Journal of Counseling Psychology

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Online First Publication, July 13, 2023. https://dx.doi.org/10.1037/cou0000693

AMERICAN PSYCHOLOGICAL ASSOCIATION

Journal of Counseling Psychology

ISSN: 0022-0167

https://doi.org/10.1037/cou0000693

Biological Marker of Withdrawal Ruptures: Dyadic Pattern of Incongruence in Oxytocin Release

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Despite widespread clinical, theoretical, and empirical support for the importance of alliance ruptures, little is known about the underlying biological level at times of rupture. The overarching goal of the present study was to investigate dyadic patterns of in-session oxytocin (OT) change between patients and therapists (e.g., patient's OT increases more than therapist's OT) as markers of withdrawal ruptures. *Hypothesis 1* construed that OT incongruence (e.g., larger patient increase in OT in comparison to their therapist OT increase) will mark the occurrence of withdrawal ruptures. *Hypothesis 2* construed that this effect of OT incongruence will be more pronounced when anxious attachment orientation is low. Surface analysis was conducted on 628 saliva samples that were gathered before and after therapeutic sessions of 53 patient–therapist dyads enrolled in a randomized control trial treating major depression. Only *Hypothesis 2* received empirical support, meaning it was only when anxious attachment orientation was low that there were significantly more withdrawal ruptures when the patient's OT increase was higher than their therapist's OT increase. This is consistent with the literature, suggesting that in times of withdrawal ruptures, the patient and therapist are in an incongruent state. Findings suggest that this incongruence is mirrored at the biological level only when anxious attachment orientation is low. Results shed light on what may be happening between patients and therapists on a biological level during a withdrawal rupture.

Public Significance Statement

This article provides the first empirical evidence of a potential biological marker for withdrawal ruptures. Findings suggest that a dyadic pattern of incongruence in oxytocin release emerges in times of withdrawal ruptures. This dyadic pattern of incongruence manifested as a patient's increase in OT that is higher than the therapist's increase in OT. This effect of OT incongruence was found only when anxious attachment orientation was low.

Keywords: withdrawal ruptures, oxytocin, attachment, dyadic patterns

Supplemental materials: https://doi.org/10.1037/cou0000693.supp

Over decades, research has demonstrated the consistent association between the working alliance and the success of therapy (Flückiger et al., 2018). For this reason, researchers have focused on understanding the role of alliance throughout therapy, with many theories and empirical testimonies dedicated to the process of rupture and repair (Safran & Muran, 2000). According to these theories, ruptures and repairs are both necessary parts of the therapeutic relationship (Eubanks et al., 2018). Empirical research focusing on ruptures within psychotherapy sessions has made significant contributions to our understanding of the alliance, as well as our understanding of the psychotherapeutic process (e.g., see Urmanche et al., 2019). Today, the gold standard methodology of identifying ruptures is by having objective observers watch therapy sessions and manually search for rupture markers throughout the entire discourse between the patient and the therapist (Eubanks et al., 2015). However, applying manual coding to therapy sessions is labor intensive, as training observers to code, as well as the coding itself, takes quite some time. In addition, it leaves the underlying biological level of the therapeutic relationship unexplored. To help make the process of identifying ruptures less labor intensive, researchers began searching for multidisciplinary markers of ruptures within sessions. One of the most promising markers in this area of research is oxytocin (OT) change throughout the therapeutic session, which also has the potential to shed light on the biological level of the therapeutic relationship.

Ruptures can be defined as a breakdown in collaboration between patients and therapists (Safran et al., 2011). This breakdown can instigate a dyadic process of repair, which potentially benefits therapy progress (Eubanks et al., 2018), provided that the therapist is aware that a rupture has occurred (Chen et al., 2020). The literature has defined two types of ruptures: confrontation ruptures

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This article was supported by the Israel Science Foundation (Grant 1820000738) awarded to Sigal Zilcha-Mano. The authors have no known conflicts of interest to disclose.

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and withdrawal ruptures. Confrontation ruptures occur when the patient directly expresses anger or dissatisfaction with their therapist or therapy. Withdrawal ruptures occur when the patient moves away from their therapist or therapeutic work in an appeasing or submissive manner (Safran & Muran, 2000). As such, confrontation ruptures are more emotionally intense and are thus more likely to impact the therapist directly, leading to situations in which both patient and therapist are aware of the rupture and engaged in it. This dyadic engagement with the rupture could manifest as congruence between patients and therapists in some aspects. For example, moments in which confrontation ruptures occur were reported as possibly characterized by higher movement synchrony between patients and therapists (Deres-Cohen et al., 2021). In contrast, withdrawal ruptures, whether by their typically lower intensity or by their covertness, are less likely to directly impact the therapist (Eubanks et al., 2019; Muran et al., 2021) and therefore more likely to manifest as incongruence within the session.

The current gold standard tools for identifying ruptures entail having an objective observer watch the entire therapy session while searching for rupture markers, such as a complaint or topic shift by the patient (Eubanks et al., 2015). Recently, researchers began implementing interdisciplinary methodologies that expand the current literature on rupture identification. These methodologies involve other realms of behavior, such as motion (Deres-Cohen et al., 2021) and acoustic properties (Dolev-Amit et al., 2021). One of the promising avenues in this respect is OT change, as it can potentially serve as a marker for ruptures, while also allowing an exploration of what occurs within the therapeutic dyad at the biological level.

