Physiologic Correlates of Perceived Therapist Empathy and Social-Emotional Process During Psychotherapy

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Abstract: The present study was designed to investigate the relationship among physiologic concordance, patient-perceived therapist empathy, and social-emotional process during psychotherapy. Simultaneous measures of skin conductance (SC) were obtained from 20 unique and established patient-therapist dyads during a live therapy session followed by patient ratings of therapist empathy. Paired SC data of hypothetical dyads were used to test the reliability of the proposed measure of SC concordance. Observer microanalyses of social-emotional process were used to compare short segments of high versus low physiologic concordance. Results show a significant positive correlation ($r = 0.47$, $p = 0.03$) between SC concordance and patient ratings of perceived therapist empathy. Microanalyses suggest that during moments of high versus low SC concordance, there were significantly more positive social-emotional interactions for both patients and therapists ($p = 0.01$). The results support a biological model of perceived patient empathy and patient-therapist social-emotional process during psychotherapy.

Key Words: Psychotherapy, perceived empathy, skin conductivity, psychophysiology, neurobiology.

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There is now ample empirical evidence to support a significant relationship between patient self-report measures of perceived therapist empathy and outcome in both psychodynamically oriented and cognitive-behavioral psychotherapies from research over the last several decades. For example, a large review of psychodynamic psychotherapy found that 72% of 115 studies relating empathy to therapeutic outcome showed a positive relationship when empathy was examined from the patient's perspective (Orlinsky et al., 1994). Patient-perceived empathy is also important in cognitive-behavioral therapy (CBT). One study of CBT for depressed outpatients found that perceived empathy contributed significantly to improvements in mood (Persons and Burns, 1985). Another CBT study of 185 patients found that high levels of patient-perceived therapist empathy led to significant clinical improvement, even when controlling for other factors (Burns and Nolen-Hoeksema, 1992). Finally, a recent meta-analysis confirms the modest but consistent importance of empathy during psychotherapy and concludes that the relationship between perceived therapist empathy and outcome during psychotherapy is well-established (Bohart et al., 2002).

Given the evidence for a significant role for perceived therapist empathy by patients during psychosocial treatments, investigations into the psychobiologic correlates that mediate empathy during psychotherapy are warranted. Facilitating this goal, recent neuroimaging studies have begun to elucidate correlates between neurobiology and empathy (Carr et al., 2003; Farrow et al., 2001; Singer et al., 2004). Moreover, several recent reviews demonstrate progress in our understanding of the neurobiology of psychosocial treatments using neuroimaging before and after psychotherapy (Etkin et al., 2005; Linden, 2006; Roffman et al., 2005). However, biologically based research during actual psychotherapy remains challenging. Multiple variables must be considered, including the complex interplay of individual as well as interpersonal emotions and cognitions in both patients and therapists in a clinical setting. The current study was designed to advance prior research and use psychophysiology as a bridge between central nervous system responses and clinically relevant factors such as patient-perceived empathy and social-emotional process during psychotherapy (Marci and Riess, 2005).

Psychophysiologic measures of the autonomic nervous system are well established correlates of emotional responses (Lang et al., 1998) with recent neuroimaging advancing our understanding of fluctuations in psychophysiology and central nervous system activity (Critchley et al., 2000; Patterson et al., 2002). Although early psychophysiology investigations of the therapeutic relationship did not directly measure perceived therapist empathy, they provided evidence that patients and therapists were "highly reactive" to each other during psychotherapy (Lacey, 1959). One early study of three patient-therapist dyads over multiple sessions of psychotherapy found that patient and therapist heart rate often varied together in "concordance," whereas at other moments, it varied oppositely in "discordance" (Di Mascio et al., 1955). This early research provided indirect evidence for a physio-

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logic component to "empathic relatedness" during psychotherapy (Kaplan and Bloom, 1960). Later studies using psychophysiology during psychotherapy found similar links between physiology and aspects of patient-therapist emotional process using different measures and different research designs (Busk et al., 1976; Stanek et al., 1973). In the only study to date directly assessing perceived empathy and simultaneous psychophysiology, an association between SC fluctuations and perceived therapist empathy was found in nonclinical student-counselor dyads (Robinson et al., 1982). The authors studied a single interview between 21 volunteer undergraduate university students and licensed therapists. They found that the frequency of hand-measured, large concurrent individual SC peaks between clients and counselors was positively correlated with student ratings of counselor empathy. They concluded that they had found the first direct evidence for an overall session measure of physiologic concordance that could be linked to reports of perceived empathy as had been suggested in the earlier studies.

