JYVÄSKYLÄ STUDIES IN EDUCATION, PSYCHOLOGY AND SOCIAL RESEARCH
599

Anu Karvonen

Sympathetic Nervous System Synchrony Between Participants of Couple Therapy

JYVÄSKYLÄN YLIOPISTO

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Esitetään Jyväskylän yliopiston kasvatustieteiden ja psykologian tiedekunnan suostumuksella
julkisesti tarkastettavaksi yliopiston Historica-rakennuksen salissa H320
joulukuun 2. päivänä 2017 kello 12.

Academic dissertation to be publicly discussed, by permission of
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UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2017

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JYVÄSKYLÄ 2017

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Pekka Olsbo, Harri Hirvi
Publishing Unit, University Library of Jyväskylä

Cover photo by Eveliina Jaatinen.

Permanent link to this publication: http://urn.fi/URN:ISBN:978-951-39-7250-9

URN:ISBN:978-951-39-7250-9
ISBN 978-951-39-7250-9 (PDF)

ISBN 978-951-39-7249-3 (nid.)
ISSN 0075-4625

Jyväskylä University Printing House, Jyväskylä 2017

ABSTRACT

Karvonen, Anu
Sympathetic nervous system synchrony between participants of couple therapy
Jyväskylä: University of Jyväskylä, 2017, 81 p.
(Jyväskylä Studies in Education, Psychology and Social Research
ISSN 0075-4625; 599)
ISBN 978-951-39-7249-3 (nid.)
ISBN 978-951-39-7250-9 (PDF)

Synchrony, or the moment-by-moment coordination between people in social situations, has been connected with increased liking and rapport. However, this type of synchrony is an underexplored area with regard to autonomic nervous system activity. The purpose of this research was to study physiological synchrony between participants in couple therapy by focusing on the sympathetic nervous system (SNS), which reflects arousal and emotional reactions. The data comprised 12 couple therapy cases (24 clients, 10 therapists) participating in the *Relational Mind in Events of Change in Multiactor Therapeutic Dialogues* (2013-2016) research project. Electrodermal activity (EDA) and heart rate were recorded from the clients and therapists at the start and at the end of the therapy. The aim of the research was threefold: to study the physiological reactions and synchrony that can be observed between participants in couple therapy, to analyze whether the levels of EDA synchrony change throughout the therapy processes, and to assess whether the possible changes in EDA synchrony are related to the therapeutic alliance or the therapy outcome. The results showed that between the participants of couple therapy, significant SNS synchrony occurred, which was not due merely to chance or to the presence of similar features within the therapy sessions. At the start of the therapy, the couples had the lowest level of SNS synchrony, whereas the co-therapists had the highest synchrony. The only significant SNS changes observed were in the couples, whose mutual synchrony increased towards the end of the therapy. The changes in SNS synchrony between the couples, and between the clients and the therapists, mostly showed a positive relationship with the increasing alliance and with the clients' better wellbeing – although one specific pattern of decreasing synchrony seemed to be beneficial. The results highlight the role of embodiment in human interaction, and assist in understanding the healing mechanisms of therapy.

Keywords: sympathetic nervous system, electrodermal activity, physiological synchrony, couple therapy, therapeutic alliance, therapy outcome, interpersonal physiology, linkage, concordance, coherence, autonomic nervous system

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TIIVISTELMÄ (FINNISH ABSTRACT)

Karvonen, Anu
Sympaattisten hermostojen synkronia pariterapiaan osallistuvien henkilöiden välillä
Jyväskylä: University of Jyväskylä, 2017, 81 s.
(Jyväskylä Studies in Education, Psychology and Social Research
ISSN 0075-4625; 599)
ISBN 978-951-39-7249-3 (nid.)
ISBN 978-951-39-7250-9 (PDF)

Synkronia eli ajallinen samankaltaisuus ihmisten välisessä vuorovaikutuksessa lisää yhteisymmärrystä ja positiivisia tunteita toista kohtaan. Tällaista synkroniaa on kuitenkin tutkittu vain vähän autonomisen hermoston tasolla. Tutkimuksen tarkoituksena oli analysoida fysiologista synkroniaa pariterapiaan osallistuvien henkilöiden välillä keskittyen erityisesti sympaattisen hermoston (sympathetic nervous system, SNS) aktivaatioon, joka kertoo vireystilasta sekä tunnereaktioista. Aineisto koostui Relationaalinen mieli monitoimijaisten terapiadialogien muutoshetkissä (2013-2016) -tutkimusprojektin kahdestatoista pariterapiatapauksesta (24 asiakasta ja 10 terapeuttia). Fysiologisina mittareina käytettiin ihon sähkönjohtavuutta (electrodermal activity, EDA) sekä sydämen sykkeeseen liittyviä muuttujia. Tavoitteena oli tutkia millaisia fysiologisia reaktioita ja synkroniaa voidaan havaita pariterapiaan osallistuvien henkilöiden välillä, muuttuvatko SNS-synkroniatasot terapian edetessä ja ovatko mahdolliset muutokset SNS-synkroniassa yhteydessä terapeuttiseen yhteistyösuhteeseen tai terapian lopputulokseen. Tulokset osoittivat, että pariterapian osallistujien välillä oli merkittävää synkroniaa, joka ei johtunut ainoastaan sattumasta tai terapiaistuntojen samankaltaisuudesta. Terapian alkuvaiheessa pariskuntien SNS synkronia oli kaikista matalinta, ja pareittain työskentelevien terapeuttien välillä taas korkeinta. Terapian loppua kohti ainoastaan pariskuntien synkroniassa oli tapahtunut merkittävä muutos: puolisoiden välinen synkronia oli kasvanut. Lisääntynyt synkronia puolisoiden välillä sekä asiakkaiden ja terapeuttien välillä oli enimmäkseen positiivisesti yhteydessä kasvavaan yhteistyösuhteen laatuun sekä asiakkaiden hyvinvoinnin kasvuun. Tutkimuksessa löytyi kuitenkin myös tietty asiakas–terapeuttiyhdistelmä, jossa vähentyvä synkronia näytti olevan hyödyllisempää. Tutkimustulokset heijastavat ruumiillisuuden tärkeää roolia ihmisten välisessä vuorovaikutuksessa ja auttavat ymmärtämään sitä, miten terapia voi auttaa asiakkaita.

Avainsanat: sympaattinen hermosto, ihon sähkönjohtavuus, fysiologinen synkronia, pariterapia, terapeuttinen allianssi, terapian tuloksellisuus, autonominen hermosto

ACKNOWLEDGMENTS

First of all, I wish to thank all the clients and therapists who participated in the Relational Mind research project and who thus made this research possible. Thank you for having the courage to open your lives to us. I sincerely thank the PI of the project, Professor Jaakko Seikkula, for giving me the opportunity to do my dissertation within the framework of the project, and for trusting me with crucial parts of the research. I have gained enormous experience over the years of the research, and see that as a unique privilege for a person completing her PhD. I have been hugely fortunate in being able to work with a family therapist of such international stature, and in being able to learn so much about psychotherapy in so doing.

In the same breath, I most warmly thank Virpi-Liisa Kykyri, Senior Researcher, who has been one of my supervisors (my "partner in crime"!) over all these years. I am grateful for the wonderful, seamless collaboration that existed in our work. If I may extend the crime metaphor: Virpi-Liisa, you ensured that although my position was one of a junior researcher I was not treated as a "sidekick," but as a researcher on the same terms as a senior researcher. Thank you for advancing my career in this manner. I also appreciate the encouragement, praise, and kind words you have said to me – in Academia, these are crucially needed. We managed to achieve some amazing things together!

I am much obliged to my main supervisor, Adjunct Professor Markku Penttonen, for guiding me in the world of research since the Master's Thesis. Thank you for always having time to answer my questions when I came knocking on your door, and for your efforts in trying to find answers when none were immediately available. I am grateful that your expertise was always at hand, and that I could always count on your help. I also wish to thank my supervisor, Adjunct Professor Jukka Kaartinen, for his support. Your warm compliments brought joy to my day more than once.

Professor Asko Tolvanen has helped me greatly with statistical analyses – many thanks for your assistance. I also want to thank Professor Wolfgang Tschacher and Professor Kenneth Hugdahl for their time and efforts in pre-examining my dissertation. Their expertise and thoughtful comments were greatly appreciated. Furthermore, I am grateful to all the people in the Department of Psychology, who have, in different ways, helped me reach my dream of becoming a Doctor of Psychology. This includes the late Professor Jari-Erik Nurmi, sadly no longer with us, who helped me to secure funding so that I could finish my research.

I'd also like to express my sincere gratitude to all the international partners of the Relational Mind research project for the wonderful, fruitful collaboration during these years. I'm especially obliged to Assistant Professor Evrinomy Avdi (Aristotle University of Thessaloniki), Professor Maria Borcsa (Hochschule Nordhausen) and Professor Zbyněk Vybíral and Michal Čevelíček (Masaryk University) for hosting me during my research visits to Greece, Germany and Czech Republic. Associate Professor Lars-Erik Malmberg generously

asked me to be an invited speaker at the University of Oxford, for which I am very grateful. Furthermore, I thank Donald Adamson for kindly reviewing the language of all my articles and the eventual dissertation.

A special thanks to my fellow (junior) researchers Helena Päivinen, Petra Nyman-Salonen and Berta Vall for sharing this journey with me. Work would have been infinitely more boring without you: thank you for all the laughter! I am so happy to have made new, amazing, and brilliant friends like you during this process. Thanks to all of my friends, especially Nina, Emma, Eve, Kaisa, and Minna, for being there for me – and for coming up with fun things to do during weekends.

Words can't describe how thankful I am to my family for their love, support, and encouragement during all these years. I think a quote from a friend sums it up well: "Your mother is so supportive and wonderful, that it's no surprise that you grew up to be such a warm and positive person." It is now just over eleven years since the three of us came in the car to Jyväskylä, so that I could take the first entrance exam to become a psychologist. Thank you, Tarja and Vellu, for always believing in me.

Furthermore, I owe a great debt of gratitude to my future parents-in-law, Leena and Rauno, for their support and warmth. Thank you also for always taking care of our precious dog, Neo: during these years it has been a life-saver to be able to freely travel and to meet friends, in order to recover and take my mind off the work for a time. Neo himself also deserves a thankyou, not just for relieving PhD stress, but also for making me grow as a person. Competing with him in various dog sports has taught me important lessons in accepting failure without giving up.

Finally, I thank my fiancé Panu for these past seven years. I have never met a funnier and smarter person than you, someone who can be my rock and at the same time still constantly sweep me off my feet. Thank you for making my life an adventure and for sharing it with me.

Jyväskylä, October 2017
Anu Karvonen

This research was supported by the Academy of Finland (grant number 265492) and the Department of Psychology, University of Jyväskylä.

LIST OF ORIGINAL PUBLICATIONS

I Seikkula, J.*, Karvonen, A.*, Kykyri, V. L., Kaartinen, J., & Penttonen, M. (2015). The embodied attunement of therapists and a couple within dialogical psychotherapy: An introduction to the Relational Mind research project. *Family Process, 54,* 703–715. [*Shared first author]

II Karvonen, A., Kykyri, V. L., Kaartinen, J., Penttonen, M., & Seikkula, J. (2016). Sympathetic nervous system synchrony in couple therapy. *Journal of Marital and Family Therapy, 42,* 369–563.

III Karvonen, A., Kykyri, V. L., Seikkula, J., Kaartinen, J., Tolvanen, A. & Penttonen, M. (2017). Sympathetic nervous system synchrony: Its relationship with the therapeutic alliance and outcome in couple therapy. Submitted manuscript.

