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Physiological Attunement and Influence in Couples Therapy: Examining the Roots of Therapeutic Presence

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ABSTRACT

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Extensive interdisciplinary common factor research has identified the therapeutic relationship as a consistent factor influencing therapeutic outcomes. We use polyvagal and interpersonal neurobiology (IPNB) theories to guide an examination of the physiological mechanisms at work in the therapeutic relationship. Both polyvagal and IPNB theories provide understandings about how humans are neurophysiologically wired for social connection. Each points to a sense of safety as being essential for meaningful connection to occur and clarifies that physiological attunement is an observable indicator of interpersonal connection. In this study, we use these theories to guide an examination of therapist physiological influence on clients in couple therapy, using continuous in-session data collection of respiratory sinus arrhythmia (RSA) for 22 heterosexual married couples and their therapist. Data were modeled in a multi-level path analytic framework to account for within-individual and within-couple effects. Results indicated that therapist RSA does not significantly predict lagged client RSA. A discussion of potential limitations, suggestions for therapists and recommendations for future study is included.

Keywords: physiological attunement, synchrony, therapeutic presence, couples therapy

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Physiological Attunement and Influence in Couples Therapy

Extensive interdisciplinary common factor research has identified the therapeutic relationship as a consistent factor influencing therapeutic outcomes (Del Re, Flückiger, Horvath, Symonds & Wampold, 2012; Horvath & Bedi, 2002; Horvath & Symonds, 1991; Flückiger, Del Re, Wampold, Symonds & Horvath, 2012; Koole & Tschacher, 2016; Martin, Garske & Davis, 2000). The importance of the relationship between therapist and client in the process of therapy was first posited by Freud (1913), yet over a century later, with decades of clear research confirming the significance of the therapeutic relationship, the field still faces challenges in knowing how best to capitalize on this understanding. Horvath (2005) wrote of the need in the field to "struggle with the question of how therapists can be trained to develop better [relationships] with their clients," (p. 4-5).

Nascent research into the groundwork of the therapeutic relationship has identified the concept of therapeutic presence as being a key factor (Colosimo & Pos, 2015; Geller & Greenburg, 2012; Geller & Porges, 2014). Presence, which has roots in Eastern traditions of mindfulness meditation, drew interest as a construct in therapy due to a growing body of neurophysiological research. Therapeutic presence involves at a basic level the therapist's awareness of what is happening within him/herself, with the client, and in the therapeutic context in the present moment. In order to maintain presence, the therapist must be able to physiologically self-regulate (Geller & Porges, 2014). While there is general agreement about what defines therapeutic presence, and a number of coding schemes and measures have been developed to identify it (Geller & Greenburg, 2002; Geller, Greenburg & Watson, 2010), neither an objective understanding nor measure of therapeutic presence exists (Geller, Greenburg & Watson, 2010).

Advances in imaging techniques have improved our ability to examine the neurological processes regulating physiological states, (Marci & Riess, 2005) fueled groundbreaking theories in neurobiology and neurophysiological regulation (Siegel, 2007; Porges, 2010), and revealed that many regulatory processes are socially influenced (Marci & Riess, 2009). The use of fMRI, CT and PET scans, and ECGs, for example, has allowed researchers glimpses into the functioning of the brain and nervous system and revealed key regulatory mechanisms and processes previously unknown. Of particular interest for systemic thinkers is the revelation that many of these regulatory processes are affected by social input, meaning that humans are evolutionarily adapted to respond to interpersonal interaction (Marci & Riess, 2005).

The social nature of neurophysiological regulation is of particular importance to marriage and family therapy (MFT) because of the implication for understanding and improving therapeutic presence in relational therapy using physiological data (Geller & Porges, 2014). According to recent neurophysiological conceptualizations, therapeutic presence may be apparent by observing physiological attunement between therapist and clients in-session. Though in-session therapist and client physiology has been examined in psychotherapeutic research for nearly a century (Glucksman, 1981), the research has not been used to examine therapeutic presence (Colosimo & Pos, 2015), and only recently has physiological attunement data begun to be collected in couples therapy (Karvonen, Kykyri, Kaartinen, Penttonen & Seikkula, 2016).

Marriage and family therapists would benefit from a better understanding of how their physiological regulation influences therapeutic presence and affects clients' physiology in session. In this study, we use polyvagal (Porges, 2011) and interpersonal neurobiology (Siegel, 2012) theories to guide an examination of therapeutic presence as it can be seen through physiological attunement between clients and therapist in-session. Using in-session data collection of respiratory sinus arrhythmia (RSA) to measure parasympathetic nervous system (PNS) activation in therapist and clients, we test whether therapist autonomic nervous system (ANS) activation predicts client activation.

Literature Review

Theoretical Underpinnings

Advances in imaging techniques and methods over the last several decades have increased understandings of neurophysiological processes and fueled theories that describe human functioning, particularly in a social context. These neurophysiological explanations of the social shaping of human experience and behavior have important implications for therapy and therapeutic relationships. Whereas research and literature on this topic has been almost entirely focused on the therapist-client dyad, examining these phenomena in a couple therapy context is essential to get a better grasp on the complex interactions of the therapeutic system in couple therapy.