Other indirect support for a physiologic basis of empathy comes from nonpsychotherapy studies of social interaction using psychophysiology. In a study in which female observers watched videotaped scenes of 5-month-old infants expressing a range of emotions, high-empathy versus low-empathy females had larger SC responses and were more likely to match facial expressions of the infants (Wiesenfeld et al., 1984). Another study demonstrated a physiologic basis for empathic accuracy, finding that a subject's rating of negative emotion while watching a videotape of a distressed married couple was highest when the subject and the target had high levels of physiologic linkage (Levenson and Ruef, 1992). Finally, in a recent study using simultaneous SC measures in patients in a nonclinical interview, there was a significant relationship between emotional distance, low levels of perceived empathy, and low SC concordance (Marci and Orr, 2006). Despite several limitations including differences in measures and a wide diversity of study designs, there appears to be converging evidence supporting the use of psychophysiology as a measure of empathy during social interaction (Eisenberg et al., 1987). Thus, there is a need for a methodologically sound index for assessing simultaneous measures of physiology that could be used in a wide variety of psychosocial treatments to enhance our biological understanding of this important element of psychosocial interventions.

In reviewing these studies, SC was consistently the most sensitive physiologic measure of emotional and empathic responsiveness. SC measures during social interaction are very sensitive indicators of arousal and are the result of direct mediation by the sympathetic branch of the autonomic nervous system (Lidberg and Wallin, 1981). As such, SC is not directly influenced by the parasympathetic nervous system or other neurohormonal influences that can confound interpretation of measures of other physiologic variables (e.g., heart rate) (Cacioppo and Tassinary, 2000). In addition, the recent neuroimaging studies on empathy noted above (Carr et al., 2003; Farrow et al,. 2001; Singer et al., 2004) combined with advances in our understanding of the central nervous system control of SC and sympathetic arousal (Critchley et al., 2003; Fredrickson et al., 1998; Patterson et al., 2002) suggest overlapping structures in the prefrontal cortex regulating empathic awareness and SC responsiveness. This neuroimaging research offers an exciting new context in which to interpret results from social psychophysiology studies.

The present study was designed to investigate the relationship between concordant physiologic arousal, perceived therapist empathy, and brief moments of social-emotional process between patient-therapist dyads during a live clinical psychotherapy session. Modeled in part after the only study that directly measured perceived empathy and psychophysiology in nonclinical dyads (Robinson et al., 1982), SC was used in the present study as a continuous physiologic measure simultaneously obtained from patient-therapist dyads. An observer-based microanalysis of physiologically defined short segments of high versus low SC concordance is added to begin to identify positive, neutral, or negative social-emotional correlates of this physiologic phenomenon. While the review strongly suggests a link between psychophysiology and perceived empathy, this is the first study to our knowledge to investigate directly patient perception of therapist empathy and simultaneous measures of physiology in a clinical population during a live clinical encounter.

METHODS

Participants

Participants included 20 unique patient-therapist dyads engaged in established psychodynamic psychotherapy recruited from the outpatient clinic of the Massachusetts General Hospital Department of Psychiatry from September 2003 to June 2005. Psychodynamic psychotherapy was chosen as a convenience sample and due to its historic emphasis on the importance of interpersonal variables for building rapport with patients (Kohut, 1971; Rogers, 1975). Participants were assessed by therapists and excluded if they showed evidence of active psychosis, homicidal or suicidal ideation, active substance abuse, or significant character pathology as reported by their therapist so as not to interfere with the ability of patients to perceive the therapeutic relationship accurately. In addition, participants were also excluded if they were taking medications other than a selective serotonin reuptake inhibitor (SSRI), to avoid interference with the SC recordings.

The study included 11 male and nine female patients with four female and eight male therapists. Therapists consisted of senior psychiatry residents and senior psychology trainees as well as senior staff psychiatrists and psychologists who identified themselves as practicing psychodynamic psychotherapy. Patient participants were adults between ages 21 and 55 with an average age of 36.3 years ($SD = 8.6$). Fifteen of the patient participants had a primary clinical diagnosis of a mood disorder, and five had a primary diagnosis of anxiety disorder. All patient participants were clinically stable, and none had been hospitalized in the past 24 months. In an effort to recruit patient-therapist dyads with a well established therapeutic relationship, patient participants had to have been seeing their present therapist for more than 10 sessions. The patient participants at the time of the study averaged 72.4 ($SD = 30.4$) sessions of experience with their therapist, suggesting a well established patient population of varying length of therapy. Seventeen of the 20 patient participants were taking psychotropic medication, all of which consisted of a single SSRI. The study procedures were approved by the Massachusetts General Hospital Human Research Committee, and in each case, informed consent was obtained from both patients and therapists following a full description of the study prior to data collection.