Taking into account the instructions given and the comments made by the co-authors, the author of this thesis collected the data, conducted the analyses, and wrote the reports of the three publications. She was also involved in planning the research design. The author recorded all the autonomic nervous system measuring sessions and interviews, and followed them live in the monitoring rooms.

Because one of the aims of Study I was to present the history of embodiment in therapy practices, the related article was first-authored together with J. Seikkula, who had the main responsibility for describing the shift from the linguistic to the corporeal turn in psychotherapy research. The present researcher had the main responsibility for gathering the data, describing the physiological methods, analyzing the data, and writing up the results. The thesis focuses on the empirical part of Study I, which was written by the present author.

FIGURES

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CONTENTS

1 INTRODUCTION

Synchrony between people refers to individuals' moment-by-moment coordination within social interactions (Delaherche et al., 2012). It was first studied by developmental psychologists in relation to language learning and to the social connections that people form, but now a great many disciplines are interested in the phenomenon – including even the fields of robotics and machine learning. This is because interpersonal synchrony has been linked to numerous aspects of successful social interaction, such as prosocial behavior (Cirelli, Einarson, & Trainor, 2014; Rennung & Göritz, 2016), and increased affiliation and rapport in relationships (Hove & Risen, 2009; Miles, Nind, & Macrae, 2009). People tend to automatically mimic others in their facial expressions, prosody, postures, movements, and behaviors, and this has been thought to foster the synchronization process (Hatfield, Cacioppo, & Rapson, 1993; van Baaren, Holland, Kawakami, & van Knippenberg, 2004). A number of brain areas, which activate during interpersonal synchrony, are involved in social and embodied cognition, in including aspects of the other in the self, and in observing actions (Cacioppo et al., 2014). However, conscious awareness of synchrony is not necessary for the prosocial benefits to occur, and people are often oblivious to their synchrony with others in social encounters.

The present research on interpersonal synchrony focused on autonomic physiology in specific multi-actor settings, namely couple therapy processes involving two spouses and two therapists. Synchrony in the involuntary autonomic nervous system reactions that occur between people is currently an underexplored area, even though it has far-reaching implications for understanding human behavior and social interactions (Palumbo et al., 2017). The majority of the studies conducted so far have been done with pre-assigned tasks, cues, or stimuli in laboratory settings. Sometimes these settings are far removed from real life; for example, couples have had to sit together quietly in the dark blindfolded, or to stare at each other for several minutes without making facial gestures or bodily movements (e.g., Helm, Sbarra, & Ferrer, 2012). In comparison, couple therapy provides a good platform to study synchronization, since it occurs within the natural flow of the interaction. Conversation is not restricted to

certain topics, and emotional reactions are genuine, in the sense that they are not induced by pictures or videos with no personal meaning for the participants. The multi-actor setting also provides an opportunity to study several relationships and dynamics within the situation; thus, the setting includes romantic partners and two colleagues working together, plus the therapeutic relationship between the clients and the therapists.

As far as I know, this was the first research to study how autonomic nervous system synchrony between participants develops in the course of therapy, and the first also to involve interactions between more than one client and one therapist. The research thus addressed the physiological reactions and synchrony observable between participants within couple therapy, whether the levels of physiological synchrony change throughout the therapy process, and whether possible changes in synchrony are related to the wellbeing of the clients and to the therapeutic alliance.

1.1 A human life perspective

The current research focused on physiological synchrony. However, it should be noted that the Relational Mind research group uses the term *embodied synchrony*, which is seen as better conveying the notion that both verbal and nonverbal components of synchrony are important in attunement to others. Embodied synchrony between people is viewed as an innate and automatic process in which our whole body is involved; thus, facial expressions, body movement, physiological sensations, and the prosody of speech are all relevant, in addition to the spoken words. In connection with this notion, a distinction can be drawn between the following perspectives:

- Treating the mind and the body as separate entities. Unfortunately Cartesian dualism still persists, especially in medicine, due to the fact that the knowledge acquired during the last 300 years has been built on a biomedical model (Mehta, 2011).
- Considering measurable brain activity as equivalent to the human mind. This has often been the underlying assumption in neuroscientific research (Bennet & Hacker, 2003). Thus, it could be said that mind/body dualism has been replaced by brain/body dualism (Hacker, 1997).
- Restricting human interaction to a straightforward cause-effect model, in line with the natural sciences. In comparison, humans can be seen as agents with intentions, i.e., entitites that do not always act in identical, repeatable, and predictable ways (Marková, 2003). Already in 1892, William James argued that the best metaphor for the human mind is a river or a stream, not a chain of events.

- Focusing only on the content of the speech in therapeutic processes (psychotherapy as the "talking cure"). Even though talking is usually an important part of psychotherapy, it seems over-reductive to consider words as the only curative factor in the relationships between clients and therapists (Koole & Tschacher, 2016).

In contrast, the view of human life in this reseach can be seen as *intersubjective*, *relational,* and *dialogical*. The interest is in the inherently social nature of our being, with language, too, viewed as communal rather than private. The claim is that human mind is a "shared mind," and that intersubjectivity is what makes us human, compared to non-human animals (Zlatev, Racine, Sinha, & Itkonen, 1998). In fact, the sharing of experiences does not happen primarily on a cognitive level, but rather within affects, perceptual processes, and action-orientation, by means of embodied interaction. Two persons can predict what the other will do, and can share control, unlike physical objects, which have no social relationships (Trevarthen, 1979).

This means that the capacity to understand others does not only depend on mentalistic or linguistic abilities, but also on the relational nature of the interactions (Gallese, 2003). Humans tend to recognize each other's intentions intuitively, because intersubjectivity is an innate capacity (Trevarthen, 1998; 2008). Instead of saying that the mind makes communication possible, the relational view of the human life leads to a constructivist perspective: the mind emerges from social interaction, and it is communication which makes the mind possible (Carpendale, Atwood, & Kettner, 2013; Mead, 1934). Similarly, speech is hardly something that occurs in isolation: it is a response to things that have been said, or in anticipation of things that will be said, dynamically and relationally. Mikhail Bakhtin (1984, p. 110), has described this dialogicality as follows:

> Truth is not born nor is it to be found inside the head of an individual person, it is born between people collectively searching for truth, in the process of their dialogic interaction.

Social reality can be seen as constructed by dialogic interaction. Consequently, relationships may get caught up in a system which produces conflicting definitions of the relationship, thereby causing subjective distress (Bateson, 1962). According to the Open Dialogue approach (Seikkula & Olson, 2003), the goal of psychotherapy can be the generatation of joint understanding, as compared to achieving a consensus between everyone. The interaction and language practices in therapy sessions should allow the tolerance of uncertainty, so that something which cannot be expressed may be given "a voice" with the help of others. Multi-actor settings therefore create a polyphony, in which the therapists, too, have their personal, intimate voice, in addition to a professional voice (Seikkula, 2008). Stern (2004) has proposed focusing on the present moment as non-verbal embodied experience, and Seikkula (2008) continues this

line of thought, suggesting that in therapy, the clients and therapists live within a joint embodied experience before this is formulated into words.

Indeed, the present decade has seen a shift from linguistic practices into a "corporeal turn" (Sheet-Johnstone, 2010) or "affective turn" (Cromby, 2012) in the human sciences, highlighting the comprehensive embodied quality of human life. Becoming oriented to the moment-by-moment unfolding dialogue involves spontaneous embodied responsiveness (Shotter, 2015), and the research described in the present work focuses on the synchrony in this responsiveness, on the level of the involuntary nervous system.

1.2 Psychophysiological measures

1.2.1 The sympathetic nervous system

The brain and the spinal cord are part of the central nervous system (CNS), whereas the autonomic nervous system (ANS) is part of the peripheral nervous system. The CNS components connected with autonomic regulation form the central autonomic network (De Morree, Szabó, Rutten, & Kop, 2013). ANS activity is, in general, not under direct voluntary control (Jänig, 1989). The purpose of the ANS is to maintain homeostasis and to adjust the body to changing circumstances. ANS activity is a major component of emotional reactions (Kreibig, 2010), and its evolution has been linked to emotional expression, facial gestures, vocal communication, and contingent social behavior (Porges, 2001). The adrenal cortex and adrenal medulla interact to constitute a link between the autonomic and endocrine systems, responding to stress and metabolic demands (Hamill, Shapiro, & Vizzard, 2011).

The main focus in the research reported here was on sympathetic nervous system (SNS) activity. The ANS is divided into the SNS and the parasympathetic nervous system (PNS), which usually function in an antagonistic way. The SNS prepares the body to act in case of emergency, whereas the PNS is connected with relaxation and recovery. Biologically, the SNS is in charge of, for example, dilating the pupils, inhibiting digestion, and increasing breathing, heart rate, sweating, and blood supply to muscles. Psychologically, the SNS has long been linked to emotions and stress, but also to attention and motivation (Blascovich, Vanman, Mendes, & Dickerson, 2011). Stressful events trigger the fight-or-flight response of the SNS, due to the activation of the sympathetic-adrenomedullary axis (Sherman, Bunyan, Creswell, & Jaremka, 2009), whereas relaxation reduces SNS responsiveness (Hoffman et al., 1982). Optimal responsiveness to stress is essential for wellbeing, task performance, and social interactions, and problems in this area can lead to severe behavioral and somatic problems (Chrousos, 2009). The two factors which largely determine individual responses to stressful situations are how the person perceives the situation, in addition to his or her general physical health (McEwen, 1998).

Here it should be noted that in the polyvagal theory of Stephen Porges (2003), the function of the ANS is described in a slightly different way, i.e., as a hierarchical and sequential system. The SNS is seen as a primitive system of mobilization, which is activated when the social engagement system (the myelinated vagus) fails. In the event that the SNS activation does not suffice in the face of threat, the most primitive immobilization strategy (the unmyelinated vagus) activates. The polyvagal theory has gained popularity, especially among psychologists and psychotherapists. Nevertheless, it appears that the physiological premises of the theory may not be valid according to current knowledge of evolutionary autonomic physiology (Grossman & Taylor, 2007).

Interestingly, Porges (2001) has described the SNS as the system "with feelings" whereas the PNS "guards against feelings." Coming close to this description, body psychotherapists see the ANS as a barometer of emotional intensity and internal conflict (Totton, 2005). In body psychotherapy, the SNS is seen as representing feelings "coming up" (anger, fear, excitement, desire, hatred) and the PNS as connected with feelings "coming down" (disappointment, grief, shame, guilt, and despair; but also, contentment, peacefulness, satisfaction). There has been much controversy about the specifity of ANS activation in different emotions (Levenson, 2014), but, for example, Kreibig's (2010) review of 134 publications suggests that there are distinct patterns of ANS activity for different emotions.

1.2.2 Electrodermal activity

Psychophysiology focuses on the constant interplay between the mind and the body, which is analyzed by studying biological processes during psychological events. By using psychophysiological recordings, it is possible to detect bodily reactions which are not necessarily observable in speech or behavior (Hugdahl, 1995). One of the oldest and most popular psychophysiological measures in recording ANS activity is electrodermal activity (EDA). The recording is relatively simple, and EDA as a phenomenon has been studied since the 1850s. EDA was analyzed in all three studies of the present research.

Physical properties and the recording of EDA

In humans, the palms and the soles of feet in particular are densely packed with sweat glands. The present understanding is that the eccrine sweat glands receive only excitatory sympathetic nerve impulses (Boucsein, 2012), meaning that SNS activity can be measured by recording changes in sweating from the hands or feet. Although postganglionic sympathetic transmission is normally adrenergic by means of noradrenaline, sudomotor transmission is cholinergic, which means that the synaptic transmitter is acetylcholine. In the present research, the electrical current necessary to measure changes in exosomatic EDA was delivered to the skin by direct current (this being the most widely applied methodology). Usually, two electrodes are attached to the participant's non-dominant fingers or palm, and a very small voltage is then applied across

the electrodes. The flowing current is measured to provide a measure of skin conductance (SC).