Porges' polyvagal theory. Polyvagal theory (Porges, 2011) concerns the function and regulatory processes of the vagus nerve--the 10th cranial nerve and part of the peripheral nervous system. It was named for its wandering path through the body; "vagus" means "wandering" in latin. The nerve branches throughout the body and innervates the visceral organs, primarily relaying information from them to the brain (afferent neurons=80-90%), but also sending signals from the brain (efferent neurons=10-20%). The vagus is part of the autonomic nervous system (ANS), and an integral component of the parasympathetic nervous system (PNS); it transmits PNS directives to most internal organs. Polyvagal theory focuses on two branches of the vagus (hence, poly- vagal), which serve different functions and which developed in different evolutionary periods. The older vagal branch, called the dorsal vagal complex (DVC), is an unmyelinated circuit and exists in most vertebrates. It regulates subdiaphragmatic organs, such as the intestines, to promote health and growth and activates a defensive physiological state of immobilization or dissociation (hard freeze) in the presence of extreme danger by slowing or shutting down resource-intensive organs. It is also involved in social connections that require "freezing without fear" response (e.g., breast-feeding or sex). The newer branch, the ventral vagal complex (VVC), exists only in mammals, and represents the evolutionary solution to the need for a more sophisticated affective and behavioral repertoire in interactions with an increasingly complex social environment. The VVC consists of myelinated neural circuits with improved speed and accuracy of neural transmission. It regulates the heart and lungs and also connects to the nerves that regulate the face and head. As part of the PNS, it acts as a "brake" to regulate sympathetic nervous system (SNS) responses, including behavioral activation (fight or flight responses) and behavioral inhibition (soft freeze), so that physiology associated with pro-social behavior, connection, and "rest and digest" can occur when the environment is perceived as safe. The DVC and VVC have a hierarchical relationship (Geller & Porges, 2014) with the more recently evolved system, the VVC and its functions, taking precedence. The DVC defensive strategies are activated in the case of VVC failure to successfully respond to the environment.

Thus, through vagal regulation of the PNS and SNS, the ANS actuates a variety of physiological states and behaviors. Particularly, the vagus nerve is the mechanism to produce three physiological states: a "safe state" wherein functions of rest, digest and social connection occur and which are associated with a high PNS and vagal tone; a "danger" state in which the vagal tone is low and PNS is inhibited such that the SNS functions of "fight or flight" or "soft freeze" physiology and behaviors are expressed; and immobilization wherein physiological shutdown occurs such that there is a "hard freeze" and/or dissociation response. The physiological states associated with the perceptions of safety, danger and freezing can be distinguished by a variety of non-invasive, objective measures. The PNS depends on the vagal nerve for the regulation of heart rate, so heart rate variability (HRV) is a good measure for PNS activity and indicates a sense of safety. Decreases in HRV and elevated heart rate indicate SNS "fight or flight" physiology.

In polyvagal theory, Porges posits that a properly functioning vagal system effectively detects environmental danger or safety through the process of neuroception--an unconscious neural evaluation of risk (Porges, 2011: p. 194)--and initiates an appropriate physiological response. Neuroception, according to Porges, relies on neural interpretation of environmental and social cues as indicators of safety or danger. Porges proposes that a neural connection between face and the heart evolved in tandem with the evolution of the VVC, to create a "social engagement system that would enable social interactions to regulate visceral state" (Porges, 2009; p. 86). Because of the neural integration between heart and face, facial expression, head gestures, tone of voice, direction of the gaze, and pupil dilation are all effective indicators of physiological state. When a physiologically calm or safe state is detected in another via facial and vocal indicators, relational safety is perceived and "neurobiological defense strategies [are] inhibited" (Geller & Porges, 2014; p. 182). This is manifested physiologically by an increase in vagal tone, which may be indicated through a measure of respiratory sinus arrhythmia (RSA), which combines HRV and respiratory data. The vagus and connected neuroanatomical structures adapt the physiological state of the assessor based on the current assessment of the other's physiology; thus, social engagement is facilitated. This sophisticated system which uses neuroception and integrated neural pathways to create bidirectional physiologic coupling and social engagement makes humans exceptionally physiologically attuned and susceptible to a sense of relational safety and danger.

Polyvagal theory has valuable implications for therapeutic presence and its role in creating a sense of safety. Because of the physiological attunement actuated by the vagal nerve and ANS, our physiological state and resultant behaviors are affected by our social context; a "neuroception of safety" is essential for calm, positive engagement. When a therapist's physiology is regulated such that he/she is fully present and communicates attention, interest and safety through the face and voice (i.e., therapeutic presence), the client can assess the therapist and therapeutic context as safe, thereby inhibiting his/her physiological defenses and promoting a calm, open, and trusting interaction (Geller & Porges, 2014; p.182). This physiologic coupling has an emotionally healing effect and may open the way for deep, effective therapeutic work to take place. Therapeutic presence makes the therapeutic relationship a safe place and thereby invites engagement.

In the case of relational therapy there are, of course, more actors and more potential for a variety of physiological influences. Each individual in the therapeutic system may assess their relational context with every other individual and attune based on a number of factors. What the role and influence of the therapist's presence and physiological regulation is in couples therapy is still being determined.

Siegel's theory of interpersonal neurobiology. Another significant theory that has been informed by improved neuroanatomical knowledge and assessment methods is Daniel Siegel's theory of interpersonal neurobiology (IPNB; Siegel, 2012). Siegel describes the brain structures that receive and relay information and which must work in harmony for well-being to occur. Lamina I--a layer of the spinal cord--and the vagal nerve bring neural information from the body into the brain. They communicate physiological state and other somatic information to the brainstem, which regulates “bodily functions and states of arousal,” including fight, flight or freeze responses (Siegel, 2012; p. 11-1). From there, the information continues to flow upward to the hypothalamus, which regulates bodily functioning through hormones released from the brain. In the middle prefrontal cortical areas, the anterior cingulate uses the information to generate emotion and coordinate attention. Interoception-- awareness of our physiological and emotional state--happens when the insula, which is also in the middle prefrontal cortex, is activated by the neural energy input. The anterior cingulate and anterior insula are linked by neural spindle cells, which linkage may facilitate self-awareness and coordinate somatic and relational information with emotion regulation (Singer, et al., 2004). One of the implications of this linkage is that self-awareness is tied to other-awareness. Balanced attention to our own physical and emotional states promotes compassionate and empathic attention to others.

