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Heart Rate Variability and the Anxious Client

Cardiac Autonomic and Behavioral Associations With Therapeutic Alliance

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Abstract: This exploratory study was designed to investigate the link between a client's heart rate variability (HRV) and the forming of a therapeutic alliance (TA) during psychotherapy. Change in HRV is associated with many psychological and physiological situations, including cardiac mortality. Cardiac effects were evaluated during therapy in 30 symptomatically anxious clients using HRV during six weekly 1-hour therapy sessions (S1–S6). Therapeutic index (TI), a measure of TA, was evaluated using skin conductance resonance between client and therapist. The Working Alliance Inventory provides a subjective measure of TA. State and trait anxiety and mood states were also assessed. Most HRV parameters were highest during S4. The sympathovagal balance was highest in S1 but stabilized after S2. In S4, TI was linked to high HRV parameters. Overall higher anxiety levels seem to be associated to lower HRV parameters. Conversely, in S4, high HRV parameters were linked to higher mood scores. This study found that a subjective measure of TA contradicted the physiological outcome. Results suggest that physiological data collected during therapy are a more accurate barometer of TA forming. These research findings suggest a need for further research identifying physiological markers in clients with a variety of mental health disorders over long-term therapy.

Key Words: Therapeutic alliance, heart rate variability, anxiety, autonomic nervous system, physiology, therapy, Working Alliance Inventory

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Our previous research has shown that the clinical construct of therapeutic alliance (TA) can be associated with events at a neurophysiological level, impacting both the brain and the body of clients during therapy (Stratford et al., 2009). TA is the key relational construct that underpins change at all levels in therapy (Miller et al., 2008). To deepen this investigation, this chapter will explore cardiac effects during therapy in symptomatically anxious clients using the control mechanism of heart rate variability (HRV). HRV allows us to reliably assess cardiovascular autonomic responses through the sympathetic and parasympathetic branches of the autonomic nervous system (ANS) (Malliani et al., 1994). This article will report on the link between a client's normal ANS status and TA over time.

HRV is a manifestation of the variation in the continuous state of dynamic equilibrium as the human body adapts to a constantly changing environment. Specifically, HRV is the beat-to-beat interval (R-R) fluctuation in heart rate (Ng et al., 2009). The heart's rhythm is controlled by the ANS, which allows our heartbeat to constantly change in response to both internal and external environmental cues. This rhythmic variation can be measured across several frequency bands known as low frequency (LF), high frequency (HF), and very LF. For this study, two bands will be of most interest: an HF component corresponding to respiratory activity in the 0.15 to 0.4 Hz band, which derives from vagal or parasympathetic activity, and an LF component in the 0.04 to 0.15 Hz band reflecting sympathetic activity with some degree of parasympathetic measure (Cohen and Taylor, 2002). The LF and HF components of R-R variability are known as respiratory sinus arrhythmia, which measures the effect of respiration on the heart. The heart accelerates on inspiration and decelerates on exhalation.

The parasympathetic or vagal branch of the ANS modulates our respiratory rate, thus decreasing our HR and slowing our heartbeat, and its activity can be assessed by the HF component of HRV, a measurement of vagal activity to the sinoatrial node (Malliani et al., 1994). The LF range reflects the activity of the sympathetic branch of the ANS, which increases our heart rate, particularly in times of real or perceived stress/danger and exercise (Andreassi, 2000).

A large body of research agrees that the ratio of LF to HF can be seen as an index of sympathetic to parasympathetic balance of heart rate modulation and represents the sympathovagal interaction of the ANS (Malliani et al., 1994). The balance of the LF to HF bands is a commonly agreed measure of the balance between the parasympathetic and sympathetic control of the heart (Carney et al., 2005).

