

This is a self-archived version of an original article. This version may differ from the original in pagination and typographic details.

Author(s): Tourunen, Anu; Kykyri, Virpi-Liisa; Seikkula, Jaakko; Kaartinen, Jukka; Tolvanen, Asko; Penttonen, Markku

Title: Sympathetic Nervous System Synchrony : An Exploratory Study of Its Relationship With the Therapeutic Alliance and Outcome in Couple Therapy

Year: 2020

Version: Accepted version (Final draft)

Copyright: © 2020 American Psychological Association

Rights: In Copyright

Rights url: <http://rightsstatements.org/page/InC/1.0/?language=en>

Please cite the original version:

Tourunen, A., Kykyri, V.-L., Seikkula, J., Kaartinen, J., Tolvanen, A., & Penttonen, M. (2020). Sympathetic Nervous System Synchrony : An Exploratory Study of Its Relationship With the Therapeutic Alliance and Outcome in Couple Therapy. *Psychotherapy*, 57(2), 160-173.
<https://doi.org/10.1037/pst0000198>

**Sympathetic nervous system synchrony: An exploratory study of its relationship with
the therapeutic alliance and outcome in couple therapy**

Anu Tourunen

Virpi-Liisa Kykyri

Jaakko Seikkula

Jukka Kaartinen

Asko Tolvanen

Markku Penttonen

Affiliation of all authors at the time of the study:

Department of Psychology, University of Jyväskylä, Finland

Current affiliation of Anu Tourunen:

Faculty of Sport and Health Sciences, University of Jyväskylä, Finland

Current affiliations of Virpi-Liisa Kykyri:

Department of Psychology, University of Jyväskylä, Finland

Faculty of Social Sciences / Psychology, University of Tampere, Finland

Funding:

This work was supported by the Academy of Finland (Human Mind Research Programme)
under Grant number 265492.

Acknowledgements:

We thank Jarno Mikkonen for his help in coding MATLAB scripts, and Petri Kinnunen and Lauri Viljanto for assisting in technical issues related to the study design.

Conflict of interest:

No potential conflict of interest is reported by the authors.

Correspondence concerning this article should be addressed to:

Dr. Anu Tourunen

Department of Psychology, Kärki 255.11

PO Box 35

FI-40014 University of Jyväskylä

Tel. +35850-4765257

anu.j.tourunen@jyu.fi

Abstract

In previous research we found that sympathetic nervous system synchrony, measured via electrodermal activity (EDA), occurs between participants at the start of couple therapy. The aim now was to test whether this synchrony changes during the therapy process, and how any changes may be related to clients' and therapists' evaluations of the working alliance, and the outcome of therapy. Twelve different couple therapy processes were analyzed (24 clients, plus 10 therapists, working in pairs; hence 4 persons per session) using EDA concordance indices and questionnaires (ORS, SRS, CORE-OM). EDA synchrony between the couples increased from the beginning to the end of therapy. This seemed to be connected to a positive linear trend in female clients' wellbeing during the therapy process. There were no statistically significant changes in the EDA synchrony between the co-therapists, or between the clients and the therapists. We found specific changes in the EDA synchrony to be related to changes in the therapeutic alliance, and/or changes in the clients' wellbeing. Heightened EDA synchrony was frequently related to a better outcome; nevertheless, there was one instance in which decreasing synchrony seemed to be more beneficial. It appears that couple therapy can bring spouses closer together also on a physiological level, which could be especially important for the wellbeing of women.

Keywords: synchrony; couple therapy; electrodermal activity; outcome; therapeutic alliance

Clinical Impact Statement

- **Question:** Does physiological synchrony between therapy participants change in the course of couple therapy, and are these changes connected with therapeutic alliance or therapy outcome?
- **Findings:** Physiological synchrony between the spouses increased in the course of couple therapy, and this was connected with a steady increase in female clients' wellbeing.
- **Meaning:** Improvements in the couple's relationship may also be reflected as higher physiological synchrony between the spouses, and this higher synchrony might be especially important for women's personal wellbeing.
- **Next Steps:** Embodied synchrony needs to be further studied in efforts to achieve effective psychotherapy, and the relationship between physiological synchrony and therapeutic alliance should be clarified.

At the present time, synchrony in the involuntary autonomic nervous system of therapy participants is an underexplored area, even though it could have far-reaching implications for understanding social interactions (Palumbo et al., 2016). The range of social behavior is limited by the person's physiological state: when a person feels threatened, social engagement becomes challenging, and fight-or-flight and avoidance systems are activated (Porges, 2003). The aim of the present study was to discover whether physiological synchrony between therapy participants changes during the therapy process, and whether any such changes are related to changes in the therapeutic alliance, and the outcome of therapy. Thus, one can ask whether the bodily connection between participants is linked to a good working relationship, and further, whether bodily attunement has predictive validity for the ultimate outcome of therapy.

Synchrony between people can be described as moment-by-moment coordination within social interactions (Delaherche et al., 2012). Depending on the population studied, the terms applied to this type of coordination include *concordance*, *compliance*, *covariation*, *linkage*, and *attunement* (Palumbo et al., 2016). Interpersonal synchrony has been linked to numerous aspects of successful social encounters, such as prosocial behavior (Cirelli, Einarson, & Trainor, 2014), and increased affiliation and rapport in relationships (Hove & Risen, 2009; Miles, Nind, & Macrae, 2009). In childhood, this synchrony helps in regulating the child's emotional states – not just within pleasant emotional states, but in remaining connected during negative emotions, without the feeling of being abandoned (Siegel, 2001).

However, nonverbal bodily synchrony has not been given much attention in the domain of psychotherapy. One question that continues to be debated is *how* psychotherapy actually helps clients (Miller, Hubble, Chow, & Seidel, 2013). The therapeutic alliance and the therapist appear to be factors with robust, but still fairly moderate effects, in terms of the variance in therapy outcomes (Martin, Garske, & Davis, 2000; Ackerman & Hilsenroth,

2003). It may be time to turn to nonverbal, bodily aspects of interaction in seeking to discover how the wellbeing of clients improves in therapy. This will also encompass a relational, rather than an individualistic view of the self. “Feeling felt” by other people seems to be especially crucial for human beings (Fishbane, 2001; 2007), and embodied synchrony has been found to occur in countless situations in which people interact with or observe each other (e.g. Konvalinka et al., 2011; Miles et al., 2009; Mønster, Håkonsson, Eskildsen, & Wallot, 2016).

In our own research project “Relational mind in events of change in multiactor therapeutic dialogues” we have studied embodied synchrony in therapy, i.e. attunement with others, via modalities such as dialogue, body movement, physiological responses, and facial expressions. A fuller introduction to our research, including also a historical account of the shift from the linguistic turn to a corporeal turn, has been provided in earlier articles; hence, it will not be repeated here (Seikkula, Karvonen, Kykyri, Kaartinen, & Penttonen, 2015; Seikkula, Karvonen, Kykyri, Penttonen, & Nyman-Salonen, 2018). Beyond this, for a more comprehensive review of physiological synchrony, including theoretical notions of interpersonal synchrony (encompassing infant-parent synchrony and attachment, emotional self- and co-regulation, emotional contagion, and empathy), the reader is recommended to turn to Karvonen (2017). To our knowledge we are the first research group to measure the sympathetic nervous system (SNS) synchrony of both clients and therapists during actual therapy in a multi-actor setting, and to link this synchrony to the alliance and the outcome of therapy. The study reported here focused on changes in sympathetic nervous system synchrony, as measured by electrodermal activity between clients and therapists within couple therapy.

Sympathetic nervous system synchrony

Measurement of electrodermal activity (EDA) is one of the most popular means to record the activity of the sympathetic nervous system (SNS) (Boucsein, 2012). Because the SNS controls sweating, EDA is a well-known channel for measuring psychological or physiological arousal. Most emotions increase EDA, though with certain exceptions, such as relief or contentment (Kreibig, 2010).

EDA was chosen as the main autonomic nervous system (ANS) measure in the current research, because synchrony in it had already been studied in relation to empathy in individual psychotherapy (Marci, Ham, Moran, & Orr, 2007; Messina et al., 2012), with observations also on synchrony between couples who discussed either neutral or conflict-laden topics (Levenson & Gottman, 1983). In addition, some theoretical notions favored the use of EDA in therapy settings. Thus, there are findings that emotionally arousing stimuli may have a strong effect on EDA (Buck, Miller, & Caul, 1974; Campos & Johnson, 1967), that EDA is highly sensitive to small changes in lower states of anxiety (Boucsein, 2012), and that EDA is also responsive to behavioral inhibition and defensive strategies, showing increases when thoughts are suppressed or emotional expressions are inhibited (Hughes, Uhlmann, & Pennebaker, 1994). Nevertheless, EDA merely provides an estimate of SNS activation. In order to capture a more comprehensive picture of the ANS synchrony between people, attunement in the parasympathetic nervous system (PNS), which is connected with relaxation and recovery, could also be studied (e.g. Thomsen & Gilbert, 1998).

Synchrony between spouses.