Interdisciplinary research used in creating the theory of IPNB includes discoveries about the functioning of the middle prefrontal cortex. There, “the brain integrates input from other people with the process of regulating the body, balancing emotional states, and creating self-awareness” (Siegel, 2006; p. 254). IPNB posits that when effective integration of mind, brain and relationships is happening, specific neural mechanisms can create a state of “resonance” in which the physiological states of two people who are attuned to each other become congruent. Siegel’s focus in this process is on the “mirror neuron system,” which was discovered in the mid-1990s (Gallese, Eagle, & Migone, 2007; Gallese, Fadiga, Fogassi, & Rizzolatti, 1996; Rizzolatti, Fadiga, Gallese, & Fogassi, 1996). Based in brain research, the mirror neuron system was first proposed when activation of areas of motor function were discovered in the brain of a subject who was watching, rather than performing, that motor function. Later studies examined neural activation in the cortical areas of an observer's brain related to pain and a variety of emotions, when exposed images or expressions of pain and other emotions (Botvinick et al., 2005; Ogino et al., 2007). Siegel (2006) noted that "the brain is capable of integrating perceptual learning . . . to create internal representations of intentional states in others" (p. 254). Based on this finding, it has been hypothesized that the mirror neuron system may be a neural basis for empathy (Gallese, 2003; Schermer, 2013). Research has demonstrated the ability of the brain, on perceiving facial and vocal cues, to produce in the viewer an internal state that mirrors not only the intentional state but also the physiological and affective states of the other person (Singer, 2006; Braadbaart, de Grauw, Perrett, Waiter, & Williams, 2014). That capacity for physiological attunement has profound implications about how social influence impacts an individual's functioning.

The mirror neuron system's influence on physiological, affective and intentional attunement are of particular importance in considering the significance of therapeutic presence. When two people are able to engage in integrated communication, which IPNB defines as connecting in ways in which each individual's experience is respected through compassion and empathy (Siegel, 2012; p. 18-1), they may mirror the other's state. For therapists, their mirroring of the client's state opens the door to empathic insight. For clients, a therapist's sense of integration and balance in dealing with painful topics and client vulnerability can "rub off" on the client in the session, allowing the client to regulate emotion in a healthier, more integrated way. In order for these things to happen, each must be fully present—aware of and "tuned in" to themselves and the other.

Integrating Polyvagal and IPNB

The two theories which underpin the physiological research in this study work in close harmony with each other. Both theories draw on information about body-brain connections to clarify how neurological and physiological processes facilitate social engagement. Both include understandings about the workings and connection of the vagus nerve, the ANS, perceptible changes in face and voice, and brain functioning. While polyvagal theory focuses more on the physiological and visceral changes, IPNB examines how brain structures and wiring create attunement. Polyvagal theory includes an understanding of "neuroception"—the perception of safety or threat based on what is happening within one's own body and what is perceived in another. Similarly, IPNB describes "interoception," or self-awareness, as instrumental to our ability to accurately perceive others. Both theories emphasize the importance of relational safety, self-awareness and other-awareness in creating meaningful interpersonal connection. This open, regulated self- and other-awareness is termed "presence."

Therapeutic presence. The concept of therapeutic presence as an essential foundation for the therapeutic relationship has been examined theoretically since the beginning of psychotherapy. Freud described the need for "an impartial, nonjudgmental, evenly applied attention" (Geller, 2012; p. 18) in which the therapist "must turn his own unconscious like a receptive organ towards the transmitting unconscious of the patient" (Freud, 1912; p. 115). Pemberton (1977) examined therapeutic presence by observing and interviewing five recognized therapists who were known for their powerful presence. He determined that therapeutic presence was influenced by the therapist's *awareness*, *acceptance* and *appreciation* of themselves in relation to others. More recently, Phelon (2001, 2004) followed a process of 'intuitive inquiry' in examining therapeutic presence. She concluded that 'healing presence' is largely dependent on the 'self of the therapist'--particularly his/her 1) personal development, commitment to growth, and integration; 2) spiritual practices and belief; 3) capacity for internal and external awareness and attention; 4) receptivity and alliance with the client. The effort to understand therapeutic presence continues because of its demonstrable effect on the therapeutic relationship and the corresponding desire among therapists to improve their ability to be present in session.

Therapeutic presence has gained increased attention as research has further demonstrated its importance in creating a safe therapeutic environment and developing the therapeutic relationship (Colosimo & Pos, 2015; Geller, 2013; Geller & Greenberg, 2012; Geller, Greenberg, & Watson, 2010; Geller & Porges, 2014; Geller, Pos, & Colosimo, 2012; Schneider, 2015). Geller & Porges (2014) reiterate that therapeutic presence is central to developing a positive therapeutic relationship. Colosimo & Pos (2015) clarified that presence is necessary to create a client-centered therapeutic context. As a common factor in the creation of the therapeutic relationship, which is itself a key influencer of therapeutic outcomes (Del Re et al., 2012; Horvath & Bedi, 2002; Horvath & Symonds, 1991; Flückiger et al., 2012; Martin, Garske, & Davis, 2000), presence is an essential construct for therapists to cultivate.

Researchers and theorists hypothesize that one way presence may promote a positive therapeutic relationship is by creating a sense of safety for clients (Geller & Greenberg, 2012; Siegel, 2007, 2010). While qualitative research has linked client perception of therapist's presence with the strength of the therapeutic alliance (Geller et al., 2010), no known quantitative research has linked presence with clients' sense of safety. However, both Porges' polyvagal theory and Siegel's theory of IPNB provide explanations for why presence and a sense of safety may be linked (Geller & Porges, 2014; Siegel, 2010).

Polyvagal theory and IPNB describe interpersonally responsive physiological and neurological mechanisms that create a sense of safety. "In offering therapeutic presence the therapist's warm facial connection, receptive posture, open heart, and listening presence help the client to feel safe and further precipitates neural regulation of the client's physiology," (Geller &

Porges, 2014; 185). According to IPNB, the client's perception of safety allows the PNS to take charge and create a physiological state that allows for social connection. In this state of connection, the client can become physiologically attuned to the therapist through the mirror neuron system because of the sense of safety created by cues in the therapist's voice and face that are manifest when the therapist is present.