HRV, Anxiety, and Psychological Disorders

Change in normal levels of HRV is associated with many psychological and physiological situations (Cohen and Benjamin, 2006; Kawachi et al., 1995), including cardiac mortality. An example is when the influence of the parasympathetic frequency is weakened; as with increased anxiety, the risk of sudden death increases (Soufer, 1998). There is also a strong relationship between high levels of anxiety and the risk of coronary heart disease (CHD) (Mittleman et al., 1995; Sherwood et al., 1992). AQ3

When we are experiencing acute stress, such as making complex decisions and speaking in public, vagal activity is reduced (Kristal-Boneh et al., 1995). There is also a link between reduced HRV, parasympathetic activity, and negative emotions such as hostility (Kawachi et al., 1995), worry or generalized anxiety disorder (Thayer et al., 1996), depression (Yeragani, 2000), panic disorder (Friedman and Thayer, 1998), and posttraumatic stress disorder (PTSD) (Cohen, 2000). In addition, personality traits of anger and mood disorders and emotional factors such as stress and anxiety have been shown to play an important role in heart disease (Soufer and Checkerdijiev, 2002).

In particular and with most relevance for this study, researchers have established a link between increased sympathetic (LF) and decreased parasympathetic (HF) frequency of HRV in anxious clients (Yeragani et al., 2001), that is, an increase in the LF/HF ratio.

This exploratory investigation into HRV during psychotherapy and over time has the potential to determine the physiological impact of therapy on clients and ultimately help therapists to understand the role of anxiety in therapy. During therapy, anxiety levels rise and fall as clients explore their issues and how they are manifesting in their lives (Fisher, 1990). AQ4

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The sample population in this study was clinically anxious participants. Anxiety is a survival strategy and, if appropriately short lived, is a normal reaction to stress. However, if it is long-lasting and inflated, it is detrimental to our psychological and physical health (Soufer et al., 2002). The World Health Organization concludes that if anxiety is our primary psychological coping mechanism, it can negatively impact cardiovascular and immune systems leading to AQ5 high blood pressure, myocardial infarction, stroke, and depression (Wilkinson and Marmot, 2003).

Anxiety is an unconscious manifesting of a learned response that gradually comes into consciousness (Wong, 1999). It is mediated by the brain through the release of chemicals in response to a fearful situation (Andreassi, 2007). Biological anxiety hypotheses are based on the malfunction of the hypothalamic-pituitary-adrenal (HPA) axis through the hyperactivity of the amygdala and the reduced activity of the hippocampus (Bear et al., 2001); this anxiety hypothesis is also applicable to the biological cause of mood disorders such as depression. However, the debate continues as to whether HPA axis abnormalities are the primary cause or a result of depression (Nestler et al., 2002).

Depression is a mood disorder expected to be the leading source of nonlethal disability in the world by the year 2020 (Wilhelm et al., 2003). Symptoms of depression are seen as episodes of low mood, loss of interest, insomnia, confusion, and fatigue, which can last for 2 years or more with high recurrence rates (Bear et al., 2001). Decades of research demonstrate that mood disorders such as depression affect our physical health (Wolsko et al., 2004). However, depression improves through applying stress reduction techniques with a decline in the subsequent harmful physiological outcomes of CHD (Antony and Swinson, 1996).

Aims

The specific aims of this study were to

1. Explore variability in HRV parameters in clients during therapy.
2. Investigate the links between HRV parameters and TA measured using physiological concordance (skin conductance resonance as a measure of therapeutic index [TI]) and the Working Alliance Inventory (WAI).
3. Assess links between anxiety, mood, and HRV parameters.

METHODS

Thirty symptomatically anxious clients (15 women and 15 men, aged between 20 and 62 years, with a mean age of 43.8 ± 11.5) were randomly selected to undertake six weekly sessions (S1–S6) of 1 hour of psychotherapy. Six experienced psychotherapists from various psychodynamic modalities volunteered to provide the therapy in the study. All clients were screened before starting therapy, for psychological and physiological medical contraindications.

This study received human ethics approval from the University of Technology Sydney. Informed consent was obtained from all participants before inclusion into the study. Before the research, confidentiality and anonymity were explained in detail to all clients. This was accompanied by a cover letter stating what the research was attempting to achieve, what was required from the participants, and that the therapy would be over six sessions. This constituted short-term psychotherapy (Coren, 2001; Despland et al., 2005).