SC has both tonic and phasic properties, meaning that there exists a more slowly changing skin conductance level (SCL) in the absence of environmental events, as well as faster peaks of skin conductance responses, either elicited by distinct stimuli (SCRs), or non-specifically without stimuli (NS-SCRs). These responses are very automatic, and cannot usually be voluntarily controlled (Hugdahl, 1995). The latency from the stimulus to SCR onset is usually around 1-3 seconds (Levinson & Edelberg, 1985; Venables & Christie, 1980), with SCR rise time being faster than decay time. SCR amplitudes are expressed in microsiemens units, and they are often logarithmically or square-root transformed in order to normalize data (Boucsein et al., 2012). Because the interactions analyzed in this research occurred naturally (without short, specific stimuli), it can be said that both SCRs and NS-SCRs were included in the analyses in seeking to assess the synchrony between persons in phasic arousal.

EDA as an indicator of arousal and emotions

EDA can be used as a general measure of psychological or physiological arousal. Arousal as a concept has both been praised and criticized. On the one hand it may be *the* fundamental explanatory principle of human behavior; on the other hand the term can be used to explain so many situations that its explanatory power is at risk of being lost (Gale & Edwards, 2016). Nevertheless, most biological systems tend to function on an optimal level, attempting to maintain homeostasis. The Yerkes-Dodson law (Yerkes & Dodson, 1908) proposed a U-shaped relationship between arousal and performance, claiming that moderate arousal is best for performance, whereas both minimal and too high arousal start to decrease performance. However, high emotional arousal can also have adaptive value, in the sense that people are able to focus on the most vital information instead of a larger set of cues, with the body becoming quickly mobilized (Hanoch & Vitouch, 2004). Concerning psychotherapy, the notion of task-specificity is interesting. One can ask whether there an optimal level of emotional arousal for a good outcome in therapy. In treating traumas and especially PTSD, a moderate level of client arousal is often preferred by therapists.

It is possible for arousal to change in the absence of emotions, but emotions usually appear in parallel with changes in arousal. Most emotional reactions, regardless of valence, are accompanied by an increase in EDA (Kreibig, 2010). A decrease in EDA has been observed in a few specific emotions, such as non-crying sadness and acute sadness (as compared to sadness about past events), contentment, and relief. Emotions have been proposed as generally reflecting preparation for motor action (Brehm, 1999; Fredrikson et al., 1998); hence, emotional moments with decreasing EDA appear to be characterized by passivity rather than an urge towards action.

The current consensus seems to be that emotional arousal cannot be defined as one unidimensional construct; rather, there can be different arousal

systems with different biological bases. In the CNS, there exist at least two origins for EDA: a limbic-hypothalamic source, influenced by thermoregulation and affects, and a premotor-basal ganglia source, related to preparation of specific motor actions (Boucsein, 2012). There may also be a reticular modulating system related to general arousal.

When one studies only EDA, one cannot determine what specific emotion the participant is feeling, merely the possible intensity of the emotion. Information from video recordings, subjective descriptions, and other ANS variables is needed in order to make conclusions about precise emotions. In the present research the interest was broadly in the "preparation for action" quality of arousal, without efforts to account for the exact reasons for the increases and decreases in EDA. It is very likely that during couple therapy sessions many of the SCRs are the result of emotional responses, but they could also be related to e.g., attentional demands, gestures, or speech. However, treating SCRs as artifacts of movement or changes in respiration is not always appropriate, since these changes may be covarying indicators of orienting or defensive responses, or of strong emotion- or stress-eliciting stimuli (Boucsein, 2012; Schneider, Schmidt, Binder, Schaefer, & Walach, 2013). In the current research the interest was in SNS synchrony between people, irrespective of the initial reason for the SNS activation. The focus was on change: on when the arousal in one person increased or decreased, and on what happened in the arousal of other people within the situation. In couple therapy, it can be assumed that emotional self-regulation and co-regulation (see Section 1.4.2) come into play when arousal increases sharply.

1.2.3 Heart rate measures

In addition to EDA, a range of cardiovascular variables are very popular in psychophysiology. The most common measures include heart rate (HR), heart rate variability (HRV), blood pressure, finger temperature, and respiratory sinus arrhytmia. The heart is innervated by both the SNS and the PNS, so an increase in heart rate could be the result of either SNS activation or PNS deactivation. However, normal variation in heart rate is controlled by the PNS through vagal influences on the SA-node, and it is known that e.g., the high frequency power in HRV (0.15 to 0.4 Hz) is mediated only by the PNS, providing information on relaxation (Stein, Bosner, Kleiger, & Conger, 1994). In the present research, heart rate measures were used in Study I to represent the stress of the participants during the therapy session. Sympathetic dominance over parasympathetic activation was assessed from the combination of HR, high and low frequency power, and respiration rate (evaluated from heart rate recording; see Methods 2.6.1). It is important to note that the stress in Study I does not automatically equal negative anxiety, but rather increased activation in the body. This activity can sometimes have a positive valence, as in the case of happy excitement.

Comparisons between HR variables and EDA reactivity were beyond the scope of this research, but it is clear that the use of more than one psychophysi-

ological measure may provide more information on the phenomena under study. EDA was chosen as the main variable in the research, on the grounds that synchrony in it had already been studied by two research groups in individual psychotherapy, and that considerable work had to be done to develop a reliable synchrony measure for multi-person situations.

In addition to practical issues, many theoretical notions also favor the use of EDA. Emotionally arousing stimuli may effect EDA more than HR (Buck, Miller, & Caul, 1974; Campos & Johnson, 1967), and EDA is highly sensitive to small changes in lower states of anxiety – as compared to the usefulness of HR in high anxiety states such as phobias (Boucsein, 2012). HR is more closely related to movement or muscular action than EDA (Fowles, 1980), thereby possibly making EDA a more artifact-free measure in naturalistic settings. Unlike cardiovascular measures, EDA is also responsive to behavioral inhibition and to defensive strategies: SCL increases if thoughts are suppressed, if emotional expressions are inhibited, or if traumatic experiences are not disclosed (Hughes, Uhlmann, & Pennebaker, 2006). These issues are often worked with in therapy, making EDA a relevant measure for research settings that encompass such situations. Finally, there is the advantage that EDA increases linearly after stimuli, compared to curvilinear post-stimuli decreases in HR (Bradley, Codispoti, Sabatinelli, & Lang, 2001).

1.3 Synchrony terminology

The term *synchrony* was chosen for this research to describe the similarity in SNS activity between persons. The terminology has varied, depending on the population studied, and other possible terms to describe synchrony include for example *concordance* (psychotherapy), *compliance* (team mates), *covariation*, *coherence*, *linkage*, *coupling*, *entrainment*, *attunement*, and *engagement* (Palumbo et al., 2017).

In this research, synchrony did not refer merely to a positive correlation between matching states, but also to a negative correlation, with reactions happening simultaneously but going in opposite directions. Note also that in referring to *positive synchrony* and *negative synchrony* there is no implication that positive synchrony is beneficial and negative synchrony detrimental; the reference is purely to the direction of the simultaneous change. The specific quality of the interaction determines what is beneficial, since negative synchrony can also be thought of as complementary synchrony. Thus, when one client gets very agitated, it may be best for the spouse and the therapists to try to stay calm. Nevertheless, in many previous studies, successful and pleasant interaction with others has indeed been connected to positive synchrony.

Finally, the term *asynchrony* describes the lack of SNS concurrence in time between participants. One example could be when a person starts to become alert, but the arousal of the other person remains steady (i.e., does not increase

or decrease). Because the focus in this research was on the change in SNS activity – with something causing the person's physiological state to adapt to situational demands – forms of positive synchrony in which nothing happens in the arousal level of the participants were not taken into account in the statistical analyses.

1.4 Theories of interpersonal synchrony

1.4.1 Infant–parent synchrony and attachment

The main focus in the present research was on adults, but a description of empirical research in interpersonal synchrony would not be complete without mentioning the important work done in developmental psychology. For example, Schore (2002) and Feldman, Greenbaum, and Yirmiya (1999) considered the affective synchrony between infants and mothers to be related to the child's self-control later in life. The attachment system can be seen as a psychobiological system, with attachment theory (Ainsworth, 1979; Bowlby, 1969) viewed as a theory of interactive biological regulation.

Feldman and colleagues have extensively studied the effects of hormones, especially oxytocin, on parenting. They found that oxytocin is connected with increased infant-parent synchrony, sensitive parenting, and parental contact (Feldman & Bakermans-Kranenburg, 2017). In fact, oxytocin provides an excellent example of the complexity of social-emotional behavior. For many years it was onsidered to be the "love hormone," involved only in positive prosocial interaction, but it has recently shown a different facet, being found to accompany gloating and feelings of envy (Shamay-Tsoory et al., 2009). In a similar way, during the 1980s, higher SNS synchrony among couples was thought to be connected with the discussion of marital problems rather than ordinary events (Levenson & Gottman, 1983). It is now recognized that SNS synchrony is a more complex phenomenon, connected also with positive emotions, such as empathy (Timmons, Margolin, & Saxbe, 2015).

According to Siegel (1999), parental sensitivity to nonverbal affective signals forms the core of secure attachments. Emotionally sensitive responses – the "dance" between persons – allow emotional communication and a sense of connection be established throughout life. Since attachment in adulthood was not considered within the individual studies of the present research, it is important to make a few remarks here.

The functioning of the attachment system does indeed appear to shape interpersonal behavior, such as seeking proximity or avoiding intimacy, and it contributes to the quality of social interactions, especially in close relationships (Mikulincer & Shaver, 2007). Competency is needed in expressing needs, emotions, and thoughts, in showing sensitivity to the partner's verbal and nonverbal signals, and in managing conflicts in order to restore relationship harmony. Also in therapy, the therapist's attachment style may influence the working re-

lationship and the outcome of therapy – especially the bond aspect of the alliance (Degnan, Seymour-Hyde, Harris, & Berry, 2016). Hence, in adulthood, attachment insecurities can interfere with the interpersonal "dance" between partners, due to a lack of balance between closeness and autonomy in the relationship. These insecurities, expressed in anxiety and avoidance, have been connected with heightened ANS reactivity to stress (Diamond & Fagundes, 2010). Interestingly, in the case of avoidant persons, a discrepancy has been observed between subjective and physiological responses: stress may not be self-reported by the persons concerned, but their EDA can increase as a sign of emotional inhibition (Roisman, 2007). These examples illustrate how attachment-system functioning could affect SNS synchrony in couple therapy.

1.4.2 Emotional self-regulation and co-regulation

The present research was conducted from a top-down perspective, not narrowing out the initial cause of the SNS activation. However, taking a bottom-up perspective, it is important to consider what could theoretically cause increased physiological synchrony between people. This chapter focuses on emotional regulation as a "pathway" to synchrony, or on synchrony making possible an emotional connection (while not excluding the possibility of simultaneous processes). Tschacher, Rees and Ramseyer (2014) have suggested causality to go in the direction that synchrony causes affect, at least in the domain of body movement.

