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How Getting in Sync Is Curative: Insights Gained From Research in Psychotherapy

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We are all constantly going in and out of sync with the people we meet in our lives: significant others, incidental encounters, and strangers. Synchrony is a ubiquitous phenomenon, considered an evolution-based mechanism of survival. In recent years, technological development has made it possible to collect much data on synchrony across disciplines. The collected data show great potential to shed light on the benefits of this universal phenomenon. At the same time, mixed results emerged, stressing the need for a theory to navigate research inquiries and discoveries. It is proposed here that synchrony serves as an individual-specific mechanism for making relationships curative in all life circumstances, especially therapeutic ones—hence its special relevance for psychotherapy. A synthesis of the majority of the literature across disciplines reveals two implicit assumptions about synchrony, resulting in two separate bodies of knowledge: (a) synchrony is a trait-like signature characterizing individuals; and (b) synchrony is a state-like phenomenon that can be manipulated in the lab. It is proposed here to personalize synchrony research by integrating the two assumptions into a comprehensive theory according to which individuals have a trait-like signature for getting in sync, which determines their physical and mental health, and that this deterministic reality can be subject to state-like manipulation. Individuals can deviate from their trait-like signature. When the deviation is toward normative activation, mental health improves, and the state-like changes are defined as therapeutic. This article calls for research to investigate how trait-like signature of synchrony develops and how it can be therapeutically changed.

Keywords: synchrony, therapeutic relationship, trait-like, state-like, multimodal

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Human beings are social creatures, constantly moving from one interpersonal interaction to the other, from the first day of our lives to the last one. These interactions affect our life expectancy as well as our physical and mental health (Holt-Lunstad et al., 2010, 2015). Psychotherapy is one such form of interpersonal interaction, a unique one, encapsulated at a certain day of the week and time of the day when two (or more) individuals assemble to bring a cure to at least one of them. Patient and therapist are generally seated one in front of the other and engage in the treatment tasks. In a psychotherapy session, from one moment to the next the patient and therapist may go in and out of sync in their acoustic parameters, motion, facial expressions, physiology, and temperature. At some moments it is as if they merged and became one unit that dynamically moves across time, fully calibrated, and synchronized. At other moments it is as if two strangers were sitting at two distant

points of the universe and almost nothing in their measurements reveals that they are facing each other in the same room, engaging together in the task of searching for relief from suffering of one of them. Is it therapeutic to get in sync? Or maybe it is therapeutic to go out of sync? Or maybe both are therapeutic to the same degree? Alternatively, do we need to know more about the individuals' tendencies to go into sync to determine what is therapeutic for them?

While at least some of these open questions have been of interest for a long time (e.g., Condon & Ogston, 1966), with the recent advances in technology and data science, they are becoming empirical. Indeed, most of the research on synchrony has been conducted in the past couple of years. The great clinical research interest shown in these questions resulted in extensive data collection together with a search for a theory to guide empirical exploration, formulate research questions, and explain the mixed evidence already assembled (Atzil-Slonim et al., 2023; Dales & Jerry, 2008; Koole & Tschacher, 2016; Koole et al., 2020; Wiltshire et al., 2020). This article proposes that the new advances in technology that enable measuring synchrony across modalities (acoustic parameters, motion, facial expressions, physiology, temperature, etc.) have the potential to answer one of the oldest theoretical questions that science and humanity have been struggling with: what makes a relationship with another individual curative?

What Is Interpersonal Synchrony?

The word “synchrony” originates from the combination of the Greek word *syn*, which means common or the same, and the term *chronos*, which means time. “Synchronous” means occurring at the same time. Synchrony always refers to a composite of at least two units of analysis. It can be *intrapersonal* synchrony between at least two

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Sigal Zilcha-Mano played a lead role in conceptualization, visualization, and writing—original draft.

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modalities within the same individual, or *interpersonal synchrony* between at least two individuals. In this article, the focus is on *interpersonal synchrony*, therefore the number of individuals is always at least two. Although size matters (Mogan et al., 2017), the focus in this article is on two, which is the number of individuals involved in the most common forms of psychotherapy. Interpersonal synchrony is thus defined here as *the dynamic correspondence (Scheidt et al., 2021) and spontaneous rhythmic and temporal coordination of two individuals' reciprocal actions, emotions, thoughts, and physiological processes* (Ackerman & Bargh, 2010; Palumbo et al., 2017).

Synchronization is a ubiquitous phenomenon that characterizes inanimate and animate objects (Ancel et al., 2009; Duranton & Gaunet, 2016; Pays et al., 2009; Sakai et al., 2010), but it plays even more critical role in interactions between human beings, who are social creatures. It has been suggested that given the critical importance of interpersonal relationships for human survival, in the course of evolution, humans have been able to maintain much larger social networks than would be expected given our brain size due to synchronization (Launay et al., 2016). Thus, it has been argued that interpersonal synchrony is an evolution-based mechanism facilitating social cohesion and bonding (Launay et al., 2016).

Human infants adopt their mother's biological rhythms already in utero (Ivanov et al., 2009; Van Leeuwen et al., 2009). From birth, babies synchronize with their parental figures (Feldman, 2017). Throughout the lifespan, synchronized interactions have been documented between babies and their caregivers (Feldman, 2017), romantic partners (Schneiderman et al., 2012; Ulmer-Yaniv et al., 2016), close friends (Feldman et al., 2013), members of military units (Levy et al., 2016), and even strangers when sitting in close proximity and executing joint tasks (Golland et al., 2015).

Synchrony Is a Multimodal Phenomenon

The modalities of interpersonal synchrony that have been most widely researched empirically to date are movement, physiology, acoustics, language, and brain-to-brain coupling. Across studies, the phenomena of synchrony have been documented in many modalities, but the vast majority of the studies focused on a single modality, in isolation from the others, despite the common assumption that these modalities are likely to be meaningfully interrelated (Koole & Tschacher, 2016; Mayo & Gordon, 2020; Shamay-Tsoory et al., 2019). In real life, interconnections between modalities are assumed to be the norm. Already in the first hours of life, the primary caregiver produces a range of stimuli across modalities: touch, sound, movement, etc., and the infant starts to be rewarded (by food, sleep, hygiene, etc.) for interacting and being in sync with the caregiver figure. During episodes of social synchrony in the gaze and affect modalities, there is a coupling of the parent's and infant's heart rhythms (Feldman, Gordon, & Zagoory-Sharon, 2011; Feldman & Eidelman, 2007) and coordinated release of oxytocin (Feldman, Magori-Cohen, et al., 2011), suggesting that synchrony early in life provides a template for the emergence of synchrony across modalities between interacting individuals (Feldman, 2017).

Such a template starts to develop and take shape early in life and manifests in interpersonal interactions over the lifespan. In these interactions, the perceptual system of one individual can be coupled with the motor system of another. The same is true regarding other modalities (Creaven et al., 2014). Synchrony may occur both across modalities in the same individual (e.g., crosstalk between the

perceptual and motor systems of the same person) and across modalities between different individuals (e.g., crosstalk between the perceptual and motor systems of two people interacting with each other). For example, as depicted in Figure 1, while working with a patient, I may listen carefully to a painful experience she is sharing with me, not noticing that my breathing begins to synchronize with the rate at which the patient moves her foot while she talks. Such intermodality synchrony is difficult to recognize because it may happen at any given time of the therapy session and may involve different modalities at different moments.

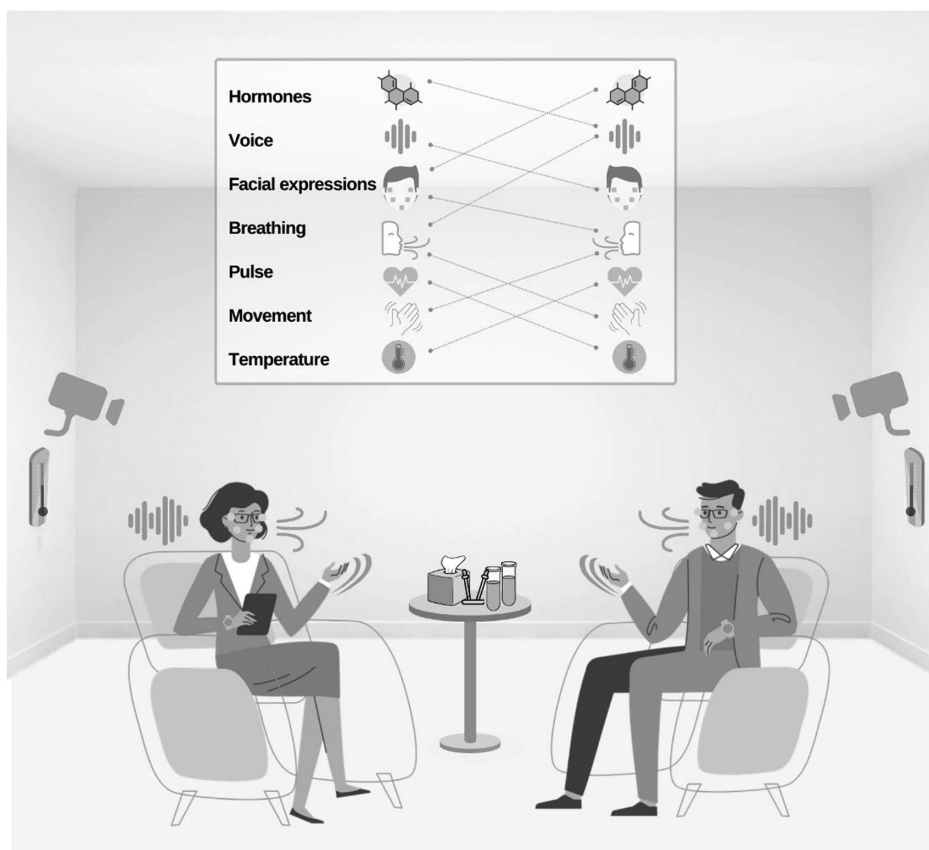
Empirical findings are still lacking for determining the existence and utility of multimodal synchrony. Theoretically, three main options can be proposed: (a) Synchrony manifests consistently and coherently across modalities as a broad construct, so that it is strongly correlated in all modalities. In this case, multimodal synchrony exists but its utility is not great because given the high correlation, measuring several modalities may be redundant, making it most parsimonious to focus on a single modality, perhaps the one that is the easiest to measure. The current literature does not support this option because associations between modalities were not found to be high (e.g., Altmann et al., 2021; Schoenherr et al., 2021). (b) No multimodal synchrony exists or if it does, it has no utility (e.g., only one modality, such as movement, shows utility in predicting interaction quality and outcome, and the rest produce mainly commonly shared "noise," i.e., a signal that has no clear utility). Both alternatives are practically identical, as a phenomenon that exists but has no utility may be as (un)important as a phenomenon that does not exist. Meta-analyses and systematic reviews do not appear to support either option, but rather suggest that the different modalities predict distinct aspects of interaction qualities and outcomes (e.g., Wiltshire et al., 2020), thus supporting the unique utility and contributions of the different modalities. (c) Synchrony as a construct manifests in interactions between modalities. In this case, multimodal synchrony exists, and it has great utility because measuring only one modality may result in mixed results or relatively small and heterogeneous effects. The importance of potential interactions between modalities has been suggested in the past (Kykyri et al., 2019), tested, and received support in a few recent studies (Bar-Kalifa et al., 2023; Kykyri et al., 2019; Tal et al., 2023). Indeed, the available literature suggests that the different modalities are not revealing an identical "story" about human synchrony (Palumbo et al., 2017; Suveg et al., 2016), but rather distinct, potentially complementary ones. Each modality may be processed in different areas of the brain, and multimodal integration may require communication between different areas in the brain, within the individual and between the individuals interacting with each other.

Psychotherapy as an Encapsulated Laboratory to Explore How a Relationship Becomes Curative

Psychotherapy is an ideal laboratory for exploring how a relationship becomes curative. Patient and therapist interact to bring a cure to the patient, and the relationship between them is often described as therapeutic, a corrective experience, and healing. The significant correlation between the strength of the patient-therapist alliance and successful outcomes of treatment is one of the most replicated findings in psychology, with dozens of studies supporting it (Flückiger et al., 2018).

What makes alliance therapeutic, however, is an open question that has been debated for the past 100 years and remains an elusive

Figure 1
Synchrony as a Multimodal Phenomenon



Note. Similar to other interpersonal interactions, synchrony between the patient and the therapist is multimodal such that the synchrony between them manifest across modalities. For example, the therapist's breathing is synchronized with the rate at which the patient moves her foot while she talks. This multimodal reality is in contrast to the unimodal focus in scientific research.

phenomenon for empirical inquiry (Zilcha-Mano, 2017). It has been recently argued that “understanding how the alliance works and using the interpersonal skills needed to produce a strong alliance will improve outcomes, in psychotherapy, in other mental health care, and most likely in all healing contexts” (Wampold & Flückiger, 2023, p. 38). But how can we reach such an understanding, and why is it still unclear after 100 years of theoretical and clinical thinking and 50 years of empirical work? The mechanisms underlying curative relationships in psychotherapy join other interpersonal relationships whose curative functions are still not entirely clear (Sbarra & Coan, 2018). It is common knowledge that high-quality relationships are associated with better life expectancy and physical and mental health (e.g., Holt-Lunstad et al., 2010; Idler et al., 2012) but the underlying mechanism transforming an interpersonal interaction into a curative one remains unclear.

Can synchrony be a potential mechanism by which alliance and possibly any interpersonal relationship become therapeutic? Here again, psychotherapy serves as a unique laboratory where all synchronized (and unsynchronized) manifestations of patient–therapist pairs occur, as they are sitting in the same room, on the same chairs, at the same distance and angles from each other 1 week after the other. If we can identify the curative effects of synchronized (or unsynchronized)

interactions on physical and mental health in the therapy room, we can provide support for the potential of synchrony (or lack thereof) to serve as a mechanism that makes interpersonal interactions curative.

Recent advances in technology have made it possible to go beyond the traditional reliance on self-report measures and start collecting automatic data from patients and therapists, moment-to-moment during treatment. These technologies have resulted in the collection of more objective information to complement the subjective information of what the patient and therapist are aware of, capable, and willing to share about their experiences. These advancements have also resulted in the ability to zoom in on moment-to-moment processes of treatment as they occur in real time, producing thousands of features of data from any single psychotherapy session (Zilcha-Mano & Ramseyer, 2020). Advances in data science have made it possible to analyze the big data produced by such automated methods.

