

BRIEF REPORT

Physiological Synchrony and Therapeutic Alliance in an
Imagery-Based TreatmentEran Bar-Kalifa
Ben-Gurion University of the NegevJessica N. Prinz
University of TrierDana Atzil-Slonim
Bar-Ilan UniversityJulian A. Rubel
Justus-Liebig-University GiessenWolfgang Lutz
University of TrierEshkol Rafaeli
Bar-Ilan University

Client–therapist synchrony in various channels (e.g., self-reported affect or physical movement) has been shown as a key process in the construction and development of therapeutic alliance. However, *psycho-physiological* synchrony between clients and therapists has been understudied, with the few extant studies typically relying on single-session data, and no studies examining it within the context of emotion-focused techniques. The main aim of the current paper is to examine the role of client–therapist physiological synchrony during segments of one emotion-focused technique—namely, imagery (IM) work—in predicting therapeutic alliance, and to compare it to the role of synchrony during segments of more traditional cognitive–behavioral (CB) techniques. We conducted an open-trial study in which 31 clients with test anxiety received a 6-session protocol-based treatment. Both clients’ and therapists’ electrodermal activity (EDA) were continuously assessed during sessions. The physiological measures for 5 sessions each ($N = 128$) were used to compute client–therapist synchrony in IM and CB segments. Therapeutic alliance was assessed using the Session Alliance Inventory. Client–therapist dyads’ synchrony during IM and CB segments was, on average, greater than chance. Synchrony varied mostly at the session (vs. the dyad) level. Multilevel analyses revealed that the synchrony within IM segments (but not within CB segments) was significantly associated with the therapeutic bond aspect (but not the task/goal aspects) of alliance. Physiological synchrony during emotion-focused IM is tied to the bond component of the therapeutic alliance at the session level.

Public Significance Statement

Our findings indicate that clients and their therapists synchronize their physiology during therapy. Furthermore, such synchrony during experiential work may contribute to the therapeutic bond.

Keywords: physiological synchrony, therapeutic alliance, imagery

This article was published Online First May 30, 2019.

Eran Bar-Kalifa, Department of Psychology, Ben-Gurion University of the Negev; Jessica N. Prinz, Department of Clinical Psychology and Psychotherapy, University of Trier; Dana Atzil-Slonim, Department of Psychology, Bar-Ilan University; Julian A. Rubel, Department of Psychology, Justus-Liebig-University Giessen; Wolfgang Lutz, Department of Clinical Psychology and Psychotherapy, University of Trier; Eshkol Rafaeli, Department of Psychology, Bar-Ilan University.

Eran Bar-Kalifa and Jessica N. Prinz contributed equally to this article. Some of the ideas and results presented in the current study were presented at the Society for Psychotherapy Research Conference in Toronto in June 2017. The protocol and the outcome results of this clinical trial were published in Prinz, Lutz, Bar-Kalifa, and Rafaeli (2016) and Prinz, Bar-Kalifa, Rafaeli, Sened, and Lutz (2019); for the full protocol, see www.osf.io/hraqd.

Correspondence concerning this article should be addressed to Eran Bar-Kalifa, Department of Psychology, Ben-Gurion University of the Negev, P.O. Box 653, Beer-Sheva 8410501, Israel. E-mail: erankb@bgu.ac.il

People tend to spontaneously synchronize their perceptual, affective, physiological and behavioral responses with each other (e.g., Koole & Tschacher, 2016; Liu, Zhou, Palumbo, & Wang, 2016; Ramseyer, 2011; Repp & Su, 2013; Semin & Cacioppo, 2008; Tschacher & Pfammatter, 2016). Such synchrony occurs more in the context of positive relationships, and tends to facilitate positive exchanges, cooperation, and helping behaviors (Bernieri, Reznick, & Rosenthal, 1988; Tschacher, Rees, & Ramseyer, 2014).

In their Interpersonal Synchrony (In-Sync) model of psychotherapy, Koole and Tschacher (2016) argue that therapeutic alliance—that is, the indication that a therapeutic relationship is positive, cooperative, and helpful—may itself be grounded in such synchrony. Specifically, the model suggests that synchrony between a client and a therapist allows the dyad to construct mutual understanding and to share emotional experiences, which ultimately facilitate therapeutic change (e.g., by improving clients' emotion-regulatory capacities). Indeed, client–therapist synchrony in various channels, including conscious experience (e.g., Atzil-Slonim et al., 2018; Kivlighan, Kline, Gelso, & Hill, 2017; Rubel, Bar-Kalifa, Atzil-Slonim, Schmidt, & Lutz, 2018), somatic-motor activity (e.g., Paulick et al., 2018, 2018; Ramseyer & Tschacher, 2011), vocal qualities (e.g., Imel et al., 2014), and physiology level (e.g., Marci, Ham, Moran, & Orr, 2007; for review, see Kleinbub, 2017) were found to be associated with salubrious therapeutic outcomes (e.g., perceived empathy and lower drop-out).

The main aim of the current paper is to examine the association between client–therapist physiological synchrony and clients' reported therapeutic alliance. Specifically, we tested the idea that synchrony in the therapeutic dyad members' electrodermal activity (EDA) will be associated with working alliance. We chose to focus on EDA as it indexes the sympathetic system, which is robustly associated with emotional arousal (Braithwaite, Watson, Jones, & Rowe, 2015).

Despite the growing number of studies that have begun to examine client–therapist synchrony in EDA, its dynamics and clinical meaning are still unclear (Kleinbub, 2017). In one of the earliest studies on the topic (Robinson, Herman, & Kaplan, 1982), 21 new client–therapist dyads were observed in one counseling interview. Clients from dyads who showed higher concordance in their electrodermal responses during the session reported that their therapists were more empathically understanding toward them. Similarly, Marci et al. (2007) analyzed single therapy sessions from 20 established client–therapist dyads; clients in dyads showing higher concordance in their electrodermal conductance levels during the session reported that their therapists were more empathically understanding. Moreover, in moments of high concordance, both clients and therapists demonstrated more positive behaviors (e.g., showing positive regard).

One limitation of these two early studies on EDA synchrony and of many of the psychophysiological synchrony ones that have followed (for review, see Kleinbub, 2017) is their reliance on a single psychotherapy session (in fact, this has been a characteristic of most studies on client–therapist synchrony in other channels [e.g., movement or self-reported affect] as well). Importantly, with data from only one session, one cannot disentangle dyad-level (i.e., between-dyad) variance from session-level (i.e., within-dyad) variance. Specifically, if synchrony varies mostly at the dyad level, we should think of it as a characteristic of client–therapist dyads, and

thus should expect it to be associated with other dyad-level characteristics (e.g., dyads who tend to show synchrony across sessions may tend to have a strong therapeutic bond across sessions). Alternatively, if synchrony varies mostly at the session level, we should think of it as a characteristic of sessions, and thus should expect it to be associated with other session-level characteristics (e.g., sessions in which dyads are synchronous should be marked by a stronger bond).