Drawing on the understandings polyvagal theory and IPNB offer to the physiological process of therapeutic presence, we argue that physiological attunement is a measure of presence. Siegel (2010) explains the important link between attunement and therapeutic presence: "we use presence . . . and move it into the social sphere of taking in another's internal state for interpersonal attunement" (p. 35). It may be that the relationship between attunement and presence mediates the recently proposed relationship between attunement and the therapeutic alliance, (Koole & Tschacher, 2016), though ongoing research is required. While the neurobiological systems that may translate presence into physiological attunement are increasingly understood, no one has yet established that link through research. Examining whether therapist physiology can predict client physiology is an important step in further examining the link between the two.

Measuring Physiology and Attunement

The measurement of therapist and client physiology has been an important part of psychotherapy research for half a century (Glucksman, 1981). Measures of heart rate (HR) and electro-dermal activity (EDA) were touted as being inexpensive, non-invasive and objective. Early investigations used HR and EDA to understand physiologic patterns in patient-therapist interaction and to get insight into the patients' response to therapy, their psychopathology and the effectiveness of psychodynamic methods. Physiological attunement between therapist and client was consistently observed in research (Coleman, Greenblatt, & Solomon, 1956; DiMascio, Boyd, & Greenblatt, 1957; Malmo, Boag, & Smith, 1957; Kaplan, 1963; Kaplan, Burch, Bloom, & Edelberg, 1963; Stanek, Hahn, & Mayer, 1973). Malmo et al., (1957) explored changes in the attunement of therapist and client physiology when the former expressed support or criticism. Therapist support precipitated decreases in speech-muscle tension and heart rate for the client, which would coincide with increased vagal tone and PNS activation. Criticism elicited increases in speech-muscle tension and heart rate, which would be consistent with lower vagal tone and SNS activation. Kaplan (1963) observed physiological responses of therapist and clients in a group setting. He noted that clients exhibited greater EDA when therapist negativity was more pronounced, indicating heightened SNS response. In another study, Kaplan et al. (1963) found greater covariance of EDA in participants with positive or negative rather than neutral affective relationships. Stanek et al., (1973) measured HR for therapist and client during the first session for 32 patients experiencing phobias. They noted significant attunement in therapist and client HR during meaningful periods of the session, for example when discussing transference material. In his review of these studies, Glucksman (1981) noted that a strong “rapport” between therapist and client decreased client SNS arousal and that physiological attunement happens “when the [therapist] is accurately perceiving and empathizing with the patient’s communications” (p. 191); in other words, when the therapist is present. These early studies began to demonstrate the physiological connectedness of therapist and client, but they were rudimentary in their ability to show causality or shed light on the mechanisms for connection. Also relevant for family therapists is the disadvantage that the research focused almost exclusively on individual therapy and dyadic attunement.

Early studies of physiological attunement lacked precision in data collection, used relatively simplistic statistical analysis of the data and were almost entirely focused on examining dyads. Advances in modern computing power have enabled more sophisticated methods of data collection and refined statistical approaches (Marci & Reiss, 2009). Current studies using simultaneous recording of physiological data in session show how current methods expand prior research (Marci & Orr, 2006; Marci, Ham, Moran & Orr, 2007; Messina et al., 2013; Karvonen et al., 2016). In three recent studies, physiological attunement was examined using EDA which was recorded continuously using two electrodes on each of the participant's hands. Marci & Orr (2006) showed that emotional distance (which would indicate lack of presence) decreases physiological attunement; Messina et al., (2013) looked at how therapist empathy (emotional awareness and engagement, characteristic of presence) affects attunement; and Karvonen et al. (2016) found physiological attunement in a "multifactor" therapy session, with a client couple and two therapists interacting. Each of these studies used advanced statistical analyses and sophisticated data collection to draw conclusions about how the therapist's presence and physiology impact what happens in session.

Overwhelmingly, research examining physiological attunement has involved only therapist-client dyads. In the first decades of physiological attunement research, the statistical analysis capabilities may have been insufficient to account for and disambiguate the bidirectional influences interacting in larger groups. With improved statistical models and neurophysiological understanding of attunement, as well as the growing prevalence and importance of relational therapy, examining multifactor attunement is increasingly pertinent. Laws (2015) pointed out that "finding ways to capture relationship processes is crucial. . . bidirectional, or mutual influence is implicated in outcomes across the lifespan," (p. 1). Anderson, Keltner, & John

(2003) showed that couples experience attunement and become more similar over time and that the level of convergence predicts relationship satisfaction and cohesiveness. Baca, Shafer and Belmeke (2006) point out that empathy— "a special mode of perceiving the psychological state or experiences of another person. . . an 'emotional knowing'" (p. 130) is crucial in working with couples and that "the purpose of couple's therapy is to teach each member how to empathize" (p.130) or be present with and attune to each other to increase their intimacy and connection. Examining physiological attunement in couples therapy and understanding how a therapist might influence a distressed couple through attunement and regulation provides important information that can benefit the field of MFT.

Karvonen and her colleagues (2016) presented the first (known) study examining physiological attunement in couple therapy. Using EDA data collected in session for husband, wife, therapist and a co-therapist, they used the EDA attunement index to examine SNS synchrony between each of 16 dyads in session. They found that co-therapists had the highest levels of dyadic attunement and couple dyads had the lowest level of attunement in their study. The take-away message was for therapists to be aware of the "automatic bodily reactions" (p.11) of individual clients and between couples and be particularly aware of their own "bodily states" (p.11).