OT is a nonapeptide produced in the paraventricular nucleus of the hypothalamus. It is involved in the building and maintaining of relationships, across species, as well as in humans (Young, 2015). Studies investigating parent–child (Feldman et al., 2011) and romantic (Schneiderman et al., 2012) interactions suggest that OT plays a key role in forming and maintaining relationships. Studies also show that OT correlates with positive moments that help strengthen the relationship (Arueti et al., 2013; Josef et al., 2019), as well as conflict-ridden moments that cause a strain in the relationship (Ne'eman et al., 2016; Shamay-Tsoory et al., 2009). Because OT is suggested to play a reciprocal role between partners (Feldman et al., 2010, 2013; Vittner et al., 2018), it is crucial to supplement single-person OT studies with studies that search for dyadic patterns of OT change. Dyadic patterns in OT excretion were documented in synchronous social activities (Spengler et al., 2017), such as dance (Josef et al., 2019). Higher levels of OT were also documented in newly acquainted romantic couples, in comparison to singles, and were associated with interactive reciprocity (e.g., affectionate touch, matching of affect; Schneiderman et al., 2012). Additionally, studies researching parent–infant dyads suggest that rising parent OT leads to an OT increase in their infant, which encourages social gaze, exploration, and social reciprocity between them (Weisman et al., 2012).

Two possible dyadic patterns of OT change can be defined: congruent and incongruent. A congruent pattern entails a similar change in OT within both partners of the interaction (e.g., levels of OT increase in both the patient and the therapist), whereas an incongruent pattern entails a differential change in OT between the partners of the interaction (e.g., patient OT level increases or decreases more than therapist OT levels or changes in the opposite direction). An example from parent–infant research demonstrated that skin-to-skin contact was accompanied by a congruent increase in OT, which was suggested to strengthen the relationship (Vittner et al., 2018). Thus, based on the literature, it can be suggested that OT serves a key role in relationships and should be investigated within both interacting partners as a dyadic pattern.

The potential importance of OT was also recently indicated in psychotherapy research (Zilcha-Mano et al., 2021). Although studies investigating OT in psychotherapy are scarce and preliminary, they demonstrate the potential of patient OT levels (Atzil-Slonim et al., 2022; Jobst et al., 2018; Zilcha-Mano, Porat, et al., 2018) and OT congruence (Zilcha-Mano et al., 2021) as predictors of therapy progress. Regarding ruptures, specifically, Zilcha-Mano, Porat, et al. (2018) identified that patient OT levels increase during sessions in which confrontation ruptures occur. In contrast, the occurrence of withdrawal ruptures was not associated with patient OT change. Although these findings suggest a link between alliance ruptures and changes at the biological level (i.e., OT excretion), they are based only on OT change in a single person (i.e., the patient). Dyadic patterns of congruence and incongruence in OT change between patients and therapists have yet to be systematically investigated as markers of alliance ruptures. Only one case study, to our knowledge, has been published on this subject. Zilcha-Mano et al. (2020) analyzed a single case study of a patient with major depressive disorder (MDD) and found that the session with the highest score of withdrawal ruptures was also characterized by OT incongruence. Specifically, OT incongruence was documented as a larger increase in patient OT in comparison to therapist OT.

Congruence and incongruence in other aspects of the therapy, however, have been investigated more systematically. These studies have focused on aspects such as cultural background (Xu & Tracey, 2016), expectations regarding therapy process (Tzur Bitan et al., 2021), ratings of alliance and genuineness (Kivlighan et al., 2017), type of therapeutic interventions perceived to be used in the therapeutic session (Deres-Cohen et al., 2021), and alliance ratings and experiences of genuineness in the therapeutic relationship (Al-Darmaki & Kivlighan, 1993). Additionally, studies investigating synchrony between patients and therapists, in modalities such as movement (Ramseyer & Tschacher, 2011), acoustic properties (Bryan et al., 2018), and physiology (Bar-Kalifa et al., 2019; Tschacher & Meier, 2020), have also reported a positive association with therapy progress and outcome. While these studies used different operationalizations of congruence and incongruence (e.g., difference scores, surface analysis, synchrony), reported findings support the notion that congruence is generally positive and incongruence is generally negative to the therapeutic process and outcome.

While the literature suggests that processes in therapy can be indicated by dyadic patterns between patients and therapists, further consideration is required when considering OT, as individual-level characteristics can influence these dyadic patterns (Macdonald, 2013). The social salience hypothesis suggests that OT regulates the salience of internal and external social cues, and thus its function is highly dependent upon the person's individual characteristics (Shamay-Tsoory & Abu-Akel, 2016). One of the most influential individual characteristics in that regard is the attachment orientation (Bales & Perkeybile, 2012; Gordon et al., 2011). Attachment theory describes both the normative operation of human bonding, as well as individual differences in this operation in the form of deactivation or hyperactivation of the attachment system in avoidantly or anxiously attached individuals, respectively (Mikulincer & Shaver, 2016).