The literature on synchrony in psychotherapy that has been accumulating based on these advancements in the past few years attempts to answer the question whether synchrony is associated with stronger therapeutic alliance and better treatment outcomes. Similar to the vast majority of the literature on synchrony across disciplines, in psychotherapy research, the dominant underlying theoretical assumption is that stronger synchrony between patient

and therapist is associated with stronger alliance and better treatment outcome. Indeed, 100% of the studies hypothesizing a specific direction of association predicted a positive direction, so that higher synchrony is associated with stronger alliance and better treatment outcomes (see online Supplemental Tables S1 and S2).

Examination of the association between patient–therapist synchrony and treatment outcome reveals that some of the findings in the literature support the “more is better” theoretical assumption (Scheidt et al., 2021; Wiltshire et al., 2020), with effect sizes in the low-to-medium range (see online Supplemental Tables S1 and S2), similar in size to those considered meaningful effects in psychotherapy research (DeRubeis et al., 2014) and psychology in general (Smedslund et al., 2022). That is, many of the studies that examined the association between synchrony and outcome found a positive association, with higher synchrony being associated with better outcomes. However, whereas in some studies, the effect reached significance (e.g., Altmann et al., 2020; F. Ramseyer & Tschacher, 2011), in others it did not (e.g., Paulick, Rubel, et al., 2018; Prinz et al., 2021). Yet other studies reported that no association exists, or even that higher synchrony is associated with a poorer process and outcome of treatment. For example, several studies found a negative association, either in general (F. T. Ramseyer, 2020) or a specific operationalization of synchrony (e.g., Gernert et al., 2023; therapists’ leading vs. patients’ leading, Reich et al., 2014; Schoenherr et al., 2021), with stronger synchrony being associated with poorer outcomes.

When focusing on the association between the strength of the patient–therapist therapeutic alliance and the level of synchrony between them, a similar pattern of mixed results emerges. Some findings support the more is the better theoretical assumption, others do not. Many of the studies examining the association between synchrony and alliance found a positive association, so that higher synchrony was associated with stronger alliance; in some, the effect reached significance (e.g., Altmann et al., 2020; F. Ramseyer & Tschacher, 2014; Shapira et al., 2022), whereas in others, it did not (e.g., Paulick, Deisenhofer, et al., 2018). Furthermore, three studies found a negative association (Aafjes-van Doorn et al., 2020; Gernert et al., 2023; Reich et al., 2014), with a stronger alliance being associated with lower levels of synchrony. One of the studies focused on movement and skin conductance synchrony (Gernert et al., 2023), another on linguistic synchrony (Aafjes-van Doorn et al., 2020), and a third on vocal synchrony (Reich et al., 2014).

Although at first sight, these patterns may not appear to be highly inconsistent, at the within-study level, much inconsistency was found (Altmann et al., 2022), when using different types of treatment conditions (e.g., cognitive behavioral therapy vs. imagery-based treatment; Prinz et al., 2022), different populations (e.g., patients with anxiety vs. depression; Paulick, Rubel, et al., 2018), and different parameters (e.g., head movement vs. body movement; F. Ramseyer & Tschacher, 2014). For example, Prinz et al. (2022) tested the associations between skin conductance synchrony and outcomes. The results showed that higher synchrony during image rescripting interventions predicted lower posttreatment test anxiety, but there was no significant association between synchrony during cognitive behavioral interventions and posttreatment test anxiety.

It has been suggested that movement synchrony was most frequently associated with psychotherapy outcome, and that language and vocalization were most frequently associated with the therapeutic alliance (Wiltshire et al., 2020). Yet, mixed results appear both across and within modalities. For example, for movement synchrony, the

modality receiving most of the empirical attention to date, some studies reported a positive association between synchrony and treatment outcome, such as lower symptom severity (e.g., F. Ramseyer & Tschacher, 2011), higher patient self-efficacy (F. Ramseyer & Tschacher, 2011, 2014), and less interpersonal problems (Altmann et al., 2020). Others found no association (e.g., Prinz et al., 2021; Schoenherr et al., 2021), association in only one type of clinical population (Paulick, Rubel, et al., 2018), or even a negative association (F. T. Ramseyer, 2020).

When deepening the inquiry to explore microprocesses occurring within the therapeutic alliance, an intriguing pattern emerges. At the sample level, both deteriorations (ruptures) and gains (repairs) in the alliance were associated with higher levels of synchrony. For example, higher levels of synchrony were associated with gains in the alliance (K. Cohen et al., 2021) but also with ruptures in it (Deres-Cohen et al., 2021; Zilcha-Mano et al., 2018). This pattern is instructive because both ruptures and gains in the alliance are theoretically expected to be therapeutic but for different reasons. Alliance ruptures are expected to enable negotiation of interpersonal needs, whereas gains in alliance (repairs) mark a successful resolution of such ruptures. Outside the field of synchrony research, the theoretical assumptions regarding the potential therapeutic benefits of both ruptures and repairs received empirical support (Eubanks et al., 2018). Could it be that the same is true for synchrony, so that both going in and out of sync have the potential to be curative?

The Proposed Theoretical Model: Both Going in and Out of Sync Are Potentially Curative in Correcting Maladaptive Trait-Like Signatures

The present synthesis of the majority of the literature on synchrony across disciplines reveals two underlying assumptions dividing current research into two subfields. One refers to synchrony as a trait-like characteristic of the individual. Studies of this type include testing trait-like prosocial behaviors and independence tendencies that predict one’s ability to get in sync (e.g., Lumsden et al., 2012). The other assumption is that synchrony is a state-like tendency. Studies based on this assumption test individuals experimentally in designs where the level of synchrony is manipulated by manipulating certain factors conceptualized as affecting it (e.g., Miles et al., 2011). This article proposes that both theoretical assumptions are correct, indeed complementary: synchrony has both trait-like and state-like components.¹ Trait-like individual differences between people exist

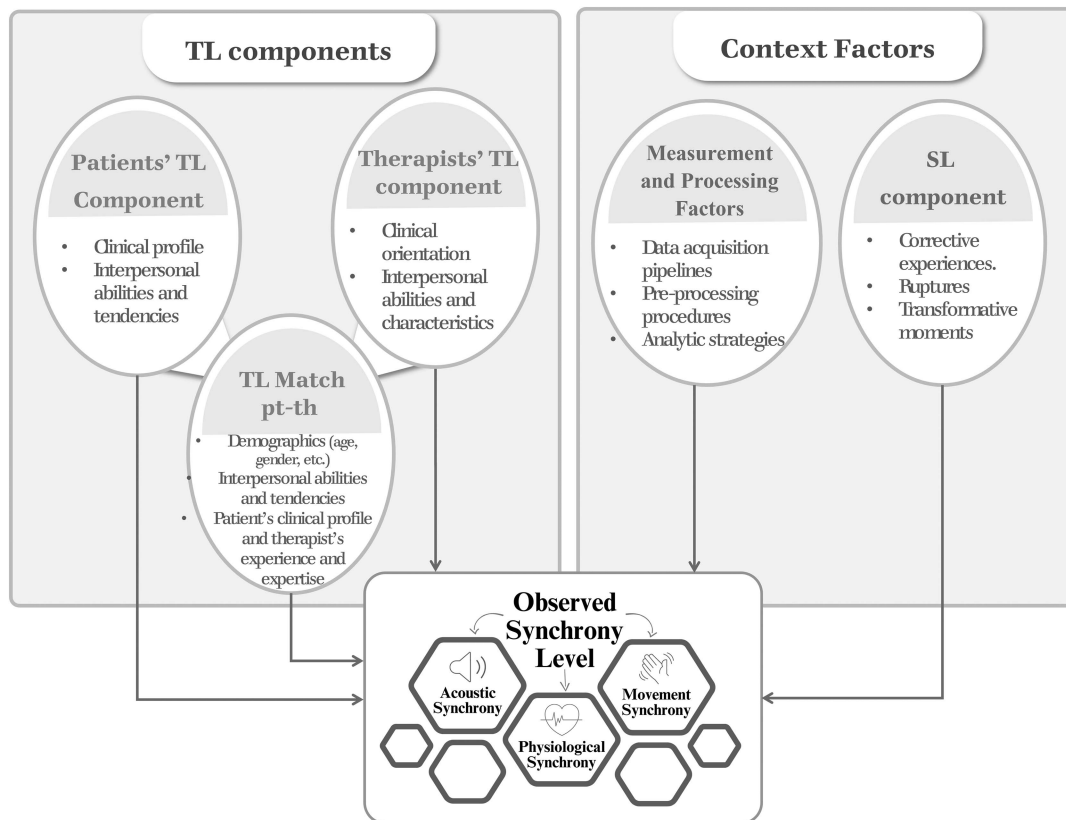
¹ The terms trait-like and state-like are used, rather than trait and state, to remain consistent with the accumulating research on disentangling trait-like and state-like components (Zilcha-Mano, 2021), and to accurately describe the constructs being measured. Although the conceptual model aims to describe actual traits versus states, the data used to test these constructs does not allow thoroughly describing traits and disentangling state from trait. The reason for this is that the common psychotherapy data evaluate the patient only at limited times before treatment (most commonly, only once, pretreatment, for each measure). Thus, if the construct is characterized by a dynamic trait (e.g., a stable fluctuation of negative affect), the data are not adequate to characterize it. In the context of synchrony, this is even more critical because, to the best of our knowledge, no study to date has examined the individual in multidyad interactions to extract a trait tendency to synchronize in dyadic interactions before the start of treatment. It should be stressed that this addition is not to argue that the trait-like is easy to assess and can be done in a single snapshot. On the contrary, this is to highlight that to accurately disentangle trait-like and state-like components, research should strive to obtain multiple time points of dyadic interactions with multiple others.

along with within-individual potential deviations from such a trait-like tendency to get in sync. Whereas the trait-like component refers to stability in the individual's tendency to get in sync over time and in various interactions, the state-like component refers to deviation from the stable trait-like component in concrete situations. It is argued here that both trait-like and state-like components must be taken into account to advance the research on synchrony. In many fields of science, including psychotherapy research, it has been argued that failing to disentangle between-individuals differences from within-individual changes may result in biased, inaccurate findings (Fisher et al., 2018; Zilcha-Mano, 2021, in press). Our proposal for personalized synchrony research by disentangling trait-like and state-like components is consistent with much of the literature seeking to disentangle trait from state characteristics of the individual (Eysenck, 1983; Steyer et al., 1999), arguing that psychological measurement does not take place in a situational vacuum, but rather, most psychological attributes reflect both stable trait (time-invariant) and more labile state (time-varying) components (Cattell, 1946; Hertzog & Nesselrode, 1987; Steyer et al., 2015). Our argument is also consistent with much methodological research demonstrating the

importance of disentangling between-individuals and within-individual effects in many fields of science (Curran & Bauer, 2011; Fisher et al., 2018; Hamaker et al., 2007; Molenaar, 2004; Wang & Maxwell, 2015).

This article proposes that the trait-like and state-like components of synchrony are part of an amalgam of components constituting the observed synchrony level in a given modality and across modalities. Figure 2 delineates the proposed framework, which is based on the relatively scant available literature, and is yet to be fully empirically investigated. The trait-like pretreatment components include the trait-like characteristics of the patients (e.g., clinical profile, attachment orientation, interpersonal problems; e.g., Lozza et al., 2018) and of the therapists (e.g., empathy, main clinical orientation, attachment orientation, interpersonal problems). They also include the match between the trait-like characteristics of the two, as evident even before they have met (e.g., match in attachment orientation; Tyrrell et al., 1999). The context components refer to factors responsible for deviations from the trait-like components and include measurement and processing factors and the state-like component. The measurement and processing factors are technical factors that may cause

Figure 2
Factors Proposed to Constitute the Observed Synchrony Level



Note. In each oval, several examples are presented, rather than an exhaustive list. Because little research is available on the unique contribution of each factor and component, the model is not the outcome of systematic investigation but rather a proposed basis for future research. Such research may result in “moving” some of the elements from the “Measurement and Processing Factors” to other factors, when greater empirical understanding of their conceptual and clinical meaning is achieved. Different mixtures of the various factors sampled in different studies are conceptualized as contributing to the wide distribution of findings across studies. TL = trait-like, SL = state-like.

variability in the assessment of any observed synchrony level, such as measurement and analytic parameters of the type identified by Scheidt et al. (2021): spatial direction, amplitude, sinusoid duration, event structure, phase, frequency, and content. The state-like component refers to context-specific deviations from one's trait-like characteristics and the dyad's trait-like characteristics, such as ruptures in the interpersonal interaction (Eubanks et al., 2018), corrective experiences (Castonguay & Hill, 2012), transformative moments (Gonçalves et al., 2012), and more. In the present article, we focused primarily on the patients' trait-like and state-like components.

Accepting the theoretical assumption of the existence of trait-like tendencies to form synchronized interactions, we need to be able to determine how they manifest and what is a desirable trait-like tendency for synchronization. This is uncharted territory because no clear framework has been proposed for disentangling trait-like and state-like components of synchrony. Based on a synthesis of the abundant literature on interpersonal relationships and of the synchrony literature, with its two underlying assumptions about synchrony, this article proposes a theory of complementary trait-like and state-like components of synchrony.

Individual-Specific Trait-Like Synchrony Signature

A fingerprint signature of an individual trait-like ability to synchronize should be able to show commonalities across interactions, settings, and types of relationship (with father, mother, romantic partner, best friend, boss, children, weak ties relationship, etc.). For synchrony to have curative potential, it should be able to capture core elements of the individual's maladaptive relational patterns, which can then be remedied as part of a corrective experience. Like our genome, such a fingerprint trait-like ability to synchronize should be able to reveal our adaptive versus maladaptive abilities and tendencies. To test these theoretical assumptions about the existence of an individual-specific trait-like ability to synchronize, it is instrumental to first determine whether we can identify a trait-like tendency to synchronize with inanimate objects that are not assumed to bring their own trait-like ability to synchronize. An experimental setting where it is possible to study trait-like synchrony without the confounding effects of the trait-like characteristics of an interaction partner may clarify whether such individual-specific synchrony signature exists. One such dynamic inanimate stimulus is music. We can ask whether each of us has an individual-specific signature when we synchronize to music, rather than to other human beings who have their own synchrony signature.