Objective Measures

Three-lead electrocardiogram (ECG) was recorded using AQ6 electrodes (EKG-Flex/Pro, Model SA9306M; Thought Technology), which were placed on the chest, one reference and two active electrodes. Three-lead ECG measures were obtained within each session and across the six sessions. This three-lead placement is sufficient for HRV analysis for variations in R-R (peak to peak) changes to be achieved (Hagemann, 2004).

Skin conductance resonance (SC-Flex/Pro, Model SA9309M; Thought Technology) was measured from both the therapist and the client with electrodes taped around their index and middle fingers.

Subjective Measures

The Spielberger State trait Anxiety Inventory (STAI) (Spielberger et al., 1983) addresses the complexity of anxiety. The inventory measures the construct of state or "in the moment" anxiety (STAI S–Anxiety Form Y-1) and trait anxiety (STAI-T–Anxiety Form Y-2), which is a relatively stable proneness to anxiety as a personality trait. The 20 questions look at feelings of apprehension, tension, nervousness, and worry. The Profile of Mood States (POMS) (a trait measure) Questionnaire was also administered to assess six mood factors and the client's total mood (McNair et al., 1971). The POMS measures a client's subjective mood state within the five subscales of depression/dejection, tension/anxiety, anger/hostility, fatigue/inertia, vigor/activity, and confusion/bewilderment (McNair et al., 1971). AQ7 The WAI questionnaire was administered to both the client and the therapist after each therapy session (Horvath and Greenberg, 1986). This 36-item questionnaire provides a subjective measure of the bonding aspect of the working alliance known as the therapeutic relationship (TA). This study replicated previous research showing that for a successful clinical therapeutic outcome, a successful TA needs to develop by S3 (Despland et al., 2001) and continue to increase over time.

Analysis

The R-R peak in the ECG data was identified and extracted (Tompkins, 1993). Matlab was used to develop the R-R interval extraction algorithm from the raw ECG data (version 7.1; Mathworks). AQ8 The data were then subjected to a band pass filter, the Butterworth filter (Renumadhavi and Madhava Kumar, 2006). A low pass Butterworth filter was used to allow for faster processing of the data (Jie et al., 2008; Renumadhavi and Madhava Kumar, 2006). The Butterworth band pass filter attenuated frequencies below 2 Hz and greater than 40 Hz. This ensured that noise in the ECG signal due to muscle movements, 50-Hz mains, drift of data from the baseline, and T-wave interference on the R-R interval was reduced. The filtered data were then subjected to a squaring function, which is a nonlinear operation and reduces noise in the data (Tompkins, 1993). The period difference between the R-R peak points is calculated and divided by the sampling rate to get the heart rate.

Four parameters, namely, LF, HF, LF/HF, and total power, were derived from the HRV power spectrogram (American College of Cardiology/American Heart Association, 1999). The HRV LF com- AQ9 ponent (0.04–0.15 Hz) is influenced by both parasympathetic and sympathetic activity, whereas the HF component (0.15–0.4 Hz) is due to parasympathetic activity (Bezerianos et al., 1999). Computing the LF/HF ratio provides an indicator of sympathovagal balance (American College of Cardiology/American Heart Association, 1999; Association AH, 1996). In the current research, we consider LF, HF, LF/HF ratio, and total power (total area under the power spectrogram).

TI, which reflects the moments of highest TA or empathic concordance between the client and the therapist, was calculated according to Marci et al. (2007) and replicated in a pilot study by Stratford et al. (2009). The TI was calculated according to Marci and Orr (2006), which was determined from the SCR measurements from AQ10 both the client and the therapist. Using this method, 5-second slopes were analyzed at 1-second increments to derive TI measure from continuous data (Oppenheim and Schafer, 1999). The TI was computed from the natural logarithmic value of the ratio of the sum of the positive SCR values, divided by the absolute sum of the negative values (Marci et al., 2007). The highest TI found across 3-minute segments of the session (which reflected the greatest TA between client and therapist) was obtained (Marci et al., 2007). High TI indicates positive concordance (TA) between client and therapist

(Marci and Orr, 2006). A third-order Butterworth band pass filter was applied (1.5–40 Hz) to remove any noise artifacts from the ECG data.