Attachment theory also describes how early experiences with primary caregivers imbue the individual with expectations regarding relationships (Bowlby, 1973; Bretherton & Munholland, 2008). Importantly, empirical studies have linked attachment orientation to differential patterns of OT excretion. The literature suggests that a more secure attachment orientation may be associated with a stronger OT response. For example, in response to their infant, secure mothers showed higher OT excretion than insecure mothers (Strathearn et al., 2009).

Anxious attachment orientation may hinder OT system activity more than avoidant attachment orientation. Recently, it was suggested that OT may build resilience against stress by facilitating processing of social information, converting the novel into the familiar, which in turn allows for stress habituation (Tops et al., 2014). However, this proposed process may malfunction in cases of insecure attachment, when the familiar induces stress by itself, as it is perceived to be unstable or undependable (Ainsworth, 1979; Tops et al., 2014). This may be more pronounced in anxiously attached individuals, as they are commonly more hypervigilant and tend to catastrophize objectively nonthreatening interactions and thus experience more stress (Mikulincer & Shaver, 2010).

While this role of OT in stress habituation is a recent suggestion in the literature (Tops et al., 2013, 2014), there is some empirical support for a weaker OT excretion in response to stress, specifically for anxiously attached individuals. Pierrehumbert et al. (2012) reported that anxious attachment was associated with weaker OT excretion in response to stress, when compared with avoidant attachment, which was also weaker when compared with secure attachment. Feldman et al. (2011) also reported similar weaker OT excretion in response to stress specifically for anxiously attached parents.

The overarching goal of the present study was to investigate dyadic patterns of congruence and incongruence in OT change as markers of alliance ruptures. We had two hypotheses. Given the suggested covert nature of withdrawal ruptures, which often emerge without being identified by therapists, we formulated *Hypothesis 1*: the more the patient exhibits higher OT increase than their therapist (i.e., OT incongruence), the more withdrawal ruptures will occur. Given the suggested weaker OT excretion in anxiously attached individuals in response to stress, we formulated *Hypothesis 2*: The effect of OT incongruence hypothesized with *Hypothesis 1* will be less pronounced for anxiously attached individuals. To test these hypotheses, we analyzed data from a randomized control trial, treating patients with MDD. This population was previously suggested to synchronize less with their therapists, specifically in movement and positive facial expressions (Altmann et al., 2021). However, this synchrony may increase when the therapeutic dyad is in a more congruent state (e.g., with their alliance ratings; Deres-Cohen et al., 2021). We tested the association of congruence and incongruence patterns of OT change between patients and therapists, as measured by saliva samples for both patients and therapists, both before and after the therapeutic session, with the occurrence of withdrawal ruptures in the alliance, as they were measured by objective observers.

Method

Study Design

This study is part of a randomized controlled trial (RCT), comparing supportive therapy (ST) and supportive–expressive therapy (SET; Zilcha-Mano, Dolev, et al., 2018) for MDD. Patients were randomly assigned to ST or SET based on the minimization algorithm (Pocock & Simon, 1975). Factors for balancing were age, gender, family status, baseline depression severity, attachment avoidance and anxiety, and personality disorders. For further information, see supplemental material. Assignment to the treatment arm was conducted by an outside institution not involved in the study. Following randomization, patients received 16 50-min sessions of ST or SET (Luborsky et al., 1995), a time-limited psychodynamic therapy adapted for depression. All procedures were approved by the institutional review board of the University of Haifa (Zilcha-Mano, Dolev, et al., 2018; Approval No. 375/19).

Patients

Out of a 100 patients with MDD enrolled in the RCT, OT was measured for 53 dyads. This is because the procedure of OT measurement for both patients and therapists was added halfway through the trial. All cases in which OT was measured for patients and therapists were included ($N = 53$). Patients were recruited through advertisements offering free treatment for depression as part of a recently ended RCT (Zilcha-Mano, Dolev, et al., 2018). At intake, all patients met the criteria for a primary diagnosis of MDD and were randomly assigned to a supportive treatment group ($N = 26$, 49% of analyzed sample) or a supportive–expressive group ($N = 27$, 51% of analyzed sample). The mean age of the patients was 31.9 years ($SD = 8.52$), and the majority were female (66.04%). Additionally, 44 of 53 patients were single (84%), seven were married or in a relationship (12%), and two were divorced or separated (4%). Forty-five of 53 patients (86%) classified themselves as Jewish, five as Muslim (8%), one as Christian (2%), and two reported "other" (4%). This distribution is similar to the incidences in the general population in the country (Israel Central Bureau of Statistics, 2022). Fourteen of 53 patients reported above-average income (26%), 13 reported average income (24%), 24 reported below-average income (45%), and two did not report information about their income (4%). The mean level of education was 14.68 years ($SD = 2.09$, range between 12 and 22).

Inclusion criteria were (a) scores above 14 on the 17-item Hamilton Rating Scale for Depression (HRSD; Hamilton, 1967) at two evaluations, 1 week apart, and current MDD based on the Mini-International Neuropsychiatric Interview (Sheehan et al., 1998); (b) if on medication, patients' dosage had to be stable for at least 3 months before the start of the study, and patients were asked to maintain stable dosage for the duration of treatment; (c) age between 18 and 60 years; (d) Hebrew language fluency; and (e) written informed consent.