Of course, these two alternatives are not necessarily mutually exclusive, as processes at both the dyad and the session levels can be at play. For example, the therapeutic alliance, which in theory is intimately tied to synchrony (Koole & Tschacher, 2016), often demonstrates both between-client and within-client effects on outcome (Falkenström, Granström, & Holmqvist, 2013), although their magnitude often differs (Accurso et al., 2015; Zilcha-Mano et al., 2016). Thus, we sought to examine, for the first time, the relative contribution of these two levels of physiological (EDA-based) synchrony in predicting alliance.

To this end, we used data from an open-trial study, in which 31 clients with test anxiety (TA) received a six-session protocol-based treatment. In addition to traditional cognitive–behavioral techniques, each of the six sessions also included imagery work (e.g., safe-place imagery, imagery with rescripting), a set of techniques found to be effective in alleviating various psychological conditions (Lee & Kwon, 2013; Nilsson, Lundh, & Viborg, 2012; Wheatley, Hackmann, & Brewin, 2009), including TA (Reiss et al., 2017). By helping clients enter in imagery into anxiety-related experiences and memories, this technique allows access to maladaptive affective-cognitive schemata in a relatively direct and emotionally laden manner. Indeed, mental images, more than verbal prompts, tend to elicit intense emotions (Holmes & Mathews, 2005, 2010). In the context of therapy, such experiential activation provides a direct opportunity for processing the maladaptive emotions associated with the anxiety-related experiences (e.g., Goldman, Greenberg, & Pos, 2005). Using these, clients and therapists can work together to get a better sense of what was so emotionally distressing in the original experience, to understand the felt emotions and their previously inhibited action tendencies, and to recognize the unsatisfied psychological needs. Subsequently, clients and therapists can work to “re-script” the original experience in imagery, a process that often engenders a transformation of the previously held maladaptive affective-cognitive schemata (e.g., “I am a deficient person, and that’s why I have poor study skills”) into less maladaptive ones (e.g., “I was just a kid; with the right guidance, I could have developed better study skills; in fact, I still can”).

In the current study we were particularly interested in the interpersonal aspect of imagery work, an aspect that is often neglected in accounts of this technique. Specifically, we examined the role of client–therapist physiological synchrony during periods of imagery work in predicting therapeutic alliance. In our view, during these emotionally intense segments, as clients get more deeply in touch with their emotions and pain, they stand to benefit from having a therapist who is synchronized with their emotions. We contend that such attuned therapists would be better able to empathize with their clients' experience, will gain an experiential understanding of their clients' experiences, and thus will be better equipped to help their clients process and regulate their distress (for review, see Butler & Randall, 2013).

Joint participation in such moments of empathic attunement (referred to, elsewhere, as “I-sharing” experiences; Pinel, Long, Landau, Alexander, & Pyszczynski, 2006), are at the heart of the therapeutic alliance (Koole & Tschacher, 2016). However, they are likely to be more pertinent when clients and therapists share emotionally laden moments. In contrast, we would expect it to be somewhat less relevant in other moments of therapy. Such (less emotional) moments can however serve as a within-dyad comparison point, thus providing context for the association between alliance (on the one hand) and synchrony during imagery work (on the other). In the present study, we were fortunate to have both imagery work and more traditional cognitive-behavioral work within each of the protocol’s sessions. This provided us with a strong within-dyad comparison point.

To summarize, client-therapist synchrony has been proposed as a key process in the construction and development of the therapeutic bond. To date, studies on the effects of physiological synchrony have relied on data from a single therapy session per dyad, and thus could not clarify to what extent synchrony is a dyad-level or a session-level phenomenon. In the present study, we used physiological recordings from 31 clients (and their therapists) who took part in a 6-session protocol-based treatment for TA; we used data from Sessions 2–6 for reasons outlined below. The treatment included, in each session, imagery work techniques that elicit intense emotional responses, and thus, provide a unique experiential context to test the theorized beneficial relational effects of synchrony; the treatment also included, in each session, some traditional cognitive-behavioral work, which allowed us to examine synchrony levels in each of the contexts, and to test the prediction that only imagery-segment synchrony will be tied to therapeutic alliance.

With these aims in mind, the following hypotheses guided our work:

Hypothesis 1: We expected to find significant synchrony within segments devoted to both imagery and cognitive-behavioral work.

Hypothesis 2: We expected to find such synchrony to show significant variability both at the between-dyad level and at the between-session level.

Hypothesis 3: Finally, we expected to find synchrony during the imagery work—but not during CB work—to be associated with alliance, and particularly with its bond facet (vs. its task/goal facets; Falkenström, Hatcher, Skjulsvik, Larsson, & Holmqvist, 2015).

Method

Treatment Program

The treatment involved six sessions, each comprising a cognitive-behavioral component as well as an imagery-based component. During the imagery work, clients (and their therapists) were invited to close their eyes and to focus on four phenomenological elements: body sensations, emotions, cognitions, and behavioral tendencies. The imagery components in each session were as follows: Session 1 included safe place imagery work (in which clients enter in imagery into a safe, calm, and relaxing scene);

Session 2 included exploratory imagery (in which clients explore a distressing situation relevant to their TA); Sessions 3 and 4 included imagery with rescripting (in which clients enter into a past test-related experience and rescript it to be less distressing); Finally, Sessions 5 and 6 included imagery with rescripting focused on a future experience (in which clients imagine a future study- or test-related situation and use mental contrasting [Oettingen & Reininger, 2016] to address expected obstacles to a desired end state). The cognitive-behavioral components in each session were as follows: Session 1 included psychoeducation about TA; Sessions 2 and 3 involved identification of automatic and alternative cognitions and behaviors; Sessions 4 and 5 included review and adaptation of learning strategies and test-taking skills; Finally, Session 6 involved consolidation and content review of the entire therapy. The six-session protocol was administered over 3 weeks. In the present study, we utilized data from Sessions 2–6 for each client, as the safe-place imagery practiced during Session 1 was intended mostly to socialize the clients to imagery work rather than to elicit strong TA-related emotions. For more details about the treatment, see Prinz, Bar-Kalifa, Rafaeli, Sened, and Lutz (2019) and Prinz, Lutz, Bar-Kalifa, and Rafaeli (2016); for the full protocol, see www.osf.io/hraqd.

Clients

The study is based on a sample comprising 31 clients treated by 10 therapists (ranging from 1 to 10 clients per therapist; $M = 3.1$, $SD = 2.6$). The clients were recruited at two sites: Trier University in Germany and Bar-Ilan University in Israel. Clients were recruited using flyers posted throughout the campuses and at the campus health services, ads placed in the newsletters of local universities, as well as a brief invitation given to participants in a TA prevention workshop offered on campus. Thirty clients were university students, and one was a trainee in a nursing program. The treatment was provided at no cost to participants. Clients eligible for the study had to meet the following criteria: Test Anxiety Inventory (TAI; Spielberger, 1980) scores >50 , no suicidality, and no current therapy addressing TA. The 31 clients ranged in age from 19 to 53 years ($M = 25.9$, $SD = 6.3$) and the majority was female (74.2%). This study was approved by Bar-Ilan University IRB.