It is reasonable to expect music-induced movement to be influenced by the particular qualities of the music, so that *context-specific* experimentally induced state-like qualities of synchrony emerge in response to certain types of musical genres (the state-like component in Figure 2). But what needs to be established is whether there is also an *individual-specific* trait-like signature of synchrony that obtains when removing the confounding element of synchronization with another human, leaving only the individual's ability to synchronize to music (the individual's trait-like component in Figure 2). In a study on dancing, participants were asked to dance freely to eight genres (Carlson et al., 2020). Using a support vector machine model, data were classified by music genre and individual dancer. Against the researchers' expectations, individual classification was more accurate than genre classification. In other words, the

findings may suggest that asking different individuals to dance to distinct genres of music (Rage Against the Machine vs. Bob Dylan) reveals more about the differences between the individuals than about what is common in all of them in response to the same type of music. Thus, when synchronizing with music, a trait-like signature fingerprint of the individual emerges. These findings bring preliminary support to the idea that there is an individual-specific trait-like signature of synchrony that obtains when removing the confounding element of synchronization with another human, leaving only the individual's ability to synchronize to music.

Similarly, a classic study by Cutting and Kozlowski (Cutting & Kozlowski, 1977) demonstrated that friends could recognize each other from their walk based only on point light (or stick figure) displays of movement, without the need for other distinguishing features. This finding has since been replicated and expanded (Bläsing & Sauzet, 2018; Troje et al., 2005; Westhoff & Troje, 2007). For example, Sevdalis and Keller (2009) showed that individuals were able to recognize their own motion-captured movements not only of walking but also of clapping to a beat and dancing, especially in the case of music that they themselves created as opposed to music they had learned (Bläsing & Sauzet, 2018).

This finding provides some support for the idea that there is a trait-like individual-specific tendency to get in sync with an inanimate entity. But, in interpersonal interaction, we need two to tango. Without the interpersonal context, the evidence reviewed above can be argued to support a motor rather than a synchrony signature. Our objective, however, is to determine whether an individual-specific trait-like signature is present when two individuals, who are both assumed to have their own trait-like tendency to synchronize, interact.

To the best of our knowledge, no study to date has tested directly the existence of a pretreatment trait-like tendency of an individual to get in sync with different partners across a range of relationship types, but some studies explored individual differences in people's tendencies to get in sync. These studies suggest that individuals with a prosocial orientation spontaneously coordinated with a confederate to a greater extent than did those with a pro-self-orientation (Lumsden et al., 2012). This literature shows the possible existence of a trait-like signature, but no studies have investigated directly whether such a signature exists. It is not clear, for example, whether across partners, the same individual shows a relatively stable trait-like pattern to synchronize. Focusing on a related though different phenomenon, a study on mimicry suggests that differences in the amount of mimicry in interactions were to a great extent explained by differences between participants in their tendency to mimic others (24% Salazar Kämpf et al., 2018). Whether this finding generalizes to synchrony, an unintentional phenomenon that is less precise an imitation than mimicry, is yet to be discovered. Moreover, most of the literature on synchrony has tested a relatively reductionist linear pattern of synchronization, ranging from low to high, with the underlying theoretical assumption that higher levels of synchrony are better. The accumulating mixed results suggest that such a linear association may be too simplistic to accurately capture reality. A pattern of constantly "moving in and out" of sync is, thus, proposed here as a normative mode of interpersonal synchrony. As specified below, such a pattern is consistent with classical theories of the potentially conflictual human needs of autonomy and interdependence (e.g., Blatt, 2008; Bowlby, 1988; Mahler et al., 1975; Ryan & Deci, 2017), and some recent conceptualization in

synchrony research (e.g., Mayo & Gordon, 2020; Praszkiec & Nowak, 2023).

State-Like Changes From the Individual-Specific Trait-Like Synchrony Signature

Studies manipulating synchrony to find universal factors affecting it share an underlying theoretical assumption that, irrespective of individual differences between human beings, within-individual state-like changes in the ability to synchronize can be achieved and manipulated using an experimental design. To isolate an individual's trait-like and state-like components, before addressing the complexity of synchronization between two individuals, with their own trait-like and state-like components, it is again instrumental to focus first on the individual's synchrony with inanimate entities, such as music. In addition to a trait-like tendency to get in sync with music, there is also evidence to suggest that state-like changes occur in individuals' interaction with music. For example, audio features extracted from the acoustic signal of music were found to influence the quality of dancers' movements. Participants were found to modify and increase their dance movements in response to changes in the volume of the bass drum (van Dyck et al., 2013). Similarly, the presence of a kick drum, bass guitar, as well as beat clarity were found to influence the speed of head movement, hand distance and speed, shoulder wiggle, and hip wiggle (Burger et al., 2013; Luck et al., 2010). Other research suggests that rock music was associated with greater head speed during dance than jazz, whereas techno, Latin, and metal were all associated with particular movement patterns (Luck et al., 2010). These findings suggest that state-like changes in synchrony with music can be induced by changing the genre of the music.

Although the literature on interpersonal synchrony does not disentangle trait-like tendencies, which are consistent across interaction partners and time, from state-like tendencies to synchronize, some indirect support for the existence of state-like deviations from one's trait-like signature can be derived from studies showing that it is possible to manipulate individuals' tendency to get in sync in the lab. For example, in the lab, the introduction of an arbitrary difference (e.g., group membership) between the participant and a study confederate was found to enhance levels of synchrony as a means to reduce perceived social distance (Miles et al., 2011). Participants synchronize their body movements more in an affiliative conversation compared to an argument (Paxton & Dale, 2013). In contrast, experiencing antipathy toward a research confederate who was late resulted in less synchronization on a subsequent movement task (Miles et al., 2010). These and similar studies (e.g., Lord et al., 2015) suggest that state-like changes in synchrony can be induced in the lab, but they lumped together trait-like differences between individuals and state-like changes from such trait-like tendencies.

The “Normative” Mode of the Synchrony System and Individual Differences in Its Operation

If a trait-like tendency to get in sync exists, it is possible to ask how such tendencies function, which forms they may take, and how individual differences may manifest from such a general pattern. Shedding light on the normative mode of the synchrony system has the potential to illuminate how synchronization becomes curative. The normative mode of operation of the synchrony system may uncover the mechanisms making synchronization curative through

the understanding of what is a healthy trait-like pattern of synchrony that is associated with better mental and physical health. It may also reveal what unhealthy patterns of a tendency to synchronize may look like and whether they can be changed. Discovering which state-like changes in this trait-like ability to synchronize may be transformative may provide an answer to one of the oldest questions in science of how interpersonal interactions become curative ones.

The trait-like ability to synchronize and individual differences in this ability may form recognizable patterns. It is proposed here that the normative pattern in which individuals synchronize is one of “moving in and out” of sync. The general tendency to synchronize manifests as microprocesses of going in and out of sync, representing a larger human phenomenon of continually oscillating between moving closer to other people and away from them. Such a tendency can be found in some form or another in many interpersonal theories under different names and operationalizations. For example, attachment theory argues that people move from actively seeking proximity to the attachment figure as a safe haven to letting themselves move away from the attachment figure to explore the world (Bowlby, 1988; Mikulincer & Shaver, 2007). Other theories argue that a tension exists between approach and avoidance tendencies in interpersonal interactions and assume fluctuation between interpersonal closeness and autonomous functioning. According to self-determination theory (SDT; Ryan & Deci, 2017), the basic psychological needs of individuals are for competence, autonomy, and relatedness. Blatt's two-configurations model of personality functioning describes an anaclitic tendency characterized by a focus on interpersonal relatedness versus introjective tendency, characterized as focusing on self-definitional needs (Blatt, 2008). Another example comes from Mahler's separation-individuation theory of child development, according to which a few months old child breaks out of an “autistic shell” into the world with human connections, moving from dependence to individuation (Mahler et al., 1975). The optimal distinctiveness theory (Brewer, 1991) also proposes that individuals have two fundamental and competing needs: the need for inclusion and the need for differentiation (Leonardelli et al., 2010). Another theoretical conceptualization, the interpersonal circumplex, describes the tension between dependence on the other and self-dependence. It aligns interpersonal characteristics along a vertical axis of status, dominance, power, ambitiousness, assertiveness, or control and a horizontal axis of agreeableness, compassion, nurturing, solidarity, friendliness, warmth, affiliation, or love (Bakan, 1966). The vertical and horizontal axes capture the broad constructs of agency versus communion (Wright et al., 2009). Recently, the potential merits of going in and out of proximity to the interaction partner have also been suggested as opportunities for improving synchronization (Mayo & Gordon, 2020; Praszkiec & Nowak, 2023).

Across theoretical conceptualizations, a healthy solution of this tension occurs when one learns that autonomy is compatible with reliance on others. Feeling protected and part of a unit that is greater than the self, individuals can also devote attention and effort to their own growth-promoting activities. These theories converge in the importance they ascribe to approach versus avoidance tendencies but differ in the time frame of focus (e.g., Mahler speaks about child development). Similarly, the few recent articles that discuss such a pattern focusing on synchrony referred either to the entire treatment (Praszkiec & Nowak, 2023) or to moment-to-moment fluctuations (Mayo & Gordon, 2020). The literature also differs in whether they

describe between-individuals tendencies (e.g., some individuals show stronger tendencies for communion whereas others show stronger tendencies for agency) or within-individual processes (e.g., changes within an individual in the process of early development, therapeutic changes, etc.). This article proposes that the processes of going in and out of sync are the basis of trait-like individual differences between people, but also exist as microphenomena occurring within the individual from one moment to the next of any interpersonal interaction. It is argued here that the dynamic movement between going in and out of sync may represent a healthy pattern of getting in sync with another individual.

A Normative Trait-Like Pattern of Going in and Out of Sync

According to the proposed theory, the process of successfully going “in and out of sync” makes possible a high degree of friendly behavior combined with a healthy sense of autonomy. This helps meet both the interdependence and dependence needs of the individual, maximizing both interpersonal and intrapersonal rewards. Thus, two opposite forces (engagement with self and engagement with another) are driving the constant dynamic of going in and out of sync. The synchronization aim is to achieve a balance between social and inward attunement, between engaging with others and disengagement from them to better engage with one’s own will. Going out of sync is also important for achieving stability and not being constantly and drastically affected by other human beings one interacts with. Such stability is needed for healthy homeostasis. A stable dynamic of going in and out of sync is important not only for the individual to be able to be on the same page with another person but also to regulate oneself while disengaging from another person.

Individuals are unexpected entities who engage in ambiguous interactions. Getting into sync with another individual requires continually updating and correcting the synchrony pattern based on feedback from the other individual. When synchronizing with another individual, say, in conversation, the listener must be able to anticipate when the speaker is going to speak and when the speaker is going to stop and wait for a response. It is a self-adjusting apparatus in which one party to the conversation communicates with the other party without cutting into the other’s turn in a smooth and seamless encounter. At any moment of the interaction, the same process appears in all modalities and, at the same time, as crosstalk across modalities (Figure 1). It is proposed to be a tightly woven synchronous web in which the warp is falling in and out of sync in the various modalities and the weft is the crosstalk between modalities. Therefore, it is not easy to accomplish a smooth synchrony. In psychotherapy, it has been demonstrated that almost 100% of sessions include processes of rupture and repair (Muran, 2019). For some individuals and in some instances, these are microprocesses, occurring without awareness, but for others, they are major occurrences, manifested as major ruptures in the interaction. Therapeutic interactions may require increased activity and tighter crosstalk between relevant systems. In a sense, in any interpersonal interaction, one may need to pay close attention to the other individual to be able to get in sync, and then update the individual-specific synchrony system to make the necessary corrections when synchrony is disrupted.

The proposed theory of interpersonal synchronization explains the curative effects of both going in and going out of sync. The underlying theoretical assumption is that in the microprocesses of interacting with another individual both have merit and are rewarding. Falling in sync produces a close and intimate interpersonal encounter. Falling out of sync initiates two important processes: (a) catching up with the other person, that is, distancing oneself from the process of synchronization to gain feedback for the system on how successful previous attempts to fall into sync were and whether the system needs updating; and (b) catching-up with the self, that is, investing energy in the self to support self-regulation, agency, and autonomy.

Falling in Sync to Achieve Self-Other Coupling

Dyadic regulation, defined as processes in which one partner regulates the other’s responses (Overall & Simpson, 2015), is a key mechanism for regulating emotions from early in life onward. Individuals in close relationships are many times attuned to their partner’s emotions, leading to synchronization of emotional responses between partners in interpersonal relationships, also known as “co-regulation” (Butler & Randall, 2013). When the parent, romantic partner, close friend, or therapist helps regulate their emotions, the child, partner, friend, or patient feel more regulated and gradually also start to regulate themselves. Such interpersonal interactions are critical for the individual’s mental and physical health. By contrast, loneliness, the subjective experience of social isolation, is associated with increased risk for a range of health morbidities and mortality (Holt-Lunstad et al., 2015). Coordinated interactions with significant others promote homeostasis, health, and well-being throughout life. People seek to be in sync with others because it is a rewarding experience. Interpersonal synchrony has been associated with activity in reward-processing regions of the brain such as the ventral striatum (Kokal et al., 2011).

Meta-analyses indicate that compared to nonsynchronous conditions, synchronous movements and vocalizations increase prosocial behaviors, enhance perceived social bonding, improve social cognition, and increase positive affect (Mogan et al., 2017). Recent research further hints at a neural mechanism underlying the ability of the brain to construe familiar others as if they were extensions of the self (Beckes et al., 2013). Such merging may increase the odds that resources available to the other will be available, when needed, to the self (Gross & Proffitt, 2013).