Exclusion criteria were (a) current high risk of suicide or self-harm (HRSD suicide item >2); (b) current substance abuse disorder; (c) current or past schizophrenia, psychosis, bipolar disorder, or severe eating disorder, requiring medical monitoring; (d) history of organic mental disease; and (e) currently in psychotherapy.

Therapists

Six therapists participated in this study, each with at least 6.5 years of expertise in psychodynamic treatment. All had formal training and experience in psychodynamic treatment. The therapists attended a 20-hr training workshop in supportive and expressive

techniques before seeing patients. All therapists completed treatment of two pilot patients, one of each treatment type, and had to demonstrate sufficient adherence before moving to the trial phase. Throughout the study, therapists received weekly personal and group supervision, provided by two experienced, licensed clinical psychologists who themselves received supervision from an international SET expert. Therapists provided both treatment conditions to act as their own controls and avoid nesting of therapists within treatment conditions, which may result in unwanted confounding. Mean clinical experience of the therapists was 12.25 years ($SD = 6.70$), mean age was 39.67 ($SD = 7.23$), and 50% were women. Five of six therapists were married and one was divorced. Five of six therapists classified themselves as Jewish and one as Atheist. The mean number of patients treated by each therapist in the present study was 8.83 ($SD = 4.92$; range = 4–16).

Measures

Salivary OT

OT was measured 628 times overall, before and after sessions 4, 8, and 12, for both patients and therapists. The extraction of OT concentration from salivary samples included two main stages: (a) sample collection, storage, and shipment and (b) extracting OT concentration from the samples. Prior to the sample, patients were asked to wash their mouth and avoid potential confounders 1 hr before (liquid or solid food intake, medication use, and romantic touch). At the time of arrival for treatment, patients were asked to place cotton swabs in their mouth for 2 min (Sarstedt Salivette Nümbrecht, Germany), and these were stored immediately at −20 °C until delivery. The same procedure was conducted for postsession saliva samples. Eventually, a change score was calculated for each measured session (four, eight, and 12) for each participant (patient and therapist). Higher scores indicated that OT levels have increased during the session. Samples were delivered in dry ice, under temperature control maintenance, to the RIAgnosis lab (Sinzing, Germany). For a more specific description of OT extraction and validity, see supplemental material.

Alliance Ruptures

The Rupture Resolution Rating System (3RS; Eubanks et al., 2015) was used to assess ruptures in three sessions over the course of treatment (sessions 4, 8, and 12). All coders received a minimum of 6 months of training (approximately 100 hr) from an experienced coder until they achieved adequate reliability. During the training and coding phase, all coders received weekly supervision to maintain reliability. Each session was coded by a pair of coders drawn from a pool of eight undergraduate students in psychology blind to the study hypothesis. Interrater reliability for withdrawal ruptures in the present study was intraclass correlation coefficient (1,2) = .89. Further elaboration on the coding process is detailed in the supplemental material.

Attachment Orientation

Attachment orientation was assessed using the Experiences in Close Relationships Questionnaire (ECR; Brennan et al., 1998), a self-report questionnaire comprised of 36 items for assessing attachment orientations in relationships. Each item is rated with a Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). ECR examines two primary dimensions: anxiety (Cronbach's $\alpha = .93$) and avoidance (Cronbach's $\alpha = .90$). Higher scores reflect greater levels of insecure attachment within each orientation. The ECR scores were taken in accordance with the measures of OT and alliance ruptures, from sessions 4, 8, and 12. To test how the effect of OT incongruence changed according to anxious attachment orientation, we coded each observation as high or low in anxious attachment orientation. This coding was done according to the median value of the anxious attachment orientation ($Mdn = 3.33$, $SD = 1.11$, range = 1.11–6.22). Descriptive statistics of the variables from the current research are presented in Table 1.

Data Analysis

To test for the effects of congruence and incongruence between patient's and therapist's OT changes on withdrawal ruptures, we used a polynomial regression, followed by a response surface analysis (we applied the same methodology that is detailed in the literature; Shanock et al., 2010, 2014). Response surface analysis requires an initial preprocessing procedure, which creates a composite representation of the mutual influence of two predictors on the dependent variable. The most common methodology reported in the literature is to fit a polynomial regression model, which includes linear, quadratic, and interaction terms of both predictors (Shanock et al., 2010; see supplemental material, for further information). Next, the surface parameters were calculated using the resulting estimates from the polynomial regression. Response surface analysis allowed testing significance for four statistics (a_1 through a_4). These statistics are used to test the effects of both congruence and incongruence separately (Barranti et al., 2017). For further explanation regarding what types of congruence and incongruence effects are tested for in response surface analysis methodology, as well as their meaning, see supplemental material.