Therapists’ Training and Supervision

Four of the 10 therapists were graduates of a masters’ program in psychology, and had no prior therapy experience; the remaining six therapists were doctoral-level students in clinical psychology, each with at least 1 year prior experience as a clinician. All therapists were trained in the treatment protocol in a 2-day workshop, which involved modeling and role-playing the intervention modules. In addition, all therapists took part in a weekly group supervision led by an experienced psychotherapist.

Procedure

To identify the imagery work segments, we reviewed the recording of all sessions, and marked the start and stop points of closed-eye imagery work completed in the session ($M_{\text{length}} = 19.8$ min; $SD = 8.4$). Similarly, we reviewed the recordings and marked

the start and stop points of the cognitive-behavioral tasks completed in the session ($M_{\text{length}} = 22.5$ min; $SD = 9.8$).

The study utilized a multiple baseline design, with pretreatment and posttreatment assessments as well as session-by-session reports. In addition, therapists' and clients' electrodermal activity (EDA) was continuously recorded during the sessions. Below, we provide details only regarding the measures used in the present study; for a fuller description of the assessment protocol, see [Prinz et al., 2019](#).

Measures

Physiological measures. In the Trier site, EDA data were recorded at a sampling rate of 500 Hz using a Becker Meditec EDA module amplifier (Karlsruhe, Germany; with 0–100 μS , Sensitivity 25 mV/ μS) connected to the acquisition computer via CesyS C028149 USB-ISOLATOR. In the BIU site, EDA data were recorded at a sampling rate of 1 KHz using the Mindware integrated system and software package (Mindware Technology, Gahanna, OH). In both sites, electrodes were attached to the thenar and hypothenar locations of clients' and therapists' nondominant hands. Continuous (1 Hz) EDA signals were extracted. These signals were examined for gross motion artifacts and for detection of nonresponsive signals (failing to exhibit $\text{SCL} > 1 \mu\text{S}$ in at least 10% of the data), which were excluded from the analysis ($N = 18$ sessions). Data from nine additional sessions could not be used for technical problems. Thus, 83% (128 out of a possible $31 \times 5 = 155$ sessions) were available for analysis.

Therapeutic alliance. The Session Alliance Inventory (SAI; [Falkenström et al., 2015](#)) was completed by the client after each session. The SAI is a six-item self-report questionnaire that assesses the therapeutic alliance. Each item is rated on a 6-point Likert scale ranging from 1 (*not at all*) to 6 (*completely*). In the current study, we used the two subscale scores: for bond ($M = 5.38$, $SD = 0.83$) and for task/goal ($M = 5.14$; $SD = 0.88$). The between- and within-person reliabilities for the composite scales were computed using procedures outlined by [Shrout and Lane \(2012\)](#); these were .87 and .65 for the bond subscale, and .86 and .71 for the task/goal subscale.

Analytic Approach

Assessing synchrony. Synchrony between clients' and therapists' EDA was computed separately for imagery work (IM) segments and for the cognitive-behavioral (CB) segments of each session using a time domain time-series analysis. Specifically, we first reviewed the recordings and marked the start and stop time of the IM task as well as those of the CB task of each session. We then removed the autocorrelated component from each EDA time series (see [Gottman, 1981](#)). This was done using R's ([R Core Team, 2013](#)) `auto.arima` function (forecast package for R; [Hyndman et al., 2018](#)), which automates the selection of ARIMA model parameters for each time series by optimizing model fit. We then computed the Cross Correlation Functions (CCFs) within ± 10 s lags on dyads' residualized EDA time-series, and used the maximal correlation as the synchrony level index (see [Chatel-Goldman, Congedo, Jutten, & Schwartz, 2014](#); [Golland, Arzouan, & Levit-Binnun, 2015](#); [Golland, Keissar, & Levit-Binnun, 2014](#); [Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005](#), for a sim-

ilar approach). To account for possible nonstationarity effects in physiological data over time, we computed the CCF in consecutive temporal windows of 120 seconds, and then averaged across windows to obtain an aggregated index of synchrony for each session's imagery segment.

To test whether the average client-therapist dyads' synchrony was greater than chance, we created surrogate data, by pairing 1,000 randomly selected time-series sequences drawn from our clients' EDA data with an equal number of randomly selected time-series sequences drawn from our therapists' EDA data. We then calculated the CCF on each of these random pairs. To test the statistical likelihood of the observed synchrony, we applied non-parametric bootstrapping procedure (with 1,000 repetitions) allowing us to compare the average CCF of the observed data to the sampling distribution of the means constructed from the surrogate data (for a similar approach, see [Feldman, Magori-Cohen, Galili, Singer, & Louzoun, 2011](#) and [Golland et al., 2014](#), for example). This procedure was conducted twice: once for the IM segments and once for the CB segments.

Assessing variability in synchrony. To estimate the between-dyad and between-session variability in synchrony, a 2-level hierarchical linear unconditional model was estimated with sessions nested within dyads.¹ Specifically, the following mixed model was estimated:

$$\text{Synchrony}_{td} = \gamma_{00} + u_{0d} + r_{td} \quad (1)$$

where the synchrony during session t for dyad d was modeled as a function of the sample's intercept (γ_{00}), as well as a Level 2 random effect (u_{0d} —representing between-dyad variability) and a Level 1 random effect (r_{td} —representing between-session variability). Again, this analysis was conducted twice: once for synchrony in IM segments, and once for synchrony in CB segments.

Assessing the association between synchrony and alliance. To test the association between client-therapist dyads' synchrony and clients' reported alliance we used an additional 2-level hierarchical linear model with sessions nested within dyads.² Specifically, the following mixed model was estimated:

$$\begin{aligned} \text{Alliance}_{td} = & \gamma_{00} + \gamma_{01} \times \text{Avg. Synchrony}_d \\ & + \gamma_{10} \times \text{Session Synchrony}_{td} + \gamma_{20} \times \text{Alliance}_{(t-1)d} \\ & + u_{0d} + r_{td} \end{aligned} \quad (2)$$

where the alliance reported at the end of session t by client from dyad d was modeled as a function of the sample's intercept (γ_{00}), the average (across all sessions) synchrony of the client with his or her therapist (γ_{01}), the synchrony of the client with his or her

¹ Unconditional three-level models (sessions nested within dyads nested within therapists) showed no better fit for the CB synchrony ($\chi^2[1] = 1.687$, $p = .194$). It did show a significant improvement in fit for the IM synchrony ($\chi^2[1] = 4.070$, $p = .045$); However, this three-level model yielded hard-to-interpret results in which all Level 2 variance was absorbed by Level 3. We believe this resulted from the nesting of (too few) clients within (too few) therapists, and therefore we opted for the two-level models (sessions nested within dyads).

