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EMPIRICAL PAPER

Physiological activation and co-activation in an imagery-based treatment for test anxiety

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Abstract

Objective: The effectiveness of Imagery Rescripting (IR) has been demonstrated in the treatment of various psychological disorders, but the mechanisms underlying it remain unclear. While current investigations predominantly refer to memory processes, physiological processes have received less attention. The main aim of this study is to test whether client physiological activation (i.e., arousal) and client-therapist physiological activation (i.e., synchrony) during IR segments predicted improvement on next-session outcomes and overall treatment response, and to compare these to the role of physiological (co)-activation during traditional cognitive-behavioral (CB) segments.

Methods: The results are based on 177 therapy sessions from an imagery-based treatment for test anxiety with 60 clients. Client and therapist electrodermal activity was continuously monitored, next-session outcome was assessed with the Outcome Rating Scale and treatment outcome was assessed using the Test Anxiety Inventory.

Results: Hierarchical linear models demonstrated that average physiological synchrony during IR segments (but not during CB ones) was significantly associated with higher well-being at both the session and the overall treatment levels. Clients' physiological arousal in either IR or CB segments was not predictive of either outcome.

Conclusion: These results provide initial evidence for the idea that physiological synchrony might be an important underlying mechanism in IR.

Keywords: electrodermal activity; physiological synchrony; Imagery Rescripting; process-outcome research; within- and between associations

Clinical or methodological significance of this article: The findings suggest that physiological synchrony during IR is associated with better session-level and overall outcomes. This information might encourage therapist to “get into” the client’s aversive image and shares some of the experience with their client.

Imagery Rescripting (IR) as an experiential treatment method is designed to directly modify the content of distressing experiences within imagery (Arntz & Weertman, 1999; Holmes et al., 2007). IR directly addresses formative aversive experiences, often rooted in childhood or adolescence, which are considered to play a central role in the formation of core dysfunctional beliefs that are linked to present problems. As such, IR enables clients to mentally

process difficult memories, modify maladaptive meanings, and access new, corrective emotional experiences (Arntz & Weertman, 1999; Rafaeli et al., 2014; Smucker et al., 1995; Young et al., 2003).

Over the last decade, the body of clinical research devoted to investigating IR has grown considerably, and evidence for its effectiveness in the treatment of various psychological disorders has amassed (e.g., posttraumatic stress disorder (e.g., Raabe et al.,

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2015; Smucker et al., 1995), social phobia (e.g., Lee & Kwon, 2013; Reimer & Moscovitch, 2015), test anxiety (Prinz et al., 2019; Reiss et al., 2017); personality disorders (e.g., Weertman & Arntz, 2007), and depression (e.g., Brewin et al., 2009)).

As for the mechanisms underlying its effects, most research to date has pointed to intrapersonal processes, particularly changes in memory representation, occurring in the course of IR (Arntz, 2012). One prominent mechanism ascribed to the technique is a change in the meaning of the aversive experience that occurs through unconditioned stimulus re-evaluation (Arntz, 2012; Dibbets et al., 2012). A somewhat different position, the retrieval competition account (Brewin, 2006; Brewin et al., 2010), suggests that IR brings about an alternative positive memory representation which competes for retrieval with the original negative memory. Other hypotheses about the mechanisms of action in IR refer to the expression of emotional needs and the subsequent facilitated satisfaction of these needs (Arntz, 2012), as well as to the narrative coherence achieved when traumatic events are elaborated and integrated into long-term autobiographical memory (Dibbets & Arntz, 2015).

Common to all these explanations is the focus on intrapersonal memory mechanisms. Notably, there is evidence for a reciprocal relation between memory processes and autonomic functions (e.g., physiological arousal; Bassi & Bozzali, 2015; Critchley et al., 2013; Hugdahl, 1996). For instance, in an early study, Bradley and colleagues (1992) demonstrated that high-arousal stimuli (namely, pictures eliciting greater electrodermal activity) were remembered better than low-arousal stimuli. Thus, we found it worthwhile to examine the role of such arousal as a possible mechanism within IR.