For this analysis, OT change values were first centered around each person's (therapist's or patient's) mean. Afterward, five variables were created for the polynomial regression: (b_1) patient OT change, (b_2) therapist OT change, (b_3) a quadratic term formed by squaring patient OT change, (b_4) a cross-product term formed by multiplying patient's and therapist's OT change, and (b_5) a quadratic term formed by squaring therapist OT change. This resulted in the five estimates used for fitting the surface. To these, we added time

Table 1
Descriptive Statistics

Variable	*M*	*Mdn*	*SD*	Range
Patient OT change	.09	.07	.20	(−0.55 to 0.87)
Therapist OT change	.07	.06	.22	(−0.96 to 0.97)
Withdrawal ruptures mean	.75	.32	1.01	(0–4.23)
ECR anxiety	3.38	3.33	1.11	(1.11–6.22)

Note. The units of OT levels for patients and therapist are in pg/ml of saliva, and change scores can be either positive (an increase) or negative (a decrease). Values in brackets indicate the range of each variable from lowest (left) to highest (right). OT = oxytocin; ECR anxiety = anxious attachment orientation; ECR = Experiences in Close Relationships Questionnaire.

as session number to control the effect of time on withdrawal ruptures. The resulting model for *Hypothesis 1* was:

$$y_{it} = b_0 + b_1\mathrm{OT}_{it} + b_2\mathrm{OT}_{jit} + b_3\mathrm{OT}_{it}^2 + b_4\mathrm{OT}_{it} \times \mathrm{OT}_{jit} + b_5\mathrm{OT}_{jit}^2 + b_6 t + e_i, \quad (1)$$

where y_{it} is withdrawal ruptures of patient i in session t, OT_{it} is OT change of patient i in session t, OT_{jit} is OT change of therapist j from session t with patient i, t is session number, and e_i is the residual.

To test for the interaction with anxious attachment orientation (*Hypothesis 2*), we added an interaction variable for each term of the model (b_1 through b_5). This allowed testing of the way the surface parameters changed with anxious attachment orientation. To better describe the effect of anxious attachment on the response surface, we coded attachment as high and low orientation of anxious attachment (by sample median, ECR anxiety = 3.33) and tested for the surface parameters (a_1 through a_4) twice, once for low orientation of anxious attachment and once for higher orientation of anxious attachment. Additionally, we controlled for avoidant attachment orientation in our analysis. The resulting model for *Hypothesis 2* was:

$$\begin{aligned} y_i = {} & b_0 + b_1\mathrm{OT}_{pi} + b_2\mathrm{OT}_{ti} + b_3\mathrm{OT}_{pi}^2 + b_4\mathrm{OT}_{pi} \times \mathrm{OT}_{ti} \\ & + b_5\mathrm{OT}_{ti}^2 + b_6 ECR_{axi} \times OT_{pi} + b_7 ECR_{axi} \times OT_{ti} \\ & + b_8 ECR_{axi} \times OT_{pi}^2 + b_9 ECR_{axi} \times OT_{pi} \times OT_{ti} \\ & + b_{10} ECR_{axi} \times OT_{ti}^2 + b_{11} ECR_{axi} + b_{12} ECR_{avi} + b_{13} t + e_i \quad (2) \end{aligned}$$

where y_{it} is withdrawal ruptures of patient i in session t, OT_{it} is OT change of patient i in session t, OT_{jit} is OT change of therapist j from session t with patient i, ECR_{axit} is ECR anxiety status (low vs. high anxious attachment orientation) of patient i from session t, ECR_{avit} is ECR avoidance score of patient i from session t, t is session number, and e_i is the residual. Finally, sensitivity analyses were conducted by removing outliers (seven outliers; larger than 3.3 absolute standardized value) and by adding rupture repair as a control variable.

Results

As a preliminary analysis, we investigated the mean difference between patients' and therapists' presession OT levels throughout therapy (i.e., OT measured before each session). Patients exhibited a significant yet slight decrease in OT levels as therapy progressed ($B = -0.01$, $SE = 0.006$, $p = .032$). Therapists, however, did not exhibit change as therapy progressed ($B = -0.004$, $SE = 0.005$, $p = .495$). Further, data analysis regarding differences in OT change between patients and therapists across sessions are elaborated in the online supplemental material.

The polynomial regression analyzed for *Hypothesis 1* yielded a single significant effect for time ($b_6 = -0.07$, $SE = 0.02$, $p = .0008$), meaning that as therapy progressed, fewer withdrawal ruptures occurred (within-dyad effect). Additionally, the therapist's OT change also reached significance in predicting withdrawal ruptures ($b_2 = -0.13$, $SE = 0.06$, $p = .049$). However, as therapist OT change is considered by other components of the model (e.g., in interaction with patient OT change), this main effect is essentially a marginal effect of therapist OT change. Interpretations of marginal effects (i.e., main effects) should be considered carefully when interaction terms are included in the model, even if those did not reach significance (Brambor et al., 2006).