Data analysis was performed using Statistica (Windows, V 8; AQ11 StatSoft). Analysis of variance was used to identify if any of the HRV parameters (LF, HF, LF/HF, and total power) were different among AQ12 the six therapy sessions. Post hoc analysis using Fischer's LSD test was used to identify where the differences existed in the comparison of the means. To compute and identify the degree of associations, AQ13 correlation analysis between HRV parameters and TI was conducted. AQ14 Significance was reported at $p \leq 0.05$. Because this is s new area of exploratory study, trends in data for $p \leq 0.1$ were also reported.

RESULTS

TI and WAI Changes Across the Six Sessions

T1 Table 1 shows high TI in S1, which decreases before it begins to increase again from S4 onward. TI is the lowest in S6. Conversely, WAI increases continuously from S1 to S6.

HRV Changes Across the Six Therapeutic Sessions

T2 Refer to Table 2 for the HRV activity in the four different HRV parameters. None of the HRV parameters were significantly different compared across the six therapy sessions. However, Fischer's post hoc analyses identified a trend of increasing HF activity between S1 and S4 ($p = 0.07$) and for total power ($p = 0.09$). There was a significant difference in the LF/HF ratio between S1 and S2 ($p = 0.03$) F1–F4 and small differences between S2 and S6 ($p = 0.049$). Figures 1 to 4 show HRV parameter changes across the six sessions. Table 2 shows the values of the different HRV parameters across the six sessions.

Associations Between HRV Parameters and TI

Increased TI in S2 showed trends toward association with higher LF ($r = 0.39$, $p = 0.05$). In S4, high TI was linked to high LF ($r = 0.50$, $p = 0.01$), HF ($r = 0.53$, $p = 0.006$), and total power ($r = 0.52$, $p = 0.008$). In S6, higher TI showed the opposite trends with links with lower LF/HF ($r = -0.38$, $p = 0.05$).

Associations Between HRV Parameters and WAI

No significant associations were found for HRV parameters and WAI. Only a trend for association between higher WAI and reduced total power was evident ($r = -0.34$, $p = 0.09$).

Associations Between HRV Parameters and Anxiety and Mood

In S1, higher post–state anxiety was linked to lower HF activity and lower total power ($r = -0.57$, $p = 0.003$, and $r = -0.42$, $p = 0.04$, respectively). Higher trait anxiety showed associations with lower LF, HF, and total power in S3 ($r = -0.40$, $p = 0.04$; $r = -0.43$, $p = 0.03$; and $r = -0.43$, $p = 0.03$, respectively). Higher pre–state anxiety levels in S5 was linked to lower LF, HF, and total power ($r = -0.40$, $p = 0.04$; $r = -0.44$, $p = 0.02$; and $r = -0.44$, $p = 0.02$, respectively).

TABLE 1. Shows the Therapeutic Index and Working Alliance Across the Six Therapy Sessions

Session #	Theraputic Index (TI)	Working Alliance Inventory (WAI)
S1	1.48 ± 0.98	72.9 ± 7.6
S2	1.26 ± 0.74	73.9 ± 7.7
S3	1.22 ± 0.75	76.0 ± 6.1
S4	1.25 ± 0.88	78.0 ± 5.5
S5	1.39 ± 1.21	79.5 ± 4.2
S6	1.20 ± 1.13	80.4 ± 4.4

TABLE 2. Shows Results for LF, HF and TP (ms^2) and LF:HF Across the Six Sessions

Session #	LF (ms^2)	HF (ms^2)	TP (ms^2)	LF:HF
S1	3.8 ± 4.0	4.9 ± 5.8	11.2 ± 11.3	2.7 ± 6.2
S2	4.0 ± 3.7	6.5 ± 6.7	14.4 ± 13.4	1.0 ± 0.8
S3	4.6 ± 5.1	8.2 ± 10.3	15.8 ± 17.9	1.2 ± 1.4
S4	5.3 ± 4.8	9.6 ± 9.4	18.8 ± 17.0	1.2 ± 1.8
S5	4.6 ± 4.2	7.9 ± 8.7	15.9 ± 15.3	1.2 ± 2.0
S6	3.7 ± 3.7	6.1 ± 7.3	12.3 ± 12.7	1.1 ± 1.7