Though the investigation of physiological arousal within imagery is a relatively new field in psychotherapy process research, recent reviews of the extant literature (e.g., Ji et al., 2016) have suggested that mental imagery exerts physiological effects through the evocation of emotion and that these effects may contribute to therapeutic change. Dibbets and Arntz (2015) demonstrated that IR leads to better outcomes when clients are more emotionally activated (specifically, when entire memories versus only parts of a memory are activated). In addition, outcomes in imaginal exposure (IE) therapy were found to be positively associated with clients' initial physiological activity (e.g., Halligan et al., 2006; Kozak et al., 1988). Though IR differs from IE in many respects, it does overlap with it in certain ways: specifically, in both clients are exposed (at least temporarily) to distressing experiences within

imagery (Smucker et al., 1995). Hence, though no studies to date have explored this question, we might expect physiological correlates shown to be relevant to IE to be involved in IR processes as well. Determining whether physiological responses to IR covary with next session symptom change is the first aim of the present work.

An objective measure of psychophysiological states, and one of the most widely used correlates of emotional responsiveness, is electrodermal activity (EDA; Boucsein, 2012; Lang et al., 1998). As a measure of the autonomic nervous system (ANS) activity, EDA is a well-established index of arousal (Sequeira et al., 2009). Additionally, since EDA is solely under control of the sympathetic branch of the ANS, it is considered to be one of the most sensitive physiological indicators of arousal attributable to emotional and cognitive processing, whether conscious or not (Dawson et al., 2017; Sequeira et al., 2009), especially for emotions such as anger, anxiety, and fear (Kreibig, 2010). EDA is also relatively easy to collect, simply requiring two electrodes attached to the participants' hand. In the present study, we therefore relied upon EDA in order to assess the emotional-related physiological concomitants.

A second aim of our work is to go beyond the intrapersonal processes explored to date (whether they be purely cognitive or involve psychophysiology), and consider the possibility that inter-personal factors may also serve as mechanisms of change in IR. In particular, we wish to examine whether *client-therapist dyadic psycho-physiological synchrony* (quantified as the cross-correlation between client and therapist EDA) may also be tied to improvement in clients' next session symptoms as well as overall treatment outcome.

Indeed, synchrony between clients and therapists in a variety of channels has been tied to good outcomes (e.g., Lutz et al., 2020; Paulick et al., 2017; Paz et al., 2021), and this has generally been true of studies examining physiological synchrony, as well (for review, see Kleinbub, 2017). For example, Marci and colleagues (2007) demonstrated a positive relationship between client-therapist synchrony in EDA and client's perception of therapist empathy. Similarly, Bar-Kalifa et al. (2019) recently found synchrony in EDA to predict a positive alliance bond as perceived by clients undergoing imagery work.

While there is still no consensus on the possible mechanisms underlying the effects of interpersonal synchrony in psychotherapy, several converging psychological constructs, such as (co-)regulation and shared experience, have been discussed in previous research.

Specifically, in their influential IN-SYNC (INterpersonal SYNChrony) model, Koole and Tschacher (2016) argued that synchronized clients and therapists engage in a process of co-regulation, in which they share the emotional load and develop a common understanding of internal experiences; the resulting state of “being on the same page” helps clients regulate their emotions.

While the IN-SYNC model puts an emphasis on the regulatory function of synchrony, a complementary process which may accompany synchrony is that of shared experience. Several studies have shown that shared experiences increase the vividness of these experiences in interpersonal relationships. For example, Boothby and colleagues (2014) examined sensory experiences—specifically, tasting sweet or bitter chocolate—and found them to be amplified for better or for worse when they were shared with another person. Boothby et al. (2016) further demonstrated that experience sharing exerts its effect only when the co-experiencer is viewed as psychologically proximate (as clients and therapists are likely to be).

One can think of physiological synchrony as an indicator of shared experience. Specifically, such synchrony may reflect the empathic attunement of therapists to their clients’ experiences. Therapists who “get into” the image described by their clients are likely to attain a better comprehension of the image’s subjective meaning (Bar-Kalifa et al., 2019); the resulting greater synchrony should then facilitate the client’s conscious processing of the emotional experience, as their therapist is in a better position to guide the client and get to the heart of the meaning of their experience.

The present study attempts to extend the existing literature tying physiological synchrony to outcomes in several ways. First, no study to date has investigated physiological synchrony—or, for that matter, physiological arousal—as possible mechanisms in IR. Doing so will help us identify both intrapersonal and interpersonal processes that may improve IR’s effects. Second, only a few studies on the mechanisms of IR have gone beyond single sessions to explore both between-dyad differences as well as within-dyad processes; doing so with physiological arousal and synchrony as predictors is particularly interesting, because both of these predictors are likely to be dynamic constructs (i.e., process variables; see Zilcha-Mano, 2019) that change over the course of therapy. In other words, both constructs may show between-dyad (“trait-like”) variability tied to other dyad-level characteristics, as well as between-session (“state-like”) variability, tied to other characteristics of the session.

