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ARTICLE

Change in Heart Rate Variability After the Adult Attachment Interview in Dissociative Patients

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QUERY SHEET

This page lists questions we have about your paper. The numbers displayed at left can be found in the text of the paper for reference. In addition, please review your paper as a whole for correctness.

Q1: Au: The name of your department is "Department of Human Science" in the address for correspondence and "Department of Human Sciences" in three affiliations. Please standardize the name of the department.

Q2: Au: Do you mean "HRV is a noninvasive measure of emotional arousal (Thayer & Brosschot, 2005) that is considered an important marker of emotion regulation" (HRV is an important marker of emotion regulation) or "HRV is a noninvasive measure of emotional arousal (Thayer & Brosschot, 2005), which is considered an important marker of emotion regulation" (emotional arousal is an important marker of emotion regulation)?

Q3: Au: EEG spelled out correctly here as "electroencephalogram"?

Q4: Au: Please add Farina (2013) to the reference list. Or should this be Farina et al. (2013)?

Q5: Au: By "maintain stationarity" do you mean "remain stationary"?

Q6: Au: By "Wilcoxon sign test" do you mean "Wilcoxon signed-ranks test"?

Q7: Au: This p value is .005 here and .006 in the abstract. Which p value is correct?

Q8: Au: Edits to "no significant difference was observed in either pre- or post-AAI" correct here?

Q9: Au: Please insert an article (a or the) in front of "defense action system."

Q10: Au: Do you mean "A. M. Speranza was trained at the AAI Training Institute of Rome in 1990 by M. Main and E. Hesse" or "A. M. Speranza trained at the AAI Training Institute of Rome in 1990 with M. Main and E. Hesse"?

Q11: Au: Do you mean "C. Trentini and C. Maggiora Vergano was trained at the AAI Training Institute of Rome by D. Jacobvitz and N. Dazzi" or "C. Trentini and C. Maggiora Vergano trained at the AAI Training Institute of Rome with D. Jacobvitz and N. Dazzi"?

Q12: Au: Change from K to κ correct here?

Q13: Au: Please provide article page range for Billman (2011).

Q14: Au: Please provide article page range for Billman (2013).

Q15: Au: Please provide chapter page range for Liotti (2009).

Q16: Au: Does HR in Table 2 stand for "heart rate" or "heart rate variability"? In the second paragraph of "Statistical Analysis," when you mention these seven parameters, you refer to "heart rate." But in the note to Table 2 you define HR as "heart rate variability." Either (a) change "HR = heart rate variability" to "HR = heart rate" in the note to Table 2 or (b) change "Heart Rate Variability" to "HR" in the title of Table 2 and amend your discussion of these parameters in the second paragraph of "Statistical Analysis."

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ARTICLE

Change in Heart Rate Variability After the Adult Attachment Interview in Dissociative Patients

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The aim of this study was to assess heart rate variability (HRV) in individuals with dissociative disorders (DD) before and after the Adult Attachment Interview (AAI). Electrocardiograms were recorded before, during, and after the AAI in 13 individuals with DD and 13 healthy participants matched for age and gender. Significant change in HRV was observed only in the DD group. After the AAI, those with DD showed significant increases in the low frequency/high frequency ratio (pre-AAI = 1.91 ± 1.19; post-AAI = 4.03 ± 2.40; Wilcoxon test = −2.76, p = .006). Our results suggest that the retrieval of childhood attachment experiences in individuals with DD is associated with a change in HRV patterns that could reflect the emotion dysregulation of dissociative psychopathological processes.

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Q1

KEYWORDS dissociative disorders, emotion dysregulation, heart rate variability, Adult Attachment Interview

INTRODUCTION

Autonomic and affective dysregulation are among the main clinical features of complex traumatic-dissociative syndromes following early relational trauma, such as complex posttraumatic stress disorder, borderline personality disorder (BPD), and dissociative disorders (DD; Austin, Riniolo, & Porges, 2007; Meares, 2012; Van der Hart, Nijenhuis, & Steele, 2006; Van der Kolk et al., 1996).