For emotions to foster constructive behavior, one needs the capacity to monitor, evaluate, and in some cases control emotions (Thompson, 1991). According to the social baseline theory, it is metabolically more cost-effective to regulate emotions in company with others than alone (Beckes & Coan, 2011). Emotional self-regulation can be either automatic or effortful. The arousal of babies is regulated primarily by caregivers, but as the child develops neurophysiologically, she starts to gain the skills to self-regulate her affects. According to Schore (2011), attachment increases the child's regulatory abilities biologically through the development of the right hemisphere, which has connections to the ANS and the limbic system. Attachment and emotional regulation thus go hand in hand.

In adulthood, human interaction is a systemic emergent property. Within interactions, individuals must both monitor others and regulate their own inner state (Beebe & Lachmann, 1998). Emotional co-regulation (or mutual/bidirectional/co-constructed regulation) does not mean the symmetrical participation of partners, but rather a situation-dependent flow. Flexibility between interacting partners predicts good socioemotional outcomes, whereas the case of one person being a strong emotional "attractor" is problematic, even in the context of positive emotions (Butler, 2015). Moving away from the cause-effect model, communication can be seen as transaction, rather than as action and reaction (Fogel, 1992).

Strategies of emotion regulation usually aim at either preventing negative emotions or at decreasing the intensity or duration of emotions which have

come up (Gross, Richards, & John, 2006). There are two prominent types of maladaptive emotional regulation, namely hyperactivating strategies and deactivating strategies (Wei, Vogel, Ku, & Zakalik, 2005). In the hyperactive strategy, the person overreacts to their negative feelings in order to make others available and to get support (emotional reactivity), whereas in the deactivating strategy negative feelings are suppressed, and the person takes a distance to avoid frustration, if others are not available (emotional cutoff). These strategies have short-term value, but their rigid use is likely to result in interpersonal problems. Attachment anxiety seems to be related to hyperactivation, and attachment avoidance to deactivation. In any case, these function as distinct constructs. Concerning physiological reactions, it has been suggested that between friends, EDA synchrony could be connected to emotional reactivity, i.e., to the hyperactivating strategy (Slovák, Tennent, Reeves, & Fitzpatrick, 2014).

In intimate relationships, the spouses do not always have the same regulatory goals. A demand-withdraw pattern has been extremely salient in the marital interaction literature (Eldridge & Christensen, 2002). The person wanting change (often the woman) becomes aroused, complains, and nags, whereas the receiving partner (often the man) withdraws emotionally and becomes defensive (Levenson, Haase, Bloch, Holley, & Seider, 2014). The pattern has also been found with same-sex couples (Baucom, McFarland, & Christensen, 2010). In the demand/withdraw pattern, the challenge in co-regulation is to calm the overaroused partner and to increase the involvement of the underaroused partner. The wife-demand/husband-withdraw pattern has been connected to declines in marital satisfaction (Heavey, Christensen, & Malamuth, 1995), but it has also been suggested that in some instances, for example in long relationships of ten years, the pattern could be a problem-solving style and could actually improve marital quality (Caughlin, 2002).

It can be concluded that three processes can give rise to dynamic interpersonal emotional patterns: similar responses to external stimuli, reacting to each other, and interpersonal emotional regulation (Butler, 2015). These processes can also become intertwined. Thus, in the present research, the different dyads present in couple therapy could have synchrony because they were focusing on the same external event (as in the case of co-therapists who are focused on the client's story); this means that synchrony can occur for reasons other than that the participants are reacting to each other or are co-regulating emotions. In close relationships people may also develop similar appraisal patterns; these further increase the convergence of responses to the external world.

Butler and Randall (2013) have defined emotional co-regulation as a self-regulating system, in which each person's state is a joint function of their own and their partner's prior state, and in which increasing emotions are dampened over time to a stable level. In contrast, codysregulation would involve emotions becoming amplified from a stable level. A distinction has been suggested between covariation of affects around a stable homeostatic level (morphostatic covariation) versus affects around an increasing/decreasing linear trend (morphogenic covariation) (Butler, 2011). For now, according to my definition, phys-

iological synchrony is more of a morphostatic process. By contrast, the previously described phenomenon of emotional reactivity (causing the interacting partner, too, to become alert), and the phenomena of emotional contagion and empathy, described in the following section, are more related to morphogenic covariation.

1.4.3 Emotional contagion and empathy

It has been suggested that behavioral matching leads to emotional transfer. The nonconscious mimicking of others is connected with affiliation and rapport bidirectionally: rapport increases mimickry and mimickry increases rapport (Lakin & Chartrand, 2003). For example, when a person matches your tapping rhythm, you end up liking her more than when the rhythm is asynchronous (Hove & Risen, 2009). The proposal has been that this automatic imitation leads to emotional contagion, that is, the catching of others' emotions, via feedback from facial and vocal expressions, postures, and behaviors (Hatfield et al., 1993). Other terms include emotion reciprocity or transmission. However, at least in facial mimicry, some researchers have not found the matching of others' facial expressions to lead to emotional contagion or to better emotion recognition (Gump & Kulik, 1996; Blairy, Herrera, & Hess, 1999). The consistent problem in making interferences regarding interpersonal synchrony is lies in unnatural laboratory settings with static stimuli (such as pictures), compared to natural interaction between people (Hess & Blairy, 2001). There is no clear knowledge of how the processes work in real life.

Interestingly, the content of of the clients' speech can have a strong influence on the therapists' *conscious* evaluation of what the clients may be feeling, whereas the therapists' emotions (affected by nonverbal cues from the clients), may reveal what the clients are *actually* feeling (Hsee, Hatfield, & Chemtob, 1992). For their part, Levenson and Ruef (1992) found that accuracy in inferring the negative emotional states of others – but not positive states – was connected with higher physiological synchrony, most consistently in SC and pulse transmission time. The sharing of others' feelings, and the ability to appraise such feelings cognitively, form part of the skills required for empathy, along with the intention to respond compassionately (Hatfield, Rapson, & Le, 2009). Decety and Jackson (2006) describe emotional contagion as highly automatic from perception to one's own experience. By constrast, empathy requires the ability to distance oneself from the other, and to have agency. Research in empathy and sympathy has often overlapped; however, empathy can be defined as mainly an emotional response or a matching of affect, whereas sympathy is a specific response of compassion or concern, which does not necessarily require the reproduction of the emotion (Gruen & Mendelsohn, 1986).

According to Gallese (2009), empathy is mediated by the activation of the same neural circuits between people. The mirror neurons and other mirroring mechanisms in the brain allow action understanding through "embodied simulation," narrowing the gap between the self and others. Sometimes a

distinction is made between affective empathy and cognitive empathy, seen as referring to two interdependent but different processes. Thus, "primitive" affective empathy has been found to involve the mirror neuron system, while the more advanced cognitive system involves the ventromedial prefrontal cortices (Nummenmaa, Hirvonen, Parkkola, & Hietanen, 2008; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009). In the study of physiological synchrony in clinical (or pseudo-clinical) settings, empathy has been connected with EDA synchrony between clients and therapists (see 1.5.2).

1.5 Interpersonal autonomic synchrony

Some examples of autonomic synchrony have been given in the previous sections, but for a recent systematic review of interpersonal autonomic physiology, the reader would be advised to turn to the comprehensive article by Palumbo and colleagues (2017). The researchers concluded that in nearly all of the studies reviewed, autonomic synchrony was significantly greater in the physical presence of the interacting partner. In addition, autonomic nervous system synchrony did *not* solely depend on a similar behavior or situation, a specific sensory modality, the valence of the situation, or the relationship type. The researchers recommended using flexible statistical models in analyzing physiological synchrony, on the grounds that physiological attunement changes during interaction. In the present research we were aware of this, so that we took into consideration both positive and negative correlations of EDA synchrony during therapy sessions.

It is important to note that autonomic synchrony tends to be very diverse across different research settings and conditions (Palumbo et al., 2017), meaning that the results from studying e.g., one's team mates in competitive situations cannot necessarily be generalized to couple therapy. Hence, in this report, previous findings are discussed mainly in relation to the synchrony of couples, and the synchrony between clients and therapists.

1.5.1 ANS synchrony between couples

Timmons et al. (2015) provide a recent literature review on physiological synchrony between couples. Synchrony was found in many psychophysiological variables, and in contexts ranging from laboratory-task conflicts to more natural daily interactions. Synchrony in the stress hormone cortisol was negatively associated with relationship satisfaction, but synchrony in other psychophysiological variables seemed to be related to good connectedness between spouses. The researchers thus concluded that synchrony seems to be generally beneficial; however, if couples become locked in patterns of negative affect reciprocity and stress response, the synchrony can become detrimental to the relationship.

One of the earliest studies concerning the detrimental conflict cycle was conducted by Levenson and Gottman (1983). Thirty married couples were given

the task of discussing either a marital problem (high conflict) or the events of the day (low conflict), at the same time as psychophysiological measures were recorded. The researchers reported that a synchrony measure, including HR, SC, pulse transmission time, and body movement, accounted for 60% of the variance in the spouses' current marital satisfaction. The couple's physiological synchrony was actually a better predictor of their relationship satisfaction than careful observation of the couple's interaction. Nevertheless, the synchrony measure did not predict changes in relationship satisfaction over the next three years, whereas a general measure of the participants' arousal, based on psychophysiological measures, did make such predictions (Levenson & Gottman, 1985). The more aroused a participant had been during the periods of interaction, the more their relationship satisfaction decreased in the following years (a correlation table showed the connection to be strongest for HR in husbands, but for SC in wives). The results can be explained by the expectations for the interaction that had been built over the relationship – involving either positive or negative anticipation.

An interesting study by Thomsen and Gilbert (1998) found U-shaped curvilinear relationships between marital satisfaction and changes in spouses' arousal during conflict discussions. However, moderate arousal was not the best option (as suggested by the Yerkes-Dodson law); in fact, extremely low or high changes in husband and wife arousal were connected with the wives' higher marital satisfaction. The highest satisfaction was related to increases in both SC and HR, rather than to one measure increasing while the other decreased. The researchers suggested that high activation reflects active work in resolving conflicts, whereas low activation might be the result of participants being comfortable with the conversation, without the need to become alert.

Recently, it has been found that touch alone can facilitate physiological synchrony (Chatel-Goldman, Congedo, Jutten, & Schwartz, 2014). When couples touched each other, this increased their EDA synchrony, regardless of the intensity or the valence of the emotions. The couples had more EDA synchrony when they were more empathetic, but touch had a stronger influence on EDA synchrony among less empathetic participants. Furthermore, holding someone's hand was found to attenuate the neural response to threat, and this was even more the case when it was the romantic partner's touch (Coan, Schaefer, & Davidson, 2006). Attachment figures can thus function better than non-attachment figures as emotion regulators, and the better the relationship, the greater is the regulatory effect. It would be interesting to apply this knowledge to couple therapy settings, but relationships characterized by discord or even by previous violence may produce different reactions to those observed during hand-holding in spouses. In the current study, the couples did not touch each other during ANS recording sessions.

In conclusion, it should be noted that the majority of studies on physiological synchrony in couples have been recorded during conflict tasks (Timmons et al., 2015). Focusing on negative issues may bring out specific types of anger and stress-related processes, and this may not show the variety of emotions inherent

in the relationship. In couple therapy, the partners can express a variety of emotions and discuss whatever comes to their mind. It can also be assumed that the therapists will intervene and try to down-regulate the situation, if the partners become very aroused during high-conflict discussion. In a way, therapists are likely to become the regulating attachment figures when the spouse is not available.