Synchrony is conceptualized to function as a social glue (Lakin et al., 2003), strengthening the relation between persons (Koole & Tschacher, 2016; Miles et al., 2009; F. Ramseyer & Tschacher, 2011; Vacharkulksemsuk & Fredrickson, 2012) and facilitating harmonious interactions (Marsh et al., 2009; Miles et al., 2009; Tarr et al., 2018), empathy, and prosocial behavior (Koehne et al., 2016; Mogan et al., 2017; Valdesolo & DeSteno, 2011; Vicaria & Dickens, 2016) between people. The bonding effect of interpersonal synchrony receives support from studies suggesting that synchronization between strangers can have effects on subsequent measures of social bonding (Hove & Risen, 2009; Launay et al., 2016; Valdesolo & DeSteno, 2011; Wiltermuth & Heath, 2009). This has been demonstrated in several experimental studies in which participants tap synchronously with an experimenter (Hove & Risen, 2009; Valdesolo & DeSteno, 2011) walk in time with others (Wiltermuth & Heath, 2009), or dance together (Reddish et al., 2013), even when

they have no visual access to one another but are synchronizing only with the sounds of another person (Kokal et al., 2011; Launay, 2015).

Individuals synchronize more readily with those with whom they seek to develop positive relationships (Miles et al., 2011). Social-psychological experiments have shown that making people move in synchrony promotes social bonding, cooperation, and helping (Mogan et al., 2017; Vicaria & Dickens, 2016; Wiltermuth & Heath, 2009), and increases liking, compassion, rapport (Hove & Risen, 2009; Vacharkulksemsuk & Fredrickson, 2012; Valdesolo & DeSteno, 2011), and sensitivity in responding to interaction partners (Valdesolo & DeSteno, 2011). Emotional facial synchrony was similarly associated with more positive feelings toward the other (Kühn et al., 2011). A higher level of affiliation was found when participants were moving in synchrony (Hove & Risen, 2009; Valdesolo et al., 2010; Wiltermuth & Heath, 2009).

Falling Out of Sync to Catch up With the Other Individual

This article argues that falling out of sync is as healthy a social tendency as falling in sync. To be continuously on the same page with another unpredictable and dynamic human being, one needs constant feedback about the other person, how far away that person is from oneself, and in which direction. Following the neurocomputational accounts of predictive coding (Millidge et al., 2021; Spratling, 2017), as implemented also for understanding synchrony (Shamay-Tsoory et al., 2019), to maintain optimal synchrony, one needs to compare and match one's own action representation with the internal representation of another person's action.

Being in sync with another individual involves a rapid, nonconscious, automatic dynamic process of inferring the other's intentions, then mobilizing resources for closely synchronizing with the other. In contrast to mimicry, to synchronize actions with another person, one cannot simply react to that person's actions but must predict (subconsciously) what the other will do, then plan to act accordingly (Sebanz et al., 2006). Thus, the synchrony system constantly produces top-down predictions about the future. These top-down predictions are then constantly compared to information collected about the self and the other, in a bottom-up flow of information from the environment. The need to fall out of sync is the result of a failure in the ability to predict the other individual's actions, responses, and reactions. When the incoming information collected through bottom-up inputs is different from the top-down prediction, this constitutes a prediction error (Millidge et al., 2021; Shamay-Tsoory et al., 2019). To reduce prediction error, re-calibrate the system, and update the top-down predictions, dynamics of interacting feedback loops are activated (Wiener, 2019), facilitating a process of seeking new information about the other by falling out of sync. The prediction error indicates how much and when it is necessary to fall out of sync. The synchrony system assesses automatically, without awareness, the progress the self is making in achieving a synchronized interaction, and if necessary, corrects the responses of the self to produce the most effective response sequence. This model suggests that going in and out of sync enables better synchrony than just staying in sync for the whole duration of the interaction. As the individuals become more accustomed to one another, prediction errors are expected to decline and there will be less need to get out of sync in order to get in sync (Millidge et al., 2021; Shamay-Tsoory et al., 2019).

Such dynamic feedback loops require theory of mind (ToM) abilities, or as articulated by Fonagy et al. (1991), self-reflective or *mentalizing* capacity, the ability to notice, think about, and accurately understand mental states (e.g., desires, feelings, beliefs, intentions) of the self and of the other. Similarly to other behavior systems, this goal-directed and goal-corrected adjustment requires several cognitive operations: (a) monitoring and appraising changes in one's internal state (e.g., affect, physiological condition); (b) monitoring and appraising the other individual's behavior and responses; and (c) estimating the gap between (a) and (b), and appraising the utility of the chosen behaviors in a given context, so that an optimal trade-off between one's own needs (see below) and the need to be in a synchronized relationship with the other is achieved. These cognitive mechanisms are present in every cybernetic, control system model of self-regulation (e.g., Carver & Scheier, 2012). The evolutionary system of synchrony continually produces top-down predictions that are constantly updated when conditions warrant revisions.

The importance of the evolving interaction between two individuals for updating and correcting the prediction errors has been demonstrated by studies in which individuals had to communicate in a new "language" (set of symbols; Galantucci & Garrod, 2011). Pairs of strangers were instructed to play cooperative games through interconnected computers. The games required players to communicate, but they could not see, hear, or touch each other. They could communicate only through a set of visual signals they had to use to produce a new "language." Findings suggest that when there was direct interaction between players, the new language quickly emerged (Fay et al., 2008; Galantucci & Garrod, 2011; Garrod et al., 2007; Healey et al., 2007), but not when isolated individuals had to play with an offline partner (Garrod et al., 2007). Thus, the findings may stress the need for bottom-up flow of information from the environment to update the top-down predictions.

Falling Out of Sync to Catch up With the Self

Falling out of sync is important not only for catching up with the other individual with whom one interacts but also with oneself. An individual needs to disengage from the other to be able to self-regulate. Empirical research suggests that interpersonal synchrony decreases a person's ability to self-regulate affect. A recent study suggests that interpersonal synchrony predicted an increase in positive affect and simultaneously a weakening in self-regulation of affect. Intrapersonal synchrony, however, tended to oppose these effects (Galbusera et al., 2019). It has been shown that synchrony makes people feel more dependent on others (Hove & Risen, 2009), and higher interpersonal synchrony during a task predicted greater difficulties in self-regulation of affect (Galbusera et al., 2019).

In dyadic regulation, clear boundaries between internal and external regulation become blurred (E. E. Cohen et al., 2010). It has been suggested that synchronization is functionally important for affiliation, bonding, and group cohesion because it merges representations of self and others (E. E. Cohen et al., 2010; Hove & Risen, 2009; Konvalinka et al., 2011; Miles et al., 2011; Wiltermuth & Heath, 2009). Synchronous activity may create a perception of the self and the synchronous other as being merged, both at the physical and conceptual levels (Mazzurega et al., 2011; Paladino et al., 2010). Support for merging of self-other representations at the neural level during synchronized action comes from a joint speaking study by Jasmin et al. (2016), which

showed that when people engaged in synchronized live speech with another person (as in chanting and prayer), the suppression of their auditory cortices, a marker of self-produced speech, diminished. This suggests that they processed self-produced speech as if it were produced by another, merging self-other representations. On one hand, the blurring of the borders between self and other may be the mechanism underlying the ability to form empathy toward another person and achieve a deep understanding of the other individual's feelings, thoughts, and perceptions of reality. On the other hand, it may be a light form of depersonalization of the individual. To retain clear boundaries, microprocesses of going out of sync may be needed to move from overlapping representations of self and others to autonomy of the self. In psychotherapy, after a strong alliance has formed, therapists may move out of sync when interacting with nonassertive overly reliant patients as a therapeutic act (Leibovich et al., 2018; Symington, 1983).

Individual Differences in Trait-Like Synchrony Signatures

It still remains to be determined whether synchrony is a behavioral system in itself (Bowlby, 1982) or a primary strategy of other behavioral systems, such as affiliation (feeling a sense of togetherness or communion) or attachment (feeling safe and secure), it is proposed here that like other behavioral systems, synchrony has both universal aspects of the species and individual ones. It is proposed here that all human beings are born with the need and capacity to constantly go in and out of sync with others, and that there are individual differences between people in its operation, making out the individual-specific trait-like signature. These individual differences are generated by different modes of activation of the synchrony system (Figure 3). It is proposed here that similarly to other behavioral systems (Mikulincer & Shaver, 2007), some individuals show the normative pattern of falling in and out of sync, whereas others show hyperactivation or deactivation of the synchrony system. Hyperactivation may originate from an exaggerated need to merge with another person, and it may manifest in the hyperactivation of the falling in sync tendency at the expense of the tendency to fall out of sync. Although (nonconsciously) seeking to constantly be in sync, not going out of sync may be an obstacle in creating a synchronized interaction. Such obstacles may result in moving from pseudosync (constant hyperactivation of the system) to failing to get in sync. Such failures may result in interpersonal ruptures that become explicit to human consciousness and impair interpersonal interactions. Deactivation of the system may originate from an exaggerated need for agency, aiming at autonomous growth, manifest in activation of the falling out of sync tendency at the expense of the tendency to fall in sync. Deactivation amounts to the inhibition or downregulation of the synchrony system by going out of sync, with the motivation of retaining one's individuality because of the discomfort caused by intimacy and interdependence or because of distrust in others' goodwill, thus perceiving self-other merge as dangerous. At both extremes (hyperactivation and deactivation) the synchrony loses its homeostasis through the exaggerated activation of excitatory and inhibitory feedback loops.

As in the case of other evolution-based behavioral systems, such individual differences may be explained by a complex amalgam of genetic, developmental, personality, and interpersonal factors that interact to form the individual's trait-like tendencies. The

temperament that characterizes the individual early in life, together with attachment relationships with significant others, may shape a mode of operation of the system that is consolidated into an individual-specific trait-like tendency to get in sync with another human being. Individuals may then assimilate their trait-like patterns into any interaction with another individual, whether a close other or a stranger. These patterns can change over the life course, especially as the result of transformative state-like deviations that gradually may become a new, more adaptive trait-like signature. Such deviations may occur in corrective therapeutic relationships with the therapist or in any other curative interaction with another human being or even a pet animal (Zilcha-Mano et al., 2011). Such transformative interactions, in which individuals are stepping out of their maladaptive modes of the synchrony system into an adaptive mode of falling in and out of sync, are those that we propose here for making interpersonal relationships curative. These theoretical premises should be tested directly, given that the available literature, for example, on the association between attachment and synchrony, is based mainly on data in which trait-like and state-like components were not fully disentangled (e.g., F. Ramseyer & Tschacher, 2011; Schoenherr et al., 2021).

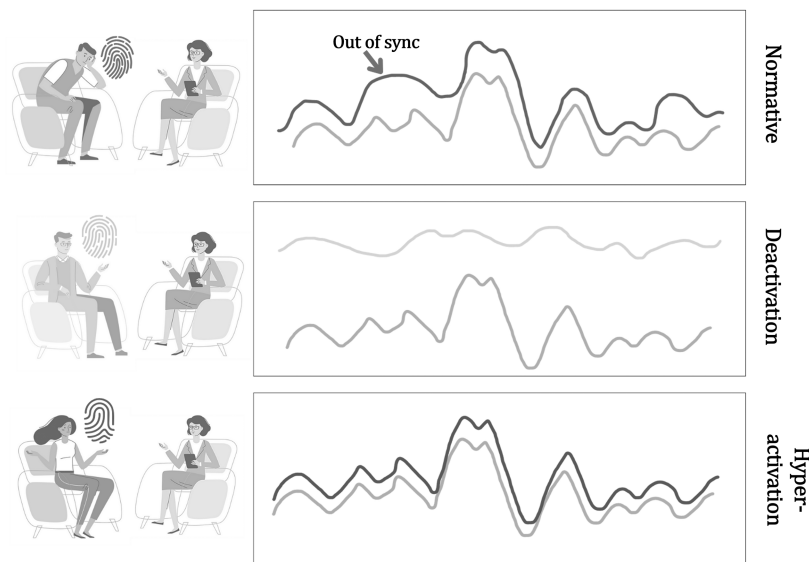
State-Like Deviations From One's Trait-Like Synchrony Tendencies: Transforming Interactions Into Curative Ones

If individuals are characterized by trait-like tendencies to synchronize, and if such trait-like tendencies are associated with the individual's physical and mental health, the question arises whether those patterns are amenable to change. That is, an important question about the state-like component of synchrony is whether an interaction with another person can be meaningfully different from the trait-like pattern of the individual, and if so, whether it can have a transformative effect on one's mental and physical health, and possibly be generalized to other relationships, creating a new more adaptive trait-like signature.

Based on the literature on basic science reviewed above, it is suggested here that state-like changes in the individual's synchronization tendencies exist. It is possible to induce state-like changes that can be assumed to deviate from one's trait-like tendencies. No study to date examined directly whether deviations from a trait-like tendency are possible because no study to date used the conceptualization suggested here. But universal effects have been found in laboratory manipulations, which indirectly suggests that the individuals participating in such manipulations changed their trait-like tendencies, even if momentarily. Several studies in psychotherapy research have disentangled the dyad's trait-like and state-like components (e.g., K. Cohen et al., 2021; Prinz et al., 2021). Although they have not estimated a trait-like tendency of the patient as manifest across dyads and over time before the start of treatment, they disentangled the trait-like tendency of the dyad from state-like changes over time within the same dyad. These studies yielded promising results, suggesting theory-based differences between the trait-like and the state-like components.

This article further suggests that new trait-like patterns of falling into sync can be updated in the course of life and be affected by a range of transformative factors, such as current curative interactions with a partner in a relationship or a therapeutic relationship with a therapist. According to attachment theory, understanding children's responses to separations from caregivers hinged on understanding the

Figure 3
The Normative Operation of the Synchrony System as Well as Individual Differences in Its Activation



Note. On the upper panel, a normative operation is delineated, which is characterized by both going in and going out of sync. In the middle and bottom panels, the two main types of deviations from the normative pattern are delineated: hyperactivation and deactivation of the system. Each individual's trait-like tendency can be characterized as resembling a more normative operation, or one of the two other types: hyperactivation and deactivation. For the sake of simplicity, only one individual in the dyad, and that individual's trait-like and state-like tendencies are described. In real life, individuals bring their trait-like tendencies and the specific state-like deviations from this tendency, to any situation.

nature of the bond that ties the child to that figure (Bowlby, 1980). We argue that to understand how an interaction transforms into a curative one, we need to observe the moment-to-moment fluctuations in synchrony during the times when the interaction is therapeutic and compare them with the trait-like synchrony signature of the individual. The therapeutic alliance provides an encapsulated healing relationship ideally suited for studying this phenomenon.