Procedures

Physiologic Measurements

Simultaneous SC measurements from both patient and therapist were recorded throughout a single full-length psychotherapy session of approximately 45 minutes for each of the 20 patient-therapist dyads. The therapy session followed a brief standardized interaction between the patient and one of the authors (C. D. M.) to test the initial reliability of the proposed measure of SC concordance (Marci and Orr, 2006). Continuous SC level was collected using Ag-AgCl electrodes secured to the distal palmar surface of the third and fourth digits of each participant's nondominant hand. Data collection and signal processing used an ADInstruments Powerlab 8SP modular instrument system (ADInstruments, Sydney, Australia) connected to a notebook computer running Chart Software Version 4.2 (ADInstruments, Sydney, Australia).

Physiologic Concordance

Following data collection, continuous SC levels from the therapy sessions were used to derive a measure of SC concordance (Marci and Orr, 2006). First, a smoothing function using a 1.5-second Bartlett window was applied to the continuously recorded SC level values (Oppenheim and Schafer, 1999). Next, the average slope of the SC level within a moving 5-second window was determined (i.e., after calculating the first 5-second slope value, the window moves forward 1 second and calculates the next 5-second slope value, producing successive 5-second SC slope values at 1-second increments). Slope was chosen as the index of SC activity because the rate of change in SC level (as an indicator of physiologic arousal) was of primary interest and was expected to be a better determinant of psychophysiologic concordance between interacting individuals than individual discrete peaks or absolute SC level. Individual peaks and absolute SC level tend to show idiosyncratic drift over time, and amplitude and frequency can vary considerably from person to person (Hugdahl, 1995).

Pearson correlations with lag-zero were then calculated over successive, running 15-second windows (corresponding to 15 slope averages) between time-locked patient and therapist SC slope values. Next, a single session index was calculated from the ratio of the sum of the positive correlations across the entire therapy session divided by the sum of the absolute value of negative correlations across the session. Because of the skew inherent in ratios, a natural logarithmic transformation of the resulting index was calculated. Thus, an index value of zero reflects equal positive and negative correlations or neutral concordance for the therapy session. Concomitantly, a value greater than zero reflects relatively more positive SC concordance over time, while a value less than zero reflects relatively more negative SC concordance over time. Statistical analyses were conducted using SPSS for Windows (Version 12.0; SPSS Inc., Chicago) with the exception of SC slope calculations, used to derive SC concordance, which were obtained from the Chart Software (Version 4.2; ADInstruments, Sydney, Australia).

Perceived Empathy

The primary empathy measure was the perceived empathic understanding of the therapist during the monitored psychotherapy session, as rated by the patient. Patients were explicitly told to focus on their experience of the therapist during the monitored session (as compared with prior sessions). In addition, patients were reassured that their therapists would not see the results of their questionnaires. Immediately following the therapy session, patient participants completed the Barrett-Lennard Relationship Inventory Empathic Understanding Sub-Scale (EUS; Barrett-Lennard, 1962).

The EUS is a 16-item questionnaire designed to assess patient perceptions of therapist ability to understand them empathically during psychotherapy. It has been used successfully in prior studies of psychophysiology with counselors and healthy college students (Robinson et al., 1982) and patients in a nonclinical interview setting (Marci and Orr, 2006). Each question requires a rating from a scale ranging from +3, "strongly agree," to –3, "strongly disagree." The EUS offers only nonzero options. Total item scores once calculated can range from −48 to +48, with higher scores indicating greater perceived empathic understanding (Barrett-Lennard, 1962). Therapist ratings on the EUS were not obtained due to a significant literature suggesting therapists consistently overrate their empathic abilities (Kurtz and Grummon, 1972).

Social-Emotional Ratings

Digital audio-video recordings were made of all sessions using a video camera that recorded with a wide-angle setting to capture both patient and therapist (Sony Digital 8 DCR-TRV510; Sony Corp. of America, New York). Audio-video clips representing the highest and lowest 1-minute period within a 3-minute window of physiologic concordance from each psychotherapy session were identified and edited using the results of the physiologic concordance algorithm. This was accomplished using a running 3-minute window through the SC concordance of each therapy session. Thus, the highest and lowest nonoverlapping 3-minute segments were chosen from each session. This resulted in 20 pairings of high-low SC concordance segments, for a total of forty 3-minute audio-video clips. The 3-minute duration was chosen to provide some context for analyzing the 1-minute segment of interest. The 1-minute duration for the analysis was based on literature supporting the use of thin-slices of social interaction for observer ratings (Ambady and Rosenthal, 1992).