In a recent literature review of physiological synchrony between romantic partners, Timmons, Margolin, and Saxbe (2015) noted that synchrony had been found over many variables, and also in many contexts. Synchrony in psychophysiological measures was generally related to good connectedness between spouses (with cortisol measures comprising an exception). The results suggest that couples' physiological synchrony can be thought of as

beneficial, but that the mutual escalation of negative emotions may represent a harmful pattern of synchrony. In fact, observations on the latter detrimental pattern of synchrony are by no means new. During the 1980s, Levenson and Gottman (1983) noticed that the physiological synchrony between spouses was stronger when they discussed a marital problem (rather than more neutral events of the day); moreover, this synchrony measure accounted for more than half of the variance in marital satisfaction. They also found that higher levels of arousal were connected with decreases in marital satisfaction over the following years (Levenson & Gottman, 1985). More recently, Coutinho et al. (2018) also found spouses' EDA synchrony to be higher during negative interactions relative to positive interactions, when spouses did structured interaction tasks.

The current view is that physiological synchrony is more complex than had been assumed, since there have also been observations connecting it to positive factors such as empathy (Timmons, Margolin, & Saxbe, 2015). Most synchrony research with couples has focused on satisfied relationships, or on the start of the romantic relationship; moreover, the setting has usually been that of a semi-structured laboratory, involving a specific range of tasks. Less is known about synchrony in non-structured settings, and in couples who are facing problems.

Synchrony in psychotherapy.

Most of the research in physiological synchrony in therapy settings has involved individual psychotherapy with one client and one therapist, and in these studies, SNS synchrony has often been linked to empathy. Marci and colleagues (2007) studied the EDA synchrony between clients and therapists and found that during moments of high EDA synchrony, the clients and therapists showed many more positive social-emotional responses than during low EDA synchrony. Thus, although among couples physiological synchrony was originally thought to be "bad" (Levenson & Gottman, 1983), among clients and therapists it has mainly

been connected to something “good.” In a study by Messina and colleagues (2013), in which pseudo-clients were used, and also listeners with different degrees of training, empathy was found to be related to EDA concordance – but only in terms of empathy as assessed by the pseudo-client. Later on, external evaluators also assessed the empathy. Their evaluations and those of the listeners were similar; however, they were not connected to either the EDA concordance or to the evaluation of empathy obtained from the pseudo-client. It may be that experientially, the condition of being under empathetic attention is a different phenomenon from what happens in observable empathetic behavior; the former may be related to EDA synchrony, and the latter not.

Research has also been conducted on some other forms of embodied synchrony in therapy, such as body movement and vocal pitch synchrony between clients and therapists. For example, Ramseyer and Tschacher (2011; 2014) found nonverbal synchrony to be connected to relationship quality and to the therapy outcome, with the symptoms of clients being reduced more in therapies with higher synchrony. However, body movement synchrony and ANS synchrony have been proposed as different processes (Codrons, Bernardi, Vandoni, & Bernardi, 2014); thus, the possible correlations between them might result from the metabolic demands incurred by movements (Noy, Levit-Binun, & Golland, 2015).

Synchrony in couple therapy.

Beyond our own work, we are not aware of any previous research on the physiological synchrony between participants of couple or family therapy. Our analysis of the start of therapy showed that in 85% of the dyads, an above-chance level of synchrony appeared during the therapy (Karvonen, Kykyri, Kaartinen, Penttonen, & Seikkula, 2016). To our surprise, even though Levenson and Gottman (1983) found that couples’ synchrony increased during discussions of problematic issues, in our research it was the couples (as opposed to

couple-therapist dyads, or therapist-therapist dyads) who showed the lowest EDA synchrony of all the participants in the beginning of therapy. Client-therapist dyads showed more EDA synchrony than did the couples, but the co-therapists showed the highest synchrony of all the dyads present.

Outcome and alliance in couple therapy

Couple therapy has shown to be an effective treatment, with success rates of around 60–75% among treated couples (Lundblad & Hansson, 2006; Gurman & Fraenkel, 2002). The therapeutic alliance (i.e. the working relationship comprising goals, tasks, and the bond between clients and therapists; Bordin, 1979), has attracted considerable interest as a good predictor of therapy outcome in individual psychotherapy (Orlinsky, Rønnestad, & Willutzki, 2004), but it has been studied to a much lesser extent in couple therapy. It should be noted that the interest in the current study was not on the relationship between the therapeutic alliance and the outcome, but rather on whether *physiological synchrony* is related to the alliance and the outcome. Nevertheless, it is useful to consider the possible trajectories of the alliance in couple therapy.

As compared to individual psychotherapy, couple and family therapy situations are special, in that there are several alliances to be established and maintained simultaneously (Friedlander et al., 2006). The couple have their own allegiance, the individual spouses and therapists create dyadic therapeutic alliances, and in the case of co-therapists they also have a mutual working relationship. The importance of between-system (therapists and clients) and within-system (couple) alliances may be different, depending on whether one is comparing psychological symptoms or relational distress as outcomes (Anderson & Johnson, 2010). Furthermore, the participants also observe the alliances of other participants, and hidden agendas may influence how the therapists create and balance the multiple alliances

(Friedlander, Escudero, & Heatherington, 2006). It has been suggested that a “split alliance,” i.e. with one spouse evaluating the alliance as significantly better than the other spouse, might lead to poorer outcomes in couple therapy (Pinsof & Catherall, 1986). In family therapy, moderate or severe split alliance in at least one session has been connected to drop out (Muñiz de la Peña, Friedlander, & Escudero, 2009). However, Knobloch-Fedders, Pinsof, and Mann (2007) found split alliance to be unrelated to the treatment response in couple therapy.

In a meta-analysis of 24 couple and family therapy studies, Friedlander, Escudero, Heatherington, and Diamond (2011) found a medium effect size ($r = .26$) for the association between alliance and outcome. This association is very similar to what has been found in meta-analyses of individual psychotherapy ($r = .275$; Horvath, Del Re, Flückiger, & Symonds, 2011). However, it seems that couples have lower scores on the “bond” spectrum of the alliance than clients in individual therapy, and that the couple scores change less during the therapy process (Bartle-Haring et al., 2012). There are also indications that the connection between the alliance and the outcome may actually be stronger for therapist evaluations than for client evaluations (Glebova et al., 2011). Gender effects have been acknowledged between male and female partners, but there is no clear consensus on how the alliance affects the outcome in relation to gender. The problem (along with methodological issues concerning the nesting of data) is that most studies so far have measured alliance in the initial phase of the therapy, whereas it has been suggested that longitudinal designs are needed to measure alliance and therapy progress (Knobloch-Fedders, Pinsof, & Mann, 2004; 2007).

Aims of the study

The main aim in this study was to analyze whether SNS synchrony between couple therapy participants changes during the therapy process. We were interested in whether the different dyads (i.e. couples, client-therapist dyads, and co-therapists) would continue to show

different levels of EDA synchrony, as they had done at the beginning of therapy (Karvonen et al., 2016), and whether there would be any changes in the synchrony of these dyads (i.e. sub-groups).

Secondly, to evaluate whether SNS synchrony is linked to beneficial or detrimental phenomena, synchrony was analyzed in relation to the outcome of the therapy (in terms of the clients' evaluations of their personal wellbeing), and both clients' and therapists' evaluations of the therapeutic alliance in each session.

Methods

Participants

The participants of the study were clients who came to the Psychotherapy Training and Research Centre (University of Jyväskylä, Finland) in the usual manner. All the couples who contacted the center at the time of the research, and who agreed to join the study, were recruited. The data eventually consisted of 12 couple therapy cases with 24 clients and 10 different therapists, who worked as co-therapists (Figure 1). The average age of the clients was 43 (range 28–61), and of the therapists 52 (range 32–63). The couples were asked to report individually their reasons for seeking therapy. These reasons included mainly problems in the couple's relationship, problems outside the relationship (e.g. with their childhood family or relatives), violence in previous relationships, and previous violence in the current relationship (three cases; there were no reports of violence during the therapy process).

Therapy took place in Finnish, except with one couple with whom the language was English (the couple's native tongue). Eleven of the couples consisted of a male and female client, while one couple comprised two female clients. Nine of the therapist dyads had a male and a female therapist, two dyads had two male therapists, and one dyad had two female therapists. Nine of the therapists were psychologists with several years of experience in

clinical work; out of these, seven were also licensed psychotherapists. One therapist was attending psychotherapy training but was not a psychologist. Seven therapist dyads had previously conducted therapy together, whereas for five therapist dyads this was their first time as co-therapists. All the participants received a “lifestyle assessment” (Firstbeat Technologies, Finland) of their heart rate data after the measuring sessions.

//Figure 1 here//

Therapy sessions

The couple therapy sessions lasted approximately 90 minutes. The two therapists were in the same room with the couple, according to the normal procedure in the Centre. Co-therapy is one way of doing systemic family therapy, and Hendrix, Fournier, & Briggs, (2001) found that sometimes it can produce even more positive outcomes than therapy conducted by a single therapist. The seating arrangement resembled a circle around a small table; the couple always sat next to each other, and the co-therapists also sat next to each other. The therapists were instructed to work in their normal style, which often tended towards a narrative or dialogical approach. The therapy was not manualized, but it contained reflective discussions between the co-therapists, usually towards the end of each session. All the sessions were recorded with six video cameras. The therapy processes lasted on average 7.75 sessions ($Mdn = 6$, $Range = 4-24$, $SD = 5.51$). Apart from one couple (who had 24 sessions), no couple attended for more than 10 sessions. With the couple who ended up having 24 sessions, the change in EDA synchrony was studied over a similar time period than with the other cases (session 2 vs. session 7). The research procedure was approved by the University of Jyväskylä Ethical Committee, and informed consent was obtained from all the participants.