In the present study, we used EDA data from 60 clients (and their therapists) who participated in a

6-session imagery-based treatment for test anxiety. Sessions 3 through 6 of the protocol use IR methods which elicit intense emotional responses, alongside traditional cognitive behavioral techniques, which are used to help consolidate the learning process. The juxtaposition of both types of techniques within these sessions allowed us to investigate physiological (co-)activation in each of the contexts and to test the prediction that the physiological arousal (i.e., intensity of client EDA response) and physiological synchrony (i.e., client-therapist cross-correlations in EDA) from the IR segments, but not from the CB ones, will be predictive of next session as well as overall treatment outcomes.

Method

Study Overview

The data were obtained from treatments which took place at a university outpatient clinic in southwest Germany between 2017 and 2020 within an open-trial study investigating the effectiveness and underlying mechanisms of IR in a sample of students suffering from test anxiety (Bar-Kalifa et al., 2019; Prinz et al., 2016, 2019). In this trial, clients were treated with a newly developed six-session treatment protocol, combining cognitive behavioral as well as imagery-based techniques. A more detailed description of the treatment models will be provided below. Following the intake interview, but prior to the first session, every client received a study information sheet and provided written informed consent. They were informed about the general study aims (namely: to test an innovative, emotionally focused treatment manual using IR in the treatment of test anxiety) but they were naive regarding the specific hypotheses of this study. All clients were aware that the sessions will be video-taped and that their heart rate and EDA will be recorded throughout the entire session (note: only EDA data are analyzed in the present study). Beyond that, they were aware that participation is voluntary and that they can stop treatment at any time for any reason and without any negative consequences. Other than receiving the psychological intervention at no cost, participants were not compensated in any way.

Clients

Students were recruited for the study using flyers and a campus newsletter. For inclusion, participants needed to meet the following criteria: (1) receive a *Test Anxiety Inventory (TAI; Spielberger, 1980)*

score higher than 54; (2) report no imminent risk for suicide; (3) not currently be in any other form of psychological treatment targeting test anxiety. Ninety-six potential clients were screened for eligibility. Five were excluded because of TAI scores below threshold. Eighteen completed the intake but opted not to join the treatment because of concerns about the setting and time demands. Seventy-five met the inclusion criteria and started the treatment. Of these, eight clients dropped out during the treatment period after completing four sessions or less. Thus, 63 clients completed the entire 6-session protocol. The recording of physiological data for three of these proved faulty, and thus, 60 clients' data were available for analyses. The majority ($n = 83.6\%$) of clients were females. Clients differed in terms of their academic field, with psychology, law, education, business, and computer science being the most frequent fields. All clients had at least one exam scheduled after treatment. For more client information, see Table I.

Therapists, Training, and Supervision

The therapists in this study were six psychotherapy trainees with an average experience of two years, and twenty masters' students in clinical psychology, with no prior therapy experience. All therapists received intensive training in using the six-session protocol. The training included reading and discussing the protocol, watching sample videos of experienced clinicians conducting IR with actors portraying test anxiety clients, and practicing each

of the six sessions in role plays. Furthermore, therapists attended weekly group supervision throughout the entire treatment period. Training and supervision were delivered by one experienced clinical psychologist, with notably experience in conducting IR.

Treatment Model

The content and tasks of all six sessions were detailed in the protocol (see Prinz et al., 2019; for the full protocol, see www.osf.io/hraqd). A segment of imagery work was a part of every session, alongside psycho-educational (i.e., learning and test-taking skills) and cognitive-behavioral (i.e., identification and cognitive restructuring of maladaptive negative thoughts) elements, as well as assignment and review of homework. The imagery segments within each session differed somewhat (session 1: safe-place imagery; session 2: imagery assessment; sessions 3–4: imagery with retrospective rescripting; sessions 5–6: imagery with prospective rescripting). For the present study, data from the first two sessions were excluded from all analyses, as these sessions did not include rescripting work. The length of the IR segments was on average 25.3 min ($SD = 28.8$) and for CB ones 21.1 ($SD = 11.2$) min.

Overview of IR segments. Prior to each imagery segment, therapists provided a brief introduction to the specific technique to be used; these introductions were kept deliberately short to avoid possible demand effects. Clients were then invited to close their eyes; therapists also closed their eyes for the majority of time, or turned their chairs sideways so as to make the experience more private for the clients. Each imagery segment began with a brief body scan, to facilitate the desired shift in attention from the outside world inwards. During the imagery, clients were asked to describe experiences as if they are happening in the here-and-now (i.e., in first person, present tense language).