No surface parameters (a_1 through a_4) yielded significance for *Hypothesis 1*. This means that, at the sample level, without including attachment orientation in the model, OT congruence or incongruence did not indicate the occurrence of withdrawal ruptures (*Hypothesis 1* is rejected). The polynomial regression analyzed for *Hypothesis 2* yielded significant effects of time ($b_{13} = -0.07$, $SE = 0.02$, $p = .001$), meaning that as therapy progressed, fewer withdrawal ruptures occurred (within-dyad effect) while controlling the effect of attachment orientation. Additionally, therapist's OT change ($b_2 = -0.25$, $SE = 0.09$, $p = .005$); therapist's OT change in quadratic term ($b_5 = 0.11$, $SE = 0.05$, $p = .02$); and anxious attachment orientation ($b_{11} = 0.44$, $SE = 0.21$, $p = .03$). were also significant in predicting withdrawal ruptures. As therapist OT change and anxious attachment orientation are considered by other components of the model (e.g., in interaction with patient OT change), these main effects are essentially marginal effects and are further interpreted in the supplemental material, as well as a full description of the polynomial models.

For *Hypothesis 2*, surface parameters reached significance only when anxious attachment orientation was low. Specifically, a significant a_3 parameter was identified ($a_3 = 0.32$, $SE = 0.12$, $p = 0.032$), which indicates a linear slope of the incongruence line imposed on the response surface (see Figure 1C). This means that the more a patient's OT change was higher than the therapist's (i.e., larger increase), the more withdrawal ruptures occurred (see Figure 1 A). Surface analysis reached no significance when anxious attachment orientation was high (*Hypothesis 2* is supported). These findings remained after removing outliers in OT change that were higher than 3.3 standardized score in absolute value for either patients or therapists ($N = 7$). These results also remained when controlling for rupture repair.