Though Karvonen et al. (2016) presented an important study establishing attunement as a real phenomenon in couples therapy, their study did not relate attunement to therapeutic presence, examine directionality of attunement more than cursorily, or relate attunement to therapeutic outcomes, thus leaving a gap that this study seeks to fill. Both polyvagal and IPNB theories indicate bi-directional physiological influence. This study seeks to add to our understanding of the extent to which and why therapist physiology and presence may be important and how the learned skill of self-regulation on the part of the therapist might effect in-session processes and client receptivity Karvonen and her colleagues (2016) examined timing offsets of periods of attunement, noting which member of the dyad's EDA led the other's and by how many seconds, but they did not include other measurements of ANS activity or determine specifically to what extent therapist physiology predicted client physiology. They found that the highest levels of dyadic attunement in a multifactor therapy setting were between co-therapists and that attunement usually happened very quickly. Applying the physiological understandings proposed by polyvagal and IPNB theories regarding attunement and gathering in-session RSA data as a measure of vagal tone and PNS allows us to further conceptualize the therapeutic system and more clearly understand the processes involved in therapeutic presence and physiological attunement. We use RSA because it measures vagal tone, which is an indication of PNS activity and corresponds to an open, receptive state indicative of presence. No studies have examined whether therapist physiology predicts client's physiology, but determining whether this is the case and to what extent it may be so is pertinent to knowing how the therapeutic relationship and therapist presence impact outcomes.

Current Study

In this study, we examined client-therapist in-session physiological attunement in 22 cases of marital therapy. Using longitudinal physiological data taken throughout the second session of therapy, we examined whether and to what extent therapist PNS activity, as measured by RSA, predicts client PNS activity.

Method

Sample

Client participants were recruited from couples who called into the BYU Comprehensive Clinic seeking counseling, with the primary complaint being marital difficulties. During the intake process, they were read a script describing the study and asked if they would be interested in participating. If they indicated interest, they were e-mailed an eligibility survey. To be eligible for the study, participants had to be a) English-speaking; b) married for at least a year; c) experiencing clinically significant distress as determined by either partner having a score <13.5 on the Couple Satisfaction Index (CSI-4; Funk & Rogge, 2007); d) free from a substance abuse problem, addiction or a severe mental disorder; e) free from any condition that would make an fMRI scan unsafe (e.g., metal implants, pregnancy); f) able to participate with their partner. Each participant was compensated with a digital copy of their MRI and $200.

Client participants included 22 couples. All participants were married for the duration of the study. Half of participants (n=22) were male and half (n=22) were female. The average age of participants is 29.45 (*SD*=4.4; range=22-38) with the sample being 85.71% White (n=36), 2.38% Black (n=1), 7.14% Asian/Pacific Islander (n=3), and 4.76% Hispanic (n=2). Couples had an average of 1.85 children (*SD*=1.53; range:0-5) and average family income was between $45,000 and $55,000. Education levels of client participants varied; for 9.52% (n=4) the highest level of education was a GED or high school, for 7.14% (n=3) an Associate degree, 26.19 (n=11) a Bachelor's degree, for 4.76 (n=2) vocational or technical school, for 38.10% (n=16) some college, and for 14.29% (n=6) a Masters or Professional degree.

Therapist participants were drawn from a pool of second-year MFT masters-level or Ph.D interns at the BYU Comprehensive clinic. They were assigned to client-participants based on availability and were emailed to let them know about the assignment. Therapist participants were compensated $50 for their participation in the study.

Therapist participants included 13 individuals with an average age of 25.3 years (SD=2.46; range 22-30). Of the therapists, 84.62% (n=11) were female and 15.38% (n=2) were male. Also, 23.08% (n=3) were single and 76.92% (n=10) were married. Therapists identified predominantly as white (69.23%; n=9) with one identifying as Asian (7.69%; n=1) and three as biracial (23.08%; n=3).

Procedures

Data collection. Data for this study comes from the Changing Hearts and Minds in relationshiPS (CHAMPS) project currently being conducted at Brigham Young University. The CHAMPS project is a broader study including multiple measures, including daily diaries, standard assessments, fMRIs, recorded videos and accelerometers. This study uses physiological data collected in-session from clients and therapist and demographic data collected during a pre-research meeting via questionnaire. Physiological data was collected using MindWare software, MindWare Mobile Impedance Cardiographs and nine electrodes to measure cardiac impedence, skin conductance and respiratory sinus arrhythmia (i.e., vagal tone). We used respiratory sinus arrhythmia data (RSA) for this study. Placement of the nine electrodes was as indicated in Mindware's Recommended Practices for Electrode Placement instructions, namely (1) ECG electrode attached to positive lead placed on the bottom left rib near the side; (2) ECG electrode attached to negative lead placed on the right collar bone (clavicle); (3) ECG electrode as ground placed on the bottom right rib on the subjects side; (4) ECG electrode attached to positive lead placed on the spine, 1.5 inches (3.81 cm) above the jugular notch at the vertebral prominens; (5) ECG electrode attached to negative lead placed on the spine 1.5 inches (3.81 cm) below the xiphoid process, at approximately T8; (6) ECG electrode attached to positive lead placed on the jugular notch just above where the collar bones meet, and offset slightly to the right to prevent artifacts as subjects will be speaking; (7) ECG electrode attached to negative lead placed just below the sternum on the xiphoid process; (8) GSR electrode placed high on the palm of the subject's non-dominant hand, at the thenar eminence; (9) GSR electrode placed high on the palm of the subject's non-dominant hand, at the hypothenar eminence. Once the electrodes for the MindWare Mobile Cardiograph were placed, readings were collected during two periods of baseline. During the first (i.e., silence) collection of baseline readings, the client and therapist participants sat quietly watching a youtube video of fish for three minutes; during the second (i.e., talking) baseline, participants counted to 20 in a normal voice, alternating between therapist, wife and husband for three minutes. After baseline periods concluded, therapy commenced, during which data for therapist, husband, and wife physiology were continuously collected. Data were cleaned of artifact and extracted in 10-second increments for analysis. All procedures were approved by the Institutional Review Board for Human Subjects research at BYU.