The IR segments in the sessions analyzed in the present paper (sessions 3–6) all began with an exploration phase, in which clients were invited to describe the image that came to mind (e.g., a traumatic past test situation or a dreaded future one) in detail. Then, clients were encouraged to focus inwards, and note their emotions, bodily sensations, behaviors (or behavioral tendencies) and cognitions. Once these were clear and vivid, clients were asked to adopt an observer point of view, and prompted to identify what they would have needed (or will need) in this particular situation.

Following this exploration phase, rescripting was carried out. In sessions 3 and 4, clients were asked

Table I. Sample characteristics: demographic and clinical variables.

Variables	Mean	Range
Client age (in years)	25.37	19–57
Academic year	4.6	1–16
	<i>n</i>	%
Marital status		
Single	45	75.0
In relationship	11	18.3
Married	3	5.0
Divorced	1	1.7
Academic field		
Psychology	14	23.3
Law	10	16.7
Education	10	16.7
Business	7	11.7
Computer science	4	6.7
Other	15	25.0
Degree being pursued		
Bachelor	45	75.0
Masters	8	13.3
Other	7	11.7

to step into the situation as their adult self and do whatever is necessary to satisfy the needs of their vulnerable self. If the client has difficulties carrying out the needed action, the therapist requested the client's permission to offer some help, and (if the client consented) did so by proposing possible actions or entering the scene to directly assist the client's adult self. Rescripting continued until the needs of the vulnerable self felt met.

In sessions 5 and 6, clients were invited to try and carry out a desired action in a future scenario. Almost inevitably, this action was blocked by some internal part preventing the client from performing the beneficial behavior. The client invited to identify this part, and then guided in creating a dialogue between this part and their healthier (or more vulnerable) part which had initiated the action. Again, if needed, the therapist would request permission and offer assistance. The aim of this work was to work out a compromise and eventually carry it out to completion in imagery.

Overview of CB segments. The CB segments of each session were based on ideas from Safren et al.'s (2005) cognitive-behavioral protocol for the treatment of ADHD. It included psychoeducation, self-assessment and monitoring, some cognitive restructuring, and the identification of behavioral goals related to learning and test-taking. Much of this work utilized work sheets that were completed in session or as homework, and then reviewed. In the relevant sessions (namely, sessions 3–6), the CB segments covered a progression of topics. In session 3, the client and therapist collaboratively identified and restructured maladaptive negative thoughts and behaviors tied to test-related situations, using monitoring sheets that were introduced in an earlier session. In sessions 4 and 5, learning and test taking skills were discussed with the aim of identifying problematic skills and modifying these. Pragmatic tools such as alarms and timers were discussed in planning the future implementation of these skills. In addition, the role of social support was discussed. In session 6, the content of all behavioral and cognitive skills learned in the previous sessions was reviewed and jointly recapped. This last session also involved the assignment of home-based practice to maintain the intervention's gains.

Measures

Test Anxiety Inventory. The Test Anxiety Inventory (TAI; Spielberger, 1980) is a 20-item self-report measure. The items are answered on a

4-point Likert scale ranging from 1 (almost never) to 4 (almost always). All items can be aggregated to a total score. The TAI showed good internal consistency in our sample of $N = 60$ clients ($\alpha = .88$). Pre-post scores were used to test for symptomatic change.

Outcome Rating Scale. The Outcome Rating Scale (ORS; Miller & Duncan, 2000) is a four-item visual analogue scale. The ORS has four dimensions: (i) overall, (ii) individually, (iii) interpersonal, and (iv) socially. All four items can be aggregated to a total score. The ORS was developed as a brief alternative to the Outcome Questionnaire 45 (Lambert et al., 2004). The ORS was assessed before each session.

Physiological measurement: client EDA and client-therapist EDA synchrony. EDA was monitored using two Ag/AgCl electrodes fixed to the third and fourth digits of both clients' and therapists' non-dominant hand. The signal was recorded with a module using the constant voltage method (Becker Meditec, Karlsruhe, Germany) with a range of 0–100 microS, and sensitivity of 25 mV/microS. The signal was sampled at 500 Hz (National Instruments multifunction Module USB-6002) and a resolution of 16 bits with DasyLab V.10 (National Instruments Ireland Resources, Limited). The signal was down-sampled to 25 Hz and stored as ASCII files. These signals were examined for gross motion artifacts (artifacts were removed by interpolating the particular peak) and for detection of nonresponsive signals (failing to exhibit EDA $> 1\mu\text{S}$ in at least 10% of the data), which were excluded from analyses. EDA was recorded at 1-s intervals, and averaged for analyses across 2-min segments.