Conclusions and Future Directions

Studies on synchrony across disciplines are many and diverse. The proposed model builds on accumulated findings and assumptions that serve as hypotheses for future research. As they accumulate, empirical findings testing the proposed theory will increase its depth and coherence. Several pathways for future research are specified below.

From Two to Many

The proposed theoretical model focuses on dyads because curative interactions often occur between two individuals. But the model may be extended to group settings at the cost of added complexity. Individuals have their trait-like tendencies and their state-like manifestations of this tendency in different interactions. For each individual, it is possible to identify these state-like deviations from the trait-like signature in interactions with each individual in the group but also with different combinations of several individuals together.

Thus, the number of possibilities is large and not easy to estimate because the network of potential state-like interactions may differ from one individual to the next. As the methodological capabilities to model such group complexity mature, future research in this area becomes increasingly promising.

Identifying an Individual's Trait-Like Signature

Identifying Trait-Like Signatures

Future studies should explore and characterize individual-specific trait-like signatures. Testing the same individual in several types of interactions and relationships (e.g., romantic partner, best friend, manager, child or parent, friendly stranger, unfriendly stranger) and in different settings (e.g., face-to-face treatment vs. telepsychotherapy) can crystalize individual-specific signatures using methods like round robin (Kenny, 1994, 2019). Although in traditional psychotherapy settings, most patients are treated by a single therapist, other unique settings exist (Kivlighan et al., 2022). Moreover, even in traditional settings, patients tend to interact with multiple professionals who engage therapeutically with them: diagnosticians, therapists, evaluators, case managers, and others, and the different interactions can serve to crystalize the patients' trait-like tendencies (Moggia et al., 2023). In addition to actual interactions, virtual reality can also be used to investigate individual-specific trait-like signatures without the confounding effects of the trait-like signature of the other partner in the interaction

(Draschkow, 2022). Technological advances provide access to virtual partners who can use vision and prosodic analysis to implement active listening behaviors such as smiling, head nods, and postural mimicry (DeVault et al., 2014; Gratch et al., 2007), and use verbal and nonverbal skills such as expressions of empathy, social dialogue, and reciprocal self-disclosure (Bickmore et al., 2005). Basic science experiments can also be instrumental in characterizing the individual-specific signature. For example, building on the classical work by Cutting and Kozlowski (1977) and their followers (Bläsing & Sauzet, 2018; Sevdalis & Keller, 2009), it is possible to examine whether individuals can recognize their friend based on the friend's point light or stick figure, interacting with the friend's significant others versus strangers. Studies characterizing individual-specific trait-like signatures should not be restricted to one modality because signatures may manifest in various modalities or in a complex intermodality manner. In the case of complex intermodality interactions, including other modality sources together in a multimodal approach may reveal important intermodality relationships that cannot be detected using data derived from a single modality.

Where Does the Trait-Like Signature Come From?

Future studies should explore the factors determining the individual's trait-like signature. In addition to such personal characteristics as temperament, personality (e.g., antisocial tendencies), attachment orientation, and gender, intergenerational factors and the sociocultural context in which the individual was raised and lives are expected to affect the trait-like signature. It is possible to speculate that the tendency to go in and out of sync depends on cultural expectations and norms, especially tendencies toward individualism versus collectivism. Another open question is whether neurodevelopmental disorders have a shared prototype trait-like signature. For example, in autism spectrum disorder (ASD), given a documented impairment in theory of mind (Andreou & Skrimpa, 2020), a potential impairment in the synchrony system may involve difficulties in evaluating where the self and the other are to produce predictions about the manners in which the gap between them can be minimized. Earlier findings support such speculation, suggesting that individuals with ASD show less anticipation of other persons' kinematics in motor planning. With increasing severity of ASD traits, participants modulated grip movements less in adaptation to a partner's movements, but performed well in a nonsocial replication task, indicating deficits only in the social domain (Curioni et al., 2017). Findings also suggest atypical movement patterns, including reduced coordination and greater variability in motor production in individuals with ASD (Bloch et al., 2019). Identifying commonalities across distinct contexts, such as when interacting with a nonhuman avatar, a human avatar, and an actual human being, can help distill an accurate characterization of the unique trait-like impairment in the synchrony system of individuals with different levels of ASD, which can serve then as potential targets for interventions aimed at facilitating curative interactions.

Testing the Theorized Individual Differences in Trait-Like Signatures

Individual differences in the operation of the synchrony system open intriguing pathways for future research testing of the proposed

theory. For example, it can be expected that tendencies for clinging and over-dependence characterizing the hyperactivation type of operation of the synchrony system will manifest as greater mimicry, following the partner, rather than mutual interdependence, which generally characterizes synchronized interactions. This empirical question can be tested by exploring the temporal precedence of leading versus following in interpersonal interactions, that is, testing the direction of imitation: Who is leading the interaction and who is the follower, operationalized as a synchronous behavior with a time delay (time lag; Altmann et al., 2022)? Future studies may also investigate whether going in and out of synch are two opposite forces or two extreme points of the same dimension.

Inducing State-Like Deviations From the Individual Trait-Like Signature

Identifying Factors Affecting the State-Like Deviations From the Trait-Like Signature

Several factors are expected to affect state-like changes: (a) The characteristics of the relationships. For example, if one mechanism underlying the need to go out of sync is to minimize prediction error, then less need to go out of sync is expected with greater familiarity (e.g., stranger vs. close friend). (b) The characteristics of the situation. For example, in a situation that increases autonomy over companionship (e.g., a competition), greater move out of sync can be expected than in situations that increase companionship over autonomy (e.g., a distress situation that activates help-seeking). When autonomy is triggered for one partner of the dyad, even going in sync may include more leading than following, as can be modeled using Granger causality models of temporal precedence. Special types of asymmetric relationships may induce unique patterns of synchrony (e.g., Wallot et al., 2016). Therapeutic relationships in which the interaction is asymmetric and therapists may choose to act in an unsynchronized manner to induce specific state-like changes are of this type. For example, when a patient becomes upset during psychotherapy, it is often not helpful if the therapist becomes similarly upset, and it is more beneficial if the therapist finds complementary ways of responding to the patient so that they both regain their homeostatic balance. This example demonstrates that it is important to take into account not only the patient's trait-like characteristics but also the characteristics of the situation in evaluating whether increasing or decreasing the level of synchrony may be adaptive. For example, increasing state-like synchrony with maladaptive over-arousal in a patient suffering from a panic attack during the session may not be adaptive even if the patient has a trait-like tendency to deactivate the synchrony system. In these circumstances, the therapist may choose to regulate these affective states and not only synchronize with them. That is, the therapist may start by meeting the patients where they are in the affective state (facilitating feelings of being recognized and understood), and synchronize with the patients, then help them regulate such maladaptive affective states. Developmental research provides evidence of the ability of one individual in the dyad (mother) to directly influence the level of synchrony between both of them (the child and the mother; Van Puyvelde et al., 2015). (c) The characteristics of the partner. Interpersonal synchrony includes, by definition, at least two individuals, and the characteristics of the partner may affect the state-like deviations from one's trait-like signature. Among others, such characteristics may include

attractiveness (Karremans & Verwijmeren, 2008) and status (Ashton-James & Levordashka, 2013).

Establishing Causal Associations

The proposed theory argues for causal effects, where an increase in synchrony *leads* to more therapeutic and curative outcomes. Causality can be established by manipulating the level of synchrony, for example, by providing training to therapists on how to change the level of synchrony (e.g., Behrends et al., 2012) or through the use of feedback. Such manipulation can enable testing whether experimentally induced increased state-like synchrony results in an increased therapeutic effect. It can be accomplished by providing multimodality feedback to human dyads or through human–virtual avatar interactions. In therapeutic interactions, the therapist and patient may use such multimodality feedback to track momentary shifts in their synchrony for a more normative activation of the synchrony system, label them (the therapist may say to a patient who generally tends to show deactivation: “you’re letting yourself fall into sync with me now much more than you generally do”), identify what enabled such shifts (“let’s try to explore what enabled you to do this”), and facilitate more such changes (“are there things we can do to make it easier for you to bring about such changes in the future?”). Momentary in-session shifts in synchrony toward a less normative activation can also be identified and carefully explored. For example, a therapist may say to a patient who generally shows hyperactivation: “I see that today you’re less inclined to let yourself go out of sync in our interaction. I wonder whether there’s something I said or done today or at our previous session that contributed to it.”

Inducing Changes Through Hormonal Augmentation

Findings suggest that oxytocin is released through the regulation of interpersonal synchrony (Feldman & Bakermans-Kranenburg, 2017) and that intranasal administration of oxytocin results in increased synchrony and social coordination. For example, intranasal administration of oxytocin was found to improve coordinated drawing (Arueti et al., 2013), rhythmical counting, and interbrain coupling of α -band oscillations during a coordination task (Mu et al., 2016). Given evidence suggesting that oxytocin may have both benevolent and malevolent interpersonal effects (Shamay-Tsoory & Abu-Akel, 2016), future studies should examine in which contexts state-like changes induced by intranasal administration of oxytocin promote the normative operation of the synchrony system.

Toward Individual-Specific Pathways to Curative Relationships: Testing the Trait-Like \times State-Like Synchrony Interaction

From a precision medicine perspective, it is instrumental to ask who are the individuals who may benefit most from state-like improvement in synchrony to achieve better physical and mental health, and which forms such state-like improvement should take. It can be speculated that the synchrony system should be the target of interventions for those who are not showing a normative activation of the system. It can be further speculated that individuals characterized by hyperactivation of the synchrony system may benefit from normalization of the system by reducing its activation. By contrast, individuals characterized by deactivation of the

synchrony system may benefit from normalization of the system by increasing its activation. In other words, the trait-like signature of the individual may determine the type of state-like changes that are required to normalize the system and improve physical and mental health. When state-like changes “correct” the maladaptive trait-like signature, the interpersonal interaction is expected to become a corrective experience and can be defined as curative. Such theoretical speculations are consistent with previous research suggesting that individuals with greater trait-like interpersonal deficits are the ones to benefit most from state-like improvements in the therapeutic alliance (for a review see Zilcha-Mano & Fisher, 2022). Further support comes from findings suggesting that individuals with hyperactivation of the amygdala are the ones who benefit most from reduction in the level of amygdala activation. Similarly, whereas individuals with hyperactivation of the reward system benefited most from reduction in its activation, those with deactivation of the reward system benefited most from increases in its level of activation (Zilcha-Mano et al., 2022).

Based on the conceptual model proposed here, a clear mechanism can be suggested underlying the generalization of the corrective experiences beyond the relationship in which they occurred. When the corrective experience becomes part of the individual’s trait-like signature by changing the top-down predictions of the system, the corrective experience has a curative effect in one’s life even outside the concrete interaction at hand. The underlying theoretical assumption is that changing the individual’s top-down predictions in interpersonal interactions into more beneficial ones results in changes in one’s perceptions and interpretations of interpersonal situations. In psychotherapy, the alliance between patient and therapist becomes curative when it changes the top-down predictions of the synchrony system. Such a correction of interpersonal expectations is a common mechanism of change underlying many theoretical orientations to psychotherapy, from cognitive therapy (correcting distorted interpersonal schemas) to psychodynamic treatment (correcting transference distortions).

Placing the Synchrony System in Context

The present article focused mainly on the synchrony system. Future investigations should explore interrelationships between the proposed synchrony system and other systems, including other behavioral evolution-based ones, such as attachment, caregiving, and exploration systems (Bowlby, 1982; Feldman, 2012; Mikulincer & Shaver, 2007). For example, future research can explore how the development of attachment to the primary caregiving figures affects the development of the trait-like synchrony signature and is affected by it. It is also important to explore the interdependence between the synchrony system and mimicry, and its potentially beneficial effects (Vicaria & Dickens, 2016). Future studies should also explore the role of synchrony as part of a dynamic network of interrelated mechanisms (e.g., changes in maladaptive cognitions, insight, affect experiencing, etc.) that interact to bring about therapeutic change.

References

- Aafjes-van Doorn, K., Porcerelli, J., & Müller-Frommeyer, L. C. (2020). Language style matching in psychotherapy: An implicit aspect of alliance. *Journal of Counseling Psychology, 67*(4), 509–522. <https://doi.org/10.1037/cou0000433>