Observer ratings of the edited clips involved a modified version of the Bales Interaction Coding System (BICS). The BICS was developed for the analysis of face-to-face social interaction and has been extensively validated in one-on-one psychotherapy and in small groups (Bales, 1951). It was designed to be value-neutral and does not adhere to any particular theoretical framework. The BICS has been used in prior research in psychophysiology and psychotherapy (Busk et al., 1976; Coleman et al., 1956; Di Mascio et al., 1955, 1957). The BICS has a total of 12 items organized into three main categories: social-emotional positive, social-emotional neutral, and social-emotional negative. The items and an abbreviated description are presented in Table 1.

Two independent observers with bachelor's-level education blinded to the goals of the study and without knowledge of the selection criteria for the 3-minute clips were trained to reliability using randomly selected 3-minute test segments from archived videotaped psychotherapy (Bales, 1951). Thus, each observer rated multiple 3-minute test segments until reliability >0.75 was achieved. Observers were trained to score each second of the interaction for the entire 3-minute segment with a binary code (1 = present, 0 = absent) for one of the 12 BICS items for both the patient and the therapist. Observers were encouraged to watch the clip several times, in slow motion if necessary, and to rate the patient and therapist separately. The 1-second duration for coding was chosen due to the short duration of the segments and to time-lock the analyses to the physiology. Once trained, each observer was independently presented the 40 clips in random order on digital compact discs representing the 20 highest and 20 lowest SC concordance segments, with one high and one low segment selected from each patient-therapist dyad. Quality control was maintained by testing reliability after both raters scored half of all segments. Note that the 1-minute segment of interest was within each 3-minute clip and identified after all ratings were completed. The means of the two observer ratings for each BICS category for the 1-minute segment of interest were calculated for use in the statistical analyses.

TABLE 1. Positive, Neutral, and Negative Social-Emotional Items With Brief Description

Items	Description
Positive	
1. Shows solidarity	Raises other person's status, gives help or reward
2. Shows positive regard	Shows obvious pleasure or satisfaction
3. Shows nonverbal acceptance	Listens intently, concurs, shows understanding
Neutral	
4. Gives suggestion	Gives suggestions implying autonomy for the other
5. Gives opinion	Gives analysis, evaluation, or expression of opinion
6. Gives orientation	Gives clarification, confirmation, or information
7. Asks for orientation	Asks for clarification, confirmation, or information
8. Asks for opinion	Asks for analysis, evaluation, or expression of opinion
9. Asks for suggestion	Asks for direction or possible ways of acting
Negative	
10. Shows disagreement	Subject shows rejection, emotional distance, or withholds help
11. Shows tension	Shows tension, obvious withdrawal, shows anxiety
12. Shows antagonism	Deflates other person's status, is defensive, or aggressive

The short (1-minute) segment of analysis resulted in low frequency of some items (item 1 shows solidarity and item 2 shows positive regard) in this relatively small sample study (N = 20). Statistical analyses of the BICS items were conducted on groups of items. Grouping BICS items has precedent, and the rationale for excluding item 3 is that it is the only item defined exclusively by nonverbal cues operationalized as active listening (Bales, 1951). In the present context over short periods of time, active listening (i.e., not speaking) occurs at a much higher rate for both patients and therapists than the other more verbally defined (i.e., speaking) items in the positive category. Thus, the analyses were conducted on the three main categories (i.e., positive, neutral, negative) with the positive category excluding item 3 (shows nonverbal acceptance). Moreover, focusing the analyses on the main BICS categories reduces the number of comparisons made and lowers the risk of type 1 error. Thus, four BICS categories were used in the analyses. Given the number of comparisons in each group in this small sample, a Bonferroni correction was applied for significance levels.

RESULTS

Reliability of Physiologic Concordance Measure

To test the reliability of the physiologic concordance algorithm, randomly matched SC data from unpaired patients and therapists from the first 10 psychotherapy sessions were analyzed. Thus, random digital SC signals were paired and analyzed to determine whether hypothetical, randomly linked dyads would produce SC concordance that approached zero or neutral concordance. Zero or neutral concordance is predicted for randomly juxtaposed SC data collected from different psychotherapy sessions, in nonoverlapping time and place, from patients and therapists who have never met. That