Therapy sessions. Participants had four therapy session meetings lasting approximately two hours each. The two hours included time for a research assistant to help participants and therapists hook up to the MindWare Mobile Impedance Cardiographs and conduct baseline readings, a 50-minute therapy session, and removal of the electrodes. Sessions were recorded for later observational coding and physiological data was synchronized with the recordings. Standard therapy methods/techniques were used in a Treatment-As-Usual (TAU) format.

Measures

As described above, client and therapist physiological data were collected using nine electrodes and MindWare Mobile Impedence Cardiographs wirelessly connected to a computer running Mindware and Noldus Observer software.

Respiratory sinus arrhythmia (RSA). RSA was gathered using electrocardiograph (ECG) and respiratory data. Respiration was derived from various ICG parameters. ECG data was collected with two ECG electrodes. They were placed on the right collarbone and on the bottom left rib near the side on each participant. An additional electrode was placed on the bottom right rib on the subject's side as a grounding signal. The ECG records the electrical activity of the heart. These electrodes were connected to the MindWare Mobile device and data was communicated wirelessly to the MindWare software. RSA is a measure of vagal tone and vagal reactivity within the PNS and indicates a "rest and digest" state.

Lagged respiratory sinus arrhythmia. Lag variables were created for husband, wife and therapist. The lag variable used RSA values for the 10-second time period immediately following the current RSA values. Lag variables were used as an outcome variable to examine the predictive relationship between therapists' RSA and clients' next 10-second RSA.

Controls. The model controlled for respiration, as it has been found that respiration may confound with RSA (Berntson, Cacioppo, & Grossman, 2007). Demographic variables which are often included as controls (e.g., age, race, education, income level) were not included in this study because we found no conceptual reason for their inclusion. They are also omitted from other published studies examining physiology which we examined (McAssey, Helm, Hsieh, Sbarra, & Ferrer, 2013; Palumbo et al., 2017).

Analysis

Since data are collected longitudinally from married individuals in therapy, there are multiple sources of non-independence. Thus, we modeled husbands' and wives' data simultaneously to control for non-independence due to being in the same couple. The hypothesized model (see Figure 1) was also fit in a multilevel model, with individuals' RSA scores (level 1) nested within case (level 2). This was done because the shared variance in outcomes due to having multiple observations (or timepoints) per participant can usually be controlled by nesting within individual. However, because this path model examines the relationship between individuals and time/change is not a research question, we could not nest within individual. Alternatively, we could nest within case because the shared variance associated with multiple observations per person occurs on a case-by-case basis. Hence, the relationship between individuals' scores is Level 1, and therapy case is Level 2. Lag variables were created for husband and wife using an influence-time of one 10-second period. The lagged RSA variables for husbands and wives were then regressed on the therapist's RSA score (of the previous 10 seconds). The hypothesized model was fit in a path analytic framework using Mplus, version 7.11 (Muthén & Muthén, 1998-2007).

Results

Preliminary analyses

The sample's descriptive statistics and correlations for key variables are in Table 1. We found that across cases (level 1 analysis), wives' RSA was slightly higher than both husbands' [$t(21) = 2.22$, $p = .037$] and therapists' [$t(21) = 1.75$, $p = .095$] RSA. Within-case (i.e., Level 1) bivariate correlations are all small, suggesting that factors others than those examined here may be more related to outcomes. The intraclass correlation indicated that 24.0% of the variance in wife's RSA and 26.4% of the variance in husband's RSA was due to shared variance at level 2 (or within case), suggesting that the majority of the variance is attributable to level 1 factors.

Fitted model

The model resulted in excellent model fit [χ^2 (5) = 10.41, p = .06; CFI = .97; TLI = .93; RMSEA = .01]. Results indicated that therapists' RSA was not significantly predictive of wife's or husband's lagged RSA [b = -.01(.02), p = .53; b = -.02(.02), p = .31]. The model accounted for 6.5% of the variance in wife's RSA and 3.2% of the variance in husband's RSA.

Discussion

While it has long been known that the therapeutic relationship is an important factor in determining therapeutic outcomes (Del Re, et al., 2012; Koole & Tschacher, 2016), we are still seeking to understand what makes the therapeutic relationship so influential and how to improve it (Horvath, 2005). IPNB and polyvagal theories offer neurophysiological understandings about the mechanisms regulating social relationships and the importance of a sense of interpersonal safety to creating a condition in which clients can be receptive in therapy (Geller & Porges, 2014). The ability of the therapist to create a sense of safety, then, is an essential element in improving therapeutic outcomes and may be accomplished by maintaining a state of focused self- and other-awareness and physiological attunement which has been termed "presence" (Colosimo & Pos, 2015; Geller & Porges, 2014; Schneider, 2015). The purpose of this study was to improve our ability to conceptualize the therapeutic system in a multifactor setting and our understanding of the physiological processes involved in therapeutic presence so we can better understand how it may impact therapeutic outcomes. Previous research examined attunement in a multifactor setting using EDA as a measure of SNS activity, but the direction of the influence and PNS activity was not examined (Karvonen et al., 2016).

Our model demonstrated no predictive influence between therapist and client vagal activity. This result gives new information about the physiological processes at work in multifactor therapy settings. In conceptualizing this study, we assumed that clients would attune to therapists and thereby improve their ability to stay regulated and receptive in therapy. We considered that if therapist PNS activity predicts client PNS activity, this would inform a case for therapists to stay physiologically and emotionally regulated in-session because of the direct influence it could have on their clients' ability to stay regulated and receptive, thus potentially improving therapeutic outcomes. We used RSA as a physiological indicator of regulation and presence in our study because PNS activity is associated with a calm, receptive state. The results of our study indicate that our assumption about why therapeutic presence is important in the therapeutic process may be incorrect. If client's PNS activity is not influenced by therapist PNS activity, it may be that the importance of therapeutic presence is not due to clients' attunement to therapists but, perhaps, in therapists' attunement to clients. Therapist attunement to clients has been associated with therapist empathy (Gallese, 2003; Schermer, 2013; Siegel, 2012: p. 18-1) and client's sense of "feel[ing] felt" (Siegel, 2011: p.11) It may be that this process is more important in achieving therapeutic outcomes and is, in fact, what the clients need.