Client-therapist EDA synchrony was measured applying cross correlation functions (CCFs) to clients' and therapists' raw EDA data (see also Bar-Kalifa et al., 2019). Before computing the CCFs, we used the `auto.arima` function (forecast package for R: Hyndman et al., 2018) to remove the autocorrelated component for each EDA time series. The function conducts automatized search for ARIMA model parameters by optimizing model fit. We then computed cross correlations with a maximum lag of ± 10 s of the dyad's residualized EDA time series and used the maximal correlation as synchrony index. (For a similar approach, see Bar-Kalifa et al., 2019; Chatel-Goldman et al., 2014; Golland et al., 2015). EDA time series can be non-stationary. Therefore, the time series were divided into 2-min windows. For each of these windows, a consecutive CCF was generated. These were averaged across

Table II. Session-level ORS predicted by prior session and average levels of clients' EDA and dyads' synchrony.

	ORS within IR segments		ORS within CB segments	
	β [95% CI]	p	β [95% CI]	p
Level 1 predictors				
Intercept	-.03 [-.28, .21]	<.001	-.02 [-.27, .24]	<.001
Client's prior session ORS	-.13 [.22, -.03]	.008	-.11 [-.21, -.01]	.032
Client's prior session EDA	-.06 [-.16, .03]	.196	-.06 [-.15, .04]	.277
Dyad's prior session synchrony	-.04 [-.13, .05]	.350	-.04 [-.14, .06]	.241
Level 2 predictors				
Client's average EDA	-.05 [-.27, .16]	.620	.10 [-.12, .33]	.380
Dyad's average synchrony	.23 [.01, .44]	.044	.08 [-.16, .33]	.492

Note. ORS = Outcome Rating Scale, IR = Imagery Rescripting, CB = cognitive-behavioral, EDA = electrodermal activity.

windows to obtain an aggregated index for each session's IR and CB segments.

One hundred eighty-one sessions (out of $63 \times 4 = 252$) were available. Due to technical problems 25 sessions were not recorded. An additional 50 sessions were excluded because of non-responsive signals. To allow the examination of both between- and within-dyad variability, a minimum of two available sessions was required for each client. This led to an additional exclusion of three clients for whom only one session's data were available. In total, 60 clients and 177 sessions were eligible for analysis.

Data Analysis

Assessing the association between clients' EDA, EDA synchrony and next session outcome. Our data has a hierarchical (three-level)¹ structure, with sessions nested within dyads and dyads nested within therapists. To account for this structure, we used hierarchical linear modeling (HLM), a statistical method that takes into account non-independence among observations and is thus ideally suited for studying multi-level data (e.g., Raudenbush & Bryk, 2002). HLM allows for simultaneous investigation of both within-dyad and between-dyad associations (Hofmann, 1997). The HLM model examined whether clients' EDA as well as client-therapist EDA synchrony (indexed by CCF scores) would be associated with the client's next-session ORS ratings. In the model, ORS (during session s of dyad d) was the criterion variable; it was modeled as a function of the client's average EDA (grand-mean centered), the client's EDA in the previous session (person-mean-centered), the dyad's average EDA synchrony (grand-mean centered), as well as EDA synchrony of the previous session (person-mean-centered), and a level 3 random effect (e_{00t} —representing between-therapist variability), a level 2 random effect (u_{0td} —representing between-

dyad variability), as well as a level 1 random effect (r_{tds} —representing between-session variability).

$$\begin{aligned} \text{ORS}_{td(s+1)} = & \gamma_{000} + \gamma_{001} * \text{Avg. EDA}_{td} \\ & + \gamma_{002} * \text{Avg. Synchrony}_{td} \\ & + \gamma_{100} * \text{Session EDA}_{tds} + \gamma_{101} * \text{Session Synchrony}_{tds} \\ & + \gamma_{102} * \text{ORS}_{tds} \\ & + e_{00t} + u_{0td} + r_{tds} \end{aligned}$$

This analysis was conducted twice: once for client's EDA and dyadic synchrony during IR segments, and once for client's EDA and dyadic synchrony during CB segments.