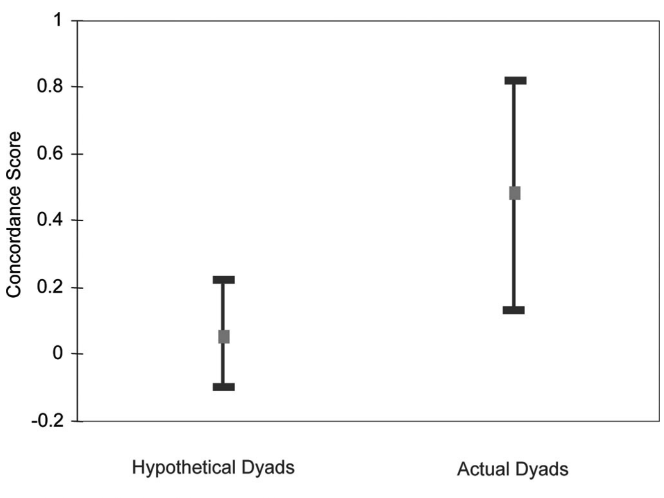

FIGURE 1. Means and standard deviations of physiologic concordance scores for hypothetical (N = 90) versus actual patient-therapist dyads (N = 10).

is, on average, we would expect zero or a balance of high and low physiologic concordance for hypothetical dyads.

The analysis included calculating the SC concordance (as described above) for all possible combinations of patients and therapists from the first 10 patient-therapist dyads recorded for the study as part of an interim analysis. Because this procedure excluded the real patient-therapist dyads (i.e., it used only those combinations of participants who were not in a therapeutic relationship together), 90 hypothetical dyads were included in the analysis ($10 \times 10 = 100$ possible combinations minus 10 actual dyads).

Figure 1 shows a comparison of the concordance scores for the hypothetical ($N = 90$) and actual ($N = 10$) patient-therapist dyads. The mean SC concordance score for the 90 hypothetical dyads of 0.06 ($SD = 0.16$) was significantly lower than the mean SC concordance score for the 10 actual patient-therapist dyads of 0.49 ($SD = 0.33$; t [98] = 4.9, $p = 0.001$). Note that the mean SC concordance score for the hypothetical dyads was close to the expected value of zero or neutral concordance, reflecting a nearly equal amount and duration of positive and negative SC concordance in the hypothetical population.

Clinical Examples of Low and High Physiologic Concordance

Figures 2 and 3 show clinical examples of low and high 3-minute segments of SC concordance from two different patient-therapist therapy sessions, respectively. The raw patient and therapist SC levels are displayed for the low physiologic concordance example in Figure 2A and for the high physiologic concordance example in Figure 3A. In each figure, the patient data are adjusted to fit the graph to appear above the therapist data. Below Figures 2A and 3A, there is a corresponding graph of the moment-to-moment SC concordance for the low (Figure 2B) and high (Figure 3B) segments. The SC concordance score for the low 3-minute segment was –1.31 (Figure 2B). In contrast, the SC concordance score for the high 3-minute segment was 2.53 (Figure 3B). Note that the dynamic nature of the fluctuations in moment-to-moment

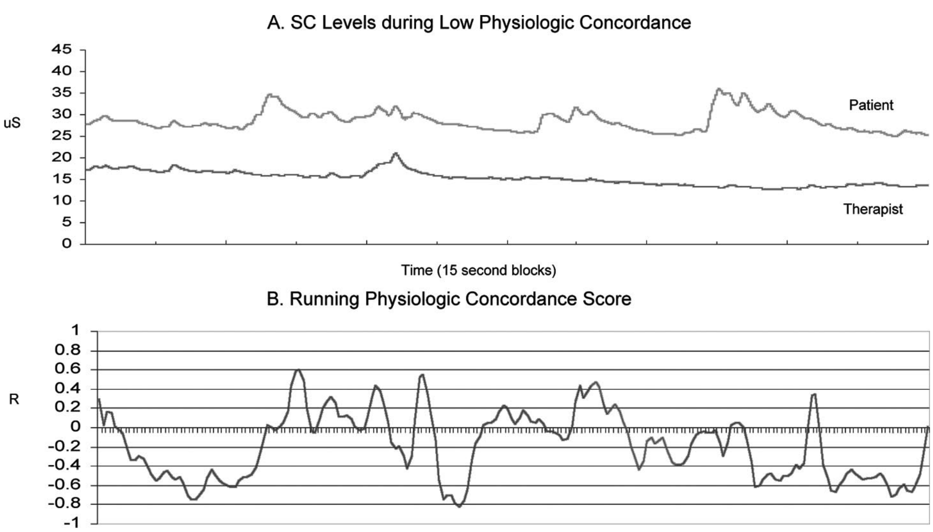

FIGURE 2. Raw skin conductivity (SC) data for a patient (top line) and therapist (bottom line) during three-minute segment of low physiologic concordance (A) with correspondence running moment-to-moment concordance score (B).