² Unconditional three-level models (sessions nested within dyads nested within therapists) showed no better fit for either the alliance task/goal subscale ($\chi^2[1] = .072$, $p = .789$) or the alliance bond subscale ($\chi^2[1] = 1.434$, $p = .231$); therefore, we opted for the two-level models (sessions nested within dyads).

therapist at session t (γ_{10}), the alliance reported by the client at the end of session $t - 1$ (γ_{20}), as well as Level 2 between-dyad (u_{0d}) and Level 1 between-session (r_{1c}) residual (random) components. This model was run three times, with either the SAI total scores, the SAI-bond subscale, or the SAI-task/goal subscale as the outcome. To disentangle between-dyad and between-session effects, the session-level predictors were person-mean centered whereas the between-dyad predictor was grand-mean centered. We reported three models: (a) using the IM synchrony index as the predictor; (b) using the CB synchrony index as the predictor; and (c) combining both indices of synchrony as predictors. Analyses were conducted using R's *lme4* package (Bates, 2005).

Results

Synchrony Within IM Work

Figure 1A presents the distribution of client–therapist dyads' synchrony scores during IM segments, which had an average of 0.254 and a *SD* of 0.044. Figure 1B presents the sampling distribution of the means constructed from the surrogate data of randomly paired IM work segments ($M = 0.230$; $SD = 0.004$). As can be seen, the sample's (observed) mean synchrony level (marked by a dashed vertical line) was higher than the upper limit of the 95% confidence interval of the sampling distribution (marked by solid vertical lines); thus, consistent with Hypothesis 1, client–therapist

dyadic synchrony during the IM segments was, on average, greater than chance.

Synchrony Within CB Work

Figure 1C presents the distribution of client–therapist dyads' synchrony scores during CB segments, which had an average of 0.254 and a *SD* of 0.050. Figure 1D presents the sampling distribution of the means constructed from the surrogate data of randomly paired CB work segments ($M = 0.226$; $SD = 0.005$). As can be seen, the sample's (observed) mean synchrony level (marked by a dashed vertical line) was higher than the upper limit of the 95% confidence interval of the sampling distribution (marked by solid vertical lines); thus, and again consistent with Hypothesis 1, client–therapist dyadic synchrony during the CB segments was, on average, greater than chance. To compare synchrony levels during IM versus CB segments we ran a 2-level multilevel model (with sessions nested within clients). This model revealed no significant difference (Est. = 0.0001, $SE = 0.006$, $p = .901$).

Partitioning Synchrony Variability

The results from the unconditional HLM analyses showed that synchrony during IM segments varied mostly at the within-dyad level. Specifically, whereas the estimated variability at Level 1

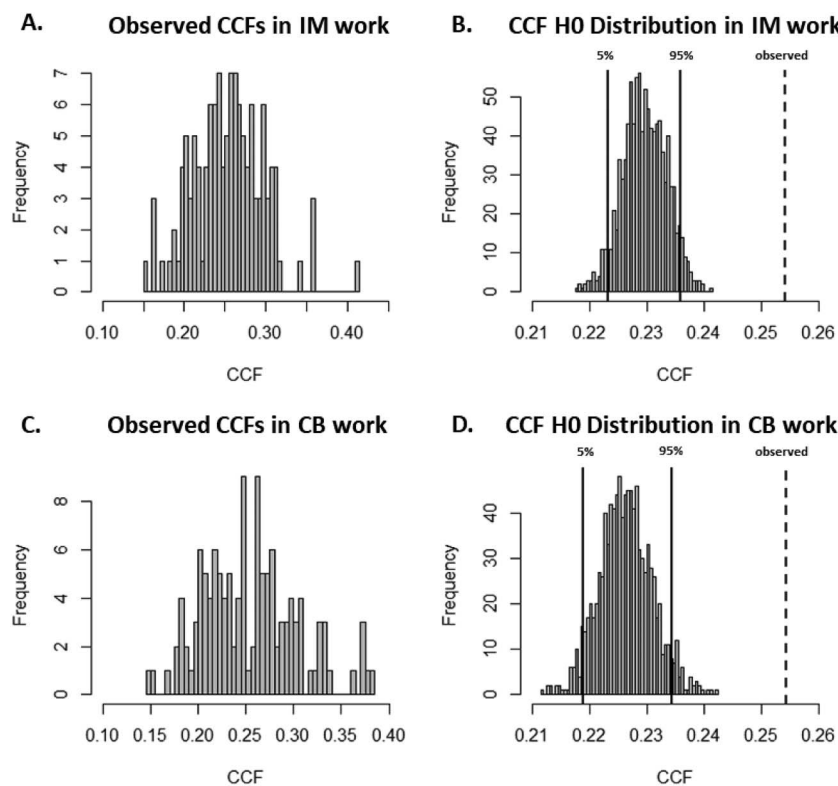


Figure 1. The client–therapist synchrony observed distribution for the imagery (IM) work (Panel A) and the cognitive-behavioral (CB) work (Panel C) segments, as well as the sampling distribution for the IM work (Panel B) and CB work (Panel D). The solid vertical lines in Panels B and D denote 95% CI; the dashed vertical lines denote the observed sample's average score. CCFs = cross correlation functions.

was significant (Est. = 0.00193, $SE = 0.00028$, $p < .001$) and represented 98.8% of the total variability, the estimated variability at Level 2 was not significant (Est. 0.00002, $SE = 0.00014$, $p = .4336$) and represented only 1.2% of the total variability. Indeed, including a Level 2 random component did not improve the fit of the model as indicated by a nonsignificant deviance test ($\chi^2[1] = 0$). Thus, in contrast to our prediction (Hypothesis 2), synchrony during IM segments varied only at the session level.

The results from the unconditional HLM analyses showed that synchrony during CB segments varied at both the within-dyad and between-dyad levels. Specifically, both the estimated variability at Level 1 (Est. = 0.00200, $SE = 0.00029$, $p < .001$) and at Level 2 (Est. = 0.00050, $SE = 0.00027$, $p < .05$) were significant, with the former representing 79.3% of the total variability. Indeed, including a Level 2 random component improved the fit of the model as indicated by a significant deviance test ($\chi^2[1] = 7$, $p = .008$). Thus, in support to our prediction (Hypothesis 2), synchrony during CB segments varied both at the session and at the dyad level.

Estimating the Association Between Synchrony During IM Segments and Alliance

Because synchrony during the IM segments showed no significant variability at Level 2, we estimated the association of synchrony and alliance only at Level 1 (i.e., session level). The results from the HLM analyses showed that synchrony was not significantly associated with the task/goal subscale of alliance (Est. = 0.987, $SE = 1.315$, $p = .455$). In contrast, and in line with Hypothesis 3, it was significantly associated with the alliance bond subscale (Est. = 1.926, $SE = 0.947$, $p = .045$).

Estimating the Association Between Synchrony During CB Segments and Alliance

The results from the HLM analyses showed that synchrony was not significantly associated with the task/goal subscale of alliance at either the session level (Est. = 0.668, $SE = 1.271$, $p = .601$), or the person level (Est. = 4.576, $SE = 3.988$, $p = .271$). Similarly, synchrony was not significantly associated with the alliance bond subscale at either the session level (Est. = -0.201, $SE = 0.961$, $p = .835$), or the person level (Est. = 5.993, $SE = 3.342$, $p = .084$), though the latter effect approached significance.