Assessing the association between clients' EDA, EDA synchrony, and treatment outcome. To test the association between clients' EDA, EDA synchrony, and treatment outcome we used an additional 2-level HLM with dyads nested within therapists. Specifically, the following mixed model was estimated:

$$\begin{aligned} \text{TAI}_{\text{post}_{td}} = & \gamma_{00} + \gamma_{01} * \text{TAI}_{\text{pre}_{td}} \\ & + \gamma_{02} * \text{Avg. EDA}_{td} \\ & + \gamma_{03} * \text{Avg. Synchrony}_{td} + u_{0t} + r_{td} \end{aligned}$$

In the model, TAI post-treatment was set as the dependent variable and modeled as a function of TAI pre-treatment, the client's average EDA (grand-mean centered), and the dyad's average EDA synchrony (grand-mean centered). In addition, the model included residual (error) components at levels 1 (between dyads, r_{td}), and 2 (between therapist, u_{0t}). Again, this analysis was conducted twice: once for client's EDA and dyadic synchrony during IR segments, and once for client's EDA and dyadic synchrony during CB segments.

Results

Association Between Clients’ EDA, EDA synchrony, and Next Session Outcome

The HLM models with next session ORS as the criterion variable and with both session-level and average level of clients’ EDA and client-therapist EDA synchrony during either IR or CB segments appear in Table II. As the table illustrates, only the average EDA synchrony during IR was positively associated with clients’ next session ORS levels ($\beta = .22$, 95% CI [.02, .41], $p = .04$).

Association Between Clients’ EDA, EDA Synchrony, and Overall Treatment Outcome

With TAI post-treatment as the outcome, the average EDA synchrony during IR was again the only significant predictor ($\beta = -.25$, 95% CI [-.50, -.01], $p = .033$). Table III presents all results. Figure 1 shows the association between client-therapist EDA synchrony during IR segments and percentage change in pre- to post-treatment TAI scores.

Discussion

The present study aimed to investigate the association between session-level and overall treatment outcomes on the one hand, and client EDA as well as client-therapist EDA synchrony assessed within IR vs. CB segments. To our knowledge, this is the first study examining these associations as potential mechanisms of change in IR. Average client-therapist EDA synchrony during IR was the sole predictor of

both session-level and overall treatment outcomes. Below, we discuss the results related to each of the study’s aims in greater detail.

The first aim of the study was to explore the previously unexamined association between clients’ physiological arousal (i.e., EDA levels) and outcomes. Contrary to our prediction, clients’ session-level arousal during either IR or CB segments was unrelated to next-session well-being; similarly, clients’ average levels of arousal were unrelated to overall treatment outcome. At first glance, these results are surprising. After all, prior research has shown that high physiological arousal, at least during the implementation of emotion-evoking techniques, is associated with better treatment outcome (e.g., Halligan et al., 2006; Kozak et al., 1988). However, a strong physiological response may differ from deep or meaningful emotional processing. Strong activation can instead reflect simple distress. Indeed, physiological indicators such as EDA tap high arousal emotions (e.g., anger or fear) better than low ones (Ji et al., 2016). Whereas IR aims to modify the emotional response within an aversive situation and take it from high to low arousal, EDA might not be the optimal index for such processes. Further research might address this limitation by employing additional autonomic nervous system indices.

Though IR might not benefit from client physiological arousal, it may benefit from the congruence or synchrony between client and therapist physiological arousal—an idea which was the focus of our second aim. As we expected, average client-therapist EDA synchrony within IR segments (but not within CB segments) was indeed associated with both session-level as well as overall treatment outcomes. We reasoned that more effective IR can involve an interpersonal process which forges a link between client and therapist, to the extent that the therapist “gets into” the client’s aversive image and shares some of the experience with their client. In line with our prediction, client-therapist EDA synchrony within CB segments did not show the same association.

Though we expected client-therapist synchrony to be tied so positive outcomes, we (like other synchrony researchers) still feel that much is unknown about the mechanisms that lead to synchrony or that mediate its effects on outcomes. Thus, we (and others: Atzil-Slonim & Tschacher, 2019) hope to see future research exploring this question further. In particular, we are eager to learn whether synchrony during imagery is indeed tied to empathic attunement, and whether this empathic attunement then leads to better outcomes through improved co-regulation (Koole & Tschacher, 2016). In this

Table III. Overall outcome in TAI predicted by average levels of clients’ EDA and dyads’ synchrony.