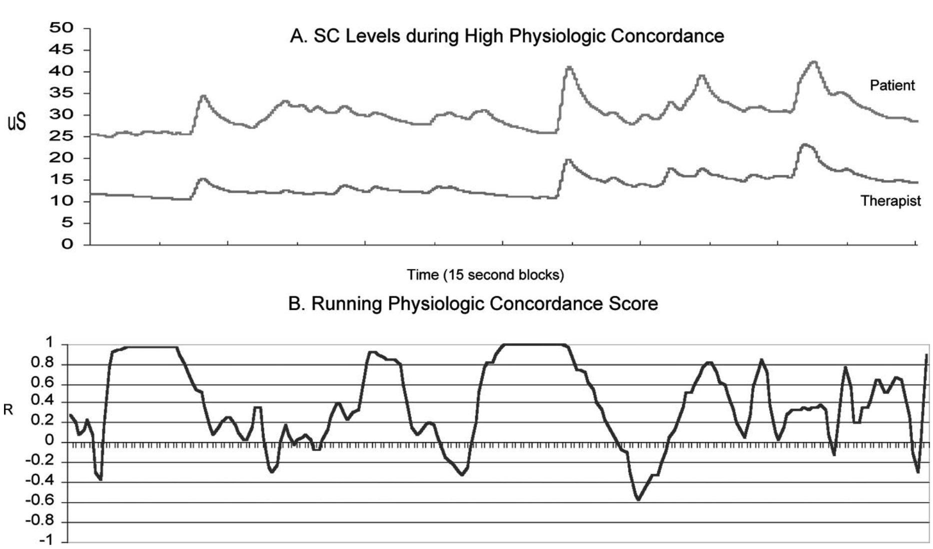

FIGURE 3. High physiologic concordance (A) with corresponding running moment-to-moment concordance score.

TABLE 2. Social-Emotional Ratings in 1-Minute High Versus Low Physiologic Concordance Segments[a]

Item	High mean (*SD*)	Low mean (*SD*)	*t* Statistic	*p* Value	Effect size (*d*)
Patients					
Positive items 1–2	1.4 (1.5)	0.4 (0.6)	2.79	0.010**	0.63**
Positive item 3	9.7 (10.1)	11.5 (14.2)	–0.54	0.59	0.12
Neutral items 4–9	43.3 (15.2)	41.9 (15.4)	0.36	0.74	0.16
Negative items 10–12	6.0 (7.9)	7.1 (6.7)	0.15	0.77	0.07
Therapists					
Positive items 1–2	1.5 (1.6)	0.2 (0.7)	4.10	0.001**	0.92**
Positive item 3	46.7 (2.4)	46.9 (3.1)	0.08	0.95	0.02
Neutral items 4–9	10.9 (9.8)	12.1 (13.6)	−0.33	0.75	0.07
Negative items 10–12	1.7 (2.3)	1.5 (1.9)	0.15	0.24	0.09

**$p < 0.05$, with Bonferroni correction.
[a]Mean ratings represent the number of seconds coded for that segment.

SC concordance was a factor in the choice of 1-minute segments for the microanalyses of social-emotional process.

Physiologic Concordance and Perceived Empathy

The patient rating of therapist empathy in this study demonstrated high internal consistency (Cronbach α) for the EUS ($\alpha = 0.84$) and was consistent with prior studies (Barrett-Lennard, 1962). The degree of patient perceived therapist empathy was also high, with a mean of 25.1 ($SD = 7.5$). There was a significant positive correlation between the primary outcome measure of patient ratings of therapist empathy (EUS) and their SC concordance score with their therapist ($r = 0.47$, $p = 0.03$). Given the high degree of variance in the number of sessions of therapy for each dyad, a regression analysis was performed with number of sessions of therapy, therapist age, and SC concordance as the independent variables and patient rating of therapist empathy as the dependent variable. The model resulted in 26% of the variance in the empathy scores explained by the independent variables, with SC concordance the only statistically significant predictor variable ($\beta = 17.5$, $p = 0.03$) and no significant regression relationship between the other predictor variables and empathy ($F\,[3, 19] = 1.86$, $p = 0.18$).