Estimating the Association Between Synchrony During Both Types of Segments and Alliance

Our final combined models, which included both IM and CB synchrony indices as predictors, revealed that only session-level synchrony during IM segments was positively associated with the alliance bond subscale (Est. = 2.329, $SE = 1.002$, $p = .023$).³

Additional Analyses

To test whether the six therapists with prior clinical experience differed from the four therapists without prior clinical experience (see Method section, above) we ran an additional series of multilevel models, which revealed no significant differences in synchrony (Est. = 0.010, $SE = 0.009$, $p = .249$ for IM segments;

Est. = 0.014, $SE = 0.0126$, $p = .268$ for CB segments) or in reports of alliance (Est. = 0.024, $SE = 0.295$, $p = .937$ for the alliance task/goal subscale; Est. = 0.485, $SE = 0.262$, $p = .075$ for the alliance bond subscale).

To test whether the alliance subscales or the synchrony indices showed a linear trend over the course of treatment we ran a series of unconditional linear growth multilevel models in which the predictor was session number and the outcomes were one of the alliance subscales or one of the synchrony indices. The fixed effects of the alliance subscales indicated relatively high initial levels of alliance (Est. = 5.006, $SE = 0.140$, $p < .0001$ for bond; Est. = 4.869, $SE = 0.140$, $p < .001$ for task/goal) as well as significant linear changes (Est. = 0.149, $SE = 0.024$, $p < .001$ for bond; Est. 0.110, $SE = 0.025$, $p < .001$ for task/goal). Of note, no such significant change was found for the synchrony indices (Est. = 0.003, $SE = 0.003$, $p = .696$, for the IM segments; Est. = 0.002, $SE = 0.003$, $p = .540$, for the CB segments).⁴ In a second step, we used the models' random effects to extract the individualized empirical Bayes estimates of the time slope for each client, and tested the correlations between these estimates. We found a significant positive association between the linear change estimates for the alliance subscales ($r = .661$, $p < .001$), as well as a significant positive association between the linear change estimates for synchrony indices ($r = .369$, $p = .045$). However, no significant associations were found between the linear changes in either alliance subscale on the one hand and either synchrony index on the other.

Discussion

The aim of this study was to investigate the dyad-level and session-level associations between therapeutic alliance and client-therapist EDA synchrony during imagery work conducted within a six-session treatment for TA, and to compare these levels and associations to those found with EDA synchrony during CB work. Whereas previous investigations have explored the ties between EDA synchrony and therapist-client empathy, the current study examined synchrony vis-à-vis alliance and did so within the context of a multisession therapy; it also focused on the synchrony that occurred within two different types of interventions: imagery work, during which the therapeutic dyad was engaged in an emotion-focused technique, and CB work, during which the therapeutic dyad focused more on psychoeducation, rational analysis, and behavioral planning.

As expected, we found client-therapist physiological synchrony to be greater than chance in both imagery and CB segments. We

³ Following a reviewer's suggestion we tested for the possibility of reverse directionality—i.e., that alliance scores reported at the end of session $t-1$ would be associated with synchrony scores during session t . We found no evidence for such pattern: the alliance bond and task/goal subscales on session $t-1$ were not associated with either the synchrony during IM segments (Est. = -0.010, $SE = 0.022$, $p = .372$ and Est. = 0.011, $SE = 0.010$, $p = .271$, respectively) or synchrony during CB segments (Est. = 0.013, $SE = 0.011$, $p = .242$; Est. = -0.001, $p = .912$).

⁴ We also ran models in which the session number was treated as a categorical predictor (allowing a test of time-independent differences in levels of synchrony); these models too did not reveal significant differences in synchrony across the different sessions ($F(4,99.2) = 0.04$, $p = .996$ for the IM segments; $F(4,97.5) = 0.32$, $p = .866$ for the CB segments).

interpret this finding to mean that in therapy (as in other close dyadic interactions; e.g., [Semin & Cacioppo, 2008](#)), the two partners tend to experience concomitant emotional activation.

To further examine the synchrony levels, we capitalized on the availability of multisession data, which allowed us to partition the variability in synchrony into within-dyad as well as between-dyad levels. Within the imagery segments, synchrony varied significantly only at the session level. Within the CB segments, synchrony varied significantly at both levels, though the overwhelming majority of the variance was at the session level.

Given the low-to-absent variability in client–therapist synchrony at the dyad level, we focused on the session level alone when examining the association between alliance and physiological synchrony in either type of segment. We expected clients to benefit more from physiological synchrony with their therapist during emotionally intense segments, in which they come into deeper contact with their emotions and pain. We contended that such synchrony will characterize sessions in which the therapists would be more attuned and thus better able to empathize with their clients' experiences, gain an experiential understanding of these, and be better equipped to help their clients process and regulate any distress that arises. In contrast, we expected synchrony within other, less emotionally laden moments, to be somewhat less relevant. As expected, we found clients' perception of the alliance bond to be more positive in sessions characterized by greater physiological synchrony during imagery work, but did not find such an association with the synchrony observed within CB work.

One plausible alternative explanation for this finding is that clients and therapists show physiological synchrony because of simultaneous exposure to anxiety-provoking or agitating content that arises in the session (e.g., [Schumacher et al., 2014](#)). For this explanation to hold, however, it will need to account not only for coactivation (in response to shared content) but also for temporal synchrony in this activation (a pattern absent from the Schumacher et al. study). Moreover, it would need to account for the differential synchrony–alliance associations found with synchrony levels obtained in the imagery versus the CB segments.

Our results extend those found in earlier studies exploring client–therapist physiological synchrony (e.g., [Marci et al., 2007](#); for review, see [Kleinbub, 2017](#)) in two major ways. First, most of these earlier studies have looked at the association between synchrony and *empathy*. In contrast, our work documents an association between synchrony and one key aspect of *therapeutic alliance*—namely, the therapeutic bond. Second, most earlier studies on client–therapist physiological synchrony utilized data from a single session (cf., [Stratford, Lal, & Meara, 2009, 2012](#)). In contrast, our work, which relied on multiple sessions for each dyad, allowed us to distinguish between-dyad and within-dyad variability in synchrony. We found client–therapist physiological synchrony to vary mostly (in CB segments) or entirely (in imagery segments) at the within-dyad or session level, but not at the between-dyad level. This finding suggests that synchrony is independent from various stable client or therapist characteristics (e.g., attachment styles), and is a state-like (rather than a trait-like) phenomenon (a finding that echoes recent results in dyadic research; see [Wilson et al., 2018](#)).