	TAI within IR segments		TAI within CB segments	
	β [95% CI]	p	β [95% CI]	p
Intercept	-.00 [-.24, .24]	.076	-.00 [-.24, .24]	.130
Client’s pre-treatment TAI	.32 [.08, .57]	.150	.29 [.05, .54]	.060
Client’s average EDA	-.06 [-.30, .19]	.586	-.08 [-.33, .16]	.632
Dyad’s average synchrony	-.25 [-.50, -.01]	.038	-.09 [-.34, .16]	.656

Note. TAI = Test Anxiety Inventory, IR = Imagery Rescripting, EDA = electrodermal activity, CB = cognitive-behavioral.

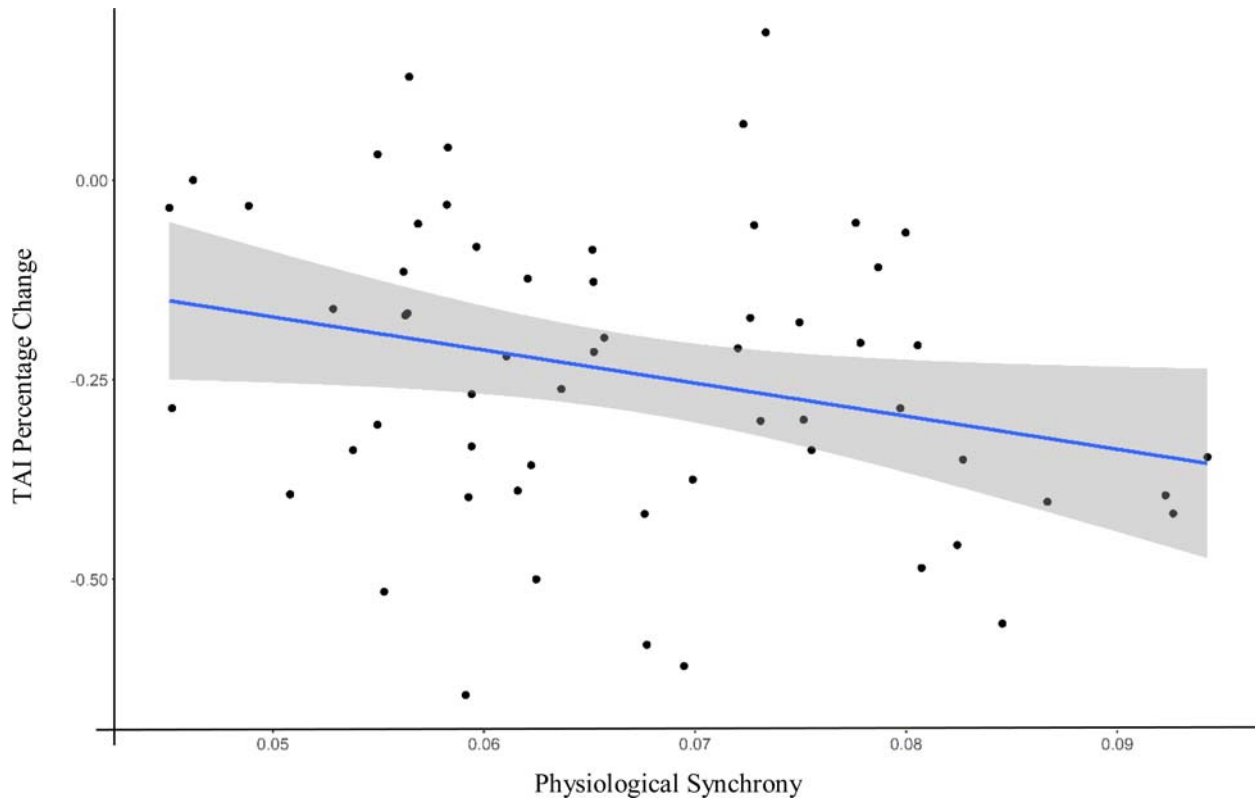


Figure 1. Association between client-therapist EDA synchrony during IR and percentage change in pre- to post-treatment TAI scores. Note: EDA = electrodermal activity, IR = Imagery Rescripting, TAI = Test Anxiety Inventory.

respect, the absence of a within-dyad association between EDA synchrony and next-session outcomes was somewhat surprising. A recent paper by Bar-Kalifa et al. (2019) explored the association between client-therapist EDA synchrony and therapeutic alliance during IR and CB segments of the same treatment protocol described, and found synchrony to be positively associated with therapeutic alliance during IR segments—though only at the *session-level*. This seeming divergence in findings may be attributable to two differences between the studies. First, the different findings for the different dependent variables (alliance versus well-being) may be due to the timing in which the two dependent variables were assessed. Therapeutic alliance was assessed directly after the session, while next-session well-being was measured directly before the next session (in most cases, one week later). Therefore, client-therapist synchrony might have a greater effect on the on session-level alliance rating, because a shorter time has elapsed. Second, the sample included in the earlier study appeared to be less variable across dyads and more variable within dyads in their synchrony scores; this meant there was little chance to find between-dyad effects of the sort found here, but more of a chance to find within-dyad (session-by-session) effects.