It has been argued that early life trauma (Schmahl, Lanius, Pain, & Vermetten, 2010) could hamper the capacity of emotive and behavioral self-regulation as shown at a biological level by abnormal development of endocrine response to stress, autonomic balance, and cortical affective regulatory functions (Oosterman, De Schipper, Fisher, Dozier, & Schuengel, 2010; Schore, 2009; Van der Hart et al., 2006). Indeed, autonomic imbalance in children during the Strange Situation (Ainsworth, Blehar, Waters, & Wall, 1978) has been correlated with disorganized-controlling attachment (Oosterman et al., 2010). The evolutionary function of attachment behavior is to be the infant's primary source for protection from danger (Bowlby, 1969/1982). When the infant's attachment signals and emotional communications, related to fear and the need for protection, are not answered by caregiver responsiveness, the infant's attachment system suffers from some disruption, and when caregivers themselves are frightening to the infant, the disruption leads to an observable disintegration in behavior. In particular, it has been suggested that activation of the attachment system in disorganized individuals could trigger dissociated traumatic memories related to fearful or neglecting experiences of attachments (Meares, 2012). This could lead to emotion dysregulation and an autonomic imbalance due to failed control of high integrative cortical functions (Farina et al., 2013; Meares, 2012).

In most studies heart rate (HR) and heart rate variability (HRV) indices have been used to measure autonomic imbalance. HRV is a noninvasive measure of emotional arousal (Thayer & Brosschot, 2005) which is considered an important marker of emotion regulation (Appelhans & Luecken, 2006).

Previous studies detected in individuals with BPD an autonomic imbalance in provocation studies (Austin et al., 2007; Dixon-Gordon, Yiu, & Chapman, 2013; Giesbrecht, Geraerts, & Merckelbach, 2007). To our knowledge, few studies have assessed HRV in persons with DD, especially in stressful conditions (for a review, see van der Kruijs et al., 2012). Reinders et al. (2006; Reinders, Willemsen, Vos, den Boer, & Nijenhuis, 2012), in two symptom provocation studies, reported a decrease in HRV in individuals with

dissociative identity disorder (DID) when listening to a trauma-related memory script, but only when they were in traumatic identity states. These data suggest that the autonomic reactions of individuals with DID are modulated by both the kind of experimental cues and the different dissociative part of their personality activated during the procedure.

The aim of this study was to investigate change in HR and HRV in individuals with DD before and after the Adult Attachment Interview (AAI; George, Kaplan, & Main, 1996), which is a semistructured interview capable of activating the attachment system through the retrieval of childhood emotional and relational memories of past attachment experiences (George et al., 1996; Liotti, 2004). It was hypothesized that individuals with DD, but not those in the control group, would exhibit a change in HRV pattern after the AAI.

METHODS AND MATERIALS

Participants

The study design was prospective. Participants in the DD group were 13 individuals (six men and seven women; mean age = 40.92 ± 11.02 years, age range = 24–60 years) who were consecutively referred for treatment at a clinic specializing in trauma-related psychological disorders. All individuals received a complete psychiatric interview performed by a trained psychiatrist (BF) and were diagnosed according to *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (*DSM–IV–TR;* American Psychiatric Association, 2000) criteria. The demographic data and diagnoses of the DD participants enrolled in the study are listed in Table 1. A control group of healthy individuals (with no Axis I and II *DSM–IV–TR* diagnosis), matched for age and gender, was also included (six men and seven women; mean age = 37.01 ± 12.08 years, age range = 28–65 years).

The exclusion criteria for all participants were as follows: left handedness, history of medical or neurological disease, head trauma, consumption of central nervous system, active drug use in the 3 weeks prior to the study, and presence of electroencephalogram abnormalities at the baseline recording. Further details can be found in Farina et al. (2013).