ANS measuring sessions

During the second (in one case the third) therapy session, ANS recordings were conducted for the first time. Within one day of that session, each participant attended an individual Stimulated Recall Interview (Kagan, Krathwohl, & Miller, 1963). Another measuring session, plus interviews, was conducted when the therapy was due to come to an end; these measurements/interviews were performed in sessions 5–7 (*Mdn* = 6 sessions). EDA was measured via exosomatic skin conductance (SC), using a direct current measurement technique. During the measuring sessions both the clients and therapists were wearing ambulatory heart rate monitors (Firstbeat Bodyguard, Firstbeat Technologies) on their chest (having had baseline recording for one or two days), two skin conductance electrodes (Ag/AgCl, Ambu Neuroline 710) on their non-dominant palm, and fabric respiration belts (BrainVision BP-BM-10) on top of their clothes, on the lower chest area.

Disposable SC electrodes were placed below the first and fourth digits and connected to a module (Brain Products), which determined the SC via a DC instrumentation amplifier using 0.5 V constant voltage. The signal was amplified in DC mode and low-pass filtered at 250 Hz. An amplifier (Brain Products Brainamp ExG 16) and a data acquisition program (BrainVision Recorder) were used to record EDA, with a sampling rate of 1000 Hz. A marker unit was used to synchronize the EDA to the video recording.

Questionnaires

The *Partners for Change Outcome Management System* (PCOMS) is an outcome management system using ultra-brief measures to assess both the alliance (Session Rating Scale, SRS; Duncan et al., 2003) and the outcome (Outcome Rating Scale, ORS; Miller, Duncan, Brown, Sparks, & Claud, 2003). It has been found to generate reliable scores (Miller, Duncan, Sorrell, & Brown, 2005). In our study, PCOMS was used mostly for

research; this meant that the therapists had access to the feedback, but that they did not systematically bring it up with the couples.

ORS is a brief visual analog scale of wellbeing, and it was completed by the clients individually at the start of every therapy session. Respondents are instructed to place a hash mark on corresponding 10 cm lines (low estimates starting from the left = 0, high to the extreme right = 10). The four lines cover (i) one's general sense of wellbeing, (ii) personal wellbeing, (iii) family/close relationships, and (iv) work/school/friendships. Hash marks are given numbers to the nearest centimeter (0–10). The clinical cut-off is 25/40 points.

After each therapy session, both the clients and the therapists completed the SRS, which is a visual analog scale similar to the ORS but describing the working alliance. The four lines represent (i) the relationship between the clients and therapists (feeling heard, understood, and respected), (ii) goals and topics, (iii) the therapists' approach/method, and (iv) the overall feeling about the session (including whether something was felt to be missing). There are no data for the therapists, but for the clients, scores of 39–40 reflect a good alliance, 35–38 a fair alliance, and 34 or below a poor alliance (Duncan, & Miller, 2008).

The clients also completed the *Clinical Outcomes in Routine Evaluation–Outcome Measure* (CORE-OM) (Evans et al., 2002) before the therapy started, when the therapy ended, and six months after the therapy had ended. The questionnaire evaluates the mental health and wellbeing of clients. CORE-OM has 34 Likert-type items, each covering five levels of agreement/disagreement, and indicating subjective well-being, problems/symptoms, life functioning, and risk to self/others. The clinical cut-off in Finland is 10 points (higher scores indicate poorer wellbeing).

Analyses of all the questionnaire data were performed using the total scores for each questionnaire.

Statistical analyses

EDA concordance index.

We calculated the EDA concordance indices for 15 different time lags, applying also Monte Carlo shuffling to assess the statistical significance of the concordances, as in our previous work (Karvonen et al., 2016). Thus we modified the methods of Marci and Orr (2006), Marci et al. (2007), and Messina et al. (2013), as described in more detail below.

The EDA signals were resampled to 1 Hz and the average slopes of the EDA were calculated, using a 5-second window, which was moved forward every second. Using successive 15-second windows, Pearson's correlations were calculated for each possible dyad and for time lags from -7 seconds to +7 seconds. This time frame was chosen because a skin conductance response reaches a peak at about 4 seconds, and returns to 50% of baseline in 1–15 seconds, most often in 4–8 seconds; Boucsein, 2012). An index denoting the synchrony level of each dyad during the whole session was calculated from the ratio of the sum of the positive correlations during the session, divided by the sum of the absolute value of the negative correlations during the session. A natural logarithmic transformation was calculated for this index because of the skewness of the ratios. An index value of greater than zero thus reflects a situation in which the dyad members' sympathetic activation changes in a similar direction throughout the therapy session (positive synchrony), i.e. with the arousal level increasing or decreasing in both persons. An index below zero occurs when one person becomes alert and the other relaxes, or vice versa (negative synchrony). If the index is zero, there are equal amounts of positive and negative synchrony between the pair. The range of the concordance index is ca. from -1.00 to +1.00.

To confirm that the observed synchronies were not merely observed by chance, Monte Carlo-shuffled EDA concordance indices were used to assess statistically significant

synchrony. Monte Carlo shuffling was performed in such a way that the time synchrony between the dyads' signals was broken up; thus, for the first subject, the normal 15-second windows were used, but for the other subject the signals from the 15-second time windows were randomly picked from the entire therapy session. After this, the concordance indexes were calculated with 100 random replications and sorted in ascending order. By detecting the 95% point of this sequence a statistical significance level of $p < .05$ was obtained. The highest actual concordance from the -7s to +7 s lags was classified as statistically significant, if the highest Monte Carlo-shuffled concordance from the -7s to +7s lags was not higher than the actual concordance. The time lag, in which each dyad had its highest synchrony, was chosen for further statistical analyses.

To clarify the statistical procedures, the interest lay in concurrent and time-lagged covariation, relating to when there was a *change* in one partner's EDA. Thus, when one person started to become more alert (e.g. emotional) or relaxed, the aim was to detect what happened in the other people who were present.

Trends in the clients' wellbeing (ORS) and the therapeutic alliance (SRS).

A contrast is a linear combination of variables, whose coefficients add up to zero, allowing comparison of different treatments – in this study, between therapy cases. When analyzing change from the beginning of therapy to the end of therapy, two persons can end up with the same amount of change, despite having a very different number of therapy sessions (e.g., one has made rapid progress and the other one slower progress). In order to compare different cases, the change has to be corrected with the number of sessions.

Hence, linear change in the therapy processes was calculated for the ORS and SRS by using contrast values and adjusting the change with the number of therapy sessions. The linear contrast was given the values from -0.5 (the first session) to +0.5 (the last session). For

example, in a therapy case with 10 sessions, the contrast values were -.50, -.39, -.28, -.17, -.06, .06, .17, .28, .39, and .50. The corresponding ORS and SRS values were multiplied using these contrast values, and divided by the length of the linear contrasts. These linear change values were used for correlation analyses.

Other statistical analyses.

Due to the hierarchical nature of the data (six different dyad combinations in each therapy case consisting of four members), Intra Class Correlations (ICCs) and their statistical significance were calculated using the Mplus (version 7.3) statistical program. Maximum likelihood was calculated with robust standard error (the MLR estimator in Mplus). Due to the low ICCs, the COMPLEX method in the Mplus program was used to ensure unbiased estimates of standard errors in testing the differences between the three subgroups (couples, co-therapists, and client-therapist dyads), and the changes in synchrony. The differences in the mean value of EDA synchrony between the three subgroups at the beginning of therapy, and towards the end of therapy, were tested using the Wald test. The null hypothesis was that the couples, co-therapists, and client-therapist dyads would not differ in their mean level of synchrony between the beginning and the end of therapy. Follow-up pairwise comparison tests were analyzed by defining new parameters (Parameter1 = synchrony of the couples – synchrony of the co-therapists, Parameter2 = synchrony of the couples – synchrony of the client-therapist dyads, and Parameter3 = synchrony of the co-therapists – synchrony of the client-therapist dyads). In addition, new parameters were defined and also used to test for changes in the mean level of synchrony within the subgroups, between the beginning and the end of therapy (for example, Parameter4 = synchrony of the couples at measuring time 1 – synchrony of the couples at measuring time 2). Other analyses, such as Pearson's correlations, were conducted using SPSS (version 24).

Results

EDA synchrony

86% of all the dyads ($N = 72$) in the twelve couple therapy cases showed statistically significant positive electrodermal activity (EDA) synchrony (similar changes in arousal) at the start of the therapy. Nine of these cases continued long enough for a second measuring session to be organized towards the end of the therapy. In this second measuring session, 93% of all the dyads had statistically significant positive synchrony ($N = 54$).