Also, although both polyvagal and IPNB theories posit bi-directional attunement in dyadic settings, we see that this may not be the case so definitively in multifactor settings. If clients are not attuning to therapists, we need more information about the process of attunement in couples therapy. Attunement may be moderated by a number of factors as individuals have more than one other person with whom they might attune. Individual's relationships with each other, their level of self- and other-awareness in session and the current process and content of the session are a few theoretically relevant potential influences of attunement. Relationship, as a moderating factor of attunement, may be suggested in polyvagal and IPNB in that as attunement is an evolutionary strategy for connection and protection, individuals' physiology would most likely be affected most by the person from whom they experience greatest safety or threat. Therefore, it may be that in a multifactor setting, clients attune to each other more than to the therapist. Next, client presence may also influence attunement. It may be that the client must be paying attention to the therapist in the present moment, instead of to self, spouse or problems, many of which are outside the moment, in order for him or her to attune to the therapist. Lastly, the process and content of therapy may influence direction, coupling and strength of attunement by affecting that which and to whom individuals give attention.

Clinical Implications

This study did not yield conclusive findings which would inform new suggestions for clinical practice. However, it may be helpful for therapists to apply the theoretical material presented about the importance of therapeutic presence—an open self- and other-awareness in the present moment—and of attunement to client experience and physiology (Siegel, 2006; 2012). Therapist's ability to "tune in" to clients and empathize with their emotional state may be an important factor in therapeutic outcomes (Koole & Tschacher, 2016). This implies the importance of immediacy, especially if therapists are struggling to know what is going on for a client in the moment. Asking clients about their emotional and physiological experience (1) lets therapists be more aware of client experience; (2) helps clients be more aware of their own experience and thereby potentially increase their presence; (3) lets the client know the therapist is interested in and aware of his/her present experience, thus increasing the sense of feeling understood (Siegel, 2011).

Next, it is important for therapists to be aware of their relationship and alliance with each client in session as this may impact therapeutic attunement and outcomes. Validated alliance inventories such as the Working Alliance Inventory (WAI), California Psychotherapy Alliance Scales (CALPAS) and Couple Therapy Alliance Scale (CTAS) (Horvath & Greenberg, 1986, 1989; Gaston, 1991; Pinsof & Catherall, 1986) and therapeutic check-ins are indicated to improve therapist awareness and improvement of alliances. Strong alliance and therapeutic relationship may moderate therapist-client attunement and improve therapist's awareness of clients' experiences in therapy. Comparing each member of the couple's alliance scores may also yield important information as therapeutic outcomes have been linked to the correlation between husbands' and wives' assessments of therapeutic alliance (Anderson & Johnson, 2010; Hight, 1998).

Finally, though this study does not offer further explanation for or support of the process of attunement in couples therapy, we still believe that it is important for therapists to pay attention to attunement processes in therapy. Particularly, therapists may note when clients are experiencing and mirroring each other's SNS activation, thus precluding an open, receptive state. In such instances, therapists can intervene using techniques such as immediacy, reframing, empathic conjecture, validation, empathy, appropriate self-disclosure and other therapeutic skills to re-negotiate a sense of safety for clients. The therapist's ability to stay calm in the face of client anger, fear, threat and conflict may not influence clients directly, but it may allow the therapist to be aware and intervene in such a way that clients can regain a sense of safety over time. Our recommendation for therapists to practice improve self-regulation and presence, then, would hinge on the impact this has on their ability to tune in to client experience rather than on their ability to influence client physiology directly.

Limitations and Future Research

We acknowledge a number of limitations in this research and suggest future research to address these limitations and add to our understanding of the processes involved in therapeutic presence and attunement in multifactor therapy. We recognize several factors which may have confounded our ability to fully examine the presence of a predictive effect between therapist and client physiology including (1) intern therapists' inadequate development of therapeutic presence, (2) the complex relationship of physiological attunement and influence in a multifactor setting, and (3) the examination of only one physiological measure to represent the complex ANS system. In future research, we recommend (1) including measures of therapeutic presence and alliance when examining physiological attunement; (2) examining attunement based on the process and content of therapy, thereby differentiating periods in which we may expect therapist physiology to influence client physiology and vice versa; (3) the use of measures of both PNS and SNS activation; (4) examining spousal physiological attunement in addition to client/therapist attunement. We hope that by addressing the limitations of this study in future research, we can continue to expand our understanding of attunement in couples therapy and how it may influence therapeutic outcomes. Because attunement has been found using RSA in other studies (Woody, Feurer, Sosoo, Hastings, & Gibb, 2016; Gates, Gatzke-Kopp, Sandsten, & Blandon, 2015) and physiological attunement has long been observed in dyads, it is notable that in this study of couple therapy, we did not find significant attunement. Clearly, understanding what is occurring between therapist and couple in therapy is worthy of further investigation.