Our findings open up several avenues for further research. For one, future studies could try to identify particular aspects of imagery work (or other therapeutic interventions) that facilitate

greater synchrony. In particular, if synchrony indeed reflects a shared emotional experience (rather than a more rudimentary sharing of external environmental demands), it is likely to be influenced by a host of complex processes. As [Koole and Tschacher \(2016\)](#) suggested in their recent In-Sync model, these may be particularly relevant to moments of I-sharing, may involve the use of common language, and may lead to more adaptive affective coregulation.

Thinking of shared or synchronous experiences in this way, future research should also try to uncover the mechanisms that tie synchrony to greater alliance. The results of prior research on such synchrony (for review, see [Kleinbub, 2017](#)) have mostly been quite general and thus less informative on this topic. To address the underlying mechanisms, future research will have to ask more specific questions—for example, why are some sessions marked by greater synchrony and others by lesser synchrony? This will require a more nuanced view, not only of the outcome (as illustrated by the distinctions found between the bond and task/goal components of alliance) but also of the session itself (e.g., its emotional intensity, or the types of interventions utilized within it).

Relatedly, though we expected a weaker association between synchrony and the other major component of alliance—that is, agreement on tasks/goals—no such association was found at all. This lends support to the idea that the emotional intensity of imagery segments—that is, of deliberately emotion-focused interventions within therapy—facilitates a deeper experiencing of emotions in both client and therapist, and is particularly relevant to the emotional bond between the two parties. We may speculate that other features of imagery work (e.g., the willingness of the client to engage in such work) may be particularly relevant to the task/goal components of alliance—that is, to the degree of agreement between client and therapist vis-à-vis therapeutic tasks and goals; of course, this speculation merits future research.

Strengths, Limitations, and Future Directions

This study's contributions should be considered in light of its limitations. To our knowledge, it is one of the first studies to assess dyadic psychophysiological synchrony over the course of multiple psychotherapy sessions (see also [Stratford et al., 2009, 2012](#)), and the first to examine EDA synchrony vis-à-vis therapeutic alliance. Moreover, the study's focus on a particular therapeutic intervention—imagery work—created an interesting opportunity to examine synchrony in the absence of eye contact. Specifically, because imagery work is conducted while the clients (and quite often, the therapists) had their eyes closed, our results can be seen as consistent with those of [Henning, Boucsein, and Gil \(2001\)](#), who found that team members need no social-visual contact with each other to synchronize. These results offer a different take on the neuroscientific work that considers the mirror neuron system as the neural foundation of empathy ([Gallese, Eagle, & Migone, 2007](#); [Messina et al., 2013](#)). Of course, the observation of others' emotional responses may be mirrored. However, our results provide evidence for additional processes likely to underlie shared experience.

One limitation of the current study is its reliance on a relatively small sample (i.e., 31 dyads), which may mean that we were underpowered to detect smaller effects. As such, our finding should be taken as preliminary until replicated, though they now

provide a good starting point for future a priori power analyses. Additionally, though the number of sessions analyzed was higher than in most previous studies of physiological synchrony, it remains a relatively small number (given the brevity of the protocol). This makes it harder to generalize from this study to ones in which a larger number of sessions are used. For instance, with a greater number of sessions, dyad-level differences may become more pronounced and thus be detectable.

The two study sites utilized different hardware systems for the acquisition of the dyads' EDA data. It would have been ideal to use the same systems, though the systems in both sites used were well-established, validated, and reliable. Importantly, both partners at each site were assessed with identical hardware, and the synchrony between partners was itself assessed using identical analyses.

The very unbalanced distribution of clients (ranging from 1 to 10) within very few therapists (10 in total) limited our ability to examine therapist effects in either synchrony levels or the association between synchrony and alliance. It may be important in future studies to collect data that are sufficiently powered to examine Level 3 variability reliably, and to test the possibility that such therapist-level variability underlies therapist effects in alliance or outcomes (e.g., Okiishi, Lambert, Nielsen, & Ogles, 2003).

Finally, an issue which has slowed the progress of attaining greater clarity about the role of synchrony within psychotherapy is the lack of an agreed-upon procedure for estimating synchrony. As Schoenherr et al. (2019) illustrated recently (albeit with regards to movement synchrony), different operationalizations of the construct can—and do—yield quite divergent results. Thus, as several authors (e.g., Kleinbub, 2017; Palumbo et al., 2017) have argued, investigators should put greater effort into establishing empirically based gold-standard procedures for operationalizing synchrony. This, in turn, would allow aggregation and comparison of results across studies, and would thus move us toward a more nuanced understanding of synchrony's effects (e.g., when and for what clients is it effective?).

Summary

These limitations notwithstanding, the results of the present study highlight the importance of physiological synchrony between clients and their therapists for therapeutic bond, and offer an intriguing possibility about the different mechanisms at work during imagery work versus CB work. We hope this study heralds a rise in the use of multisession assessments of client and therapist synchronized physiology, as there is much to learn from studying these subtle but important markers of client (and therapist) responses to the rich processes that make up therapy.