All participants gave written informed consent. The research was approved by the ethics review boards of Catholic University and Università Europea.

HRV

HRV is a measure of changes in the beat-to-beat interval between heartbeats over time that provides information about the functioning of the sympathetic and parasympathetic nervous systems (Stein & Pu, 2012). HRV can be

TABLE 1 Demographic Data, Diagnoses, and AAI Scoring of DD Participants

No.	Sex	Age	*DSM–IV–TR* diagnosis	ICD-10 code	AAI scoring
1	Male	26	Dissociative amnesia, conversion disorder	F44.7	U/F2/F4
2	Female	30	Dissociative identity disorder	F44.81	U/CC/E1/E2/Ds2
3	Male	44	Dissociative amnesia, posttraumatic stress disorder	F44.0, F43.1	U/CC/E2/Ds2
4	Female	31	Depersonalization disorder, major depression	F44.9, F32.10	Ds1
5	Male	47	Dissociative disorder not otherwise specified, avoidant personality disorder	F44.9, F60.6	U/E1/E2
6	Male	42	Depersonalization disorder, borderline personality disorder	F44.9, F60.31	U/E3/E1
7	Male	52	Dissociative disorder not otherwise specified	F44.9	U/CC/E2/Ds2
8	Female	42	Dissociative amnesia	F44.0	U/CC/E2/E1/Ds3
9	Female	23	Dissociative amnesia, conversion disorder	F44.7	U/CC/E1/Ds3/F5
10	Female	50	Dissociative amnesia, somatization disorder	F44.7	U/E1/E2
11	Male	43	Dissociative disorder not otherwise specified	F44.9	U/CC/E2/E1/Ds2
12	Female	44	Dissociative disorder not otherwise specified, posttraumatic stress disorder, borderline personality disorder	F44.9, F43.1, F60.31	U/CC/E1/Ds3/E2
13	Female	60	Dissociative amnesia, posttraumatic stress disorder	F44.0, F43.1	U/CC/E1/E3/Ds2

Notes: AAI = Adult Attachment Interview; DD = dissociative disorders; *DSM–IV–TR = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision;* ICD-10 = International Classification of Diseases–10; F = Secure/Autonomous; Ds = Dismissing; E = Preoccupied; U = Unresolved with respect to loss or trauma; CC = Cannot Classify; F44.7 = mixed dissociative (conversion) disorders; F44.81 = multiple personality disorder; F44.0 = dissociative amnesia; F43.1 = posttraumatic stress disorder; F44.9 = dissociative (conversion) disorder, unspecified; F32.10 = mild depressive episode without somatic syndrome; F60.6 = anxious (avoidant) personality disorder; F60.31 = emotionally unstable personality disorder, borderline type.

analyzed in both time and frequency domains. Time domain methods are based on the analysis of beat-to-beat intervals, whereas frequency domain methods analyze different spectral components of HRV, such as low frequency (LF) and high frequency (HF). The HF component is believed to reflect parasympathetic activity, whereas the LF component, although its

nature is more controversial, is often assumed to reflect both sympathetic and parasympathetic activity (Billman, 2011, 2013).

The HRV study was carried out on the electrocardiogram (EKG) trace obtained by Farina (2013). EKGs were recorded using a modified lead II derivation (with the right shoulder negative and the left lower torso positive). The sampling rate was 256 Hz, with a digital resolution of 16 bits per sample. Impedance was kept below 5KΩ.

EKGs were recorded before, during, and after the AAI. The DD group and the control group were evaluated in baseline conditions and in a resting position after the AAI for five consecutive minutes of quiet wakefulness. Dedicated software recognized individual electrocardiographic R wave peaks and calculated R–R intervals (tacogram). Another software program was used for the automatic evaluation of the HRV parameters (Niskanen, Tarvainen, Ranta-Aho, & Karjalainen, 2004).