Timmons et al. (2015) list some research questions for the future, one of which is how physiological synchronization is mediated. Is it by vocal, facial, tactile, or olfactory cues? In researching into this, there appeared to be one study in which merely the presence of one's partner was enough for HR synchrony to be manifested – even when vocal, facial, and tactile cues were removed (Helm et al., 2011). However, with SC, visual cues may be needed for synchrony to emerge (Liu, Zhou, Palumbo, & Wang, 2016). It is clear that more work is needed to elucidate the significance of physiological synchrony between people, including also longitudinal follow-up designs. In the present research, the couples were followed from the start of therapy until six months after the end of therapy, that is, for a period of almost one year.

1.5.2 ANS synchrony between clients and therapists

As long ago as the 1950s, psychophysiological measures were implemented to analyze psychotherapeutic processes. DiMascio, Boyd and Greenblatt (1957) studied the HR and skin temperature of psychiatrists and clients during psychotherapy, and reported that only the most affectively charged statements of the client were connected with the therapist's physiological activity. Especially when the clients were expressing "tension," the therapist's and the client's HR patterns were in positive synchrony. In contrast, the client's direct expressions of "antagonism" towards the therapist were reflected as negative synchrony.

In his influential article, John Lacey (1959) suggested that psychophysiological assessments could be used to evaluate psychotherapeutic processes and the therapeutic outcome, but his warnings on specific pitfalls lessened enthusiasm for using psychophysiological measures in subsequent years. According to Lacey, physiological reactions could, when used correctly, predict conflicts and reveal subtle changes in arousal and affects, be related to therapist- and technique-related issues, and be used as a measure of change in psychotherapy. However, in the following decades, efforts were made to keep social factors constant. This was done in order to avoid effects on physiological responses, even though it is now recognized that social environments moderate psychophysiological responses (Cacioppo, Berntson, & Andersen, 1991). The presence of others can have a very powerful effect, and studies in which participants are doing tasks in the laboratory will not necessarily capture the phenomenon under study in the same way as it manifests itself in social situations.

Studies on ANS and EDA synchrony have mostly focused on the concept of empathy in psychotherapy. In the study of Marci, Ham, Moran and Orr (2007), client-evaluated empathy was connected with EDA synchrony, and patients and therapists had significantly more positive social-emotional

responses during moments of high EDA synchrony. Messina et al. (2013) also found pseudoclient-evaluated empathy to be connected to EDA synchrony, but the listeners' and the observers' empathy ratings were not connected to the ratings of clients, or to the EDA synchrony. The authors reflected that the clients could have been evaluating affective empathy (connected to EDA synchrony), whereas the listeners and observers could have been evaluating cognitive empathy. Interestingly, listeners who were therapists scored higher in empathy measures than psychologists or listeners without psychological training.

Nevertheless, a focus merely on empathy might imply too narrow a view of EDA synchrony, especially in couple or family therapy. It has been suggested that EDA synchrony could also generally reflect the intensity of the interaction (in a study of teammates; Chanel, Kivikangas, & Ravaja, 2012), or emotional reactivity (in a study of friends; Slovák et al., 2014); also, it might depend on the context more than the type of relationship or the emotions (Palumbo et al., 2017). It can be concluded that interpersonal autonomic synchrony has not been extensively studied, and – beyond this research – there appear to be no existing studies on synchrony in multi-member therapy.

Finally, there is no conclusive evidence on how different modalities of interaction, such as synchrony in body movement or vocal pitch, are connected to ANS synchrony. For example, body movement synchrony and ANS synchrony have been suggested as different processes (Codrons, Bernardi, Vandoni, & Bernardi, 2014), with possible correlations between them resulting from metabolic demands from movements (Noy, Levit-Binun, & Golland, 2015). Ramseyer and Tschacher (2011; 2014) found similar head movements between clients and therapists to be connected to the overall therapy outcome, whereas synchrony in other body movements predicted good outcomes from individual sessions. Quite surprisingly, synchrony in vocal pitch between clients and therapists has been linked to client distress and to poorer therapeutic alliance (Reich, Berman, Dale, & Levitt, 2014).

There is evidently a need for a comprehensive understanding of multimodal synchronization in human interaction. The duration of the "social presence" with others seems to lasts on average 6 seconds in the domain of body movement synchrony (among healthy same-sex dyads), but individual characteristics such as attachment styles may influence this duration (Tschacher, Ramseyer, & Koole, 2017). In therapy, the notion of a social presence means that the therapist is receptive and "open" to attuning with the client. This could be expected to lead to beneficial outcomes from therapy.

1.6 Couple therapy

Couple therapy can be viewed as an effective treatment, since randomly selected treated couples are better off at the end of therapy than about 60–75% of untreated couples (Gurman & Fraenkel, 2002). However, about one third of couples do not seem to gain from treatment, and after two or more years from

the end of therapy there is significant deterioration in 30–60% of couples (Snyder, Castellani, & Whisman, 2006). Gottman, Coan, Carrere, and Swanson (1998) suggest that relapse is connected to the spouses' inabilities to soothe themselves and each other. It is often the case in therapy that the therapist takes the soothing role to facilitate the examination of dysfunctional patterns, but this may lead to deterioration if the skills do not generalize into the couple's normal life. In the present research, 25% of the couple therapy cases did not continue long enough to have the second ANS recording session (in or near the sixth therapy session); hence, the results might not represent those couples who are the least motivated, or the least able to work with their issues.

It appears that the physiological soothing of the male client in particular, either by himself or his spouse, has the capacity to predict marital outcome (Gottman, Coan, Carrere, & Swanson, 1998). This may happen via the husband soothing himself and thus de-escalating the situation, or via the wife using e.g., humor to soothe the husband. However, Gottman's work often highlights that down-regulating negative conflict is not enough: noticing positive emotions is equally important (Gurman, Lebow, & Snyder, 2015). If the couple's conflicts are dealt with in therapy, it does not mean that positive feelings will rush in to fill this void. The latter, too, have to be addressed in therapy, and the spouses have to respond to each other's relationship bids.

In more than half of couples seeking therapy, mild to moderate physical aggression has occurred (Holtzworth-Munroe, Meehan, Herron, Rehman, & Stuart, 2003). This was also apparent in the data of this research, which included spouses who had experienced violence in their previous romantic relationship, as well as three couples who had had experience of intimate partner violence (IPV) in their current relationship. There has been some controversy about using couple therapy in IPV cases, but it has also been recognized that there can be different subtypes of batterers, and that there are reasons to include partners in treatment (Stith, Rosen, McCollum, & Thomsen, 2004). Furthermore, 50–70% of battered wives remain with or return to their partner.

1.7 Gender differences

Most of the couples in this research were of the opposite sex, with one couple comprising two female clients. Gottman et al. (1998) claim that it is natural in romantic relationships for the partners to reciprocate even high intensity negativity, and that reciprocity becomes detrimental only if it is escalating negativity – especially on the part of the husband. The researchers suggest that the escalation of negativity reflects the husband's refusal to accept influence from his wife, meaning that on the whole, the problem does not lie in emotions, but in power. Interestingly, it seems that the wives of dominant husbands tend to be dissatisfied, but that the husbands of dominant wives do not have the same problem (Gottman & Levenson, 1984; Thomsen & Gilbert, 1998). These results have been explained via different behavioral patterns: dominant husbands can be unre-

sponsive to arguments and are likely to attempt to control the interaction, whereas wives spend a lot of time talking, which does not in itself decrease the husband's marital satisfaction.

Another specific gender behavior recognized in the literature is the previously mentioned wife-demand/husband-withdraw pattern (Christensen & Heavey, 1990), which may also partly depend on biological differences. Additionally, women can have a special role in driving relational dynamics: according to research, their behavior during conflict may impact on the couple's relationship satisfaction, mood, and emotions more than men's behavior (Laurent, Kim, & Capaldi, 2008; 2009; Schoebi, 2008). It has also been shown that if the couple has low ANS synchrony during a conflict, the female clients experience more negative emotions after the interaction (Nelson, Laurent, Bernstein, & Laurent, 2017).

According to previous research, women are better than men in judging expressions and nonverbal cues (Fischer, 2000), and may score higher than men in empathy tasks (Gleichgerrcht & Decety, 2013; Lennon & Eisenberg, 1987; Toussaint & Webb, 2005). These skills would most likely affect sympathetic activation. Nevertheless, the differences in empathy may also be due to biases in self-reports, or due to different upbringing and socialization. Derntl et al. (2010) found the behavior of men and women to be the same in empathy tasks; however, women rated themselves as more empathetic and had stronger brain activation in emotion-related areas. Moreover, the gender differences in self-reported empathy may be due to differences in general emotional responsivity (Rueckert, Branch, & Doan, 2011) – a measure that has also been connected to EDA synchrony (Slóvak et al., 2014). On the physiological level, Boucsein (1992) reported that females display higher tonic EDA while males show greater EDA reactivity under stimulation.

In conclusion, even though gender may not have an effect on the outcome of therapy in individual psychotherapy, gender differences have been observed in the behavior and physiology of spouses in romantic relationships, as well as in the connection between alliance and outcome in couple therapy. Päivinen (2016) converges with Gottman in suggesting that gender truly matters in couple therapy, since problems between the spouses are often connected to gender expectations and to unequal roles in the relationship. For its part, therapy is frequently thought of as gender neutral, although gender does have an effect on experiences and possibilities within therapy. Even the National Institute of Health in the US now has a new policy, requiring researchers always to take into account sex as a biological variable: the evidence for biological differences simply cannot be ignored out of fear of "sexism," since this could jeopardize equality in the quality of research and treatment applied to men and women (McCarthy, 2017).

1.8 Personality and psychophysiological reactivity

In the current research it was not possible to study the effects of client personality on physiological synchrony, since the clients were not requested to complete questionnaires which would have allowed an analysis of their personality. However, it is likely that the temperament and personality of the clients could affect their interaction with others, and thus also their physiological synchronization. There are several theories combining personality with neuroscience, but especially the idea, that there are physiological systems responsible for appetitive and aversive motivation in human personality, has become prominent in recent years (Corr, 2013; DeYoung & Gray, 2009). I here set out a brief summary of Jeffrey Gray's influential neuropsychological theory of personality, Reinforcement Sensitivity Theory (RST), as it relates to psychophysiological reactions (Gray, 1982; revised Gray & McNaughton, 2000).

The revised RST comprises three systems: fight–flight–freeze (FFFS), the behavioral approach system (BAS), and the behavioral inhibition system (BIS) (Corr & Perkins, 2006). The FFFS is responsible for escaping unpleasant situations, and the personality associated with FFFS includes fear-proneness and avoidance. BAS, for its part, mediates reactions to pleasant and appetitive stimuli, and the associated personality includes optimism, a reward-orientation, and impulsivity (also addictive, high-risk behavior, and possibly mania). Lastly, BIS is activated in goal conflicts by increasing the negative valence of stimuli (inputs to FFFS) until a resolution occurs involving either approach or avoid – that is, the person is anxious, worries, and ruminates. A "high BIS" person thus constantly looks for signs of danger.

Often BIS and BAS work together and can jointly influence behavior (the joint subsystems hypothesis, JSH; Corr, 2001). Concerning personality, differences in BIS and BAS reactivity seem to reflect stable individual differences in positive and negative affectivity (Bijttebier, Beck, Claes, & Vandereycken, 2009). Individuals at the extreme end of the BIS and BAS spectrum are at risk of developing psychopathology (Pickering & Gray, 1999). An important issue to note is that fear and anxiety are seen as physiologically distinct processes in RST. Thus, fear operates when one is departing from danger (FFFS), and anxiety when one is thinking about either approaching or avoiding danger (BIS) (Gray & McNaughton, 2000).