References

- Accurso, E. C., Fitzsimmons-Craft, E. E., Ciao, A., Cao, L., Crosby, R. D., Smith, T. L., . . . Peterson, C. B. (2015). Therapeutic alliance in a randomized clinical trial for bulimia nervosa. *Journal of Consulting and Clinical Psychology, 83*, 637–642. <http://dx.doi.org/10.1037/ccp0000021>
- Atzil-Slonim, D., Bar-Kalifa, E., Fisher, H., Peri, T., Lutz, W., Rubel, J., & Rafaeli, E. (2018). Emotional congruence between clients and therapists and its effect on treatment outcome. *Journal of Counseling Psychology, 65*, 51–64. <http://dx.doi.org/10.1037/cou0000250>
- Bates, D. (2005). Fitting linear mixed models. *R. R. News, 5*, 27–30.
- Bernieri, F. J., Reznick, J. S., & Rosenthal, R. (1988). Synchrony, pseudosynchrony, and dissynchrony: Measuring the entrainment process in mother–infant interactions. *Journal of Personality and Social Psychology, 54*, 243–253. <http://dx.doi.org/10.1037/0022-3514.54.2.243>
- Braithwaite, J. J., Watson, D. G., Jones, R., & Rowe, M. (2015). *A guide for analysing electrodermal activity (EDA) & skin conductance responses (SCRs) for psychological experiments* (Revised version 2.0). Retrieved from <http://www.biopac.com/wp-content/uploads/EDA-SCR-Analysis.pdf>
- Butler, E. A., & Randall, A. K. (2013). Emotional coregulation in close relationships. *Emotion Review, 5*, 202–210. <http://dx.doi.org/10.1177/1754073912451630>
- Chatel-Goldman, J., Congedo, M., Jutten, C., & Schwartz, J. L. (2014). Touch increases autonomic coupling between romantic partners. *Frontiers in Behavioral Neuroscience, 8*, 95. <http://dx.doi.org/10.3389/fnbeh.2014.00095>
- Falkenström, F., Granström, F., & Holmqvist, R. (2013). Therapeutic alliance predicts symptomatic improvement session by session. *Journal of Counseling Psychology, 60*, 317–328. <http://dx.doi.org/10.1037/a0032258>
- Falkenström, F., Hatcher, R. L., Skjulsjøvik, T., Larsson, M. H., & Holmqvist, R. (2015). Development and validation of a 6-item working alliance questionnaire for repeated administrations during psychotherapy. *Psychological Assessment, 27*, 169–183. <http://dx.doi.org/10.1037/pas0000038>
- Feldman, R., Magori-Cohen, R., Galili, G., Singer, M., & Louzoun, Y. (2011). Mother and infant coordinate heart rhythms through episodes of interaction synchrony. *Infant Behavior & Development, 34*, 569–577. <http://dx.doi.org/10.1016/j.infbeh.2011.06.008>
- Gallese, V., Eagle, M. N., & Migone, P. (2007). Intentional attunement: Mirror neurons and the neural underpinnings of interpersonal relations. *Journal of the American Psychoanalytic Association, 55*, 131–175. <http://dx.doi.org/10.1177/00030651070550010601>
- Goldman, R. N., Greenberg, L. S., & Pos, A. E. (2005). Depth of emotional experience and outcome. *Psychotherapy Research, 15*, 248–260. <http://dx.doi.org/10.1080/10503300512331385188>
- Golland, Y., Arzouan, Y., & Levit-Binnun, N. (2015). The mere presence: Synchronization of autonomic signals and emotional responses across co-present individuals not engaged in direct interaction. *PLoS ONE, 10*, e0125804.
- Golland, Y., Keissar, K., & Levit-Binnun, N. (2014). Studying the dynamics of autonomic activity during emotional experience. *Psychophysiology, 51*, 1101–1111.
- Gottman, J. M. (1981). *Time-series analysis: A comprehensive introduction for social scientists*. New York, NY: Cambridge University Press.
- Henning, R. A., Boucsein, W., & Gil, M. C. (2001). Social-physiological compliance as a determinant of team performance. *International Journal of Psychophysiology, 40*, 221–232. [http://dx.doi.org/10.1016/S0167-8760\(00\)00190-2](http://dx.doi.org/10.1016/S0167-8760(00)00190-2)
- Holmes, E. A., & Mathews, A. (2005). Mental imagery and emotion: A special relationship? *Emotion, 5*, 489–497. <http://dx.doi.org/10.1037/1528-3542.5.4.489>
- Holmes, E. A., & Mathews, A. (2010). Mental imagery in emotion and emotional disorders. *Clinical Psychology Review, 30*, 349–362. <http://dx.doi.org/10.1016/j.cpr.2010.01.001>
- Hyndman, R., Athanasopoulos, G., Bergmeir, C., Caceres, G., Chhay, L., O'Hara-Wild, M., . . . Yasmeeen, F. (2018). forecast: Forecasting functions for time series and linear models. R package (Version 8.4) [Computer software]. Retrieved from <http://pkg.robjhyndman.com/forecast>
- Imel, Z. E., Barco, J. S., Brown, H. J., Baucom, B. R., Baer, J. S., Kircher, J. C., & Atkins, D. C. (2014). The association of therapist empathy and synchrony in vocally encoded arousal. *Journal of Counseling Psychology, 61*, 146–153. <http://dx.doi.org/10.1037/a0034943>
- Kivlighan, D. M., Jr., Kline, K., Gelso, C. J., & Hill, C. E. (2017). Congruence and discrepancy between working alliance and real rela-