In the first ANS recording sessions, the mean EDA concordance index was 0.25 for the couples ($SD = 0.19$), 0.63 for the co-therapists ($SD = 0.18$), and 0.42 for the client-therapist dyads ($SD = 0.21$). In the second ANS recording session towards the end of therapy, the equivalent indices were 0.34 for the couples ($SD = 0.17$), 0.66 for co-therapists ($SD = 0.15$), and 0.40 for the client-therapist dyads ($SD = 0.25$).

The Intra Class Correlation (ICC) in the first ANS measuring session was 0.002 ($p = .968$) and in the second measuring session 0.003 ($p = .990$), meaning that the variance between the therapy cases did not deviate from zero. Due to the low ICCs, a multilevel model was not needed. To correct for the possible bias in standard errors, the COMPLEX method was used. The Wald test showed differences between the subgroups (couples, co-therapists, and client-therapist dyads) in both the first and the second measuring session ($Wald = 23.897$, $df = 2$, $p < .001$, and $Wald = 23.755$, $df = 2$, $p < .001$, respectively). Follow-up tests with the new parameters showed that all the subgroups were different from each other in the first measuring session (all $p \leq .001$).

In the second measuring session the synchrony between the co-therapists and the clients, and between the co-therapists and the client-therapist dyads, continued to be different (both $p \leq .001$); however, the synchrony between the couples was not different from the

synchrony between the client-therapist dyads ($p = .378$). Finally, tests were conducted on whether the synchrony in each subgroup changed. The only statistically significant change was observed in the synchrony between the couples, which increased ($p = .027$). The effect size of this change was medium (Cohen's $d = .57$). Figure 2 depicts the three subgroups in both measuring sessions.

//Figure 2 here//

Therapy outcome based on CORE-OM

At the start of the couple therapy process, the female clients were slightly above the clinical cut-off of 10 points in the CORE-OM ($M = 10.59$). They thus manifested lower wellbeing than their spouses ($M = 6.55$). The clients showed a decrease in CORE-OM scores from the start of therapy to the end of therapy ($t(15) = 2.63, p = .019$), indicating improved wellbeing. The clients' scores were below the clinical cut-off at the end of therapy, and at the six-month follow-up (Table 1). For the following correlation analysis, the change in the CORE-OM scores for female and male clients was calculated (a) from the start of therapy to the end of therapy, and (b) from the start of therapy to the six-month follow-up.

//Table 1 here//

The relationship between EDA synchrony, and therapeutic alliance (SRS) and therapy outcome (ORS, CORE-OM)

In order to identify possible connections between the changes in EDA synchrony and the questionnaire data, the EDA synchrony change from the first measuring session to the second measuring session was calculated for the dyads according to gender. This made the sample sizes equivalent and accounted for possible physiological differences between the genders (females can display higher tonic EDA, while males may show greater EDA reactivity under

stimulation; Boucsein, 1992). Because of the small sample size (change could be calculated for nine therapy cases), the following results should be regarded as illustrative. Note, however, that the correlations had to be strong ($r > .77$) for statistically significant results to appear, and the trends were calculated from $N = 79-93$ therapy sessions (data was not cross-sectional). Tables 2, 3 and 4 show the calculated Pearson's correlations (two-tailed).

A mutual increase in EDA synchrony between the spouses (from the beginning of therapy to the end of therapy) seemed to be connected to three things: (i) a stronger positive trend in the wellbeing of the female clients during the therapy process (ORS); (ii) increased EDA synchrony between the female clients and the female therapists; (iii) decreased EDA synchrony between the male clients and the female therapists. It should be noted that as the EDA synchrony between the male clients and male therapists increased, the female clients showed a positive trend in their evaluations of the therapeutic relationship (SRS); moreover, their wellbeing had improved when therapy ended (CORE-OM). By contrast, the male therapists showed a decreasing trend in their alliance evaluations (SRS) as the EDA synchrony between them and the male clients increased. Interestingly, decreasing EDA synchrony between the male clients and the female therapists appeared to be connected to an increasing trend in the wellbeing of the female clients (ORS); it was also connected to the male therapists giving increasingly better evaluations of the therapeutic relationship (SRS). Finally, an increase in the female clients' and the male therapists' EDA synchrony was connected to improved wellbeing of the male clients at the six-month follow-up (after therapy; CORE-OM).

//Tables 2, 3, 4 here//

Discussion

The aim of this study was to analyze whether sympathetic nervous system synchrony between the participants in couple therapy changed from the beginning of therapy to the end of therapy, and how the changes might be related to the therapeutic alliance and the outcome of the therapy. We had previously found that couples, co-therapists, and client-therapist dyads had different levels of synchrony at the start of therapy: couples had the lowest synchrony, whereas therapists had the highest synchrony (Karvonen et al., 2016). The current analysis showed that the EDA synchrony between the spouses increased to the same level as that between the clients and the therapists. However, there was no statistically significant change in the synchrony between the co-therapists, or between the clients and the therapists.

Clinically, the results suggest that a feeling of emotional disconnection is also reflected as physiological disconnection between the spouses, and that couple therapy may bring spouses closer together also on a physiological level. It is not yet known, whether there is an optimal range of sympathetic nervous system synchrony in therapy processes, but in a relationship enrichment program involving satisfied couples (a “control group” for the current research), the spouses seemed to have higher EDA synchrony during the sessions, as compared to the clinical data (Haltia et al., 2017). Nevertheless, high synchrony cannot be directly defined as good or bad, since it depends on the valence of the situation. Physiological synchrony can reinforce positive relational processes, or support survival in conflict situations (Nelson et al., 2017).

Because of the small sample (nine couple therapy cases), the analysis of connections between EDA synchrony, alliance, and wellbeing should be treated with caution. However, our results were in accordance with the work of Anderson and Johnson (2010), who studied alliance and psychological distress in 173 couples. We observed EDA synchrony to be connected to clients’ individual wellbeing in a similar way as alliance was in their study. When one considers these two studies (on EDA synchrony and on the alliance) together,

certain observations can be highlighted, with possible relevance to couple therapy outcomes. First of all, increasing EDA synchrony/alliance between the male client and the (female) therapist was inversely related to the female client's wellbeing, with greater distress ensuing on the part of the client. Secondly, increasing EDA synchrony/alliance between the spouses was connected to improved wellbeing on the part of the female client. Thirdly, EDA synchrony, and also the alliance, was *not* significantly associated with the male client's wellbeing during the therapy process. Nevertheless, we did find that increasing EDA synchrony between female clients and male therapists seemed to be connected to improved wellbeing on the part of the male client, from the start of therapy to the six-month follow-up.

Overall, our findings support recent conclusions to the effect that SNS synchrony between romantic partners can be linked to positive factors (Timmons et al., 2015): in the present study the increased EDA synchrony between the couple show a strong correlation with a steady improvement in the women's wellbeing during the therapy process. This raises the question of why the strong connection was only found for the female clients and not among the male clients. According to a large meta-analysis by Jackson, Miller, Oka, and Henry (2014), wives in marital therapy are 51% less likely to be satisfied with their marital relationship than their husbands, suggesting more room for improvement in relationship satisfaction. Women may also desire greater intimacy than men, whereas men might desire greater autonomy; this could lead to a demand/withdraw pattern if the partners' needs are not met (e.g. Christensen & Heavey, 1990). This mismatch might have consequences for the relationship on a physiological level: it has been shown that if the couple exhibit low autonomic nervous system synchrony during a conflict, the female partner will experience more negative affect after the conflict (Nelson, Laurent, Bernstein, & Laurent, 2016). Among severely disturbed adolescents, too, alliance or engagement has been observed to play a more

important role for females than males in predicting changes in symptoms (Nevid, Ghannadpour, & Haggerty, 2017).

Hence, the results of this study suggest that physiological connection with the spouse might be especially important for the personal wellbeing of women, and the nature of this relationship should be researched more and taken into account in couple therapy practices. However, causality cannot be determined from correlation. It may be that the EDA synchrony of the couple is more important for the wellbeing of women than it is for men, or alternatively, that the EDA synchrony of the couple tends to be more affected by the women's wellbeing than by the men's wellbeing. On the basis of a study on body movement synchrony among healthy adults, Tschacher, Rees and Ramseyer (2014) favor the interpretation that synchrony causes affect, not the other way round.

Surprisingly, our results suggest that more factors are in play than merely an increase in EDA synchrony between the couple being beneficial to the clients. In fact, the male spouse's *decreased* synchrony with the female therapist was connected to a steady improvement in female clients' wellbeing during therapy. Anderson and Johnson (2010) suggest that this might result from a split alliance, or else from a process in which female clients internalize and manifest stress if their spouses develop a strong alliance with a female therapist. On the other hand, we found that the male spouse's increased synchrony with the male therapist was linked to steadily increasing evaluations of the female clients' therapeutic alliance during the therapy – and also to the improved wellbeing of female clients when therapy ended. This might support Anderson and Johnson's latter interpretation (rather than the "split alliance" interpretation). Furthermore, increased synchrony between female clients and male therapists was connected to improved wellbeing among male clients at the six-month follow-up after therapy. These results appear to suggest the existence of indirect outcomes concerning physiological synchrony with therapists in couple therapy: it is not necessarily *my* synchrony

with the therapist that leads to a good therapy outcome in the long run, but rather how *my spouse* attunes with him. The findings highlight the importance of maintaining alliances with both spouses, and the importance of how these alliances are monitored by the clients (Friendlander et al., 2006).