Whereas assessing the mood factors in S4 showed that high LF, HF and total power were significantly linked to high TA, DD, AH, VA and total mood score (refer to Table 3). T3

DISCUSSION

This study has found some useful associations between clients' HRV over six psychotherapy sessions and the state of TA. HRV occurs in response to physical and mental stress (Malik and Camm, 1995) and is widely accepted as a more sensitive measurement of the connection between the aroused brain and the responding heart (Soufer and Checkerdijiev, 2002). This exploratory study can now contribute to this debate by showing that the psychologically demanding task of psychotherapy impacts on the HRV of clients both within sessions and over time.

Significant associations were shown between some HRV parameters and TA, anxiety, and mood. TI, the physiological reflection of TA, showed the alliance to be at its most concordant in S1. It continued to decrease until after S3, when it began to build once the alliance was established (Miller et al., 1997). TI was at its highest in S4 and S5 but decreased sharply to be at its lowest in S6, which could be seen as an artifact of S6 being the last therapy session.

Conversely, using subjective measures, the WAI questionnaire, clients reported the lowest WAI score gradually building until the highest was reported in S6. The largest increment in self-reported WAI was between S2 and S3. This indicates the difference between a client's perceived experience of the alliance in therapy and the physiological reality of the phenomenon.

Clinical changes in the client's HRV were evident across the six therapy sessions. There was an increasing trend in parasympathetic activity (HF) after S1 that was shown to peak in S4. Parasympathetic activity is a marker of a more relaxed state, with slower heart activity and less rapid breathing (Bourne and Russo, 1998).

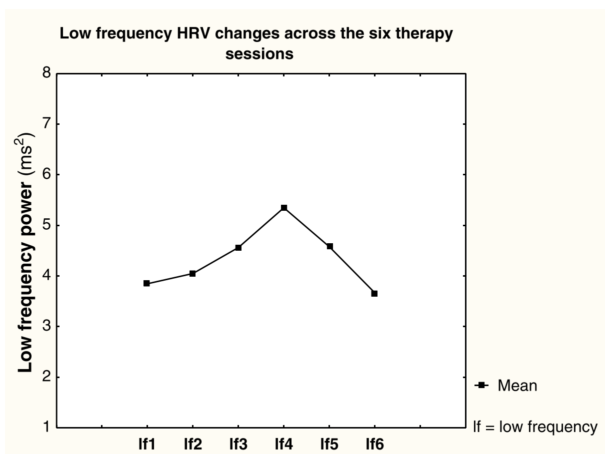

FIGURE 1. LF HRV changes.

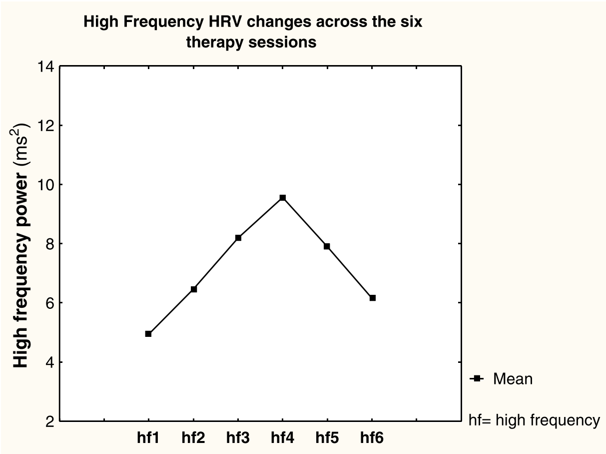

FIGURE 2. HF HRV changes.