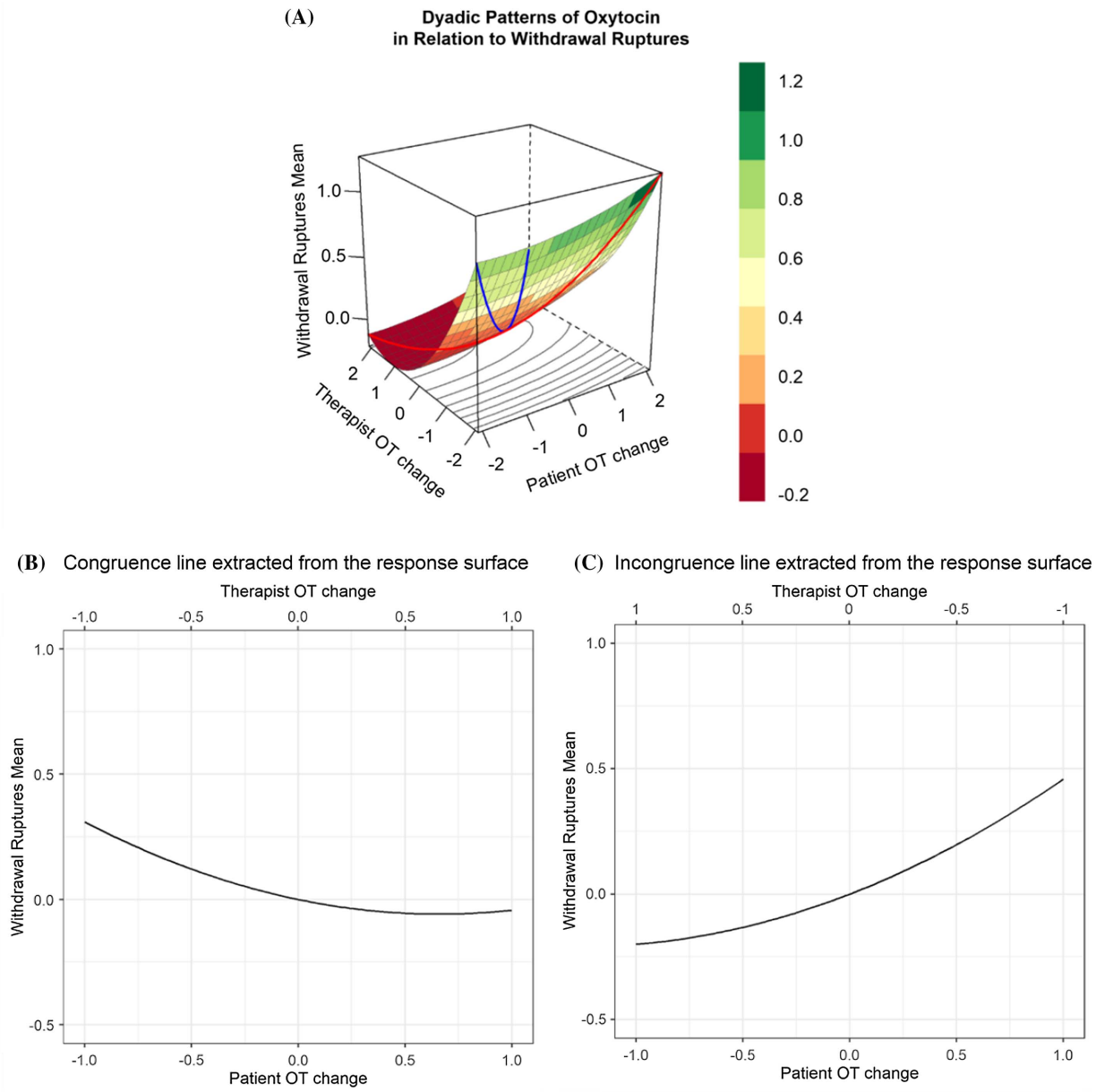
Discussion

The overarching goal of the present study was to investigate dyadic patterns of congruence and incongruence in OT change as markers of alliance ruptures. To accomplish this overarching goal, this study had two hypotheses. The first hypothesis was that the more the patient exhibits higher OT increase than their therapist (i.e., OT incongruence), the more withdrawal ruptures will occur. The second hypothesis was that the effect of OT incongruence hypothesized with *Hypothesis 1* would be less pronounced for anxiously attached individuals. Only the second hypothesis received empirical support. This dyadic pattern of OT incongruence is consistent with the definition of withdrawal ruptures as an incongruence within the therapeutic dyad (Safran et al., 2011). Results also suggest that this dyadic pattern of OT incongruence marks the occurrence of withdrawal ruptures only when anxious attachment orientation is low. As far as we know, this is the first demonstration showing the dynamic of withdrawal ruptures between patients and therapists as they are mirrored at the biological level.

An interesting finding of the present study is that the expected effect of OT incongruence was found only when attachment anxiety orientation was low. By indicating that the effect of OT incongruence does not emerge for anxiously attached patients, these findings may provide a glimpse into an underlying biological

Figure 1

Response Surface Analysis of Patient's and Therapist's OT Changes Among Low Anxiety Attachment Patients



Note. Panel A. The *x*- and *y*-axes represent patient's and therapist's (respectively) OT changes from pre- to postsession. The *z*-axis is patient's mean of withdrawal ruptures. The a_3 parameter was significant only when anxious attachment orientation was low, meaning that the more the patient's OT change was higher (i.e., larger increase) than the therapist's OT change, there were more withdrawal ruptures This effect displayed by the incongruence linear line starts from the bottom left corner of the cube and runs to the upper right corner. Panel B. Two-dimensional representation of the congruence line, represented as the blue color in Panel A. This line represents the relationship between congruence trend in OT change between patient and therapist and withdrawal ruptures. The second *x*-axis above the plot represents a therapist OT change that is similar to the patient OT change. No significant trends were identified for the congruence line. Panel C. Two-dimensional representation of the incongruence line, represented as the red color in Panel A. This line represents the relationship between incongruence trend in OT change between patient and therapist and withdrawal ruptures. The second *x*-axis above the plot represents a therapist OT change that is opposite to the patient OT change. A significant linear trend was identified for the incongruence line, the more the patient OT change was higher than the therapist OT change, the more withdrawal ruptures occurred. OT = oxytocin. See the online article for the color version of this figure.

process at play during a withdrawal rupture. It is interesting to speculate about the specific critical role that the attachment system may play in the occurrence of a rupture. One potential interpretation is that, in the moments leading up to a rupture, the patient feels distressed as their needs are not being met by their therapist (Muran et al., 2021). This interpersonal distress can activate the attachment system (Mikulincer & Shaver, 2016), as is perhaps indicated by the patient's OT response. Our findings suggest that attachment orientation plays a critical role in this chain process, which may not function normally for anxiously attached patients. Anxious attachment orientation is defined as an overactivation of the attachment system, which commonly induces stress for the individual (Mikulincer & Shaver, 2016).

A possible post hoc explanation that the findings were significant only for those with lower levels of attachment anxiety is that, for anxiously attached patients, this constant hyperactivation of the attachment system overshadows the specific OT response to the withdrawal rupture. This suggested interpretation is supported by both theoretical conceptualization within attachment theory and the available literature on OT. Regarding attachment theory, anxious attachment orientation is classically linked to overactivation of the attachment system, even in neutral contexts, regardless of interpersonal distress (i.e., ruptures; Mikulincer et al., 2002; Shaver & Mikulincer, 2002). Regarding OT, numerous studies have provided evidence that OT excretion and attachment orientation interact and influence each other (Fox & Hane, 2008; Pierrehumbert et al., 2012; Strathearn et al., 2009). Furthermore, the biobehavioral model (Feldman, 2012) addresses this mutual influence as part of a larger multisystem synchrony phenomenon, where biological and behavioral processes of attachment interact and influence each other.

Findings are consistent with a leading theory regarding the role of OT. The social salience hypothesis (Shamay-Tsoory & Abu-Akel, 2016) integrates many apparently contradictory empirical findings in the field and suggests that OT regulates the salience of internal and external social cues. Additionally, this theory stresses the importance of individual characteristics, including attachment orientation, as they can influence the response and role of OT. The present study demonstrates this potential influence of individual characteristics by reporting different OT responses when the attachment system operates in low versus high levels of anxiety. Furthermore, considering the social salience hypothesis of OT, an increase in patient OT at times of withdrawal ruptures may indicate their increased sensitivity to external social cues exerted by their therapist. Importantly, by virtue of their hypervigilance and hypersensitivity (Mikulincer & Shaver, 2016), anxiously attached patients may be sensitive to external social cues exerted by their therapist even in objectively neutral contexts, regardless of an occurring rupture. In other words, an alliance rupture may not prove to be a change in context for them and thus does not entail a change in activity of the OT system. This interpretation should be considered cautiously, however, as it is only based on preliminary results and requires further reinforcement by future studies.