The following parameters were considered in the time domain: mean and standard deviation of HR and mean and standard deviation of the RR interval. In the frequency domain, HRV was analyzed using parametric autoregressive model analysis, which allows for accurate estimation of power spectral density when analyzing short time intervals during which the signal is supposed to maintain stationarity (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). LF (0.04–0.15 Hz) and HF (0.15–0.4 Hz) bands were considered. In the frequency domain the power of the LF and HF bands was expressed in normalized units (nu), and the LF/HF ratio was calculated.

A detailed description of HRV analysis, standards of measurement, physiological interpretation, and clinical use is available in Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (1996).

Statistical Analysis

Scores obtained for HRV parameters were compared using the nonparametric Wilcoxon sign test for within comparison (pre-AAI vs. post-AAI) and Mann–Whitney's *U* test for between comparison (DD group vs. controls). The use of nonparametric tests was chosen for two reasons: (a) None of the present variables were normally distributed (Shapiro–Wilk test, $p < .05$) in any condition (DD group vs. controls, pre-AAI vs. post-AAI); and (b) several studies have reported that HRV is not normally distributed in healthy individuals (Nunan, Sandercock, & Brodie, 2010).

In cases of multiple comparisons, in order to avoid family-wise Type I error, we applied a formal Bonferroni correction to each family of comparisons by dividing the limit of significance by the number of comparisons (seven comparisons: mean and standard deviation of HR, mean and standard

deviation of the RR interval, LF and HF components, LF/HF ratio). Therefore, the threshold level for significance was $p = .05/7 = .007$.

All analyses were performed using the SPSS 19.0 statistical package for the social sciences (IBM, Armonk, NY, USA).

RESULTS

AAI Results

AAIs were coded by certified coders[1] as follows: 12 out of 13 individuals with DD (92.3%) were classified as Unresolved/disorganized (U/d) with respect to attachment and 1 was classified as Dismissing (Ds). Indices of unresolved/disorganized responses were related to experiences of loss (eight cases), abuse (three cases), or both (one case) regarding primary caregivers (parents or grandparents). Eight out of 12 individuals received a Cannot Classify (CC) alternative category because they showed a global disruption of attachment strategy, with oscillations between opposite and contradictory states of mind (Dismissing, Preoccupied) in addition to their first U/d classification.

In the control group nine individuals were classified as Secure/autonomous (F), three as Ds, and one as U/d for loss.

HRV Results

HRV results are displayed in Table 2. In the control group, no statistically significant differences were observed before and after the AAI. In contrast, after the AAI those with DD showed a significant increase in the LF/HF ratio (pre-AAI = 1.91 ± 1.19; post-AAI = 4.03 ± 2.40; Wilcoxon test = –2.76, $p = .005$).

In the between-groups comparison, no significant difference was observed in either pre- or post-AAI.

DISCUSSION

As hypothesized, the retrieval of childhood emotional and relational memories was associated with a change in HRV only in the DD group, characterized by a significant increase in the LF/HF ratio.

This pattern could reflect an increase in sympathetic cardiac control and/or a decrease in parasympathetic control, which are often observed in stressful conditions (Berntson & Cacioppo, 2007).

In the present study 12 DD participants (93%) and only one control (8%) were classified on the AAI as U/d. It must be underlined that although disorganization of attachment is a risk factor for DD (Dutra,

TABLE 2 Within-Comparison Results for Heart Rate Variability Parameters Pre- and Post-AAI