- Ackerman, J. M., & Bargh, J. A. (2010). Two to tango: Automatic social coordination and the role of felt effort. In B. Bruya (Ed.), *Effortless attention: A new perspective in the cognitive science of attention and action* (pp. 335–372). Boston Review. <https://doi.org/10.7551/mitpress/9780262013840.003.0015>
- Altmann, U., Brümmer, M., Meier, J., & Strauss, B. (2021). Movement synchrony and facial synchrony as diagnostic features of depression: A pilot study. *Journal of Nervous and Mental Disease*, 209(2), 128–136. <https://doi.org/10.1097/NMD.0000000000001268>
- Altmann, U., Schoenherr, D., Paulick, J., Deisenhofer, A. K., Schwartz, B., Rubel, J. A., Stangier, U., Lutz, W., & Strauss, B. (2020). Associations between movement synchrony and outcome in patients with social anxiety disorder: Evidence for treatment specific effects. *Psychotherapy Research*, 30(5), 574–590. <https://doi.org/10.1080/10503307.2019.1630779>
- Altmann, U., Strauss, B., & Tschacher, W. (2022). Cross-correlation-and entropy-based measures of movement synchrony: Non-convergence of measures leads to different associations with depressive symptoms. *Entropy*, 24(9), Article 1307. <https://doi.org/10.3390/e24091307>
- Ancel, A., Beaulieu, M., Le Maho, Y., & Gilbert, C. (2009). Emperor penguin mates: Keeping together in the crowd. *Proceedings of the Royal Society B: Biological Sciences*, 276(1665), 2163–2169. <https://doi.org/10.1098/rspb.2009.0140>
- Andreou, M., & Skrimpa, V. (2020). Theory of mind deficits and neurophysiological operations in autism spectrum disorders: A review. *Brain Sciences*, 10(6), 393–398. <https://doi.org/10.3390/brainsci10060393>
- Arueti, M., Perach-Barzilay, N., Tsoory, M. M., Berger, B., Getter, N., & Shamay-Tsoory, S. G. (2013). When two become one: The role of oxytocin in interpersonal coordination and cooperation. *Journal of Cognitive Neuroscience*, 25(9), 1418–1427. https://doi.org/10.1162/jocn_a_00400
- Ashton-James, C. E., & Levordashka, A. (2013). When the wolf wears sheep's clothing: Individual differences in the desire to be liked influence nonconscious behavioral mimicry. *Social Psychological and Personality Science*, 4(6), 643–648. <https://doi.org/10.1177/1948550613476097>
- Atzil-Slonim, D., Soma, C. S., Zhang, X., Paz, A., & Imel, Z. E. (2023). Facilitating dyadic synchrony in psychotherapy sessions: Systematic review and meta-analysis. *Psychotherapy Research*, 33(7), 898–917. <https://doi.org/10.1080/10503307.2023.2191803>
- Bakan, D. (1966). *The duality of human existence: An essay on psychology and religion*. Rand McNally.
- Bar-Kalifa, E., Goren, O., Gilboa-Schechtman, E., Wolff, M., Rafael, D., Heimann, S., Yehezkel, I., Scheniuk, A., Ruth, F., & Atzil-Slonim, D. (2023). Clients' emotional experience as a dynamic context for client-therapist physiological synchrony. *Journal of Consulting and Clinical Psychology*, 91(6), 367–380. <https://doi.org/10.1037/ccp0000811>
- Beckes, L., Coan, J. A., & Hasselmo, K. (2013). Familiarity promotes the blurring of self and other in the neural representation of threat. *Social Cognitive and Affective Neuroscience*, 8(6), 670–677. <https://doi.org/10.1093/scan/nss046>
- Behrends, A., Müller, S., & Dziobek, I. (2012). Moving in and out of synchrony: A concept for a new intervention fostering empathy through interactional movement and dance. *The Arts in Psychotherapy*, 39(2), 107–116. <https://doi.org/10.1016/j.aip.2012.02.003>
- Bickmore, T., Gruber, A., & Picard, R. (2005). Establishing the computer-patient working alliance in automated health behavior change interventions. *Patient Education and Counseling*, 59(1), 21–30. <https://doi.org/10.1016/j.pec.2004.09.008>
- Bläsing, B. E., & Sauzet, O. (2018). My action, my self: Recognition of self-created but visually unfamiliar dance-like actions from point-light displays. *Frontiers in Psychology*, 9, Article 1909. <https://doi.org/10.3389/fpsyg.2018.01909>
- Blatt, S. J. (2008). *Polarities of experience: Relatedness and self-definition in personality development, psychopathology, and the therapeutic process*. American Psychological Association.
- Bloch, C., Vogeley, K., Georgescu, A. L., & Falter-Wagner, C. M. (2019). INTRApersonal synchrony as constituent of INTERpersonal synchrony and its relevance for autism spectrum disorder. *Frontiers in Robotics and AI*, 6, Article 73. <https://doi.org/10.3389/frobt.2019.00073>
- Bowlby, J. (1980). *Attachment and loss: Vol. 3. Sadness and depression*. Basic Books.
- Bowlby, J. (1982). *Attachment and loss: Vol. 1. Attachment* (2nd ed.). Basic Books. (Original work published 1969)
- Bowlby, J. (1988). *A secure base: Clinical applications of attachment theory*. Routledge.
- Brewer, M. B. (1991). The social self: On being the same and different at the same time. *Personality and Social Psychology Bulletin*, 17(5), 475–482. <https://doi.org/10.1177/0146167291175001>
- Burger, B., Thompson, M. R., Luck, G., Saarikallio, S., & Toiviainen, P. (2013). Influences of rhythm- and timbre-related musical features on characteristics of music-induced movement. *Frontiers in Psychology*, 4, Article 183. <https://doi.org/10.3389/fpsyg.2013.00183>
- Butler, E. A., & Randall, A. K. (2013). Emotional coregulation in close relationships. *Emotion Review*, 5(2), 202–210. <https://doi.org/10.1177/1754073912451630>
- Carlson, E., Saari, P., Burger, B., & Toiviainen, P. (2020). Dance to your own drum: Identification of musical genre and individual dancer from motion capture using machine learning. *Journal of New Music Research*, 49(2), 162–177. <https://doi.org/10.1080/09298215.2020.1711778>
- Carver, C. S., & Scheier, M. F. (2012). *Attention and self-regulation: A control-theory approach to human behavior*. Springer Science & Business Media.
- Castonguay, L. G., & Hill, C. E. (2012). *Transformation in psychotherapy: Corrective experiences across cognitive behavioral, humanistic, and psychodynamic approaches*. American Psychological Association.
- Cattell, R. B. (1946). *The description and measurement of personality*. World Book Company.
- Cohen, E. E., Ejsmond-Frey, R., Knight, N., & Dunbar, R. I. (2010). Rowers' high: Behavioural synchrony is correlated with elevated pain thresholds. *Biology Letters*, 6(1), 106–108. <https://doi.org/10.1098/rsbl.2009.0670>
- Cohen, K., Ramseyer, F. T., Tal, S., & Zilcha-Mano, S. (2021). Nonverbal synchrony and the alliance in psychotherapy for major depression: Disentangling state-like and trait-like effects. *Clinical Psychological Science*, 9(4), 634–648. <https://doi.org/10.1177/2167702620985294>
- Condon, W. S., & Ogston, W. D. (1966). Sound film analysis of normal and pathological behavior patterns. *Journal of Nervous and Mental Disease*, 143(4), 338–347. <https://doi.org/10.1097/00005053-196610000-00005>
- Creaven, A. M., Skowron, E. A., Hughes, B. M., Howard, S., & Loken, E. (2014). Dyadic concordance in mother and preschooler resting cardiovascular function varies by risk status. *Developmental Psychobiology*, 56(1), 142–152. <https://doi.org/10.1002/dev.21098>
- Curioni, A., Minio-Paluello, I., Sacheli, L. M., Candidi, M., & Aglioti, S. M. (2017). Autistic traits affect interpersonal motor coordination by modulating strategic use of role-based behavior. *Molecular Autism*, 8(1), Article 23. <https://doi.org/10.1186/s13229-017-0141-0>
- Curran, P. J., & Bauer, D. J. (2011). The disaggregation of within-person and between-person effects in longitudinal models of change. *Annual Review of Psychology*, 62(1), 583–619. <https://doi.org/10.1146/annurev.psych.093008.100356>
- Cutting, J. E., & Kozlowski, L. T. (1977). Recognizing friends by their walk: Gait perception without familiarity cues. *Bulletin of the Psychonomic Society*, 9(5), 353–356. <https://doi.org/10.3758/BF03337021>
- Dales, S., & Jerry, P. (2008). Attachment, affect regulation and mutual synchrony in adult psychotherapy. *American Journal of Psychotherapy*, 62(3), 283–312. <https://doi.org/10.1176/appi.psychotherapy.2008.62.3.283>
- Deres-Cohen, K., Dolev-Amit, T., Peysachov, G., Ramseyer, F. T., & Zilcha-Mano, S. (2021). Nonverbal synchrony as a marker of alliance ruptures. *Psychotherapy*, 58(4), 499–509. <https://doi.org/10.1037/pst0000384>

- DeRubeis, R. J., Gelfand, L. A., German, R. E., Fournier, J. C., & Forand, N. R. (2014). Understanding processes of change: How some patients reveal more than others-and some groups of therapists less-about what matters in psychotherapy. *Psychotherapy Research*, 24(3), 419–428. <https://doi.org/10.1080/10503307.2013.838654>
- DeVault, D., Artstein, R., Benn, G., Dey, T., Fast, E., Gainer, A., Georgila, K., Gratch, J., Hartholt, A., Lhomme, M., Lucas, G., Marsella, S., Morbini, F., Nazarian, A., Scherer, S., Stratou, G., Suri, A., Traum, D., Wood, R., ... Morency, L. P. (2014). SimSensei Kiosk: A virtual human interviewer for healthcare decision support. In A. Lomuscio, P. Scerri, A. Bazzan, & M. Huhns (Eds.), *AAMAS '14: Proceedings of the 2014 international conference on Autonomous agents and multi-agent systems* (pp. 1061–1068).
- Draschkow, D. (2022). Remote virtual reality as a tool for increasing external validity. *Nature Reviews Psychology*, 1(8), 433–434. <https://doi.org/10.1038/s44159-022-00082-8>
- Durantou, C., & Gaunet, F. (2016). Behavioural synchronization from an ethological perspective: Overview of its adaptive value. *Adaptive Behavior*, 24(3), 181–191. <https://doi.org/10.1177/1059712316644966>
- Eubanks, C. F., Muran, J. C., & Safran, J. D. (2018). Alliance rupture repair: A meta-analysis. *Psychotherapy*, 55(4), 508–519. <https://doi.org/10.1037/pst0000185>
- Eysenck, H. J. (1983). Cicero and the state-trait theory of anxiety: Another case of delayed recognition. *American Psychologist*, 38(1), 114–115. <https://doi.org/10.1037/0003-066X.38.1.114>
- Fay, N., Garrod, S., & Roberts, L. (2008). The fitness and functionality of culturally evolved communication systems. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 363(1509), 3553–3561. <https://doi.org/10.1098/rstb.2008.0130>
- Feldman, R. (2012). Biobehavioral synchrony: A model for integrating biological and microsocial behavioral processes in the study of parenting. *Parenting: Science and Practice*, 12(2–3), 154–164. <https://doi.org/10.1080/15295192.2012.683342>
- Feldman, R. (2017). The neurobiology of human attachments. *Trends in Cognitive Sciences*, 21(2), 80–99. <https://doi.org/10.1016/j.tics.2016.11.007>
- Feldman, R., & Bakermans-Kranenburg, M. J. (2017). Oxytocin: A parenting hormone. *Current Opinion in Psychology*, 15, 13–18. <https://doi.org/10.1016/j.copsyc.2017.02.011>
- Feldman, R., & Eidelman, A. I. (2007). Maternal postpartum behavior and the emergence of infant-mother and infant-father synchrony in preterm and full-term infants: The role of neonatal vagal tone. *Developmental Psychobiology*, 49(3), 290–302. <https://doi.org/10.1002/dev.20220>
- Feldman, R., Gordon, I., Influx, M., Gutbir, T., & Ebstein, R. P. (2013). Parental oxytocin and early caregiving jointly shape children's oxytocin response and social reciprocity. *Neuropsychopharmacology*, 38(7), 1154–1162. <https://doi.org/10.1038/npp.2013.22>
- Feldman, R., Gordon, I., & Zagoory-Sharon, O. (2011). Maternal and paternal plasma, salivary, and urinary oxytocin and parent-infant synchrony: Considering stress and affiliation components of human bonding. *Developmental Science*, 14(4), 752–761. <https://doi.org/10.1111/j.1467-7687.2010.01021.x>
- Feldman, R., Magori-Cohen, R., Galili, G., Singer, M., & Louzoun, Y. (2011). Mother and infant coordinate heart rhythms through episodes of interaction synchrony. *Infant Behavior & Development*, 34(4), 569–577. <https://doi.org/10.1016/j.infbeh.2011.06.008>
- Fisher, A. J., Medaglia, J. D., & Jeronimus, B. F. (2018). Lack of group-to-individual generalizability is a threat to human subjects research. *Proceedings of the National Academy of Sciences of the United States of America*, 115(27), E6106–E6115. <https://doi.org/10.1073/pnas.1711978115>
- Flückiger, C., Del Re, A. C., Wampold, B. E., & Horvath, A. O. (2018). The alliance in adult psychotherapy: A meta-analytic synthesis. *Psychotherapy*, 55(4), 316–340. <https://doi.org/10.1037/pst0000172>
- Fonagy, P., Steele, M., Steele, H., Moran, G. S., & Higgitt, A. C. (1991). The capacity for understanding mental states: The reflective self in parent and child and its significance for security of attachment. *Infant Mental Health Journal*, 12(3), 201–218. [https://doi.org/10.1002/1097-0355\(199123\)12:3<201::AID-IMHJ2280120307>3.0.CO;2-7](https://doi.org/10.1002/1097-0355(199123)12:3<201::AID-IMHJ2280120307>3.0.CO;2-7)
- Galantucci, B., & Garrod, S. (2011). Experimental semiotics: A review. *Frontiers in Human Neuroscience*, 5, Article 11. <https://doi.org/10.3389/fnhum.2011.00011>
- Galbusera, L., Finn, M. T. M., Tschacher, W., & Kyselo, M. (2019). Interpersonal synchrony feels good but impedes self-regulation of affect. *Scientific Reports*, 9(1), Article 14691. <https://doi.org/10.1038/s41598-019-50960-0>
- Garrod, S., Fay, N., Lee, J., Oberlander, J., & Macleod, T. (2007). Foundations of representation: Where might graphical symbol systems come from? *Cognitive Science*, 31(6), 961–987. <https://doi.org/10.1080/03640210701703659>
- Gernert, C. C., Nelson, A., Falkai, P., & Falter-Wagner, C. M. (2023). Synchrony in psychotherapy: High physiological positive concordance predicts symptom reduction and negative concordance predicts symptom aggravation. *International Journal of Methods in Psychiatric Research*. Advance online publication. <https://doi.org/10.1002/mpr.1978>
- Golland, Y., Arzouan, Y., & Levit-Binnun, N. (2015). The mere co-presence: Synchronization of autonomic signals and emotional responses across co-present individuals not engaged in direct interaction. *PLOS ONE*, 10(5), Article e0125804. <https://doi.org/10.1371/journal.pone.0125804>
- Gonçalves, M. M., Mendes, I., Cruz, G., Ribeiro, A. P., Sousa, I., Angus, L., & Greenberg, L. S. (2012). Innovative moments and change in client-centered therapy. *Psychotherapy Research*, 22(4), 389–401. <https://doi.org/10.1080/10503307.2012.662605>
- Gratch, J., Wang, N., Gerten, J., Fast, E., & Duffy, R. (2007). Creating rapport with virtual agents. In C. Pelachaud, J. C. Martin, E. André, G. Chollet, K. Karpouzis, & D. Pelé (Eds.), *Intelligent virtual agents: 7th international conference, IVA 2007. Lecture notes in computer science* (pp. 125–138). Springer Berlin Heidelberg.
- Gross, E. B., & Proffitt, D. (2013). The economy of social resources and its influence on spatial perceptions. *Frontiers in Human Neuroscience*, 7, Article 772. <https://doi.org/10.3389/fnhum.2013.00772>
- Hamaker, E. L., Nesselrode, J. R., & Molenaar, P. C. (2007). The integrated trait-state model. *Journal of Research in Personality*, 41(2), 295–315. <https://doi.org/10.1016/j.jrp.2006.04.003>
- Healey, P. G., Swoboda, N., Umata, I., & King, J. (2007). Graphical language games: Interactional constraints on representational form. *Cognitive Science*, 31(2), 285–309. <https://doi.org/10.1080/15326900701221363>
- Hertzog, C., & Nesselrode, J. R. (1987). Beyond autoregressive models: Some implications of the trait-state distinction for the structural modeling of developmental change. *Child Development*, 58(1), 93–109. <https://doi.org/10.2307/1130294>
- Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., & Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspectives on Psychological Science*, 10(2), 227–237. <https://doi.org/10.1177/1745691614568352>
- Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: A meta-analytic review. *PLoS Medicine*, 7(7), Article e1000316. <https://doi.org/10.1371/journal.pmed.1000316>
- Hove, M. J., & Risen, J. L. (2009). It's all in the timing: Interpersonal synchrony increases affiliation. *Social Cognition*, 27(6), 949–960. <https://doi.org/10.1521/soco.2009.27.6.949>
- Idler, E. L., Boulifard, D. A., & Contrada, R. J. (2012). Mending broken hearts: Marriage and survival following cardiac surgery. *Journal of Health and Social Behavior*, 53(1), 33–49. <https://doi.org/10.1177/0022146511432342>
- Ivanov, P. C., Ma, Q. D. Y., & Bartsch, R. P. (2009). Maternal-fetal heartbeat phase synchronization. *Proceedings of the National Academy of Sciences of the United States of America*, 106(33), 13641–13642. <https://doi.org/10.1073/pnas.0906987106>