Couple therapy sessions can be challenging; they might mobilize the BIS in particular, at points when the clients evaluate whether the discussion is dangerous or pleasant. A threat can lead to different behavioral reactions depending on the client's *perceived* defensive distance, and in turn, distinct defensive behaviors mobilize different psychophysiological processes. The current research did not include estimates of RST functioning, but in the future the use of e.g., Reinforcement Sensitivity Theory–Personality Questionnaire (RST-PQ; Corr & Cooper, 2015) along with physiological synchrony could be a fruitful way to study individual differences in nonverbal attunement between partici-

pants. EDA has been hypothesized to increase when BIS is activated (Fowles, 1980), but it may also reflect the entire defensive system (Corr & Perkins, 2006). In comparison, BAS has strongly been associated with HR (Fowles, 1980; Heponiemi, Keltikangas-Järvinen, Kettunen, Puttonen, & Ravaja, 2004).

1.9 The therapeutic alliance and the outcome of therapy

The effectiveness of psychotherapy has been well established, but a significant question still remains debated, namely, how does psychotherapy actually work? (Miller, Hubble, Chow, & Seidel, 2013). It seems that specific therapy techniques do not explain the outcome (representing merely 0–1% of variance); also that the therapeutic alliance has a moderate but robust effect (5%), and that the therapist can predict the outcome somewhat more than the alliance (5–9%). Despite these predictive factors, most of the variance in the outcome remains unexplained.

A positive therapeutic alliance, i.e., the working relationship between clients and therapists, has been considered to be one of the best predictors of outcome in individual psychotherapy (Orlinsky, Rønnestad, & Willutzki, 2004). Bordin (1979) has described the alliance as comprising collaboration on therapeutic goals and on how to achieve them, in addition to the more affective "bond" within which clients feel respected and understood. However, alliance has been studied to a much lesser extent in couple therapy, and the findings are mixed concerning whether the alliance changes or stays relatively stable in couple therapy (Knobloch-Fedders, Pinsof, & Mann, 2004; 2007). Gender effects have been found concerning the relationship between alliance and outcome in couple therapy, but again, there is no consensus on the results. It has also been suggested that a "split alliance", that is, one spouse evaluating the alliance as significantly better than the other spouse, might lead to poorer outcomes in couple therapy (Pinsof & Catherall, 1986). However, Knobloch-Fedders et al. (2007) found split alliance to be unrelated to the treatment response.

Safran and Muran (2006) point out that the concept of alliance may have already outlived its usefulness, and that the focus could be directed more towards the relational context in which therapeutic processes unfold. The researchers pose questions relating to this as follows (Safran & Muran, 2006, p. 290):

> What role does mutual regulation between patient and therapist play in the change process? How does the process of mutual regulation between the patient and the therapist influence the patient's capacity for affect regulation?

It may be that the physiological synchrony between clients and therapists is part of the alliance, as encompassed, for example, in Bordin's (1979) description of the formation of the bond. Findings linking synchrony to client-felt empathy offer support for this hypothesis (Marci et al., 2007; Messina et al., 2013). Tradi-

tional conceptualizations of the alliance may have overemphasized conscious rational collaboration, while underestimating the nonconscious factors such as bodily synchrony (Safran & Muran, 2006). Koole and Tschacher (2016) have recently proposed a model to explain how the synchrony between clients and therapists fosters the alliance: the suggestion is that bodily coordination enables inter-brain coupling between the participants, which in turn promotes the co-regulation of emotions, leading to a good therapeutic outcome. To our knowledge, physiological synchrony between the participants of therapy has not been longitudinally studied in relation to evaluations of the alliance or to the outcome of therapy. Study III in the present research addressed these questions by correlating changes in synchrony with changes in alliance and outcome.

Interestingly, it has shown that it is the therapist's and not the client's variability in the alliance which predicts outcome in individual therapy – with as much as 97% of the outcome differences being related to the therapists (Baldwin, Wampold, & Imel, 2007). Those therapists who achieve better outcomes with clients also score higher on interpersonal skills such as empathy and warmth (Anderson, Ogles, Patterson, Lambert, & Vermeersch, 2009). The top therapists seem to respond to the client empathetically, and to engage, affirm, and stay flexible in therapeutic interaction (Orlinsky & Ronnestad, 2005). In EDA, this would most likely show up as positive synchrony between clients and therapists, as observed in previous research on individual psychotherapy.

It should nevertheless be noted that in couple and family therapy, there several alliances have to be established and maintained simultaneously (Friedlander et al., 2006), suggesting that physiological synchrony could be more complex in multi-member than in dyadic settings. The couple has their own mutual alliance, and the spouses and therapists create individual therapeutic alliances, but the participants also observe others' alliances. It has been pointed out that, for example, hidden agendas may affect how the therapists can create and balance the multiple simultaneous alliances (Friedlander, Escudero, & Heatherington, 2006). The therapist's effort to build an emotional connection with one spouse might cause a rupture with that spouse's partner, and this might also be manifested as changes in physiological synchrony. In light of these issues, it is not surprising that the therapeutic alliance often develops more slowly in couple therapy than in individual therapy (Rait, 2000).

It is by no means simple to define a good outcome in couple therapy. In the current research the outcome measure was individual wellbeing, but other studies have assessed relationship satisfaction. The problem is that spouses can come to therapy with different goals, and a positive outcome for one spouse is not necessarily positive for the other. Women have been observed to want change when they come to therapy, whereas men are often happy enough to maintain the current state of affairs (Heavey, Layne, & Christensen, 1993; Jacobson, 1989). According to Delaney (2006), it is often the woman who suggests to her partner that the couple should seek therapy.

Ultimately, there are severe consequences when important relationships do not function properly, suggesting that it is important to improve couple

therapy practices. Among people seeking mental health services, maritally distressed individuals are overrepresented (Lin, Goering, Offord, Campbell, & Boyle, 1996), and marital distress has direct detrimental effects on physical health (Kiecolt-Glaser & Newton, 2001). It has been theorized that physiological soothing, by oneself or by one's partner, will turn out to be an important component in couple therapy (Levenson et al., 1994). There could be possibilities to study this aspect by looking at physiological synchrony between couples.

1.10 Aims of the research

The three studies included in the present research encompassed a shift from qualitative case-type research towards quantitative research on the entire dataset, as data gathering continued and as additional methods were developed. The first study focused on one couple therapy session, the second study on the start of couple therapy with ten couple therapy cases (and one case example), and the third study on the entire therapy process with all twelve cases.

The aim of **Study I** was threefold: to present the background of embodiment in therapeutic dialogues, to explain the design of the newly initiated Relational Mind research project, and to illustrate some physiological observations involving HR measures and EDA from one couple therapy case. The aim of the empirical part was to find moments of synchrony in EDA and moments of highest individual stress in HR variables, followed by a qualitative study of these moments from video recordings and transcriptions. The hypothesis was that often, all four participants would simultaneously synchronize in EDA and in stress reactions (e.g., Hatfield et al., 1993; Trevarthen, 2008; van Baaren et al., 2004).

The main aim in **Study II** was to analyze whether there was any statistically significant EDA synchrony between couples, co-therapists, and client-therapist dyads at the initial phase of couple therapy. To achieve this, existing EDA synchrony methods were applied, and new methods developed, to assess statistically significant versus chance-level synchrony. The hypotheses were that statistically significant synchrony would be found (Marci et al., 2007; Messina et al., 2013), and that the highest synchrony would occur in the couples (Levenson & Gottman, 1983; 1985). The more qualitative aim of the study was to select a case example with the lowest EDA synchrony and to examine the video-assisted interviews (conducted immediately after the therapy). The question at issue was whether personal descriptions of the clients' and therapists' thoughts, feelings and bodily sensations could shed some light on the observed EDA synchrony levels. It was anticipated that low EDA synchrony would be connected with less empathetic remarks.

Study III introduced a process perspective. The main aim was to examine whether the EDA synchrony of couples, co-therapists, and client-therapist dyads changed from the beginning of therapy to the end of therapy. It was expected that the synchrony levels would not remain the same as therapy pro-

gressed, and that they would most likely show increases if the participants became more familiar with each other, and if the couple's relationship improved (Cirelli et al., 2014; Hove & Risen, 2009; Lakin & Chartrand, 2003; Miles et al., 2009). The second aim was to study how the changes in EDA synchrony were related to the changes in the therapeutic alliance and the outcome of therapy, the last of these being measured by clients' individual evaluations of wellbeing. It was hypothesized that increased EDA synchrony would be connected with increased alliance and better wellbeing (as in body movement synchrony; Ramseyer & Tschacher, 2011; 2014).

2 METHOD

All the data in this research were gathered during 2013–2016 for the research project *Relational Mind in Events of Change in Multiactor Therapeutic Dialogues*. The project was funded by the Academy of Finland and it formed part of the Human Mind (MIND) research programme. The research procedures had approval from the University of Jyväskylä Ethical Committee.

2.1 Participants

The participants in the project belonged to the usual client group of the Psychotherapy Training and Research Center of the University of Jyväskylä. Local collaborators (e.g., family counselling centers) were given information on the project, and the research was advertised in a newspaper. Some clients were also referred to the project by the local crisis center. All couples who agreed to join the study at the time of the research project were included in the sample. Informed consent was obtained from all the participants, and the final dataset comprised 12 different couple therapy cases, thus forming in total 24 clients and 10 therapists. The therapists worked in pairs with each couple, so there were always four people in the sessions. The clients were on average 43 years old (range 28–61), and the therapists 52 years old (range 32–63) at the time of the study.

Most of the couples lived together (six couples were married, and four were cohabiting). Two of the couples lived separately. Half of the couples had mutual children, while a few couples had children from their previous relationships. The clients represented several educational levels: primary education (three clients), upper secondary education (nine clients), a Master's degree (eight clients), and a Doctor's degree (four clients). Often, the spouses shared a similar educational level. Most of the clients were in working life; however, a few clients were either unemployed, retired, or taking care of a child at home.

Eleven couples comprised a female and a male client, and one couple comprised two female clients. As regards the co-therapist pairs, nine of the dyads had opposite genders, while three dyads were of the same gender (two dyads with two male therapists, and one dyad with two female therapists). Nine of the therapists were psychologists with extensive experience in clinical work, and seven were also licensed psychotherapists according to Finnish law (having had at least three years of training). One therapist was attending psychotherapy training, but was not a psychologist. The therapists were assigned to cases based on initial information concerning the clients, plus convenience in scheduling the sessions, i.e., they were not based on the gender of the therapists. Half of the co-therapists dyads had previously conducted therapy together, whereas for the other half it was their first time as co-therapists.

The couples individually reported reasons for seeking therapy. The main goals that the clients named were mostly related to improving the couple's relationship. Improving personal wellbeing and dealing with outside stressors were also named by some clients. In addition, there were three cases in which there had been intimate partner violence in the current relationship. In a few cases there had been violence in the previous relationship, but not in the current one. The perpetrators had had individual contact or group meetings for batterers before starting the couple therapy, and each case was assessed by experts in domestic violence in terms of whether or not couple therapy was suitable for the clients' situation. It was required that both clients should feel safe in talking about their relationship, and should want to have couple therapy. An agreement was also made that no violence could occur during the therapy process. Altogether, the data reflected the actual societal situation fairly well, since it has been estimated that in 25–75% of couples seeking therapy there has been relationship aggression (Stith et al., 2004), and that 50–60% of couples presenting for counseling have experienced at least one incident of violence in their relationship (Lawson, 2003).

The case example in Study I included the first couple to participate in the project. Study II included all the cases gathered at that time of the project (ten cases), along with one case example to illustrate the findings. Study III was a population study using the final number of twelve couple therapy cases.