	Pre-AAI		Post-AAI		Wilcoxon test	
Parameter	*M*	*SD*	*M*	*SD*	*Z*	*p*
Controls						
RR	0.79	0.11	0.74	0.09	−0.24[b]	.807
RR *SD*	0.5	0.02	0.04	0.01	−0.24[b]	.807
HR	77.01	9.21	82.41	10.71	−0.32[a]	.753
HR *SD*	5.49	2.43	4.94	2.32	−0.35[b]	.727
LF	62.50	21.15	70.95	20.69	−1.64[a]	.101
HF	24.85	14.71	20.62	17.74	−1.36[b]	.173
LF/HF	5.07	4.90	7.68	6.25	−2.27[a]	.023
Individuals with DD						
RR	0.72	0.09	0.79	0.08	−2.13[a]	.033
RR *SD*	0.08	0.14	0.11	0.17	−0.46[a]	.649
HR	85.27	11.26	80.66	12.40	−2.48[b]	.013
HR *SD*	4.73	2.56	5.71	2.83	−0.11[a]	.917
LF	50.37	14.54	62.92	21.34	−2.27[a]	.023
HF	34.70	14.85	27.61	25.30	−1.29[b]	.196
LF/HF	1.91	1.19	4.03	2.40	−2.76[a]	.005

Notes: AAI = Adult Attachment Interview; RR = R wave–to–R wave interval; HR = heart rate variability; LF = low-frequency spectral component; HF = high-frequency spectral component, LF/HF = LF/HF ratio; DD = dissociative disorders.

[a]Based on positive ranks. [b]Based on negative ranks.

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Bureau, Holmes, Lyubchik, & Lyons-Ruth, 2009; Liotti, 2009; Ogawa, Sroufe, Weinfield, Carlson, & Egeland, 1997), it is not a diagnostic criterion for DD. Indeed, a prevalence of U/d individuals of about 18% was reported in the nonclinical population (Bakermans-Kranenburg & van IJzendoorn, 2009).

The change in HRV in individuals with DD after the AAI could be interpreted as evidence of the affective dysregulation of dissociative processes. According to many scholars, emotion dysregulation can be viewed as an expression of a lack of top-down regulative roles of high-order mental functions, which are typically altered in individuals with developmental trauma (Schmahl et al., 2010; Van der Hart et al., 2006; Van der Kolk et al., 1996). However, a great body of literature reports that vulnerability to dissociation is closely related to attachment disorganization in infancy, which manifests in opposite and contradictory behaviors during the activation of the attachment system (Dutra et al., 2009; Hesse & Main, 2006; Ogawa et al., 1997) and is associated with unresolved/disorganized AAI responses in adulthood (Riggs et al., 2007; Steele, 2003; Stovall-McClough & Cloitre, 2006), resembling the alternation between different states or dissociative parts of the personality.

Furthermore, in accordance with Porges's polyvagal theory (for a review, see Porges, 2007), it is possible to speculate that our results reflect modifications of the balance among the three components of the autonomic nervous system (Nijenhuis & Den Boer, 2007): Alteration in the ventral vagal complex system could lead to a hyperactivation of the sympathetic component and

to a depression of the parasympathetic system in response to the threats. However, some scholars suggest that hypoarousing dorsal vagal response is the physiological marker of dissociation, supposing that it is the marker of some parts of the personality mediated by defense action system that can be described as tonic immobility/feigning death that may imply dorsal vagal parasympathetic dominance (Nijenhuis & Den Boer, 2007). However, it must be underlined that this interpretation remains largely speculative. Indeed, HRV data provide only a very limited and indirect assessment of cardiovascular autonomic regulation and cannot be used to evaluate how information is processed within the central nervous system or to locate the central nervous system sites from which putative changes in autonomic regulation might originate.

Our result overlap with those observed in BPD, which is known to be characterized by severe emotion dysregulation (Linehan, 1995). Weinberg, Klonsky, and Hajcak (2009) reported that BPD participants exhibited increased sympathetic and decreased parasympathetic activity during a stressful task.