This may indicate that once TA is established by S3 (Miller et al., 1997), clients were becoming less stressed. Research shows that when TA begins to form, clients are better able to work through trauma (Ledoux and Gorman, 2001) and develop new coping mechanisms, which ultimately produce new neural pathways through the phenomena of neuroplasticity (Soufer and Checkerdijiev, 2002). This study shows that physiological shifts take place during therapy, observed by the increasing trend of parasympathetic activity over the six sessions. This indicates that the ANS can be a measure of, or at least provide an indication of, these alterations.

Both parasympathetic (HF) and sympathetic (LF) activity continued to rise from S1 to S4 and peaked in S4. Sympathetic activity, which is a marker of increased arousal and drive (Carney et al., 2005), was also at its highest in S4. This result adds to the growing body of research demonstrating that increased anxiety is exhibited when clients are challenged or attempting to gain insight in therapy (Berntson and Torello, 1982). Once again, this increase in autonomic activity stresses the importance of S4 in terms of significant neurophysiological and psychological data collected in this specific session (Stratford et al., 2009). With the increase in the sympathetic and parasympathetic activity, there was also a significant increase in total power in S4. Total power is the reflection of the entire cardiac ANS or the total power represented by the HRV spectrogram and can influence LF and HF by affecting the variance of the total energy distribution (Malik, 1996).

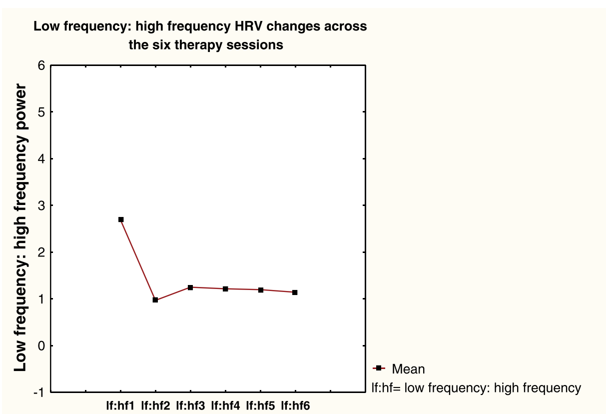

FIGURE 3. LF-to-HF ratio HRV changes.

There were differences in the LF (sympathetic) to HF (parasympathetic) ratio (LF/HF) between the beginning of therapy in S1 and the subsequent sessions. In S1, parasympathetic (HF) activity was low, indicating that clients were perhaps not so relaxed as they entered therapy.

After S1, clients appeared to be attempting to establish a state of dynamic physiological equilibrium, as indicated by a decrease in the LF/HF ratio. From S2, as LF increased, so did HF. This suggests that as TA developed over time, clients became focused on balancing their ANS activity, thus becoming more proficient in containing their anxiety. This pattern persisted right across the sessions from S2 to S6.

As the sympathetic branch of the ANS increased, indicating client anxiety, the parasympathetic branch also intensified, showing that the client was attempting to remain in a balanced physiological state through this significant sympathovagal shift. HRV provides a "window" into the interaction of the parasympathetic and sympathetic branches of the ANS (Cohen, 2000). This result could indicate that a predictor of alliance is a client's ability to regulate his/her ANS. After S4, the sympathetic (LF) branch of the ANS decreased and was below S1 levels by S6, indicating that flight/fight phenomenon was reduced, which could be attributed to successful therapy after just six sessions. The parasympathetic (HF) branch also diminished in concert with the LF but overall maintained a higher level than S1 at the end of therapy. This ending phenomenon was also supported by the data showing that by S6, when client and therapist had reported the highest bonding on the WAI scale, the LF/HF ratio was low. These data suggest that although the clients were reporting a high level of alliance through the WAI in S6, the TI or physiological data were showing client-therapist concordance at its lowest, indicating differences between self-perceived TA and empirical data. Hence, data collected in the last session (ending of therapy) need to be investigated in future studies over the short- and long-term and in clients with varying presenting issues for understanding the "phenomenon of ending."