More research is needed to discover why *decreasing* physiological synchrony between clients and therapists could be connected to something beneficial in couple therapy; after all, in individual psychotherapy, higher EDA synchrony has so far been linked only to positive qualities regarding the interaction, and to the empathy between one client and one therapist (Marci et al., 2007; Messina et al., 2013). As indicated above, the couple's increased EDA synchrony was connected with decreased EDA synchrony between the female therapist and the male client, but increased EDA synchrony between the female therapist and the female client – thus raising further questions about the dynamics of physiological synchrony and the function of it. Anderson and Johnson (2010) have proposed a model in which the distress of women is ameliorated by developing a strong alliance (here EDA synchrony) with the therapists, and relationship distress is ameliorated through a strong alliance (EDA synchrony) between spouses.

It should be noted that with a sample as small as this, one cannot rule out the possibility that a variable other than gender was affecting the results. For example, in the group of female therapists, there were some therapists who had less experience in couple/family therapy than was the case among the group of male therapists. Less experienced family therapists could have a different level of synchrony with spouses than more experienced therapists. Note also that the client data also included three cases of intimate partner violence, in which the targets were females. It could be speculated that the perpetrators and the targets of violence may have different reactivity in arousal than other clients. Nevertheless, numerous studies have demonstrated that relationship violence is highly prevalent among

couples seeking treatment (e.g. Simpson, Doss, Wheeler, & Christensen, 2007); hence the results obtained in this study reflect the situations typically faced by practitioners. Since the aim was to study how the *changes* in synchrony, alliance and outcome are related to each other, if some of the variables remained steady throughout the treatment, this could have masked some possible connections between the variables. This might be especially true for the EDA synchrony between co-therapists and the alliance evaluations.

In our previous work we hypothesized that the high synchrony between co-therapists might be the result of them both directing their attention to the clients, and possibly (because of their role and training) to similar features of the clients' speech and behavior. The current results support this idea, since the EDA synchrony between the co-therapists remained the same throughout the therapy. Nevertheless, the synchrony between co-therapists tended to be very high, so this synchrony could reflect a shared orientation and understanding of the couple's situation. It is also not known whether the variables resulting in the high synchrony remain the same during therapy or change. We do have some observations that when co-therapists have different therapeutic agendas and affiliations in relation to the couple, this may manifest itself in the form of much lower EDA synchrony than is usual between co-therapists (Kykyri et al., unpublished). It should be noted here that the results of the current study might not generalize well into situations with one therapist present in the situation. Nevertheless, we observed somewhat similar levels of EDA synchrony ($CI M = 0.40-0.42$) between clients and therapists, as has been found in individual psychotherapy ($CI M = 0.49$; Marci et al., 2007).

Since the therapeutic alliance has been proposed as one of the best predictors of outcome (e.g. Orlinsky et al., 2004), it was also important to study the relationship between EDA synchrony and the alliance. A *decrease* in EDA synchrony between the male clients and the female therapists was related to a positive trend in the male therapists' alliance

evaluations, whereas an *increase* in EDA synchrony between the male clients and the male therapists was related to a negative trend. In contrast with the latter finding, the female clients showed a positive trend in their alliance evaluations as the synchrony between the male client and the male therapists increased. One reason for the discrepancy might be that clients evaluate a more “primitive” and non-conscious affective alliance, one that seems to be connected with EDA synchrony. By contrast, therapists may focus more on a cognitive type of empathy (Messina et al., 2013). According to Bordin’s (1979) definition of the alliance, it includes agreement on goals, how to achieve them (task), and development of a personal bond. Hence, it might be that the clients emphasize the bond in their evaluations, whereas therapists focus on assessing goals or tasks. A study by Glebova et al. (2011) gives some support to this interpretation; in that study, the couples thought of the alliance as a single phenomenon, but the therapists differentiated between a bond-related and a goal/task-related alliance.

A limitation in our study was that the clients (as two individuals) evaluated the alliance in relation to the co-therapist team, and did not score each therapist separately. The therapists (again as two individuals) also rated the alliance in relation to the couple, not to individual clients (or to their co-therapist). This meant that the EDA concordance of a client–therapist dyad could not in fact be correlated with the alliance of a dyad as such, but rather with a “triad.” This was a conscious decision, taken on the grounds that making the clients evaluate therapists separately might have had unforeseen consequences for the couple therapy process; nevertheless, our decision could have masked some connections with EDA synchrony (such as the client having a good alliance with one therapist but a poor alliance with the other therapist). In the future, it would be interesting to apply more nuanced methods to study the relationship between physiological synchrony and alliance in couple therapy, such as using

the System for Observing Family Therapy Alliances (SOFTA; Friedlander et al., 2006) to analyze systemic aspects of alliance.

Another important limitation in the study was that the clients' wellbeing was only measured individually, and that information concerning relational outcomes such as marital satisfaction was not measured precisely. Anderson and Johnson (2010) suggest that the importance of between- and within-systems alliances might vary, depending on whether the outcome studied is individual or relational wellbeing. In some studies, no link has been found between ANS synchrony and marital satisfaction, suggesting that synchrony may reflect rapidly-changing interactional dynamics more than long-term relationship satisfaction (Nelson et al., 2017). However, in the future it would be important to study both personal and interpersonal aspects related to physiological synchrony, such as wellbeing of individual clients, their personality, emotional self- and co-regulation skills, dyadic adjustment and marital satisfaction.

We would stress that the biggest limitation in this study was the small sample size, comprising 24 clients and 10 different therapists. Despite this, the EDA concordance index analysis was performed with dyad combinations consisting of 54 to 72 pairs, and the alliance and outcome evaluations covered from 79 to 93 therapy sessions, used in the calculation of linear trends. With a larger sample, one could expect to find more connections between EDA synchrony and the different variables.

In conclusion, it seems that sympathetic nervous system synchrony exhibits more complex phenomena in multi-person settings, such as couple therapy, than in dyadic settings. More research will be needed to study also possible moderator and mediator effects, and to discover whether physiological synchrony is linked to the bond-aspect of alliance, or to the synchrony in other interactional modalities, such as body movement or prosodic features. Since our results concerning EDA synchrony and outcome were very similar to those in

Anderson and Johnson's (2010) study on alliance and outcome in couple therapy, it would seem that physiological synchrony shares common ground with the therapeutic alliance. Nevertheless, we did not find very many significant correlations between trends in the alliance and changes in EDA synchrony, and this would suggest that the two phenomena do not overlap completely.

In the future, it would be interesting to move the analysis from the overall session level to brief moments of interaction (seconds and minutes). Thus, one would endeavor to study the interaction qualitatively during moments of high positive and negative EDA synchrony, applying a mixed-method approach. It would also be important to study emotional regulation and possible co-regulation of emotions in relation to physiological synchrony – for example to discover whether patterns of “soothing” or “spiraling” (conflict escalation) could be observed. In any case, to achieve these various aims, a wide-ranging picture of autonomic nervous system activity will be needed, encompassing also the parasympathetic nervous system. The final aim is to combine different interactional modalities, seeking thus to arrive at a comprehensive picture of embodied attunement between people. It is not enough to study task-specific interactions, since talking about “positive issues” and “negative issues” with the spouse in the laboratory does not capture the complexity of natural communication and daily life.

Concerning clinical implications, we would wish to raise awareness concerning the nonverbal, bodily aspects of interaction. Therapists have tended to focus on how meanings change in language, but clients often stress that the most helpful part of therapy is being heard and respected, while feeling safe. If more room can be made for emotional and bodily sensations in therapy, this could be especially helpful for people who have trouble finding words for their experiences. If practitioners pay attention to their own bodily feelings and

observe the bodily reactions in clients, letting the bodily sensations “speak”, new avenues for the therapeutic process may be gained.

With regard to couple and family therapy with more than one therapist, it is important for the therapists to acknowledge each other’s comments and orientation, to avoid the presence of two “different therapies” in the same session. Furthermore, our results, together with the work of Anderson and Johnson (2010), suggest caution in aiming to build a strong alliance (especially if one is a female therapist) with the male client, at the expense of the alliance with the female client. Clinically, it can make sense to put a lot of effort into building an alliance with the spouse who is not so motivated or invested in the therapy, but it would appear that this decision could have pitfalls, in terms of increasing the female client’s distress.

Future research should clarify the role of gender in couple therapy processes – also in relation to therapist gender. Couple therapists must constantly negotiate family dynamics and tap into learned gender roles (Newberry, Alexander, & Turner, 1991). While the gender of the therapist might not have a large effect to individual psychotherapy outcome (Zlotnick, Elkin, & Shea, 1998), there is some evidence that male and female therapists can have different strengths in couple therapy, and might be treated differently by clients (Blow, Timm, & Cox, 2008). For example, male therapists have been found to talk more and be more directive than female therapists in couple therapy (Shields, & McDaniel, 1992).