Nevertheless, the therapeutic alliance may play an important role in dyadic synchrony. For example, studies on motion synchrony have described it as an embodied component of the therapeutic relationship (Ramseyer & Tschacher, 2011). Similarly, physiological synchrony may also reflect such embodied synchrony—which may or may not be detectable using standard self-reported measures of alliance (e.g., Bar-Kalifa et al., 2019; Koole et al., 2020; Tschacher & Meier, 2020). Given the preliminary nature of this field, we are eager to see future studies further explore the link between synchrony (in various channels) and alliance.

In sum, dyadic synchrony in EDA appears to be involved in IR processes and may be an active ingredient related to symptom improvement and increased well-being. Still, to better understand the mechanisms at hand, future studies will need to further explore the interaction between intrapersonal physiological processes as well as interpersonal physiological patterns on the one hand, and therapeutic outcomes during IR on the other hand. Such studies will also help determine the generalizability of these findings to individuals with other disorders for which IR may be a useful means of intervention.

Limitations and Future Directions

Several limitations of this study are noteworthy. Our results are based on a relatively homogenous sample, which consisted of a population suffering from test anxiety. Replication and extension studies would be needed before generalizing its conclusions to other patient populations or even to patients with test anxiety treated with other protocols. Furthermore, our sample was composed predominantly of young female college students from a wealthy Western European campus. This may also limit the generalizability of the present results to other populations, which requires future studies with more diverse samples.

The unbalanced structure of our data (with the number of clients-per-therapist ranging from 1 to 7) made the interpretation of therapist effects harder than would have been possible with more balanced data. Future research should take that into account.

The study lacks a control group, which weakens our ability to draw outcome (rather than process) conclusions. Future work with this protocol could benefit from comparing it to active controls (other than the multi-baseline design which allowed a comparison among various pre-treatment wait periods—see Prinz et al., 2019); along these lines, it may be interesting to adopt a dismantling design in which certain elements (e.g., particular imagery exercises or certain CB elements) are removed in one arm of the study but not the other, to test their specific contribution to efficacy.

Additionally, our use of CB segments as a within-person control has some drawbacks, especially without counter-balancing the segments. The CB segments in this protocol typically involve conversations between the client and the therapist focused on psychoeducation, elaboration of alternative thoughts, or planning of behavioral exercises. The sequencing of segments within session was determined based on clinical considerations—in some cases (session 3), we scheduled the CB segment earlier in the session, to elicit exemplar situations which were later explored in IR; in other cases (sessions 4–6), we did the reverse. In any case, CB conversations are inherently less experiential and may not afford equivalent opportunities for shared experience as are offered in IR. For this reason, the results should not be seen as a head-to-head comparison between CB and IR interventions and their effectiveness; instead, the CB segments help establish a within-dyad and within-session baseline level. Naturally, IR segments involve more emotion activation than the CB segments (see also Rafaeli et al., 2010; Wheatley et al., 2009).

Though the current study focused on sympathetic arousal (assessed using the EDA index), future work could benefit from a cleaner collection of heart-rate

data from clients and therapists, which would allow examining both sympathetic and parasympathetic functioning (e.g., heart rate variability). The latter may be very interesting as it opens a window into exploring client emotional regulation, and client-therapist synchrony in such regulation (i.e., co-regulation; see Butler & Randall, 2013; Thayer et al., 2009).

Conclusion

This study adds to a growing body of research attempting to unravel how IR works. Our findings underscore the importance of investigations of physiological processes during IR to better understand the mechanisms of action underlying it and to identify ways of making the technique more effective. The present study provides preliminary evidence that client-therapist physiological synchrony—in this case in EDA—may be involved in therapeutic change within IR.

Ethical approval: All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was IRB-approved.

Data availability statement

The datasets analyzed in the current study are available from the corresponding author on reasonable request.

Note

¹ The sample consisted of a variable number of clients-per-therapist (ranging from 1 to 7 [$M = 2.6$, mode = 1]), creating an unbalanced distribution at level 3. In regard to the high therapist effect within both contexts (IR: ICC = .10 and CB: ICC = .10) and the fact that the results of the two-level HLM and the three-level HLM showed no difference, we opted for the three-level model.

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