- Jasmin, K. M., McGettigan, C., Agnew, Z. K., Lavan, N., Josephs, O., Cummins, F., & Scott, S. K. (2016). Cohesion and joint speech: Right hemisphere contributions to synchronized vocal production. *The Journal of Neuroscience*, *36*(17), 4669–4680. <https://doi.org/10.1523/JNEUROSCI.4075-15.2016>
- Karremans, J. C., & Verwijmeren, T. (2008). Mimicking attractive opposite-sex others: The role of romantic relationship status. *Personality and Social Psychology Bulletin*, *34*(7), 939–950. <https://doi.org/10.1177/0146167208316693>
- Kenny, D. A. (1994). *Interpersonal perception: A social relations analysis*. Guilford Press.
- Kenny, D. A. (2019). *Interpersonal perception: The foundation of social relationships*. Guilford Press.
- Kivlighan, D. M., III, Cohen, K., Zilcha-Mano, S., Palgi, S., & Zilberstein, A. (2022). Examining state and trait alliance in group therapy: A within-person and between-person actor-partner interdependence model. *Group Dynamics: Theory, Research, and Practice*, *26*(2), 137–150. <https://doi.org/10.1037/gdn0000152>
- Koehne, S., Schmidt, M. J., & Dziobek, I. (2016). The role of interpersonal movement synchronisation in empathic functions: Insights from Tango Argentino and Capoeira. *International Journal of Psychology*, *51*(4), 318–322. <https://doi.org/10.1002/ijop.12213>
- Kokal, I., Engel, A., Kirschner, S., & Keysers, C. (2011). Synchronized drumming enhances activity in the caudate and facilitates prosocial commitment—If the rhythm comes easily. *PLOS ONE*, *6*(11), Article e27272. <https://doi.org/10.1371/journal.pone.0027272>
- Konvalinka, I., Xygalatas, D., Bulbulia, J., Schjødt, U., Jegindø, E. M., Wallot, S., Van Orden, G., & Roepstorff, A. (2011). Synchronized arousal between performers and related spectators in a fire-walking ritual. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(20), 8514–8519. <https://doi.org/10.1073/pnas.1016955108>
- Koole, S. L., Atzil-Slonim, D., Butler, E., Dikker, S., Tschacher, W., & Wilderjans, T. (2020). In sync with your shrink: Grounding psychotherapy in interpersonal synchrony. In J. P. Forgas, W. D. Crano, & K. Fiedler (Eds.), *Applications of social psychology: How social psychology can contribute to the solution of real-world problems* (pp. 161–184). Taylor and Francis. <https://doi.org/10.4324/9780367816407-9>
- Koole, S. L., & Tschacher, W. (2016). Synchrony in psychotherapy: A review and an integrative framework for the therapeutic alliance. *Frontiers in Psychology*, *7*, Article 862. <https://doi.org/10.3389/fpsyg.2016.00862>
- Kühn, S., Müller, B. C., van der Leij, A., Dijksterhuis, A., Brass, M., & van Baaren, R. B. (2011). Neural correlates of emotional synchrony. *Social Cognitive and Affective Neuroscience*, *6*(3), 368–374. <https://doi.org/10.1093/scan/nsq044>
- Kykyri, V. L., Tourunen, A., Nyman-Salonen, P., Kurri, K., Wahlström, J., Kaartinen, J., Penttonen, M., & Seikkula, J. (2019). Alliance formations in couple therapy: A multimodal and multimethod study. *Journal of Couple & Relationship Therapy*, *18*(3), 189–222. <https://doi.org/10.1080/15332691.2018.1551166>
- Lakin, J. L., Jefferis, V. E., Cheng, C. M., & Chartrand, T. L. (2003). The chameleon effect as social glue: Evidence for the evolutionary significance of nonconscious mimicry. *Journal of Nonverbal Behavior*, *27*(3), 145–162. <https://doi.org/10.1023/A:1025389814290>
- Launay, J. (2015). Musical sounds, motor resonance, and detectable agency. *Empirical Musicology Review*, *10*(1–2), 30–40. <https://doi.org/10.18061/emr.v10i1-2.4579>
- Launay, J., Tarr, B., & Dunbar, R. I. (2016). Synchrony as an adaptive mechanism for large-scale human social bonding. *Ethology*, *122*(10), 779–789. <https://doi.org/10.1111/eth.12528>
- Leibovich, L., Nof, A., Auerbach-Barber, S., & Zilcha-Mano, S. (2018). A practical clinical suggestion for strengthening the alliance based on a supportive-expressive framework. *Psychotherapy*, *55*(3), 231–240. <https://doi.org/10.1037/pst0000195>
- Leonardelli, G. J., Pickett, C. L., & Brewer, M. B. (2010). Optimal distinctiveness theory: A framework for social identity, social cognition, and intergroup relations. In M. P. Zanna & J. M. Olson (Eds.), *Advances in experimental social psychology* (Vol. 43, pp. 63–113). Academic Press.
- Levy, J., Goldstein, A., Zagoory-Sharon, O., Weisman, O., Schneiderman, I., Eidelman-Rothman, M., & Feldman, R. (2016). Oxytocin selectively modulates brain response to stimuli probing social synchrony. *NeuroImage*, *124*(A), 923–930. <https://doi.org/10.1016/j.neuroimage.2015.09.066>
- Lord, S. P., Sheng, E., Imel, Z. E., Baer, J., & Atkins, D. C. (2015). More than reflections: Empathy in motivational interviewing includes language style synchrony between therapist and client. *Behavior Therapy*, *46*(3), 296–303. <https://doi.org/10.1016/j.beth.2014.11.002>
- Lozza, N., Spoerri, C., Ehlert, U., Kesselring, M., Hubmann, P., Tschacher, W., & La Marca, R. (2018). Nonverbal synchrony and complementarity in unacquainted same-sex dyads: A comparison in a competitive context. *Journal of Nonverbal Behavior*, *42*(2), 179–197. <https://doi.org/10.1007/s10919-018-0273-8>
- Luck, G., Saarikallio, S., Burger, B., Thompson, M. R., & Toiviainen, P. (2010). Effects of the Big Five and musical genre on music-induced movement. *Journal of Research in Personality*, *44*(6), 714–720. <https://doi.org/10.1016/j.jrp.2010.10.001>
- Lumsden, J., Miles, L. K., Richardson, M. J., Smith, C. A., & Macrae, C. N. (2012). Who syncs? Social motives and interpersonal coordination. *Journal of Experimental Social Psychology*, *48*(3), 746–751. <https://doi.org/10.1016/j.jesp.2011.12.007>
- Mahler, M., Pine, F., & Bergman, A. (1975). *The psychological birth of the human infant*. Basic Books.
- Marsh, K. L., Richardson, M. J., & Schmidt, R. C. (2009). Social connection through joint action and interpersonal coordination. *Topics in Cognitive Science*, *1*(2), 320–339. <https://doi.org/10.1111/j.1756-8765.2009.01022.x>
- Mayo, O., & Gordon, I. (2020). In and out of synchrony-behavioral and physiological dynamics of dyadic interpersonal coordination. *Psychophysiology*, *57*(6), Article e13574. <https://doi.org/10.1111/psyp.13574>
- Mazzurega, M., Pavani, F., Paladino, M. P., & Schubert, T. W. (2011). Self-other bodily merging in the context of synchronous but arbitrary-related multisensory inputs. *Experimental Brain Research*, *213*(2–3), 213–221. <https://doi.org/10.1007/s00221-011-2744-6>
- Mikulincer, M., & Shaver, P. R. (2007). Boosting attachment security to promote mental health, prosocial values, and inter-group tolerance. *Psychological Inquiry*, *18*(3), 139–156. <https://doi.org/10.1080/10478400701512646>
- Miles, L. K., Griffiths, J. L., Richardson, M. J., & Macrae, C. N. (2010). Too late to coordinate: Contextual influences on behavioral synchrony. *European Journal of Social Psychology*, *40*(1), 52–60. <https://doi.org/10.1002/ejsp.721>
- Miles, L. K., Lumsden, J., Richardson, M. J., & Neil Macrae, C. (2011). Do birds of a feather move together? Group membership and behavioral synchrony. *Experimental Brain Research*, *211*(3–4), 495–503. <https://doi.org/10.1007/s00221-011-2641-z>
- 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*(3), 585–589. <https://doi.org/10.1016/j.jesp.2009.02.002>
- Millidge, B., Seth, A., & Buckley, C. L. (2021). *Predictive coding: A theoretical and experimental review*. ArXiv. <https://doi.org/10.48550/arXiv.2107.12979>
- Mogan, R., Fischer, R., & Bulbulia, J. A. (2017). To be in synchrony or not? A meta-analysis of synchrony's effects on behavior, perception, cognition and affect. *Journal of Experimental Social Psychology*, *72*, 13–20. <https://doi.org/10.1016/j.jesp.2017.03.009>
- Moggia, D., Schwartz, B., Rubel, J. A., Zimmermann, D., Kästel, B., & Lutz, W. (2023). Is it me, is it you or is it both of U.S.? Applying the social