The WAI outcome seems to be reflected in the HRV information, highlighting a connection between mind and cardiac factors. This shows that components of HRV may be used in the future as a AQ13 measure of the connection between client anxiety levels and successful therapy, presupposing a positive clinical outcome. Qualitative research suggests that clients become more engaged in therapy when they feel less anxious (Horvath and Greenberg, 1986).

These results may signify that the client's HRV results may signify that the client was making an effort to normalize the body's

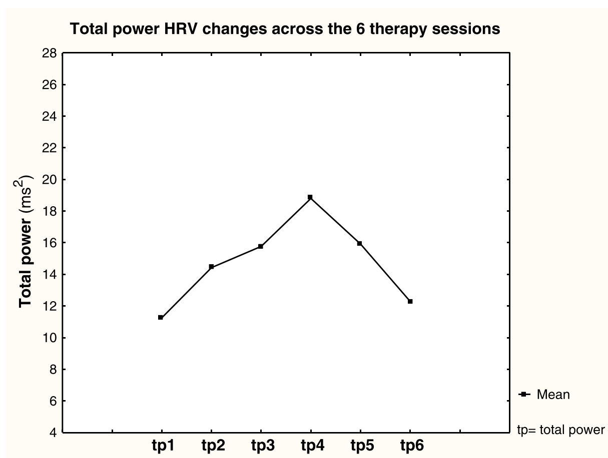

FIGURE 4. Total power HRV changes.

TABLE 3. Shows Correlations (*r*) Between LF, HF and TP (ms^2) and Mood Scores Across the Six Sessions

Mood Factors	LF	HF	Total Power
Tension-Anxiety	$r = 0.42$, $p = 0.04$	$r = 0.40$, $p = 0.046$	$r = 0.46$, $p = 0.02$
Depression-Dejection	$r = 0.40$, $p = 0.046$	$r = 0.42$, $p = 0.04$	$r = 0.43$, $p = 0.03$
Anger-Hostility	$r = 0.55$, $p = 0.004$	$r = 0.58$, $p = 0.002$	$r = 0.55$, $p = 0.006$
Vigor-Activity	$r = 0.43$, $p = 0.03$	$r = 0.48$, $p = 0.02$	$r = 0.46$, $p = 0.02$
Total mood score	$r = 0.50$, $p = 0.01$	$r = 0.51$, $p = 0.008$	$r = 0.51$, $p = 0.009$

biological and psychological response to the anxiety of developing a new relationship (Robles and Kiecolt-Glaser, 2003). This could also presuppose that individuals with increased levels of anxiety have an impaired ability to control the parasympathetic or HF branch of the ANS during therapy (Soufer, 1998).

HRV also showed associations with anxiety and mood scores in the clients. In S1, increased post–state anxiety was significantly linked to decreased parasympathetic activity. The Spielberger State Anxiety Questionnaire is a perceptive marker of a client's transient state of anxiety (Spielberger et al., 1983). It is commonly used in counseling and psychotherapy and is designed to detect an increase in state anxiety when a client is under psychological stress. In S5, increased pre–state anxiety was also related to a decrease in overall HRV. The trend for this decrease in parasympathetic, sympathetic, and total power was also evident in S3, which was significantly connected to increased trait anxiety levels. Trait anxiety measures the unique constant baseline anxiety of a client. The higher a client's trait anxiety level is, the more susceptible he/she is to elevations in his/her state anxiety levels, especially when issues of self-esteem and a sense of inadequacy are in question. Interestingly, trait anxiety does not increase in times of physical danger (Spielberger et al., 1983). This study indicates that the HRV of clients who exhibit high trait and pre/post–state anxiety is lower when under psychological stress. These clients appear to be displaying the "freeze" aspect of the flight/fight syndrome, where the parasympathetic branch of the ANS calms the body from an overactive vagus nerve, performing a "peacekeeper" role (Thayer et al., 1996). Conversely, higher parasympathetic and sympathetic activity and total power were linked to high mood factor scores. In S4, an increase in HRV parameters was significantly linked to the client's POMS scores in the areas of depression/dejection, anger/hostility, vigor/activity, tension/anxiety, and the total mood score. The POMS (McNair et al., 1971) questionnaire defines depression/dejection as a depressed mood accompanied by feelings of inadequacy, worthlessness, sadness, and emotional isolation. Tension/anxiety measures both heightened musculoskeletal and unobservable somatic tension. Anger/hostility charts the level of intense anger and antipathy toward others. Vigor/activity is an attempt to define friendliness, which is associated with high energy and the total mood score and is seen as a one-off inclusive estimation of a person's affective status. This may denote that clients who experience mood disorders may be trying to regulate their ANS into optimal functioning. Sympathetic activity endeavors to stimulate the cascade of stress hormones in readiness for the flight/fight response, and the parasympathetic branch, which slows the HR and relaxes the body, produces the freeze response. Together, they are attempting to return the body to the state of homeostasis or balance (Thayer et al., 1996). Allostasis is a process of always trying to achieve this homeostatic state. However, the debate is do we reach homeostasis completely, or are we constantly in a state of allostasis? Our results suggest that this may be the case. Once TA is established by S3, clients appear to have progressed to a more homeostatic state by S4.

