transformed variables revealed Cronbach's α of .80 for the subscale inhibited and .67 for the subscale disinhibited.

Next, quantifications were examined for support of the decision to use only a definitely present score as evidence of the presence of a symptom. Transformation plots showed that for the items in which all three answer categories were used, the categories were highly unevenly spaced. For these items (items 2, 3, 5, 7, and 8), there was almost no distinction between some evidence of symptom and symptom not present. The uneven spacing of the answer categories indicated that the distinction between symptom not present and the intermediate category some evidence of disorder conferred little added information compared with the distinction between both these answer categories and symptom definitely present. Because the quantifications supported a dichotomy and not a continuum of symptoms of attachment disorders, children were grouped according to the definite presence of a symptom of inhibited or disinhibited attachment. Based on this criterion, seven children showed disinhibited symptoms, two children showed inhibited symptoms, and another two children showed both disinhibited and inhibited symptoms. Interviews were conducted and coded by the first author, who had attended a 3-day workshop by Dr. N.W. Boris in combination with individual training in identifying symptoms of disordered attachment. The first author also took a 1-week workshop by Dr. R.A. Marvin for classifying preschool attachment. The second rater was a master student who was trained by the first author. Interrater reliability between the raters was measured using the κ statistic, indicating κ of .86 for inhibited symptoms and .71 for disinhibited symptoms (n = 16).

Data Analyses

Repeated-measures analysis of variance was conducted to compare HR, RSA, and PEP between subjects (group) and within subjects (across the episodes of the Strange Situation). Planned contrasts were used to examine whether HR, RSA, and PEP changed from the start until the end of the Strange Situation and, more specifically, on separation and reunion with the caregiver. HR, RSA, and PEP change scores on separation and reunion were calculated for each child. Change scores were computed as the difference between two succeeding episodes. Positive values for change therefore reflect an increase in the indicators of autonomic regulation. The mean of these increased scores was used as a measure of reactivity across the Strange Situation. One-way analysis of variance, including analyses of homogeneity of variances, was conducted to evaluate the relationship between group (foster and control) and the measures of reactivity as well as the differences in HR, RSA, and PEP variability between the groups.

Within the foster group, multiple regression analyses were used to predict changes in RSA and PEP reactivity across the procedure and on separation and reunion with the foster caregiver and the stranger. Predictors were child's time in placement and symptoms of disinhibited attachment (step 1) and the interaction between time in placement (centered) and symptoms of disinhibited attachment (step 2), based on multiplications of these variables (Aiken and West, 1991). Sex and age of the child were not included because there were no significant associations with the dependent and independent variables under study.

RESULTS

Differences in lnRSA, PEP, and HR Reactivity of Foster and Control Children

Overall differences between foster and control children were not significant for the level of lnRSA across the episodes of the procedure (Wilks Λ = .90, $F_{5,104}$ = 2.21; p = .06). Planned contrasts between episodes, however, revealed that the Strange Situation elicited a larger decrease in lnRSA (from episode 2 to episode 10) in the control children than in the foster children ($F_{1,108}$ = 8.79, $p < .001$). Levene's test was significant with regard to the measure of lnRSA reactivity across the Strange Situation ($F_{1,108}$ = 8.09; $p < .01$), indicating that foster children showed less variability in lnRSA reactivity across the episodes of the Strange Situation than control children. Taking these differences in variability into account, analyses of variance of lnRSA reactivity revealed that control children showed significantly more lnRSA reactivity (mean −0.02, SD 0.04) than foster children (mean −0.01, SD 0.03) ($F_{1,108}$ = 6.88; $p < .01$).

Differences between foster and control children on the specific separation and reunion episodes were not significant. Total group analyses on the combined group foster and control children revealed significant lnRSA effects on the first ($F_{1,108}$ = 6.61; $p < .05$) and second ($F_{1,108}$ = 5.13; $p < .05$) separations. LnRSA effects on reunion were not significant in the total group. These results are summarized in Figure 1.

Overall differences between foster and control children on HR and PEP reactivity as well as HR and PEP responses to the specific separation and reunion episodes were explored but were found to be not significant. However, analyses on the total group of children revealed significant HR increases on the first separation ($F_{1,108}$ = 10.90; $p < .001$).