- relations model to disentangle the components of the therapeutic bond. *Psychotherapy Research*, 33(1), 30–44. <https://doi.org/10.1080/10503307.2022.2126334>
- Molenaar, P. C. (2004). A manifesto on psychology as idiographic science: Bringing the person back into scientific psychology, this time forever. *Measurement: Interdisciplinary Research and Perspectives*, 2(4), 201–218. https://doi.org/10.1207/s15366359mea0204_1
- Mu, Y., Guo, C., & Han, S. (2016). Oxytocin enhances inter-brain synchrony during social coordination in male adults. *Social Cognitive and Affective Neuroscience*, 11(12), 1882–1893. <https://doi.org/10.1093/scan/nsw106>
- Muran, J. C. (2019). Confessions of a New York rupture researcher: An insider's guide and critique. *Psychotherapy Research*, 29(1), 1–14. <https://doi.org/10.1080/10503307.2017.1413261>
- Overall, N. C., & Simpson, J. A. (2015). Attachment and dyadic regulation processes. *Current Opinion in Psychology*, 1, 61–666. <https://doi.org/10.1016/j.copsyc.2014.11.008>
- Paladino, M. P., Mazzurega, M., Pavani, F., & Schubert, T. W. (2010). Synchronous multisensory stimulation blurs self-other boundaries. *Psychological Science*, 21(9), 1202–1207. <https://doi.org/10.1177/0956797610379234>
- Palumbo, R. V., Marraccini, M. E., Weyandt, L. L., Wilder-Smith, O., McGee, H. A., Liu, S., & Goodwin, M. S. (2017). Interpersonal autonomic physiology: A systematic review of the literature. *Personality and Social Psychology Review*, 21(2), 99–141. <https://doi.org/10.1177/1088868316628405>
- Paulick, J., Deisenhofer, A. K., Ramseyer, F., Tschacher, W., Boyle, K., Rubel, J., & Lutz, W. (2018). Nonverbal synchrony: A new approach to better understand psychotherapeutic processes and drop-out. *Journal of Psychotherapy Integration*, 28(3), 367–384. <https://doi.org/10.1037/int0000099>
- Paulick, J., Rubel, J. A., Deisenhofer, A. K., Schwartz, B., Thielemann, D., Altmann, U., Boyle, K., Strauß, B., & Lutz, W. (2018). Diagnostic features of nonverbal synchrony in psychotherapy: Comparing depression and anxiety. *Cognitive Therapy and Research*, 42(5), 539–551. <https://doi.org/10.1007/s10608-018-9914-9>
- Paxton, A., & Dale, R. (2013). Argument disrupts interpersonal synchrony. *Quarterly Journal of Experimental Psychology*, 66(11), 2092–2102. <https://doi.org/10.1080/17470218.2013.853089>
- Pays, O., Dubot, A. L., Jarman, P. J., Loisel, P., & Goldizen, A. W. (2009). Vigilance and its complex synchrony in the red-necked pademelon, *Thylogale thetis*. *Behavioral Ecology*, 20(1), 22–29. <https://doi.org/10.1093/beheco/arm110>
- Praszkier, R., & Nowak, A. (2023). In and out of sync: An example of gestalt therapy. *Trends in Psychology*, 31(1), 75–88. <https://doi.org/10.1007/s43076-021-00133-8>
- Prinz, J., Boyle, K., Ramseyer, F., Kabus, W., Bar-Kalifa, E., & Lutz, W. (2021). Within and between associations of nonverbal synchrony in relation to Grawe's general mechanisms of change. *Clinical Psychology & Psychotherapy*, 28(1), 159–168. <https://doi.org/10.1002/cpp.2498>
- Prinz, J., Rafaëli, E., Reuter, J. K., Bar-Kalifa, E., & Lutz, W. (2022). Physiological activation and co-activation in an imagery-based treatment for test anxiety. *Psychotherapy Research*, 32(2), 238–248. <https://doi.org/10.1080/10503307.2021.1918353>
- Ramseyer, F., & Tschacher, W. (2011). Nonverbal synchrony in psychotherapy: Relationship quality and outcome are reflected by coordinated body-movement. *Journal of Consulting and Clinical Psychology*, 79(3), 284–295. <https://doi.org/10.1037/a0023419>
- 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, Article 979. <https://doi.org/10.3389/fpsyg.2014.00979>
- Ramseyer, F. T. (2020). Exploring the evolution of nonverbal synchrony in psychotherapy: The idiographic perspective provides a different picture. *Psychotherapy Research*, 30(5), 622–634. <https://doi.org/10.1080/10503307.2019.1676932>
- Reddish, P., Fischer, R., & Bulbulia, J. (2013). Let's dance together: Synchrony, shared intentionality and cooperation. *PLOS ONE*, 8(8), Article e71182. <https://doi.org/10.1371/journal.pone.0071182>
- Reich, C. M., Berman, J. S., Dale, R., & Levitt, H. M. (2014). Vocal synchrony in psychotherapy. *Journal of Social and Clinical Psychology*, 33(5), 481–494. <https://doi.org/10.1521/jscp.2014.33.5.481>
- Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Press. <https://doi.org/10.1521/978.14625/28806>
- Sakai, M., Morisaka, T., Kogi, K., Hishii, T., & Kohshima, S. (2010). Fine-scale analysis of synchronous breathing in wild Indo-Pacific bottlenose dolphins (*Tursiops aduncus*). *Behavioural Processes*, 83(1), 48–53. <https://doi.org/10.1016/j.beproc.2009.10.001>
- Salazar Kämpf, M., Liebermann, H., Kerschreiter, R., Krause, S., Nestler, S., & Schmukle, S. C. (2018). Disentangling the sources of mimicry: Social relations analyses of the link between mimicry and liking. *Psychological Science*, 29(1), 131–138. <https://doi.org/10.1177/0956797617727121>
- Sbarra, D. A., & Coan, J. A. (2018). Relationships and health: The critical role of affective science. *Emotion Review*, 10(1), 40–54. <https://doi.org/10.1177/1754073917696584>
- Scheidt, C. E., Pfänder, S., Ballati, A., Schmidt, S., & Lahmann, C. (2021). Language and movement synchronization in dyadic psychotherapeutic interaction—a qualitative review and a proposal for a classification. *Frontiers in Psychology*, 12, Article 696448. <https://doi.org/10.3389/fpsyg.2021.696448>
- Schneiderman, I., Zagoory-Sharon, O., Leckman, J. F., & Feldman, R. (2012). Oxytocin during the initial stages of romantic attachment: Relations to couples' interactive reciprocity. *Psychoneuroendocrinology*, 37(8), 1277–1285. <https://doi.org/10.1016/j.psyneuen.2011.12.021>
- Schoenherr, D., Strauss, B., Stangier, U., & Altmann, U. (2021). The influence of vocal synchrony on outcome and attachment anxiety/avoidance in treatments of social anxiety disorder. *Psychotherapy*, 58(4), 510–522. <https://doi.org/10.1037/pst0000393>
- Sebanz, N., Bekkering, H., & Knoblich, G. (2006). Joint action: Bodies and minds moving together. *Trends in Cognitive Sciences*, 10(2), 70–76. <https://doi.org/10.1016/j.tics.2005.12.009>
- Sevdalis, V., & Keller, P. E. (2009). Self-recognition in the perception of actions performed in synchrony with music. *Annals of the New York Academy of Sciences*, 1169(1), 499–502. <https://doi.org/10.1111/j.1749-6632.2009.04773.x>
- Shamay-Tsoory, S. G., & Abu-Akel, A. (2016). The social salience hypothesis of oxytocin. *Biological Psychiatry*, 79(3), 194–202. <https://doi.org/10.1016/j.biopsych.2015.07.020>
- Shamay-Tsoory, S. G., Saporta, N., Marton-Alper, I. Z., & Gvirts, H. Z. (2019). Herding brains: A core neural mechanism for social alignment. *Trends in Cognitive Sciences*, 23(3), 174–186. <https://doi.org/10.1016/j.tics.2019.01.002>
- Shapira, N., Atzil-Slonim, D., Tuval-Mashiach, R., & Shapira, O. (2022, July). Measuring linguistic synchrony in psychotherapy. In A. Zirikly, D. Atzil-Slonim, M. Liakata, S. Bedrick, B. Desmet, M. Ireland, A. Lee, S. MacAvaney, M. Purver, R. Resnik, & A. Yates (Eds.), *Proceedings of the eighth workshop on computational linguistics and clinical psychology* (pp. 158–176). Association for Computational Linguistics.
- Smedslund, G., Amulf, J. K., & Smedslund, J. (2022). Is psychological science progressing? Explained variance in PsycINFO articles during the period 1956 to 2022. *Frontiers in Psychology*, 13, Article 1089089. <https://doi.org/10.3389/fpsyg.2022.1089089>
- Spratling, M. W. (2017). A review of predictive coding algorithms. *Brain and Cognition*, 112, 92–97. <https://doi.org/10.1016/j.bandc.2015.11.003>
- Steyer, R., Mayer, A., Geiser, C., & Cole, D. A. (2015). A theory of states and traits—Revised. *Annual Review of Clinical Psychology*, 11(1), 71–98. <https://doi.org/10.1146/annurev-clinpsy-032813-153719>

- Steyer, R., Schmitt, M., & Eid, M. (1999). Latent state-trait theory and research in personality and individual differences. *European Journal of Personality, 13*(5), 389–408. [https://doi.org/10.1002/\(SICI\)1099-0984\(199909/10\)13:5<389::AID-PER361>3.0.CO;2-A](https://doi.org/10.1002/(SICI)1099-0984(199909/10)13:5<389::AID-PER361>3.0.CO;2-A)
- Suveg, C., Shaffer, A., & Davis, M. (2016). Family stress moderates relations between physiological and behavioral synchrony and child self-regulation in mother-preschooler dyads. *Developmental Psychobiology, 58*(1), 83–97. <https://doi.org/10.1002/dev.21358>
- Symington, N. (1983). The analyst's act of freedom as agent of therapeutic change. *International Review of Psycho-Analysis, 10*, 283–291. <http://psycnet.APA.org/record/1984-10095-001>
- Tal, S., Bar-Kalifa, E., Kleinbub, J. R., Leibovich, L., Deres-Cohen, K., & Zilcha-Mano, S. (2023). A multimodal case study utilizing physiological synchrony as indicator of context in which motion synchrony is associated with the working alliance. *Psychotherapy, 60*(1), 86–97. <https://doi.org/10.1037/pst0000465>
- Tarr, B., Slater, M., & Cohen, E. (2018). Synchrony and social connection in immersive virtual reality. *Scientific Reports, 8*(1), Article 3693. <https://doi.org/10.1038/s41598-018-21765-4>
- Troje, N. F., Westhoff, C., & Lavrov, M. (2005). Person identification from biological motion: Effects of structural and kinematic cues. *Perception & Psychophysics, 67*(4), 667–675. <https://doi.org/10.3758/BF03193523>
- Tyrell, C. L., Dozier, M., Teague, G. B., & Fallot, R. D. (1999). Effective treatment relationships for persons with serious psychiatric disorders: The importance of attachment states of mind. *Journal of Consulting and Clinical Psychology, 67*(5), 725–733. <https://doi.org/10.1037/0022-006X.67.5.725>
- Ulmer-Yaniv, A., Avitsur, R., Kanat-Maymon, Y., Schneiderman, I., Zagoory-Sharon, O., & Feldman, R. (2016). Affiliation, reward, and immune biomarkers coalesce to support social synchrony during periods of bond formation in humans. *Brain, Behavior, and Immunity, 56*, 130–139. <https://doi.org/10.1016/j.bbi.2016.02.017>
- Vacharkulksemsuk, T., & Fredrickson, B. L. (2012). Strangers in sync: Achieving embodied rapport through shared movements. *Journal of Experimental Social Psychology, 48*(1), 399–402. <https://doi.org/10.1016/j.jesp.2011.07.015>
- Valdesolo, P., & DeSteno, D. (2011). Synchrony and the social tuning of compassion. *Emotion, 11*(2), 262–266. <https://doi.org/10.1037/a0021302>
- Valdesolo, P., Ouyang, J., & DeSteno, D. (2010). The rhythm of joint action: Synchrony promotes cooperative ability. *Journal of Experimental Social Psychology, 46*(4), 693–695. <https://doi.org/10.1016/j.jesp.2010.03.004>
- van Dyck, E., Moelants, D., Demey, M., Deweppe, A., Coussement, P., & Leman, M. (2013). The impact of the bass drum on human dance movement. *Music Perception, 30*(4), 349–359. <https://doi.org/10.1525/mp.2013.30.4.349>
- Van Leeuwen, P., Geue, D., Thiel, M., Cysarz, D., Lange, S., Romano, M. C., Wessel, N., Kurths, J., & Grönemeyer, D. H. (2009). Influence of paced maternal breathing on fetal-maternal heart rate coordination. *Proceedings of the National Academy of Sciences of the United States of America, 106*(33), 13661–13666. <https://doi.org/10.1073/pnas.0901049106>
- Van Puyvelde, M., Loots, G., Meys, J., Neyt, X., Mairesse, O., Simcock, D., & Pattyn, N. (2015). Whose clock makes yours tick? How maternal cardiorespiratory physiology influences newborns' heart rate variability. *Biological Psychology, 108*, 132–141. <https://doi.org/10.1016/j.biopsycho.2015.04.001>
- Vicaria, I. M., & Dickens, L. (2016). Meta-analyses of the intra- and interpersonal outcomes of interpersonal coordination. *Journal of Nonverbal Behavior, 40*(4), 335–361. <https://doi.org/10.1007/s10919-016-0238-8>
- Wallot, S., Mitkidis, P., McGraw, J. J., & Roepstorff, A. (2016). Beyond synchrony: Joint action in a complex production task reveals beneficial effects of decreased interpersonal synchrony. *PLOS ONE, 11*(12), Article e0168306. <https://doi.org/10.1371/journal.pone.0168306>
- Wampold, B. E., & Flückiger, C. (2023). The alliance in mental health care: Conceptualization, evidence and clinical applications. *World Psychiatry, 22*(1), 25–41. <https://doi.org/10.1002/wps.21035>
- Wang, L. P., & Maxwell, S. E. (2015). On disaggregating between-person and within-person effects with longitudinal data using multilevel models. *Psychological Methods, 20*(1), 63–83. <https://doi.org/10.1037/met0000030>
- Westhoff, C., & Troje, N. F. (2007). Kinematic cues for person identification from biological motion. *Perception & Psychophysics, 69*(2), 241–253. <https://doi.org/10.3758/BF03193746>
- Wiener, N. (2019). *Cybernetics or control and communication in the animal and the machine*. MIT Press. <https://doi.org/10.7551/mitpress/11810.001.0001>
- Wiltermuth, S. S., & Heath, C. (2009). Synchrony and cooperation. *Psychological Science, 20*(1), 1–5. <https://doi.org/10.1111/j.1467-9280.2008.02253.x>
- Wiltshire, T. J., Philipsen, J. S., Trasmundi, S. B., Jensen, T. W., & Steffensen, S. V. (2020). Interpersonal coordination dynamics in psychotherapy: A systematic review. *Cognitive Therapy and Research, 44*(4), 752–773. <https://doi.org/10.1007/s10608-020-10106-3>
- Wright, A. G., Pincus, A. L., Conroy, D. E., & Hilsenroth, M. J. (2009). Integrating methods to optimize circumplex description and comparison of groups. *Journal of Personality Assessment, 91*(4), 311–322. <https://doi.org/10.1080/00223890902935696>
- Zilcha-Mano, S. (2017). Is the alliance really therapeutic? Revisiting this question in light of recent methodological advances. *American Psychologist, 72*(4), 311–325. <https://doi.org/10.1037/a0040435>
- Zilcha-Mano, S. (2021). Toward personalized psychotherapy: The importance of the trait-like/state-like distinction for understanding therapeutic change. *American Psychologist, 76*(3), 516–528. <https://doi.org/10.1037/amp0000629>
- Zilcha-Mano, S. (in press). Individual-specific animated profiles of mental health. *Perspectives on Psychological Science*.
- Zilcha-Mano, S., & Fisher, H. (2022). Distinct roles of state-like and trait-like patient-therapist alliance in psychotherapy. *Nature Reviews Psychology, 1*(4), 194–210. <https://doi.org/10.1038/s44159-022-00029-z>
- Zilcha-Mano, S., Mikulincer, M., & Shaver, P. R. (2011). Pet in the therapy room: An attachment perspective on animal-assisted therapy. *Attachment & Human Development, 13*(6), 541–561. <https://doi.org/10.1080/14616734.2011.608987>
- Zilcha-Mano, S., Porat, Y., Dolev, T., & Shamay-Tsoory, S. (2018). Oxytocin as a neurobiological marker of ruptures in the working alliance. *Psychotherapy and Psychosomatics, 87*(2), 126–127. <https://doi.org/10.1159/000487190>
- Zilcha-Mano, S., & Ramseyer, F. T. (2020). Innovative approaches to exploring processes of change in counseling psychology: Insights and principles for future research. *Journal of Counseling Psychology, 67*(4), 409–419. <https://doi.org/10.1037/cou0000426>
- Zilcha-Mano, S., Solomonov, N., Posner, J. E., Roose, S. P., & Rutherford, B. R. (2022). Proof of concept of the contribution of the interaction between trait-like and state-like effects in identifying individual-specific mechanisms of action in biological psychiatry. *Journal of Personalized Medicine, 12*(8), Article 1197. <https://doi.org/10.3390/jpm12081197>

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