S4 has shown significant associations between high TA, HRV, anxiety, and mood states. Current research suggests that if the TA is not established by S3 (Miller et al., 2008), successful clinical outcome is in question (Marmar et al., 1989). However, earlier research suggests that S4 may be more predictive of a successful therapeutic outcome than S3 is (Luborsky et al., 1983).

This implication reinforces the findings in this article and our earlier findings (Stratford et al., 2009) regarding the clinical importance of S4 and reaffirms the role of the sympathetic and parasympathetic components of HRV as an important objective measure of a client's TA during therapy.

CONCLUSIONS

Variations in the ANS have clinical significance (Yeragani, 2000) and are therefore an important determinant in the neurophysiological response of clients during therapy. The interaction between the brain switching on the neurochemicals (Soufer and Checkerdijiev, 2002) of stress and anxiety and the heart's response could be indicative of TA developing. Hence, cardiac parameters may be an indicator for assessing the degree of TA over therapeutic sessions.

An increased anxious emotional response during psychological and social stressful situations predisposes individuals to be more vulnerable to heart disease (Blumenthal et al., 2002). HRV is believed to signpost variations in cortical activity (Critchley et al., 2003), so this could be used to establish the state of TA. Growing evidence of how therapy impacts both the brain and the body of clients is becoming a key concept in the treatment and diagnosis of clients (Marci et al., 2006). Our preliminary study of brain activity and TA established links with neural activity from different sites of the brain during moments of physiological concordance or high TA, which establishes the oscillation of the ANS of both the client and therapist (Stratford et al., 2009).

This study has identified links between TA, anxiety, mood disorders, and HRV. Although this exploratory study has shown that changes in HRV over six sessions of psychotherapy parallel changes in objective and subjective measures of TA, the present study was limited by a six-session timeframe. More sessions with clients could have produced a clearer picture on the neurophysiology of TA and clinical outcome. This study has shown that there is room for further understanding of HRV as a predictor of noncardiac conditions and that there is much more research required to improve the efficacy of HRV as a reliable indicator of psychotherapeutic processes in working with anxiety and mood disorders. Such a study could also be furthered in clients with chronic conditions such as complex PTSDs, personality disorders, and affective disorders.

Future research could further investigate the implications of HRV over long-term studies and as a physiological tool to measure client psychological disorders that are free of bias introduced by using self-reports only (Benbassat and Baumal, 2004). The neurophysiological and psychological significant effects of S4 also need to be investigated in further studies, particularly over a longer timeframe. Although this exploratory study has shown that changes in HRV over six sessions of psychotherapy seem to parallel some changes in objective and subjective measures of alliance, the limitations in measurement timeframes and the further development of HRV as a predictor of noncardiac conditions indicate that much more work is required to improve the efficacy of HRV as a reliable indicator of psychotherapeutic processes and outcomes in working with anxiety-related conditions. Further research producing better training would also better equip therapists to help clients to reduce the risk of stress related heart disease with psychotherapy.

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DISCLOSURES

The authors declare no conflict of interest.

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