The challenges in psychotherapy research seem to lie in the identification of effective treatments, finding out the underlying mechanisms of change, and studying the factors that may influence the outcome (Snyder, Castellani, & Whisman, 2006). On the basis of the present findings and the work of other researchers on body movement synchrony (e.g. Ramseyer & Tschacher, 2014), it seems that embodied synchrony does indeed have an effect on outcome and alliance, and that it needs to be further researched in efforts to achieve

effective psychotherapy. Emotional bonds emerge through complex, indirect interactions that are hard to capture by only using observational methods or self-reports (Muñiz de la Peña et al., 2009). In pursuing these efforts, it seems appropriate to view psychotherapy as a “dance”: a unique, constantly fluctuating, and evolving encounter between persons with different relational patterns (Schattner, Tishby, & Wiseman, 2017), in which the ability to attune to and synchronize with others is of the utmost importance.

Table 1

ORS, SRS and CORE-OM

	The first therapy session			The last therapy session					
	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>			
ORS female client	12	27.04	6.05	12	28.58	7.56			
ORS male client	11	26.64	9.00	11	32.18	7.37			
SRS female client	12	36.08	3.73	12	36.79	4.27			
SRS male client	11	36.09	3.21	12	36.92	3.63			
SRS female therapist	10	34.70	3.68	10	36.90	1.91			
SRS male therapist	11	33.77	3.06	11	35.82	1.52			
	Pre therapy			Post therapy			Follow-up (6 months)		
	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>
CORE-OM female client	12	10.59	6.35	8	6.84	2.60	9	8.39	5.39
CORE-OM male client	11	6.55	5.35	8	5.44	2.44	9	5.32	3.94

Note. Outcome Rating Scale (ORS) and Session Rating Scale (SRS) values for the first and last couple therapy session, and Clinical Outcomes in Routine Evaluation – Outcome (CORE-OM) values at the start of therapy, end of therapy, and six-month follow-up. Note that the change in ORS and SRS was not calculated based on the first and last session, but all $N = 79-93$ sessions (linear trend for the whole therapy process).

Table 2

Changes in Sympathetic Nervous System Synchrony

		EDA synchrony female client + male therapist	EDA synchrony female client + female therapist	EDA synchrony male client + male therapist	EDA synchrony male client + female therapist	EDA synchrony co-therapists
EDA synchrony couple	<i>r</i>	.64	.77*	-.44	-.93**	.28
	<i>p</i>	.089	.026	.327	.002	.467
	<i>N</i>	8	8	7	7	9
EDA synchrony female client + male therapist	<i>r</i>		.49	.23	-.44	.40
	<i>p</i>		.265	.620	.382	.323
	<i>N</i>		7	7	6	8
EDA synchrony female client + female therapist	<i>r</i>			-.13	-.68	.62
	<i>p</i>			.805	.094	.101
	<i>N</i>			6	7	8
EDA synchrony male client + male therapist	<i>r</i>				.43	.01
	<i>p</i>				.399	.977
	<i>N</i>				6	7
EDA synchrony male client + female therapist	<i>r</i>					-.63
	<i>p</i>					.132
	<i>N</i>					7

*Correlation is significant at the .05 level

**Correlation is significant at the .01 level

Note. Pearson correlations (2-tailed) between the changes in the electrodermal activity (EDA) synchrony of the dyads, calculated from the beginning phase of therapy towards the end of therapy.

Table 3

Changes in Synchrony and Trends in Therapeutic Alliance

		SRS female client linear trend	SRS male client linear trend	SRS male therapist linear trend	SRS female therapist linear trend
EDA synchrony couple	<i>r</i>	-.36	.08	.53	-.12
	<i>p</i>	.341	.831	.138	.751
	<i>N</i>	9	9	9	9
EDA synchrony female client + male therapist	<i>r</i>	.14	.24	.18	-.50
	<i>p</i>	.749	.562	.675	.205
	<i>N</i>	8	8	8	8
EDA synchrony female client + female therapist	<i>r</i>	.02	.05	.31	.29
	<i>p</i>	.955	.904	.461	.486
	<i>N</i>	8	8	8	8
EDA synchrony male client + male therapist	<i>r</i>	.79*	-.44	-.77*	-.23
	<i>p</i>	.034	.319	.038	.616
	<i>N</i>	7	7	7	7
EDA synchrony male client + female therapist	<i>r</i>	.66	.16	-.90**	-11.00
	<i>p</i>	.107	.730	.006	.818
	<i>N</i>	7	7	7	7
EDA synchrony co-therapists	<i>r</i>	-.07	-.10	-.09	.07
	<i>p</i>	.859	.801	.818	.863
	<i>N</i>	9	9	9	9

*Correlation is significant at the .05 level

**Correlation is significant at the .01 level

Note. Pearson correlations (2-tailed) between the changes in the electrodermal activity (EDA) synchrony of the dyads, and clients' and therapists' linear trends in evaluations of the therapeutic relationship (SRS) during the therapy processes.

Table 4

Changes in Synchrony and Therapy Outcome

		ORS female client linear trend	ORS male client linear trend	CORE-OM female client post therapy	CORE-OM male client post therapy	CORE-OM female client follow-up	CORE-OM male client follow-up
EDA synchrony couple	<i>r</i>	.79*	.43	.34	.28	-.21	-.52
	<i>p</i>	.012	.247	.450	.543	.683	.290
	<i>N</i>	9	9	7	7	6	6
EDA synchrony female client + male therapist	<i>r</i>	.41	.28	-.32	.61	-.47	-.89*
	<i>p</i>	.309	.497	.539	.197	.423	.042
	<i>N</i>	8	8	6	6	5	5
EDA synchrony female client + female therapist	<i>r</i>	.41	.43	.09	.22	-.27	-.59
	<i>p</i>	.310	.283	.851	.638	.659	.295
	<i>N</i>	8	8	7	7	5	5
EDA synchrony male client + male therapist	<i>r</i>	-.54	.16	-.91*	.28	.02	.70
	<i>p</i>	.206	.728	.011	.596	.978	.189
	<i>N</i>	7	7	6	6	5	5
EDA synchrony male client + female therapist	<i>r</i>	-.82*	-.40	-.51	-.38	-.09	.15
	<i>p</i>	.025	.370	.247	.397	.880	.814
	<i>N</i>	7	7	7	7	5	5
EDA synchrony co-therapists	<i>r</i>	.49	-.41	.10	.22	.08	-.27
	<i>p</i>	.186	.267	.832	.636	.881	.608
	<i>N</i>	9	9	7	7	6	6

*Correlation is significant at the .05 level

**Correlation is significant at the .01 level

Note. Pearson correlations (2-tailed) between the changes in the electrodermal activity (EDA) synchrony of the dyads, and (i) clients' linear trends in evaluations of wellbeing (ORS) during the therapy processes, and (ii) the clients' changes in wellbeing (change in CORE-OM from the start of therapy to the end of therapy, and to the six-month follow up). Note that higher scores in CORE-OM equal worse wellbeing (i.e. the direction is reversed).

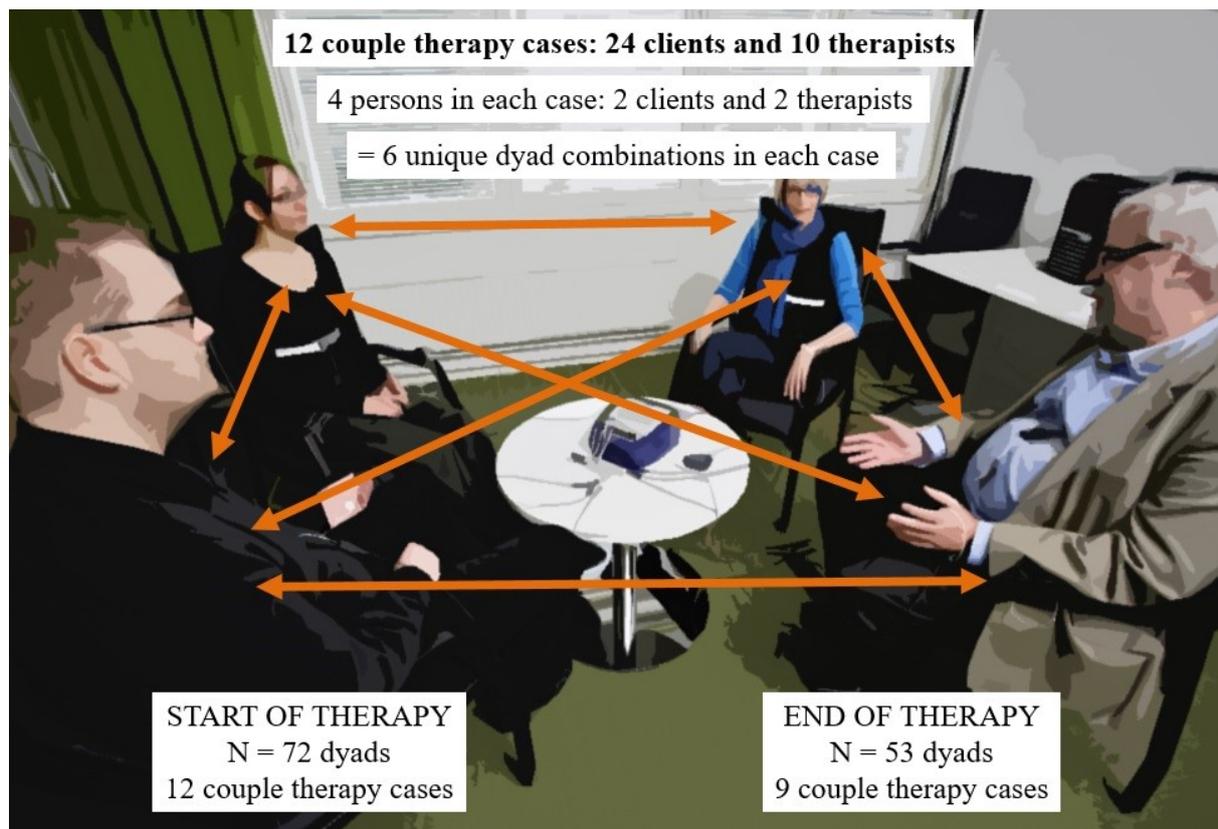


Figure 1. Illustration of the study data, and a simulation picture of the research setting.