Individual Differences in lnRSA and PEP Reactivity in Relation to the Foster Caregiver

Regression analyses on time in placement and disinhibited symptoms of lnRSA reactivity across the

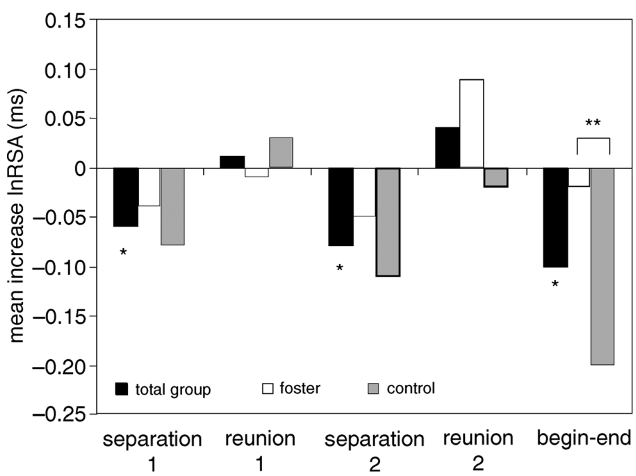

Fig. 1 Mean lnRSA (respiratory sinus arrhythmia [in logs]) increases of foster and control children on separation and reunion with the caregiver. *$p < .05$ represents significant main effects on the total group children (foster and control children together). **$p < .001$ represents a significant interaction effect of group on mean lnRSA increases from the begin (episode 2) to the end (episode 10) of the procedure.

procedure revealed no significant effects (R^2 = 0.01, $F_{2,57}$ = 0.36; p = .70). There were also no effects as regards responses to separation. With respect to mean lnRSA increases on the second reunion, the regression equation with the interaction between time in placement and disinhibited attachment was significant (R^2 = 0.16, $F_{1,56}$ = 8.08; p < .01), indicating that children without disinhibited symptoms showed lnRSA decreases when time in placement was relatively short and lnRSA increases when placements were longer. In contrast, children with disinhibited symptoms tended to show lnRSA increases when time in placement was relatively short, but lnRSA responses on reunion were less clear when placements were longer.

Regression analyses of time in placement and disinhibited symptoms of PEP reactivity across the procedure revealed no significant effects (R^2 = 0.09, $F_{2,57}$ = 2.81; p = .07). Examination of the individual predictors revealed a significant effect of disinhibited symptoms (t = 2.14; p < .05), indicating higher PEP increases across the Strange Situation for children with symptoms of disinhibited attachment. Predictions of PEP changes on separation and reunion were not significant.

Individual Differences in lnRSA and PEP Reactivity in Relation to the Stranger

On separation, it was found that the interaction between time in placement and disinhibited attachment predicted significant changes in lnRSA (R^2 = 0.16, $F_{1,56}$ = 7.34; p < .01), indicating that symptomatic children with shorter placements showed stronger lnRSA changes on separation from the stranger than children without symptoms of disinhibited attachment and children with symptoms but longer placements. Regression analyses to predict lnRSA changes on reunion as well as PEP changes on separation and reunion with the stranger showed no significant effects.

DISCUSSION

The findings revealed differences as well as similarities between foster and control children in ANS regulation. Both foster and control children showed HR reactivity on separation, indicating general arousal of the cardiovascular system. However, foster children showed less lnRSA reactivity across the procedure than control children, which suggests less vagal regulation in foster children. Specific autonomic effects of separation and reunion were not significantly different for foster and control children. Individual differences in vagal regulation within the foster group were partly explained by time in placement and symptoms of disinhibited attachment.

In the total group children, effects of separation were found on HR and lnRSA, indicating HR increases and lnRSA decreases. The absence of HR increases on the second separation, which is in line with the study of Zelenko et al. (2005) but in contrast to an earlier study (Spangler and Grossmann, 1993), indicates that being left with the stranger elicited more arousal than being left alone. However, habituation and the order of these two types of reunions may be an alternative explanation. The lnRSA effects suggest that both being left alone or with the stranger challenges the vagal system. With regard to reunion, we found no significant HR effects, which is in line with earlier studies (Spangler and Grossmann, 1993; Zelenko et al., 2005). The absence of lnRSA effects on reunion was unexpected, given the lnRSA increases on reunion with the caregiver found by Stevenson-Hinde and Marshall (1999). However, the reunion episodes in our study were preceded by shorter separations than the reunion in the study of Stevenson-Hinde and Marshall (6 minutes at maximum instead of 25 minutes). PEP changes were not significant, indicating less involvement of the sympathetic nervous system in the regulation of affect and behavior on separation and reunion.

Theoretical Implications

Vagal regulation, which may be indexed by lnRSA reactivity, in response to environmental challenges, indicates a socially mediated response that, depending on age and circumstance may adaptively scaffold the development of affect regulation (Schore, 2001). Foster children showed less evidence of vagal regulation during the Strange Situation, which may be indicative of long-term effects of preplacement experiences and/or the differences between primary attachment relationships and developing secondary attachment relationships. A similar limitation in vagal regulation in foster children in daily life situations that normally would elicit engagement with an attachment figure may partly explain why foster children remain at risk of the development of psychopathology despite their placement. Although the variability in vagal regulation was less for foster children, low vagal regulation was not universal, and some of the findings point to the importance of placement stability.