2.2 The couple therapy setting

The couple therapy followed the normal procedures of the Psychotherapy Training and Research Center. The therapy sessions were scheduled to last 1.5 hours, and all sessions were recorded with six video cameras: one camera each for the face of each participant, and two cameras to capture the overall setting (with whole body images of both clients and therapists). The clients always sat next to each other, and the therapists also sat next to each other, with the arrangement resembling a circle around a table (Figure 1). The therapists were encouraged to work in their normal, non-manualized style, the approach of

which could be described as dialogical or narrative. Usually, there were reflective discussions between the therapists, often occurring towards the end of the sessions.

2.3 Autonomic nervous system recordings

Autonomic nervous system (ANS) recordings were made for both clients and therapists in the initial phase of couple therapy, and towards the end of the therapy. The first ANS recording occurred during the second therapy session (in one case the third because of scheduling problems), so that the participants would be less anxious about the overall situation, and so that the technical equipment would not disturb the beginning of building the rapport. The second ANS recording was organized in session five, six, or seven (*Mdn* = 6), depending on the estimated time for the therapy to end. The design of the essential elements in the study procedure is depicted in Figure 1.

During the ANS recording sessions the clients and the therapists were wearing the following devices:

- **Ambulatory heart rate monitoring** (Firstbeat Bodyguard, Firstbeat Technologies, Jyväskylä, Finland). This recording lasted for a total of three days. Usually it started from one to two days before the ANS recording session, and lasted until the individual's Stimulated Recall interview was over. Two disposable electrodes were fastened to the skin below the right collarbone and to the edge of the left rib cage. The measurement accuracy was 1 ms (1000 Hz).
- **Electrodermal activity** (EDA) was recorded during the session via two skin conductance (SC) electrodes (Ag/AgCl, Ambu® Neuroline 710, Ballerup, Denmark) on the participant's non-dominant palm, below the first and fourth digits. The palm was chosen as the location, because in piloting it was found that there was less measurement error from hand movements when the electrodes were in that area, as compared to fingertips.
- **Respiration** was recorded during the session via a fabric belt (BrainVision BP-BM-10, Brain Products, Gilching, Germany), which was fastened on top of the clothes, on the lower chest area. Respiration was not analyzed in this research.

An amplifier (BrainProducts Brainamp ExG 16, Brain Products, Gilching, Germany) and data acquisition program (BrainVision Recorder, Brain Products, Gilching, Germany) were used to record EDA and respiration, with a sampling frequency of 1000 Hz. SC was determined using 0.5 V constant voltage (GSR sensor, Brain Products, Gilching, Germany). The signal was amplified in DC mode and low-pass filtered at 250 Hz.

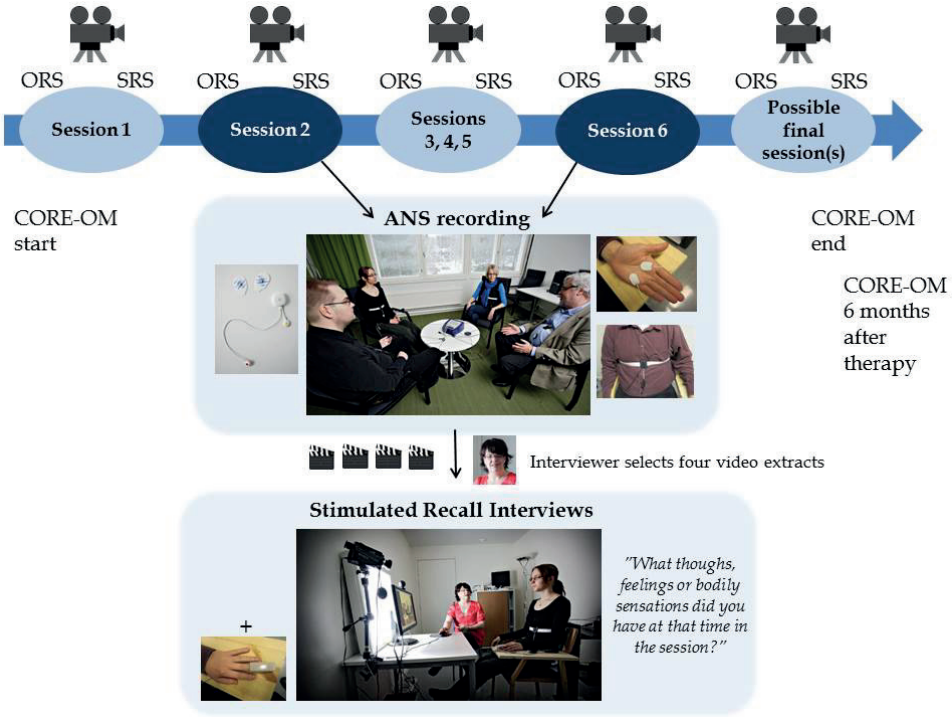

FIGURE 1 Depiction of the essential elements of the research design and the recorded autonomic nervous system (ANS) measures. The pictures are simulations of the real setting. ORS = Outcome Rating Scale, SRS = Session Rating Scale, CORE-OM = The Clinical Outcomes in Routine Evaluation – Outcome Measure.

A specially made marker unit was used to synchronize the ANS measures to the video, except for ambulatory heart rate, which was synchronized to the other variables on the basis of the recorded time logs. Out of these ANS measures, Study I assessed heart rate data and EDA, whereas Study II and Study III focused on EDA.

All the participants in the research later received a Lifestyle Assessment (Firstbeat Technologies, Jyväskylä, Finland) generated from their heart rate data. This compared various aspects, including the quality of sleep and the amount of stress, relaxation, and exercise, to the participant's age group average in Finland.

2.4 Stimulated Recall Interviews

After every ANS recording session, video-assisted Stimulated Recall Interviews (SRIs; Kagan, Krathwohl, & Miller, 1963) were organized for each participant individually, within one day of the therapy session. In these interviews a psychologist, who was not one of the therapists, showed the participants four video extracts from the therapy session. The extracts lasted for about 2–4 minutes, and the total interview lasted about 30–60 minutes. All the participants watched the same video extracts, the selection criteria of which included one or more of the following phenomena: visible emotional expression from one or more participants, notable changes in social interaction (e.g., a dialogue after several monologues), or notable changes in SC (one participant becoming increasingly alert, or changes that visually resembled synchrony between the participants) (Kykyri, Karvonen, Wahlström, et al., 2017).

The participants were encouraged to share their thoughts and feelings at any time while watching the extracts, but if the participants did not stop the video, the basic question at the end of the video extract was: "What thoughts, feelings, or bodily sensations did you have at that time in the therapy session?" Hence, the participants were prompted to share recollections from the sessions, but they naturally also shared a good many reflections which had formed later, or during the SRI. If the interviewer was unsure, she/he asked to specify whether the participant remembered having had that thought or feeling in the session, or whether it appeared later on.

The same ANS measures were recorded in the SRIs as during the therapy session, but in addition, finger pulse volume was recorded, and the participants also wore neck microphones during the interviews.

2.5 Questionnaires

The clients completed standard income questionnaires within the clinic when they agreed to participate in the couple therapy. All the data from the questionnaires listed below were statistically analyzed. In Study III this was done using the total scores for each measure, while in the Study I and Study II case examples, the participants' individual total scores were used.

Outcome Rating Scale

The clients filled the Outcome Rating Scale (ORS; Miller, Duncan, Brown, Sparks, & Claud, 2003) individually, at the beginning of every couple therapy session – including sessions with no ANS recording. ORS is an ultra-brief visual scale to assess wellbeing, with instructions to mark the estimate of wellbeing on a 10 cm line (0 = the worst, 10 = the best). Estimations include the general sense of wellbeing, personal wellbeing, family/close relationships, and

work/school/friendships. The total score is 40, with 25 points representing the clinical cutoff.

Session Ratings Scale

At the end of every couple therapy session both clients and therapists completed the Session Ratings Scale (SRS; Duncan et al., 2003). Like ORS, this is also an ultra-brief visual scale, here designed to assess the working alliance. Participants evaluated the relationship with the therapists/clients; also the goals and topics of the session, the therapeutic approach, and the overall feeling of the session. SRS has only been validated for clients. The scores in it reflect the quality of the therapeutic alliance numerically, as follows: 39–40 is good, 35–38 is fair, while 34 or below represents a poor alliance (Duncan & Miller, 2008). In this research we wanted to test SRS with the therapists as well as with the clients.

The Clinical Outcomes in Routine Evaluation – Outcome Measure

The Clinical Outcomes in Routine Evaluation – Outcome Measure (CORE-OM; Evans et al., 2002) was completed by the clients three times: before the couple therapy started, when the therapy ended, and six months after the therapy had ended. CORE–OM is a measure designed to systematically evaluate the subjective wellbeing of the clients, and the outcome of therapy. It contains 34 phrases with five levels of agreement/disagreement. The dimensions of the phrases encompass symptoms and problems, subjective wellbeing, functioning and social relationships, and risk behavior towards oneself or others. Higher values represent worse wellbeing and the clinical cut-off is 10 points (this is the case also in Finland; see Lehmus & Törmänen, 2015). All four dimensions were included in the calculation of the total score, which was used in the analysis.

2.6 Quantitative analyses

The statistical methods used in the research are as listed below (for a summary, see also Table 1, p. 46).

2.6.1 Study I

Calculation of stress levels from the heart rate data

In Study I, The highest moments of stress during the couple therapy session were located for each participant from the heart rate (HR) data. This information was combined with a qualitative analysis of the dialogue from the therapy video, to evaluate why these specific moments could have caused stress for the individuals.

The R–R interval data were analyzed using the Firstbeat Analysis Server software (Firstbeat Technologies, Jyväskylä, Finland), which corrected the signal for artifacts. The data were then resampled at 5 Hz by linear interpolation. Second-by-second heart rate variability (HRV) values were calculated with a short-time Fourier transform, using a constant duration Hanning window. HR and HRV variables describing respiratory patterns were calculated using neural network modeling of the data (Martinmäki, Rusko, Kooistra, Kettunen, & Saalasti, 2006; Saalasti, 2003). The intensity of the stress was calculated via a program from the HR, high frequency and low frequency HRV and the respiratory variables (Firstbeat Technologies, 2014; Kettunen & Saalasti, 2008). The end result, the "Absolute Stress Vector," had high values when HR was elevated, HRV was decreased from the basic resting level of the individual, and the respiration rate was low relative to HR. The highest moments of stress for each participant were located from the Absolute Stress Vector.

Moments of synchrony in EDA

Electrodermal activity (EDA) signals from the couple therapy session were visually examined to find representative moments of synchrony between two, three, or four participants. It was required that both tonic and phasic skin conductance (SC) activation should be present during these moments (i.e., with SCL increases along with SCRs). In the end, the two selected moments also represented one of the highest SCLs for the participants who were in synchrony. Time lags and the overall level of EDA synchrony during the session were analyzed using EDA concordance indices (see the following section).

2.6.2 Study II

EDA concordance indices

EDA synchrony between participants was analyzed in Study II at the start of the couple therapy, during the first ANS recording session. The calculation was made for all ten couple therapies conducted at the time of the research. The method for calculating the overall level of EDA synchrony between a dyad from an interaction period was obtained from the research of Marci and colleagues (Marci & Orr, 2006; Marci et al., 2007). This method was modified, partly on the basis of Messina and colleagues' (2013) work with time lags, but also through assessing the statistical significance of synchrony using different methods. The MATLAB R2013a program was used to generate the concordance indices. The procedure is described in detail below.