Physiologic Concordance and Social-Emotional Ratings

Reliability was calculated using an intraclass correlation coefficient two-way mixed effects model. The two observers overall showed high interrater agreement for the ratings (0.82) with individual category reliability greater than 0.75 maintained for each of the individual BICS categories. Table 2 summarizes the results of the 1-minute comparisons between high and low SC concordance segments for patients and therapists. The results show that both patients and therapists had significantly more positive social-emotional responses (excluding item 3) during high versus low moments of physiologic concordance. Thus, patients showed over three times more solidarity (item 1) plus positive regard (item 2) in the high segment with a mean of 1.4 ($\pm$1.5) seconds versus the low segment with a mean of 0.4 ($\pm$0.6) seconds ($t\,[19] = 2.79$, $p = 0.010$, $d = 0.63$). Similarly, therapists showed significantly more solidarity plus positive regard in the high (1.5 $\pm$ 1.6) versus low (0.2 $\pm$ 0.7) segments ($t\,[19] = 4.10$, $p = 0.001$, $d = 0.92$). No other BICS categories showed significant results.

DISCUSSION

This study examined the use of simultaneous SC recordings from patients and therapists followed by a measure of patient-perceived therapist empathy during a live clinical encounter. The reliability of a proposed measure of SC concordance was verified by a comparison between a subset of the patient-therapist dyads with digitally created hypothetical dyads derived from SC data of patients and therapists who neither met nor interacted with each other. In addition, the overall index of SC concordance during the psychotherapy sessions significantly and positively correlated with patient perceptions of therapist empathy. Finally, observer ratings of 1-minute audio-video segments suggest that patients and therapists show significantly more positive social-emotional responses of increased solidarity and positive regard during high versus low SC concordance. Taken together, the results of the present study suggest a biologically based model of perceived patient empathy and patient-therapist positive social-emotional process during psychotherapy.

The present study has several strengths. To our knowledge, this is the first study of social psychophysiology conducted in a clinical population during a live psychotherapy session to test patient-perceived empathy. While the proposed measure of SC concordance used in this study is novel, the comparison of hypothetical versus actual patient-therapist dyads suggests that it is reliable. The reliability of this novel approach is further supported by recently published data using the same measure of SC concordance in an antecedent to the present study (Marci and Orr, 2006). The finding of a significant correlation between physiologic concordance and patient-perceived therapist empathy supports previous work on which this study was modeled (Robinson et al., 1982). Whereas the latter study used a nonclinical interaction with healthy college students and relied on a manual analogue method for measuring simultaneous SC fluctuations, the present study extends this earlier work by using a live clinical encounter and offering a modern alternative for quantifying SC concordance. The present SC concordance measure moves beyond counting peaks and evaluating mean levels and offers an alternative to the only other published continuous time-series approach to physiologic measures during social interaction (Levenson and Gottman, 1983). Finally, in addition to the relationship with perceived empathy, the present study is the first to examine observer coding of short segments classified on a purely physiologic basis—that is, high versus low SC concordance. These microanalyses offer preliminary insight into the moment-to-moment psychobiology and social-emotional process between patients and therapists during psychotherapy.

Although observer coding of emotion is extremely tedious and requires extensive training to achieve reliability, it permits detailed examination of patient-therapist process during brief segments of psychotherapy uniquely defined by biological parameters. While preliminary in nature, the results of the BICS microanalyses of the 1-minute audio-video segments intriguingly show significantly higher positive social-emotional responses in the high versus low concordance moments. While interpretations of these results must be made with caution, it is interesting to note that the finding of increased positive social-emotional response was significant for both patients and therapists. The positive social-emotional response items (i.e., shows solidarity and shows positive regard) are consistent with models of social rapport that emphasize the role of mutual attentiveness, mutual responsiveness, and positivity during social interaction (Tickle-Degnen and Rosenthal, 1990). Thus, while only accounting for 26% of the overall variance in patient perceived empathy, detailed investigation of the 1-minute segments suggests that SC concordance may play a role in the perception of other positive social constructs such as the therapeutic alliance that are also important for outcomes in psychosocial treatments (Crits-Christoph and Connolly, 2003; Martin et al., 2000).

The results of the present study build on prior research and complement recent neuroimaging studies referred to in the introduction to offer potential insights into a clinically relevant biologically based model of empathy between therapists and patients. This model is predicated on the overlap between neurobiological control of SC fluctuations and structures implicated in neuroimaging studies of empathy. In regard to the neurobiology of SC responses, several studies implicate the prefrontal cortex and anterior cingulate in the control of SC responses (Critchley et al., 2003; Fredrickson et al., 1998; Patterson et al., 2002). Moreover, neuroimaging studies of emotional responses (Cacioppo and Gardner, 1999; Murphy et al., 2003; Phan et al., 2002) and social interaction consistently implicate similar regions (Berthoz et al., 2002; Eisenberger et al., 2003; Iacoboni et al., 2004; Ruby and Decety, 2004). These data, when combined with the neuroimaging studies, support a specific definition of empathy. For example, a recent study demonstrated that females watching their significant other receive a shock activated the affective component of a well defined "pain matrix" in the observer even when the observer was not receiving a shock (Singer et al., 2004). The authors also reported a direct correlation between activity in the observers' anterior cingulate cortex and self-reported level of empathic sensitivity. Other studies used responses to pictures of emotional faces to demonstrate similar but attenuated activation in a brain network (including the inferior frontal, insular, and premotor cortices) while participants were merely observing compared with imitating the emotion in the picture (Carr et al., 2003).