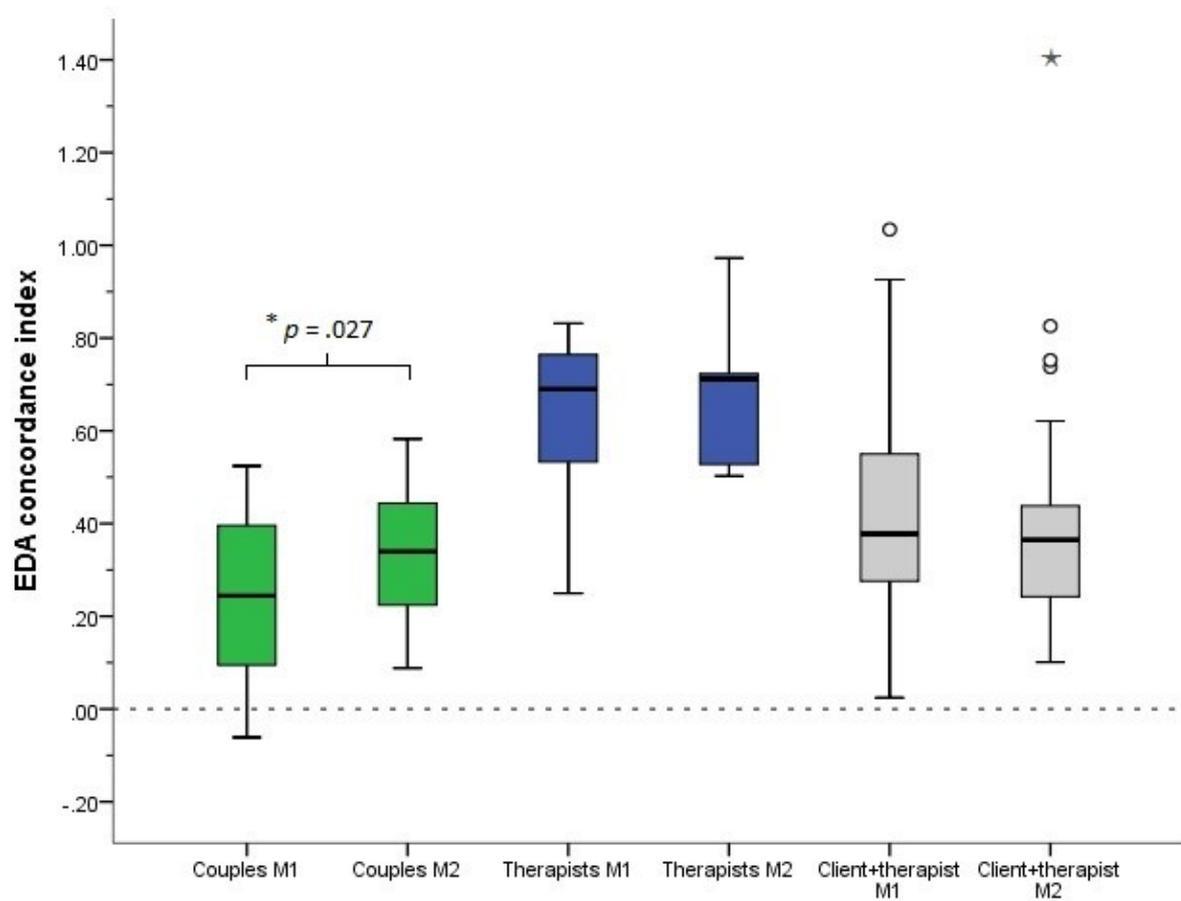


Figure 2. Boxplot figure of the EDA concordance indexes in the first measuring sessions (M1), and the second measuring sessions (M2). The boxes show the first and third quartile, with the median in the middle, and the whiskers representing the minimum and maximum. Outliers are marked with a circle, and one far out outlier is marked with a five-point star.

References

- Ackerman, S. J., & Hilsenroth, M. J. (2003). A review of therapist characteristics and techniques positively impacting the therapeutic alliance. *Clinical Psychology Review, 23*, 1–33.
- Anderson, S. R., & Johnson, L. N. (2010). A Dyadic Analysis of the Between and Within System Alliances on Distress. *Family Process, 49*, 220–235.
- Bartle-Haring, S., Knerr, M., Adkins, K., Delaney, R. O., Gangamma, R., Glebova, T., ... & Meyer, K. (2012). Trajectories of therapeutic alliance in couple versus individual therapy: Three-level models. *Journal of Sex & Marital Therapy, 38*, 79–107.
- Blow, A. J., Timm, T. M., & Cox, R. (2008). The role of the therapist in therapeutic change: does therapist gender matter?. *Journal of Feminist Family Therapy, 20*, 66–86.
- Bordin, E. S. (1979). The generalizability of the psychoanalytic concept of the working alliance. *Psychotherapy: Theory, Research & Practice, 16*, 252.
- Boucsein, W. (2012). *Electrodermal activity*. NY, USA: Springer Science & Business Media.
- Buck, R., Miller, R. E., & Caul, W. F. (1974). Sex, personality, and physiological variables in the communication of affect via facial expression. *Journal of Personality and Social Psychology, 30*, 587–596.
- Campos, J. J., & Johnson, H. J. (1967). Affect, verbalization, and directional fractionation of autonomic responses. *Psychophysiology, 3*, 285–290.
- Christensen, A., & Heavey, C. L. (1990). Gender and social structure in the demand/withdraw pattern of marital conflict. *Journal of Personality and Social Psychology, 59*, 73–81.
- Cirelli, L. K., Einarson, K. M., & Trainor, L. J. (2014). Interpersonal synchrony increases prosocial behavior in infants. *Developmental Science, 17*, 1003–1011.
- Codrons, E., Bernardi, N. F., Vandoni, M., & Bernardi, L. (2014). Spontaneous group synchronization of movements and respiratory rhythms. *PLoS ONE, 9*(9), e107538.
- Coutinho, J., Oliveira-Silva, P., Fernandes, E., Gonçalves, O. F., Correia, D., Perrone McGovern, K., & Tschacher, W. (2018). Psychophysiological synchrony during verbal interaction in romantic relationships. *Family Process*. Online early view: <https://doi.org/10.1111/famp.12371>
- Duncan, B. L. & Miller, S. D. (2008). 'When I'm good, I'm very good, but when I'm bad I'm better': a new mantra for psychotherapists. *Psychotherapy in Australia, 15*, 60–9.

- Duncan, B. L., Miller, S. D., Sparks, J. A., Claud, D. A., Reynolds, L. R., Brown, J., & Johnson, L. D. (2003). The Session Rating Scale: Preliminary psychometric properties of a “working” alliance measure. *Journal of Brief Therapy, 3*, 3–12.
- Evans, C., Connell, J., Barkham, M., Margison, F., McGrath, G., Mellor-Clark, J., & Audin, K. (2002). Towards a standardised brief outcome measure: psychometric properties and utility of the CORE—OM. *The British Journal of Psychiatry, 180*, 51–60.
- Feldman, R. (2012). Bio-behavioral synchrony: A model for integrating biological and microsial behavioral processes in the study of parenting. *Parenting, 12*, 154–164.
- Fishbane, M. D. (2001). Relational narratives of the self. *Family Process, 40*, 273–291.
- Fishbane, M. D. (2007). Wired to connect: Neuroscience, relationships, and therapy. *Family Process, 46*, 395–412.
- Friedlander, M. L., Escudero, V., & Heatherington, L. (2006). *Therapeutic alliances in couple and family therapy: An empirically informed guide to practice*. Washington, DC, US: American Psychological Association.
- Friedlander, M. L., Escudero, V., Horvath, A. O., Heatherington, L., Cabero, A., & Martens, M. P. (2006). System for observing family therapy alliances: A tool for research and practice. *Journal of Counseling Psychology, 53*, 214–225.
- Friedlander, M. L., Escudero, V., Heatherington, L., & Diamond, G. M. (2011). Alliance in couple and family therapy. *Psychotherapy, 48*, 25–33.
- Glebova, T., Bartle-Haring, S., Gangamma, R., Knerr, M., Delaney, R. O., Meyer, K., ... & Grafsky, E. (2011). Therapeutic alliance and progress in couple therapy: multiple perspectives. *Journal of Family Therapy, 33*, 42–65.
- Gurman, A. S., & Fraenkel, P. (2002). The history of couple therapy: A millennial review. *Family Process, 41*, 199–260.
- Haltia, M., Jaatinen, K., Karolaakso, T., Lampinen, E., Kaartinen, J., Penttonen, M., & Kykyri, V.-L. (2017). Pariskunnan keskinäisen kehollisen synkronian tarkastelu edellyttää vuorovaikutustilanteen havainnointia. *Perheterapia, 33*, 21-35.
- Hendrix, C. C., Fournier, D. G., & Briggs, K. (2001). Impact of co-therapy teams on client outcomes and therapist training in marriage and family therapy. *Contemporary Family Therapy, 23*, 63-82.
- Horvath, A. O., Del Re, A. C., Flückiger, C., & Symonds, D. (2011). Alliance in individual psychotherapy. *Psychotherapy, 48*, 9–16.
- Hove, M. J. & Risen, J. L. (2009). It's all in the timing: Interpersonal synchrony increases affiliation. *Social Cognition, 27*, 949–960.