- tionship: Variance decomposition and response surface analyses. *Journal of Counseling Psychology*, 64, 394–409. <http://dx.doi.org/10.1037/cou0000216>
- Kleinbub, J. R. (2017). State of the art of interpersonal physiology in psychotherapy: A systematic review. *Frontiers in Psychology*, 8, 2053. <http://dx.doi.org/10.3389/fpsyg.2017.02053>
- Koole, S. L., & Tschacher, W. (2016). Synchrony in psychotherapy: A review and an integrative framework for the therapeutic alliance. *Frontiers in Psychology*, 7, 862. <http://dx.doi.org/10.3389/fpsyg.2016.00862>
- Lee, S. W., & Kwon, J. H. (2013). The efficacy of imagery rescripting (IR) for social phobia: A randomized controlled trial. *Journal of Behavior Therapy and Experimental Psychiatry*, 44, 351–360. <http://dx.doi.org/10.1016/j.jbtep.2013.03.001>
- Liu, S., Zhou, Y., Palumbo, R., & Wang, J. L. (2016). Dynamical correlation: A new method for quantifying synchrony with multivariate intensive longitudinal data. *Psychological Methods*, 21, 291–308. <http://dx.doi.org/10.1037/met0000071>
- Marci, C. D., Ham, J., Moran, E., & Orr, S. P. (2007). Physiologic correlates of perceived therapist empathy and social-emotional process during psychotherapy. *Journal of Nervous and Mental Disease*, 195, 103–111. <http://dx.doi.org/10.1097/01.nmd.0000253731.71025.fc>
- Mauss, I. B., Levenson, R. W., McCarter, L., Wilhelm, F. H., & Gross, J. J. (2005). The tie that binds? Coherence among emotion experience, behavior, and physiology. *Emotion*, 5, 175.
- Messina, I., Palmieri, A., Sambin, M., Kleinbub, J. R., Voci, A., & Calvo, V. (2013). Somatic underpinnings of perceived empathy: The importance of psychotherapy training. *Psychotherapy Research*, 23, 169–177. <http://dx.doi.org/10.1080/10503307.2012.748940>
- Nilsson, J.-E., Lundh, L.-G., & Viborg, G. (2012). Imagery rescripting of early memories in social anxiety disorder: An experimental study. *Behaviour Research and Therapy*, 50, 387–392. <http://dx.doi.org/10.1016/j.brat.2012.03.004>
- Oettingen, G., & Reininger, K. M. (2016). The power of prospection: Mental contrasting and behavior change. *Social and Personality Psychology Compass*, 10, 591–604. <http://dx.doi.org/10.1111/spc3.12271>
- Okishi, J., Lambert, M. J., Nielsen, S. L., & Ogles, B. M. (2003). Waiting for supershrink: An empirical analysis of therapist effects. *Clinical Psychology & Psychotherapy*, 10, 361–373. <http://dx.doi.org/10.1002/cpp.383>
- Palumbo, R. V., Marraccini, M. E., Weyandt, L. L., Wilder-Smith, O., McGee, H. A., Liu, S., & Goodwin, M. S. (2017). Interpersonal autonomic physiology: A systematic review of the literature. *Personality and Social Psychology Review*, 21, 99–141. <http://dx.doi.org/10.1177/1088868316628405>
- Paulick, J., Deisenhofer, A.-K., Ramseyer, F., Tschacher, W., Boyle, K., Rubel, J., & Lutz, W. (2018). Nonverbal synchrony: A new approach to better understand psychotherapeutic processes and drop-out. *Journal of Psychotherapy Integration*, 28, 367–384. <http://dx.doi.org/10.1037/int0000099>
- Paulick, J., Rubel, J. A., Deisenhofer, A. K., Schwartz, B., Thielemann, D., Altmann, U., . . . Lutz, W. (2018). Diagnostic features of nonverbal synchrony in psychotherapy: Comparing depression and anxiety. *Cognitive Therapy and Research*, 42, 539–551. <http://dx.doi.org/10.1007/s10608-018-9914-9>
- Pinel, E. C., Long, A. E., Landau, M. J., Alexander, K., & Pyszczynski, T. (2006). Seeing I to I: A pathway to interpersonal connectedness. *Journal of Personality and Social Psychology*, 90, 243–257. <http://dx.doi.org/10.1037/0022-3514.90.2.243>
- Prinz, J. N., Bar-Kalifa, E., Rafaeli, E., Sened, H., & Lutz, W. (2019). Imagery-based treatment for test anxiety: A multiple-baseline open trial. *Journal of Affective Disorders*, 244, 187–195. <http://dx.doi.org/10.1016/j.jad.2018.10.091>
- Prinz, J. N., Lutz, W., Bar-Kalifa, E., & Rafaeli, E. (2016). Imagery rescripting und psychophysiologische zusammenhänge anhand eines ImRs-behandlungskonzepts für prüfungsangst: Überblick und erste erfahrungen [Imagery rescripting and psychophysical relations based on the ImRs-therapy concept used for test anxiety: Review and first experience]. *PPmP: Psychotherapie, Psychosomatik, Medizinische Psychologie*, 66, 481–485.
- Ramseyer, F. (2011). Nonverbal synchrony in psychotherapy: Embodiment at the level of the dyad. In W. Tschacher & C. Bergomi (Eds.), *The implications of embodiment: Cognition and communication* (pp. 193–207). Exeter, UK: Imprint Academic.
- Ramseyer, F., & Tschacher, W. (2011). Nonverbal synchrony in psychotherapy: Coordinated body movement reflects relationship quality and outcome. *Journal of Consulting and Clinical Psychology*, 79, 284–295. <http://dx.doi.org/10.1037/a0023419>
- R Core Team. (2013). R: A language and environment for statistical computing [Computer Software]. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from <http://www.R-project.org/>
- Reiss, N., Warnecke, I., Tolgou, T., Krampen, D., Luka-Krausgrill, U., & Rohmann, S. (2017). Effects of cognitive behavioral therapy with relaxation vs. imagery rescripting on test anxiety: A randomized controlled trial. *Journal of Affective Disorders*, 208, 483–489. <http://dx.doi.org/10.1016/j.jad.2016.10.039>
- Repp, B. H., & Su, Y. H. (2013). Sensorimotor synchronization: A review of recent research (2006–2012). *Psychonomic Bulletin & Review*, 20, 403–452. <http://dx.doi.org/10.3758/s13423-012-0371-2>
- Robinson, J. W., Herman, A., & Kaplan, B. J. (1982). Autonomic responses correlate with counselor-client empathy. *Journal of Counseling Psychology*, 29, 195–198. <http://dx.doi.org/10.1037/0022-0167.29.2.195>
- Rubel, J. A., Bar-Kalifa, E., Atzil-Slonim, D., Schmidt, S., & Lutz, W. (2018). Congruence of therapeutic bond perceptions and its relation to treatment outcome: Within- and between-dyad effects. *Journal of Consulting and Clinical Psychology*, 86, 341–353. <http://dx.doi.org/10.1037/ccp0000280>
- Schoenherr, D., Paulick, J., Worrack, S., Strauss, B. M., Rubel, J. A., Schwartz, B., . . . Altmann, U. (2019). Quantification of nonverbal synchrony using linear time series analysis methods: Lack of convergent validity and evidence for facets of synchrony. *Behavior Research Methods*, 51, 361–383. <http://dx.doi.org/10.3758/s13428-018-1139-z>
- Schumacher, S., Gaudlitz, K., Plag, J., Miller, R., Kirschbaum, C., Fehm, L., . . . Ströhle, A. (2014). Who is stressed? A pilot study of salivary cortisol and alpha-amylase concentrations in agoraphobic patients and their novice therapists undergoing in vivo exposure. *Psychoneuroendocrinology*, 49, 280–289. <http://dx.doi.org/10.1016/j.psyneuen.2014.07.016>
- Semin, G. R., & Cacioppo, J. T. (2008). Grounding social cognition: Synchronization, entrainment, and coordination. In G. R. Semin & E. R. Smith (Eds.), *Embodied grounding: Social, cognitive, affective, and neuroscientific approaches* (pp. 119–147). New York, NY: Cambridge University Press.
- Shrout, P., & Lane, S. P. (2012). Psychometrics. In M. R. Mehl & T. S. Conner (Eds.), *Handbook of research methods for studying daily life* (pp. 302–320). New York, NY: Guilford Press.
- Spielberger, C. D. (1980). *Test Anxiety Inventory: Preliminary professional manual*. Menlo Park, CA: Mind Garden.
- Stratford, T., Lal, S., & Meara, A. (2009). Neurophysiology of therapeutic alliance. *Gestalt Journal of Australia & New Zealand*, 5, 19–47.
- Stratford, T., Lal, S., & Meara, A. (2012). Neuroanalysis of therapeutic alliance in the symptomatically anxious: The physiological connection revealed between therapist and client. *American Journal of Psychotherapy*, 66, 1–21. <http://dx.doi.org/10.1176/appi.psychotherapy.2012.66.1.1>
- Tschacher, W., & Pfammatter, M. (2016). Embodiment in psychotherapy—A necessary complement to the canon of common factors. *European Psychotherapy*, 13, 9–25.
- Tschacher, W., Rees, G. M., & Ramseyer, F. (2014). Nonverbal synchrony and affect in dyadic interactions. *Frontiers in Psychology*, 5, 1323. <http://dx.doi.org/10.3389/fpsyg.2014.01323>

- Wheatley, J., Hackmann, A., & Brewin, C. (2009). Imagery rescripting for intrusive sensory memories in major depression following traumatic experiences. In N. Grey (Ed.), *A casebook of cognitive therapy for traumatic stress reactions* (pp. 78–92). New York, NY: Routledge.
- Wilson, S. J., Bailey, B. E., Jaremka, L. M., Fagundes, C. P., Andridge, R., Malarkey, W. B., . . . Kiecolt-Glaser, J. K. (2018). When couples' hearts beat together: Synchrony in heart rate variability during conflict predicts heightened inflammation throughout the day. *Psychoneuroendocrinology*, *93*, 107–116. <http://dx.doi.org/10.1016/j.psyneuen.2018.04.017>
- Zilcha-Mano, S., Muran, J. C., Hungr, C., Eubanks, C. F., Safran, J. D., & Winston, A. (2016). The relationship between alliance and outcome: Analysis of a two-person perspective on alliance and session outcome. *Journal of Consulting and Clinical Psychology*, *84*, 484–496. <http://dx.doi.org/10.1037/ccp0000058>

Received September 17, 2018

Revision received April 19, 2019

Accepted April 19, 2019 ■