Our data are also partially consistent with previous findings suggesting a change in HRV in DD (van der Kruijs et al., 2012). For example Reinders and coworkers (2006, 2012), in two symptom provocation studies, reported a decrease in HRV in individuals with DID while listening to a trauma-related memory script, but only when they were in traumatic identity states. These findings support the theory of structural dissociation of the personality (Nijenhuis & Den Boer, 2007; Nijenhuis, Van der Hart, & Steele, 2002; Van der Hart et al., 2006), suggesting that the autonomic reactions of individuals with DID are modulated not only by the kind of experimental cues but also by the type of dissociative part of the personality that is activated during measurement. DD is a heterogeneous category of mental disorder: There is the possibility that some individuals with DD could have different responses to the AAI because they may alternate between different states or dissociative parts of their personality. In the present research we did not evaluate the dissociative structure of the personality, which represents a limitation of this study.

It is also interesting to point out that the change in HRV observed in DD participants could also be a function of an unresolved state of mind that leads to dissociation. Future research is needed to clarify this topic.

In conclusion, our results seem to suggest that in individuals with DD, the retrieval of childhood attachment experiences is associated with an increase in the LF/HF ratio, which could reflect evidence at a biological level of the emotion dysregulation of dissociative processes. Our data suggest the importance of DD treatment approaches focused on the regulation of autonomic imbalance and bodily bottom-up strategies to control hyperarousal states (Ogden, Pain, & Fisher, 2006).

Unfortunately, the lack of coordination between the EKG trace and AAI transcript did not allow for an analysis of the change in HR and HRV in relation to the specific contents of the interview. Furthermore, the small sample size and speculations related to the LF component and the LF/HF ratio, which are still under discussion (Billman, 2013), represent the main limitations of our study.

NOTE

1. A. M. Speranza trained at the AAI Training Institute of Rome in 1990 by M. Main and E. Hesse; C. Trentini and C. Maggiora Vergano trained at the AAI Training Institute of Rome by D. Jacobvitz and N. Dazzi. Interrater agreement on four-ways comparison was 92.3% ($\kappa = .87$, $p = .000$).

REFERENCES

Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. (1978). *Patterns of attachment: A psychological study of the Strange Situation*. Hillsdale, NJ: Erlbaum.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

Appelhans, B. M., & Luecken, L. J. (2006). Heart rate variability as an index of regulated emotional responding. *Review of General Psychology*, *10*, 229–240. doi:10.1037/1089-2680.10.3.229

Austin, M. A., Riniolo, T. C., & Porges, S. W. (2007). Borderline personality disorder and emotion regulation: Insights from the polyvagal theory. *Brain and Cognition*, *65*, 69–76. doi:10.1016/j.bandc.2006.05.007

Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2009). The first 10,000 Adult Attachment Interviews: Distributions of adult attachment representations in clinical and non-clinical groups. *Attachment & Human Development*, *11*, 223–263. doi:10.1080/14616730902814762

Berntson, G. G., & Cacioppo, J. T. (2007). Heart rate variability: Stress and psychiatric conditions. In M. Malik & A. J. Camm (Eds.), *Dynamic electrocardiography* (pp. 56–63). Oxford, England: Blackwell.

Billman, G. E. (2011). Heart rate variability—A historical perspective. *Frontiers in Physiology*, *2*, 86. doi:10.3389/fphys.2011.00086

Billman, G. E. (2013). The LF/HF ratio does not accurately measure cardiac sympatho-vagal balance. *Frontiers in Physiology*, *4*, 26. doi:10.3389/fphys.2013.00026

Bowlby, J. (1982). *Attachment and loss* (Vol. 1). New York, NY: Basic Books. (Original work published 1969)

Dixon-Gordon, K. L., Yiu, A., & Chapman, A. L. (2013). Borderline personality features and emotional reactivity: The mediating role of interpersonal vulnerabilities. *Journal of Behavior Therapy and Experimental Psychiatry*, *44*, 271–278. doi:10.1016/j.jbtep.2012.12.001