These results suggest a distinct neural network for empathy and emotional responsiveness informed by recent increases in our understanding of "mirror" mechanisms in humans that are implicated in the ability to take another's emotional perspective (Iacoboni et al., 2005; Kohler, 2002; Miller, 2005). These mechanisms reflect the ability of neurons to react in a similar manner when an individual observes versus performs an action. Thus, there is accumulating evidence for a definition of empathy and sympathy that involves a "shared representational network," which creates common representations of mental states of "self" and "other" (Decety and Sommerville, 2003). This ability involves the prefrontal cortex, which plays an integral role in coordinating and contrasting these cognitive representations. Thus, in the present study, it is perhaps not surprising that a measure of SC concordance between well established patient-therapist dyads during psychotherapy resulted in associations with patient perceptions of therapist empathic relatedness and shared positive social-emotional states. If similar brain networks are in some way involved in empathic and autonomic responses, then vicarious and empathic experiences may be regulated via a shared or concordant neuropsychobiology of representational networks.

The proposed measure of SC concordance also has several limitations. While modern computing has greatly simplified the ability to interrogate time-series models of continuous physiologic signals, it is important to note the significant challenges of modeling SC, which is inherently nonstationary, aperiodic, and stochastic in nature. Physiologic systems are constantly changing, with an indeterminate number of influences present in an intrapersonal context focused on internal regulation and homeostasis (Porges and Bohrer, 1990). As such, no current model can perfectly capture a physiologic process as complex as SC from an individual over arbitrarily constrained epochs of time (e.g., minutes, hours, days). Consequently, any SC concordance algorithm is at best an approximation of the intrapersonal and interpersonal dynamics under investigation. Thus, while the current methodology demonstrates flexibility and sensitivity in the present context, limitations include oversampling as a result of the overlapping window as well as potentially spurious correlations as a result of not controlling for autocorrelation (Levenson and Gottman, 1983).

The present study has other limitations, and the findings need to be placed into an appropriate research context. Despite the relatively large sample size for a study of this type and complexity, this is a small sample with a novel scoring methodology and limited outcome measures in a single psychotherapy session. The study is not randomized and is conducted in nongender-balanced therapeutic dyads with patients diagnosed with a mixture of mood and anxiety disorders. It is also important to note that while the study included patients on SSRIs, the use of the first derivative rather than absolute values with the present algorithm limits any possible influence of SSRI use on SC concordance (Siepmann et al., 2003; Thorell et al., 1987). Finally, the microanalysis finding of increased positive social-emotional interactions during the high concordance moments, while interesting, needs to be interpreted with caution given the relatively low frequency of the events in this category.

The study of the psychobiology of empathy during psychotherapy offers a unique opportunity to inform clinical practice, improve training of clinicians, and illuminate change processes unique to the human dyadic relationship. The current results support the concept of SC concordance and, in combination with recent neuroimaging studies, offer clinical evidence for an interpersonal neurobiology with shared representational states and an underlying physiology during empathic moments in psychotherapy (Siegel, 2000). Future research should include additional types of therapy (e.g., cognitive-behavioral therapy) and additional physiologic measures (e.g., heart rate, respiratory rate) as well as prospective study designs with gender controls utilizing other important psychotherapy constructs beyond empathy such as the therapeutic alliance to determine whether SC concordance varies similarly in other therapy modalities, how SC concordance may change over time, and what, if any, is the relationship between SC concordance and outcomes in psychotherapy.

Given increasing emphasis on manual-based therapy and medication management (Ablon and Marci, 2004), a biologically based clinical model of empathy with a coherent two-person psychology may help maintain an appropriate emphasis on the importance of more humanistic and relationship variables at work in clinical practice. Given that the lack of perceived empathy has been shown to be the best predictor of poor outcomes in psychotherapy (Mohr, 1995), therapists and their patients stand to benefit from future research that expands our understanding and improves our capacity for this important clinical psychosocial construct.

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