- Hughes, C. F., Uhlmann, C., & Pennebaker, J. W. (1994). The body's response to processing emotional trauma: Linking verbal text with autonomic activity. *Journal of Personality, 62*, 565–585.
- Karvonen, A., Kykyri, V. L., Kaartinen, J., Penttonen, M., & Seikkula, J. (2016). Sympathetic Nervous System Synchrony in Couple Therapy. *Journal of Marital and Family Therapy, 42*, 369–563.
- Karvonen, A. (2017). *Sympathetic nervous system synchrony between participants of couple therapy*. Jyväskylä studies in education, psychology and social research, 599. <http://urn.fi/URN:ISBN:978-951-39-7250-9>
- Knobloch-Fedders, L. M., Pinsof, W. M., & Mann, B. J. (2004). The formation of the therapeutic alliance in couple therapy. *Family Process, 43*, 425–442.
- Knobloch-Fedders, L. M., Pinsof, W. M., & Mann, B. J. (2007). Therapeutic alliance and treatment progress in couple psychotherapy. *Journal of Marital and Family Therapy, 33*, 245–257.
- Konvalinka, I., Xygalatas, D., Bulbulia, J., Schjødt, U., Jegindø, E. M., Wallot, S., ... & Roepstorff, A. (2011). Synchronized arousal between performers and related spectators in a fire-walking ritual. *Proceedings of the National Academy of Sciences, 108*, 8514–8519.
- Kreibig, S. D. (2010). Autonomic nervous system activity in emotion: A review. *Biological Psychology, 84*, 394–421.
- Kykyri, V-L, Tourunen, A., Nyman-Salonen, P., Kurri, K., Wahlström, J., Kaartinen, J., Penttonen, M., & Seikkula, J. (unpublished). Alliance formations in couple therapy – a multi-modal and multi-method study.
- Levenson, R. W., & Gottman, J. M. (1983). Marital interaction: physiological linkage and affective exchange. *Journal of Personality and Social Psychology, 45*, 587–597
- Levenson, R. W., & Gottman, J. M. (1985). Physiological and affective predictors of change in relationship satisfaction. *Journal of Personality and Social Psychology, 49*, 85–94.
- Lundblad, A. M., & Hansson, K. (2006). Couples therapy: effectiveness of treatment and long-term follow-up. *Journal of Family Therapy, 28*, 136–152.
- Marci, C. D. & Orr, S. P. (2006). The effect of emotional distance on psychophysiological concordance and perceived empathy between patient and interviewer. *Applied Psychophysiology and Biofeedback, 31*, 115–128.

- Marci, C. D., Ham, J., Moran, E., & Orr, S. P. (2007). Physiologic correlates of perceived therapist empathy and social-emotional process during psychotherapy. *The Journal of Nervous and Mental Disease*, *195*, 103–111.
- Martin, D. J., Garske, J. P., & Davis, M. K. (2000). Relation of the therapeutic alliance with outcome and other variables: a meta-analytic review. *Journal of Consulting and Clinical Psychology*, *68*, 438–450.
- 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.
- Miles, L. K., Nind, L. K., & Macrae, C. N. (2009). The rhythm of rapport: Interpersonal synchrony and social perception. *Journal of Experimental Social Psychology*, *45*, 585–589.
- Miller, S. D., Duncan, B. L., Brown, J., Sparks, J. A., & Claud, D. A. (2003). The outcome rating scale: A preliminary study of the reliability, validity, and feasibility of a brief visual analog measure. *Journal of Brief Therapy*, *2*, 91–100.
- Miller, S. D., Duncan, B. L., Sorrell, R., & Brown, G. S. (2005). The partners for change outcome management system. *Journal of Clinical Psychology*, *61*, 199–208.
- Miller, S. D., Hubble, M. A., Chow, D. L., & Seidel, J. A. (2013). The outcome of psychotherapy: yesterday, today, and tomorrow. *Psychotherapy*, *50*, 88–97.
- Mønster, D., Håkonsson, D. D., Eskildsen, J. K., & Wallot, S. (2016). Physiological evidence of interpersonal dynamics in a cooperative production task. *Physiology & Behavior*, *156*, 24–34.
- Nelson, B. W., Laurent, S. M., Bernstein, R., & Laurent, H. K. (2016). Perspective-taking influences autonomic attunement between partners during discussion of conflict. *Journal of Social and Personal Relationships*, *34*, 139–165.
- Nevid, J. S., Ghannadpour, J., & Haggerty, G. (2017). The role of gender as a moderator of the alliance-outcome link in acute inpatient treatment of severely disturbed youth. *Clinical Psychology & Psychotherapy*, *24*, 528–533.
- Newberry, A. M., Alexander, J. F., & Turner, C. W. (1991). Gender as a process variable in family therapy. *Journal of Family Psychology*, *5*, 158–175.
- Noy, L., Levit-Binun, N., & Golland, Y. (2015). Being in the zone: Physiological markers of togetherness in joint improvisation. *Frontiers in Human Neuroscience*, *9*, Article 187.
- Orlinsky, D. E., Rønnestad, M. H., & Willutzki, U. (2004). Fifty years of process-outcome research: Continuity and change. In M. J. Lambert (Ed.), *Bergin and Garfield's*

- handbook of psychotherapy and behavior change* (5th ed., pp. 307–390). New York, US: Wiley.
- Palumbo, R. V., Marraccini, M. E., Weyandt, L. L., Wilder-Smith, O., McGee, H. A., Liu, S., & Goodwin, M. S. (2016). Interpersonal autonomic physiology a systematic review of the literature. *Personality and Social Psychology Review, 21*, 99–141.
- Porges, S. W. (2003). The polyvagal theory: Phylogenetic contributions to social behavior. *Physiology & Behavior, 79*, 503–513.
- 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.
- Ramseyer, F., & Tschacher, W. (2014). Nonverbal synchrony of head-and body-movement in psychotherapy: different signals have different associations with outcome. *Frontiers in Psychology, 5*, 979.
- Seikkula, S., Karvonen, A., Kykyri, V. L., Kaartinen, J., & Penttonen, M. (2015). The embodied attunement of therapists and a couple within dialogical psychotherapy: An introduction to the Relational Mind research project. *Family Process, 54*, 703–715.
- Seikkula, J., Karvonen, A., Kykyri, V. L., Penttonen, M., & Nyman-Salonen, P. (2018). The relational mind in couple therapy: a Bateson-inspired view of human life as an embodied stream. *Family Process*. [Epub ahead of print.] doi: 10.1111/famp.12382
- Schattner, E., Tishby, O., & Wiseman, H. (2017). Relational Patterns and the Development of the Alliance: A Systematic Comparison of two Cases. *Clinical Psychology & Psychotherapy, 24*, 555–568.
- Simpson, L. E., Doss, B. D., Wheeler, J., & Christensen, A. (2007). Relationship violence among couples seeking therapy: Common couple violence or battering?. *Journal of Marital and Family Therapy, 33*, 270–283.
- Snyder, D. K., Castellani, A. M., & Whisman, M. A. (2006). Current status and future directions in couple therapy. *Annual Review of Psychology 57*, 317–344.
- Thomsen, D. G., & Gilbert, D. G. (1998). Factors characterizing marital conflict states and traits: Physiological, affective, behavioral and neurotic variable contributions to marital conflict and satisfaction. *Personality and Individual Differences, 25*, 833–855.
- Timmons, A. C., Margolin, G., & Saxbe, D. E. (2015). Physiological linkage in couples and its implications for individual and interpersonal functioning: A literature review. *Journal of Family Psychology, 29*, 720–731.

Tschacher, W., Rees, G. M., & Ramseyer, F. (2014). Nonverbal synchrony and affect in dyadic interactions. *Frontiers in psychology, 5*, 1323.

<https://doi.org/10.3389/fpsyg.2014.01323>

Zlotnick, C., Elkin, I., & Shea, M. T. (1998). Does the gender of a patient or the gender of a therapist affect the treatment of patients with major depression?. *Journal of Consulting and Clinical Psychology, 66*, 655–659.