Dutra, L., Bureau, J. F., Holmes, B., Lyubchik, A., & Lyons-Ruth, K. (2009). Quality of early care and childhood trauma: A prospective study of developmental pathways to dissociation. *Journal of Nervous and Mental Disease*, *197*, 383–390. doi:10.1097/NMD.0b013e3181a653b7

Farina, B., Speranza, A. M., Dittoni, S., Gnoni, V., Trentini, C., Vergano, C. M., . . . Marca, G. D. (2013). Memories of attachment hamper EEG cortical connectivity in dissociative patients. *European Archives of Psychiatry and Clinical Neurosciences*, *264*, 449–458. doi:10.1007/s00406-013-0461-9

George, C., Kaplan, N., & Main, M. (1996). *Adult Attachment Interview protocol* (3rd ed.). Berkeley: University of California at Berkeley.

Giesbrecht, T., Geraerts, E., & Merckelbach, H. (2007). Dissociation, memory commission errors, and heightened autonomic reactivity. *Psychiatry Research*, *150*, 277–285. doi:10.1016/j.psychres.2006.04.016

Hesse, E., & Main, M. (2006). Frightened, threatening, and dissociative parental behavior in low-risk samples: Description, discussion, and interpretations. *Development and Psychopathology*, *18*, 309–343. doi:10.1017/S0954579406060172

Linehan, M. M. (1995). *Understanding borderline personality disorder*. New York, NY: Guilford Press.

Liotti, G. (2004). Trauma, dissociation and disorganized attachment: Three strands of a single braid. *Psychotherapy: Theory, Research, Practice, Training*, *41*, 472–486.

Liotti, G. (2009). Attachment and dissociation. In P. Dell & J. A. O'Neil (Eds.), *Dissociation and dissociative disorders:* DSM–V *and beyond*. New York, NY: Routledge.

Meares, R. (2012). *A dissociation model of borderline personality disorder*. New York, NY: Norton.

Nijenhuis, E. R. S., & Den Boer, J. A. (2007). Psychobiology of traumatization and trauma-related structural dissociation of the personality. In E. Vermetten, M. J. Dorahy, & D. Spiegel (Eds.), *Traumatic dissociation: Neurobiology and treatment* (pp. 219–236). Arlington, VA: American Psychiatric Publishing.

Nijenhuis, E. R. S., Van der Hart, O., & Steele, K. (2002). The emerging psychobiology of trauma-related dissociation and dissociative disorders. In H. D'Haenen, J. A. Den Boer, & P. Willner (Eds.), *Biological psychiatry* (pp. 1079–1098). London, England: Wiley.

Niskanen, J. P., Tarvainen, M. P., Ranta-Aho, P. O., & Karjalainen, P. A. (2004). Software for advanced HRV analysis. *Computer Methods and Programs in Biomedicine*, *76*, 73–81. doi:10.1016/j.cmpb.2004.03.004

Nunan, D., Sandercock, G. R., & Brodie, D. A. (2010). A quantitative systematic review of normal values for short-term heart rate variability in healthy adults. *Pacing and Clinical Electrophysiology*, *33*, 1407–1417. doi:10.1111/j.1540-8159.2010.02841

Ogawa, J. R., Sroufe, L. A., Weinfield, N. S., Carlson, E. A., & Egeland, B. (1997). Development and the fragmented self: Longitudinal study of dissociative symptomatology in a non-clinical sample. *Development and Psychopathology*, *9*, 855–879. doi:10.1017/S0954579497001478

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Ogden, P., Pain, C., & Fisher, J. (2006). A sensorimotor approach to the treatment of trauma and dissociation. *Psychiatric Clinics of North America*, *29*, 263–279, xi–xii. doi: S0193-953X(05)00095-X

Oosterman, M., De Schipper, J. C., Fisher, P., Dozier, M., & Schuengel, C. (2010). Autonomic reactivity in relation to attachment and early adversity among foster children. *Development and psychopathology*, *22*, 109–118. doi:10.1017/S0954579409990290