Important clinical implications can be carefully suggested when considering withdrawal ruptures and OT response as signaling behaviors. It can be suggested that, when a patient with low anxious attachment orientation feels their needs are not being met, the attachment system is activated, signaling distress and interpersonal need (Kobak et al., 2016). This signaling can manifest both behaviorally to their therapist (i.e., their caregiver) in the form of a rupture marker (e.g., silence or changing the topic) and physiologically and internally with the OT system (probably in addition to other physiological phenomena). However, clinical wisdom and psychotherapy research have demonstrated that, in the case of withdrawal ruptures, these signals are too minor and often go unnoticed and stay "under the radar" of the therapist (Eubanks et al., 2019). Our findings add to this literature by documenting a possible discrepancy within patients between the seemingly low intensity of their behavior (withdrawal markers such as silence or changing a subject) and the high intensity of their biology (an increase in OT).

Significant clinical implications can be carefully suggested based on these interpretations of the results. First, therapists may benefit from training that focuses on honing the skill of identifying these minor behavioral signals (Eubanks et al., 2019), so they will better identify that their patient is distressed and requires the care and attention of the therapist as an attachment figure. Therapists may also benefit from education that raises awareness about internal processes occurring within the patient (e.g., that cause an increase in OT levels) that does not directly correspond with similar processes within the therapist. This knowledge may be of use to the therapist by providing more nuanced information to their understanding of the current state of the therapy. Second, therapists can perhaps help their patients to recognize these minor signals and strengthen them in therapy sessions. Later, this can be generalized to significant others outside the therapy room. Although consistent with theoretical and clinical knowledge about ruptures, these suggestions should still be considered carefully, as these findings require further replication by future studies. These implications may be relevant only for patients with low anxious attachment orientation, as no significant effects were found for patients with high anxious attachment orientation.

In addition to dyadic patterns of OT, some single-person effects have emerged as significant in the polynomial models. Regarding OT, results further indicate that a decrease in therapist OT was associated with greater occurrences of withdrawal ruptures. This finding may suggest that therapists are not only unaware of the occurring rupture but are also less sensitive to social cues exerted by their patients at times of withdrawal ruptures (Shamay-Tsoory & Abu-Akel, 2016). Regarding attachment, results indicate that individuals characterized by higher anxious attachment orientation tend to initiate more withdrawal ruptures. This is consistent with literature suggesting that insecurely attached patients tend to show more withdrawal ruptures (Miller-Bottome et al., 2018). However, these interpretations are based on marginal effects in a statistical model that considers the variability of these components in other, nonsignificant interaction components as well. As such, interpretations should be considered carefully (Brambor et al., 2006). Given the post hoc nature of these findings, future research is needed to further substantiate these interpretations by directly testing for these and other potential indicators of withdrawal ruptures to achieve a more complete phenomenological description.

The results of this study should be interpreted with care as there are some limitations to consider. First, this is the first attempt to investigate dyadic patterns of OT change as markers of withdrawal ruptures. Further research is required to replicate this finding and consolidate this connection between the emergence of withdrawal ruptures and OT change of both patient and therapist.

Second, although the reported sample size is large relative to other studies on OT in psychotherapy, it is still small to medium: Future studies should test for these findings with larger samples. Third, the association between OT incongruence and withdrawal ruptures was tested in specific preselected sessions according to the treatment protocol. Future analyses should test if these findings remain when analyzing session by session. Fourth, we measured peripheral OT via saliva samples. There is an ongoing debate and research in the literature about the correlation and validity of different methods of OT measurement (for an extensive review, see McCullough et al., 2013). Future studies are encouraged to investigate dyadic patterns of OT using different established methods of OT measurement (e.g., plasma). Fifth, OT measurements occurred before and after the sessions, while ruptures could have occurred throughout the session; for example, either close to its end or in the first few minutes. Considering the expected time delay between occurring events and the individual peripheral OT response (10–15 min; Geva et al., 2020; Jong et al., 2015), some ruptures may have influenced the measured OT more than others. Unfortunately, this was unavoidable, as continuously measuring OT throughout the session is not yet possible without measurement equipment that is too intrusive for the therapeutic situation. Finally, ruptures were not the only events that may have influenced patients' and therapists' OT response. It is safe to assume that many within-session dyadic processes are interacting with the OT system. Additionally, different attachment orientations of patients probably entail different kinds of interactions with their therapists. More research is required to turn this pioneering study into a more complete demonstration of the link between patient characteristics, properties of the therapeutic relationship, and the underlying biological processes.

The present study demonstrates that, for individuals with low anxious attachment orientation, a higher OT increase (compared to their therapist) may indicate the occurrence of a withdrawal rupture. Findings are consistent with theoretical literature on attachment and OT and may suggest that the incongruence between patients and therapists at times of withdrawal ruptures is mirrored at the biological level. As findings regarding patients with low anxious attachment orientation suggest that these ruptures are more emotionally arousing for them than they let on, training therapists to attend to signals of distress by their patients might be beneficial. In turn, therapists can help patients learn how to better communicate their needs, first in therapy, and later to significant others in their life.

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Received December 1, 2022
Revision received May 22, 2023
Accepted May 22, 2023 ■