The therapists who participated in this study may have lacked the clinical and personal development necessary to possess the level of therapeutic presence which would result in their ability to affect client physiology. For therapist presence to create a sense of safety that brings therapist and clients in to attunement, there must be a high degree of awareness of self and other and the ability to maintain that awareness through constant self-regulation. All therapists in this study were intern therapists, still in training. As such, it is likely they experienced more anxiety and less physiological regulation than would a more mature therapist, thus interfering with their ability to be fully present (Shamoon, Lappan, & Blow, 2017). Because a measure for therapist presence, other than physiological attunement itself, was not included in the study, we cannot ascertain to what extent therapist training and competencies in those areas were present or how they may have impacted the therapists' ability to influence client physiology. In the future, we recommend adding measures to examine and control for therapeutic presence and, because therapeutic presence has proven to be difficult to measure effectively, therapeutic alliance. One measure of therapeutic presence that may be considered is the Therapeutic Presence Inventory-client version (TPI-C) which is under development (Geller, Greenberg & Watson, 2010) and which examines client's experience of therapist presence. Although it measures a different construct, we also recommend the use of a validated measure of therapeutic alliance (e.g., CTAS, WAI, CALPAS) because this reflects the client's experience of the therapist's alignment with him/her in terms of empathy and emotional attunement (Bender, 2014; Meissner, 1996) which may have important implications for moderating physiological attunement.

As we have noted previously, because of an unfortunate dearth of multifactor attunement research, the dynamics of physiological attunement in such a setting are not well known. Thus, another potentially confounding factor in identifying physiological influence in session is the nature of the research setting itself. It may be, for example, that in multifactor settings, the strength of individuals' relationship moderates their level of attunement and that married couples would be more likely to attune to each other than to the therapist. We did not look at whether husband and wife's physiology predicted each other in our model, though research supports couple attunement (Levenson & Gottman, 1983). Although in their study of physiological attunement in couple therapy, Karvonen and colleagues (2016) found that clients attuned to therapists to a higher degree than they did to each other, in a situation in which the therapist did not exert a high degree of presence or self-regulation, couples might have attuned to each other more than to the therapist. This further indicates that including a measure of therapeutic presence and alliance would be an important part of future research.

An important aspect of the dynamics of physiological attunement is how the content and process of social interactions may influence the direction of the attunement. Both polyvagal and IPNB theories postulate a bi-directional influence between individuals, but provide only basics about when each individual might be the one to influence the other's physiology. In periods of the session in which the therapist is feeling empathy for the client, IPNB and polyvagal theories predict that the therapist would mirror client physiology rather than the other way around. Client attunement to therapist physiology would be predicted and valuable during periods of client SNS activation, when the therapist's ability to remain calm helps clients emotionally regulate.

Because we looked at RSA scores for the entire session, rather than periods of client activation, it is possible that periods wherein therapist physiology predicted client physiology were lost in the bigger picture of bi-directional influence. Thus, in future research, distinguishing and examining periods in which therapist physiology versus client physiology would be expected to influence the other, and looking for a predictive influence for those periods specifically may be of use in further understanding the dynamics of physiological attunement. To facilitate an examination of such periods of influence, it may be helpful to determine if there are thresholds of ANS activation beyond which or within which attunement is more likely to occur. As we continue to learn about the mechanisms and processes of attunement we may find that certain physiological conditions are more conducive to attunement than others.

Another potential limitation of our study was using RSA as the sole measure of ANS activity and attunement. This may have narrowed the view too far to detect therapist influence. According to polyvagal theory, it is neuroception that provides the mechanism for physiological attunement, and the evolutionary purpose of neuroception is to assess the environment for threats. Thus, SNS activity, which escalates in response to threats, may be particularly important in examining attunement. So, though RSA has been used to examine dyadic attunement (Creaven, Skowron, Hughes, Howard, & Loken, 2014; Ostlund, Measelle, Laurent, Conradt, & Ablow, 2017; Smith, Woodhouse, Clark, & Skowron, 2016), and it seems to be a good measure of presence because of its indication of vagal tone, which coincides with PNS activation and a "safe" state, it may not have represented the ANS sufficiently to observe attunement and influence in session. Historically, EDA has been used most frequently in studying attunement in therapy; including EDA and ICG in the study would have brought in information about the SNS and may have broadened our observation enough to detect therapist influence.

Conclusion

The purpose of this study was to expand our understanding of the processes involved in therapeutic presence and physiological attunement in a multifactor therapy setting. Using IPNB and polyvagal theories, we explored the mechanisms underlying therapist-client physiological attunement and conducted a study investigating how therapist PNS activity, as measured by RSA, influences client PNS activity in 22 cases of marital therapy. We found no predictive influence between therapist and client RSA, which led us to believe that (1) attunement between therapist and client physiology in a multifactor setting may involve therapist physiology being influenced by client physiology, rather than the other way around; (2) recommendations to therapists regarding improving the therapeutic relationship and outcomes hinge on the therapists' attunement to client physiology rather than the other way around; (3) there are factors at work in the processes of physiological attunement in couples therapy that bear continued investigation. The results of this study support additional research exploring the processes of therapeutic presence and attunement in couples therapy. Particularly, we recommend examining how the therapeutic alliance and therapeutic presence may moderate physiological attunement and how and when couples attune to each other and to the therapist. We further recommend that therapists develop their ability to maintain therapeutic presence in session so they can attune to client physiology and thereby work to improve therapeutic outcomes.

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Table 1. Descriptive Statistics and Pearson Correlations for Level 1 (n=22)

	RSA			Lag RSA		Respiration Rate	
	Wife	Husband	Therapist	Wife	Husband	Wife	Husband
Wife RSA	1						
Husband RSA	0.12	1					
Therapist RSA	-0.04	-0.1	1				
Wife Lag RSA	0.22	0.01	-0.02	1			
Husband Lag RSA	0.14	0.14	-0.04	0.12	1		
Wife Respiration Rate	-0.07	-0.05	0.01	-0.14	-0.04	1	
Husband Respiration Rate	-0.01	-0.13	0.06	-0.01	-0.12	0.03	1
Mean	5.69	5.21	5.27	5.69	5.21	17.03	16.99
Standard Deviation	0.90	0.92	0.51	0.90	0.92	0.84	1.70

Figure 1. Hypothesized Level 1 Path Model