Porges, S. W. (2007). The polyvagal perspective. *Biological Psychology*, *74*, 116–143. doi:S0301-0511(06)00176-1

Reinders, A. A., Nijenhuis, E. R., Quak, J., Korf, J., Haaksma, J., Paans, A. M., . . . den Boer, J. A. (2006). Psychobiological characteristics of dissociative identity disorder: A symptom provocation study. *Biological Psychiatry*, *60*, 730–740. doi:10.1016/j.biopsych.2005.12.019

Reinders, A. A., Willemsen, A. T., Vos, H. P., den Boer, J. A., & Nijenhuis, E. R. (2012). Fact or factitious? A psychobiological study of authentic and simulated dissociative identity states. *PLoS One*, *7*, e39279. doi:10.1371/journal.pone.0039279

Riggs, S. A., Paulson, A., Tunnell, E., Sahl, G., Atkison, H., & Ross, C. A. (2007). Attachment, personality, and psychopathology among adult inpatients: Self-reported romantic attachment style versus Adult Attachment Interview states of mind. *Development and Psychopathology*, *19*, 263–291. doi:10.1017/S0954579407070149

Schmahl, C., Lanius, R. A., Pain, C., & Vermetten, E. (2010). Biological framework for traumatic dissociation related to early life trauma. In R. A. Lanius, E. Vermetten, & C. Pain (Eds.), *The impact of early relational trauma on health and disease: The hidden epidemic* (pp. 178–188). Cambridge, England: Cambridge University Press.

Schore, A. N. (2009). Relational trauma and the developing right brain: An interface of psychoanalytic self psychology and neuroscience. *Annals of the New York Academy of Sciences*, *1159*, 189–203. doi:10.1111/j.1749-6632.2009.04474.x

Steele, H. (2003). Unrelenting catastrophic trauma within the family: When every secure base is abusive. *Attachment and Human Development*, *5*, 353–366. doi:10.1080/14616730310001633438

Stein, P. K., & Pu, Y. (2012). Heart rate variability, sleep and sleep disorders. *Sleep Medicine Reviews*, *16*, 47–66. doi:10.1016/j.smrv

Stovall-McClough, K. C., & Cloitre, M. (2006). Unresolved attachment, PTSD, and dissociation in women with childhood abuse histories. *Journal of Consulting and Clinical Psychology*, *74*, 219–228. doi:10.1037/0022-006X.74.2.219

Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. (1996). Heart rate variability: Standards of measurement, physiological interpretation and clinical use. *Circulation*, *93*, 1043–1065.

Thayer, J. F., & Brosschot, J. F. (2005). Psychosomatics and psychopathology: Looking up and down from the brain. *Psychoneuroendocrinology*, *30*, 1050–1058. doi:10.1016/j.psyneuen.2005.04.014

Van der Hart, O., Nijenhuis, E., & Steele, K. (2006). *The haunted self: Structural dissociation and the treatment of chronic traumatization*. New York, NY: Norton.

Van der Kolk, B. A., Pelcovitz, D., Roth, S., Mandel, F. S., McFarlane, A., & Herman, J. L. (1996). Dissociation, somatization, and affect dysregulation: The complexity of adaptation of trauma. *American Journal of Psychiatry*, *153*, 83–93.

van der Kruijs, S. J., Bodde, N. M., Carrette, E., Lazeron, R. H., Vonck, K. E., Boon, P. A., . . . Aldenkamp, A. P. (2012). Neurophysiological correlates of dissociative symptoms. *Journal of Neurology, Neurosurgery & Psychiatry*, *85*, 174–179. doi:10.1136/jnnp-2012-302905

Weinberg, A., Klonsky, E. D., & Hajcak, G. (2009). Autonomic impairment in borderline personality disorder: A laboratory investigation. *Brain and Cognition*, *71*, 279–286. doi:10.1016/j.bandc.2009.07.014