The findings did not reveal evidence of increased sympathetic activation of the mobilization system, indexed by PEP reactivity, in foster children. This may not be surprising in normative samples, but for children with a background of relationship trauma, even short separations may be alarming due to hypersensitivity as well as lack of social regulation skills learned through interactions with a stable attachment figure. However, the lack of sympathetic reactions may indicate that for both foster and control children, separation was not threatening enough to activate the sympathetic nervous system. As the results of this study showed, this may especially be the case for children with disinhibited attachment for whom separation and exposure to strangers do not appear to cause alarmed behavior.

Limitations

Symptoms of attachment disturbances were examined only for foster children. Assessments of these symptoms in normative samples are needed for a fuller understanding of these apparent symptoms as evidence of the presence of respectively disinhibited or inhibited attachment disorder. Furthermore, the present study included relatively few children with clinical symptoms of attachment disturbances. Replication in groups characterized by more symptoms of disturbed attachment (e.g., institutionalized children) is necessary to determine the robustness of the effects. Moreover, replication of the findings concerning the underlying structure of the items of the interview (Disturbances of Attachment Interview) is needed in larger samples.

It was hypothesized that control and foster children would differ in ANS regulation, based on the importance of undisrupted caregiving for the development of affect regulation. Results largely confirmed this hypothesis, but also revealed large individual differences, which, given the moderate sample size, may have obscured the more subtle group differences between control and foster children, as shown in the effects that just fell short of significance.

Clinical Implications

Early experiences of relationship disruption and trauma in foster children as well as short placements with relatively new caregivers may impinge on children's adaptation to environmental and relational challenges. The positive association between time in placement and vagal regulation on reunion suggests that stable placements may facilitate adaptive affect regulation, although the correlational nature of the study means that caution should be exerted regarding the direction of the causal effect. Children with symptoms of disinhibited attachment were exempt from this effect. Instead, symptomatic children with a short time in their current placement showed vagal regulation responses on reunion with the foster caregiver that were similar to the vagal responses of nonsymptomatic children longer in placement, whereas symptomatic children longer in placement resembled the nonsymptomatic children shorter in placement. In addition, children with disinhibited symptoms displayed atypical reactions to the stranger, indicating more vagal regulation in response to separation from the stranger than children without these symptoms. These patterns are consistent with a model of further maladaptation of affect regulation and attachment in children with symptoms of disinhibited attachment, even while in a relatively stable placement. These findings underscore the need for careful assessment of the needs of children exposed to severe neglect and multiple caregiving disruptions for interactional guidance or parent-child psychotherapy even when they are placed in a foster family (American Academy of Child and Adolescent Psychiatry, 2005; Fisher et al., 2006; Oosterman et al., 2007).

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Sleep-Disordered Breathing in Overweight and Obese Children and Adolescents: Prevalence, Characteristics and the Role of Fat Distribution Stijn L. Verhulst, Nancy Schrauwen, Dominique Haentjens, Bert Suys, Raoul P. Rooman, Luc Van Gaal, Wilfried A. De Backer, Kristine N. Desager

Aims: To determine the prevalence of sleep-disordered breathing (SDB) in a clinical sample of overweight and obese children and adolescents, and to examine the contribution of fat distribution. *Methods:* Consecutive subjects without chronic lung disease, neuromuscular disease, laryngomalacia, or any genetic or craniofacial syndrome were recruited. All underwent measurements of neck and waist circumference, waist-to-hip ratio, % fat mass and polysomnography. Obstructive apnoea index ≥1 or obstructive apnoea–hypopnoea index (OAHI) ≥ 2, further classified as mild (2 ≤ OAHI < 5) or moderate-to-severe (OAHI ≥5), were used as diagnostic criteria for obstructive sleep apnoea (OSA). Central sleep apnoea was diagnosed when central apnoeas/hypopnoeas ≥10 s were present accompanied by >1 age-specific bradytachycardia and/or >1 desaturation <89%. Subjects with desaturation ≤85% after central events of any duration were also diagnosed with central sleep apnoea. Primary snoring was diagnosed when: snoring was detected by microphone and normal obstructive indices and saturation. *Results:* 27 overweight and 64 obese subjects were included (40 boys; mean (standard deviation (SD)) age 11.2 (2.6) years). Among the obese children, 53% were normal, 11% had primary snoring, 11% had mild OSA, 8% had moderate-to-severe OSA and 17% had central sleep apnoea. Half of the patients with central sleep apnoea had desaturation <85%. Only enlarged tonsils were predictive of moderate-to-severe OSA. On the other hand, higher levels of abdominal obesity and fat mass were associated with central sleep apnoea. *Conclusion:* SDB is very common in this clinical sample of overweight children. OSA is not associated with abdominal obesity. On the contrary, higher levels of abdominal obesity and fat mass are associated with central sleep apnoea. **Arch Dis Child** 2007;92:205–208.