The EDA signals were resampled from 1000 Hz to 1 Hz, and sample-to-sample differences [(x(t)–x(t–1)] were calculated in order to detect change. The average slope was determined with a moving window of 5 seconds by calculating the value for the first 5 seconds, then moving the window one second forward, calculating the average slope for the next period. Pearson correlations were calculated for each dyad using successive windows of 15 seconds with 15

different time lags, ranging from -7 seconds to + 7 seconds. A skin conductance response reaches a peak at about 4 seconds and returns to 50% of baseline in 1 – 15 s (most often in 4–8 s) (Boucsein, 2012). Hence, the 15-second window was seen as appropriate for this research. EDA concordance indices, describing the overall synchrony between a dyad during the entire couple therapy session, were calculated from the ratio of the sum of the positive correlations divided by the sum of the absolute value of the negative correlations. Finally, a natural logarithmic transformation was performed for the indices (as the ratios were skewed). The resulting EDA concordance index, ranging roughly from -1 to +1, can be read in the following way: an index above 0 reflects more positive synchrony between the dyad, that is, the changes in arousal are similar to each other for the participants. An index below 0 reflects negative or complementary synchrony between the dyad, meaning that their arousal levels change in different directions (with one becoming more alert, the other more relaxed). An index of 0 reflects equal amounts of positive and negative synchrony.

Time lags. Out of the 15 different time lags, the lag in which the dyads had the highest level of positive synchrony was chosen for further statistical analysis. Between persons A and B, if the highest synchrony is at a negative lag, A is mostly synchronizing with or "following" B, rather than the other way round. Conversely, if the highest synchrony is at a positive lag, B is mostly attuning to A. When the highest synchrony is at zero lag, it means that the persons are tending to react to the situation at the same time.

Monte Carlo shuffled EDA concordance indices

To assess autocorrelation (meaning that successive EDA values are not independent from each other) and to find statistically significant synchrony, time synchrony was detached between the dyads in computing Pearson correlations. For the first participant, normal successive 15-second windows were used, but for the other participant these 15-second windows were randomly picked from the entire therapy session. Monte Carlo shuffled EDA concordance indices were then computed with 100 random replications, and sorted in ascending order. The 95% point of this sequence (reflecting the 95% confidence interval) was detected, obtaining the statistical significance level of $p < .05$. A similar procedure has been used, for example, in the statistical identification of synchronous neural spiking (Harrison, Amarasingham, & Kass, 2013). The original EDA concordance indices were statistically significant if their values were higher than the Monte Carlo-shuffled concordance indices.

EDA concordance indices for hypothetical cases

Autocorrelation and statistical significance were further addressed by compiling hypothetical couple therapy cases from the data. This was done by drawing each participant from a different case, resulting in two clients and two therapists who had never been in the same room with each other, but who had been

part of their own couple therapy session. This evaluation was done to assess possible effects of the "flow of therapy," that is, if synchrony was a result of all participants having the same pattern of EDA because of the sessions themselves (e.g., high arousal at the start of therapy, decreasing towards the end of the session). The EDA concordance indices were calculated for these hypothetical cases as described above.

Other statistical methods

The highest EDA concordance indices from all the dyads (n = 60) were further divided into couples (n = 10), co-therapists (n = 10), and client-therapist dyads (n = 40). One-way ANOVA was used to study the differences between these subgroups using Bonferroni correction. One-way ANOVA was also used to test whether there were differences between the actual EDA concordance indices, the Monte Carlo-shuffled indices, and the EDA concordance indices of hypothetical cases. The SPSS (version 23) program was used for these statistical analyses.

2.6.3 Study III

Study III also used the EDA concordance indices, but focused on comparing the first ANS recording sessions (at the start of therapy) to the second ANS recording sessions (at the end of therapy). Initially, there were 72 different dyads; these comprised the subgroups of 12 couples, 12 co-therapist dyads, and 49 client-therapist dyads. Out of these, three therapy cases did not continue long enough to have the second ANS recording session, decreasing the dyads to 54 when comparing EDA changes over the entire therapy process (9 couples, 9 co-therapist dyads, and 36 client-therapist dyads).

The true change across therapy was analyzed (i.e., independently of the number of therapy sessions) by calculating the linear change: the linear contrast was given the values of -0.5 and +0.5 (for the start of therapy vs. the end of therapy), and the corresponding ORS and SRS values were multiplied and divided by the length of the linear contrasts**.**

To account for a possible hierarchical structure or for nesting in the data of the therapy cases, intra-class correlations (ICC) were used to assess the need for a multilevel model, using the Mplus (version 7.3) program. The maximum likelihood was calculated with robust standard error (MLR estimator in Mplus). The multilevel model was not needed because of the small ICCs; hence, the COMPLEX method in the Mplus model was used to ensure unbiased estimates of standard errors in testing differences between the three subgroups (couples, co-therapists, and client-therapist dyads) and changes in synchrony. The Wald test was used to analyze the differences between the three subgroups at the start of therapy and towards the end of therapy, and follow-up pairwise comparison tests were conducted by defining new parameters. The new parameters were also used to test for changes within subgroups, from the start of therapy to the end of therapy.

Pearson correlations between changes in EDA synchrony, trends in ORS and SRS, and the changes in CORE-OM, were calculated using SPSS (version 24). Hierarchical linear regression was also considered as an alternative method to analyze the connections between these variables, but the sample size was too small to perform reliable analyses (a sample smaller than 50 leads to biased estimates of the second-level standard errors; e.g., Maas & Hox, 2005). Furthermore, since the data was not gathered in the same intervals, the information would have basically condensed to correlational analysis when the interest was in change over time. Hence, Pearson correlation was deemed as the best option to illustrate possible connections between the variables in the small sample.

2.7 Qualitative content

The focus of this research was mostly on the quantitative analyses, but some qualitative information on the participant's verbal and nonverbal behavior was also used to highlight the physiological findings. I had followed all the ANS recording sessions and SRIs in the monitoring rooms, and afterwards I returned to watch and listen to the video recordings again. Transcriptions of the phrases selected for the studies were made by me, and transcriptions of the entire sessions and SRIs were made by students of psychology (who had received training in transcribing).

In Study I, the analyzed episodes were selected on the basis of the highest cardiovascular stress of the participants, and also of moments of EDA synchrony between participants during the therapy session. Information from the SRIs was used in Study I and Study II. Thus, I selected from the interviews those stretches of the participants' speech which I deemed to be directly related to the EDA synchrony episodes during the therapy sessions (as exhibiting either high or low EDA synchrony; see 2.6.1, 2.6.2). I then briefly summarized them for the studies.

It can be said that no specific qualitative analysis method (e.g., content or thematic analysis) was used, since the approach was physiology-driven. I tried not to move beyond what the participants said, seeking rather to describe and summarize the speech and the nonverbal behavior. The interpretations from this content were treated as different possibilities. Hence, the approach can be described as an explorative, data-driven qualitative analysis, based on physiological findings.

My possible inferences from the material were also formed in and influenced by workshops. Within these, the entire research team worked with the project material, attempting to reach an understanding of the participants' interactions.

TABLE 1 Summary of the measures and statistical methods used in the research.

STUDY AND SAMPLE	INFORMATION	STATISTICAL METHODS
STUDY I One couple therapy case: - 2 clients - 2 therapists The first ANS recording session	Electrodermal activity Cardiac activity Session Rating Scale The Clinical Outcomes in Routine Evaluation – Outcome Measure Therapy session and Stimulated Recall videos (Knowledge of the entire therapy process)	Electrodermal activity concordance index Absolute Stress Vector
STUDY II 10 couple therapy cases: - 20 clients - 10 therapists 60 dyad combinations Out of this data, also one couple therapy case as an example The first ANS recording sessions	Electrodermal activity Outcome Rating Scale Session Rating Scale Therapy session and Stimulated Recall Interview videos	Electrodermal activity concordance indices Monte Carlo-shuffled electrodermal activity concordance indices Electrodermal activity concordance indices for hypothetical cases One-way ANOVA Bonferroni corrections Eta-squared effect size Cohen's *d* effect size Pearson correlation
STUDY III 12 couple therapy cases: - 24 clients - 10 therapists 72 dyad combinations The first and second ANS recording sessions (Three couple therapy cases did not continue long enough to have the second ANS recording session.)	Electrodermal activity Outcome Rating Scale Session Rating Scale The Clinical Outcomes in Routine Evaluation – Outcome Measure	Electrodermal activity concordance indices Intra-class correlation (ICC) COMPLEX method Wald test Cohen's *d* effect size Linear contrasts Pearson correlation

3 OVERVIEW OF THE ORIGINAL STUDIES

3.1 Study I

The embodied attunement of therapists and a couple within dialogical psychotherapy: An introduction to the Relational Mind research project

The aim of the study was to conduct initial observations of physiological reactions and synchrony between participants during couple therapy, using one case as a vignette. Mary and Mart (pseudonyms) had moderate to severe psychological distress based on CORE-OM. They wished to participate in couple therapy, mainly because of their individual mental health problems, and not because of specific marital issues. The analysis in the study focused on the first ANS recording session, which was the second couple therapy session. The discussion during the session tended to concentrate on the life events of Mart, such as the tragic death of his mother, and his conflict with his brother. Both of the therapists were women.

From visual analysis of the raw EDA signals of the participants, it became evident that Mary and Therapist 1 had strikingly similar arousal throughout the session. This was later confirmed by their EDA concordance index (CI), which exhibited one of the highest dyad synchronies in the whole data set (CI = 1.03; not reported in the original study) (Figure 2). The therapists mainly attuned to Mary (with 1–2 s lag), but Mart mostly attuned to the therapists (1 s lag). Mary's expressive behavior (e.g., prosodic variation, sometimes very loud voice, use of irony in speech) might have caused attention being drawn to her. By contrast, Mart spoke with in a quiet monotone, and showed little facial expression. It could also be that Mary's sympathetic nervous system was the quickest to react, with others responding later and Mart having the slowest responses.

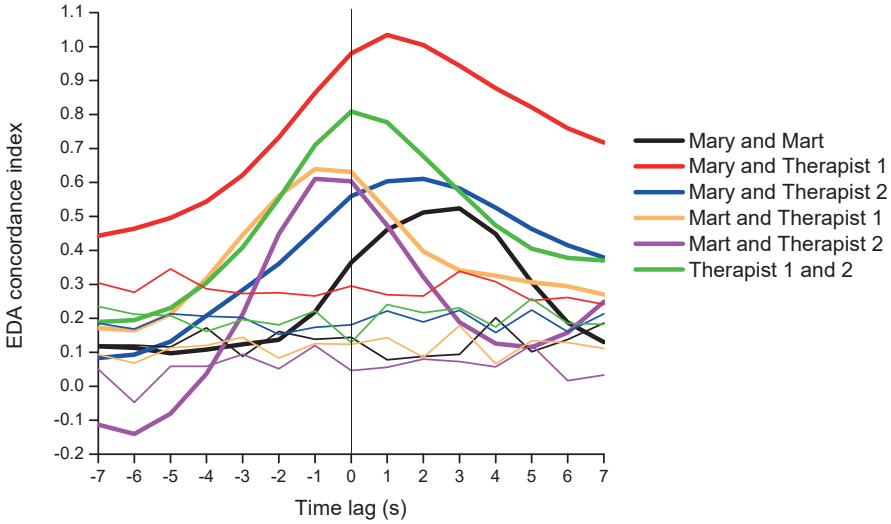

FIGURE 2 Electrodermal activity concordance indices in the couple therapy case example. The narrow lines are the Monte Carlo shuffled EDA concordance indices for each dyad (representing chance level synchrony). Thus, when the bold line has higher values than the narrow line, the positive synchrony is statistically significant ($p < .05$).

Two moments of EDA synchrony, that is, when the arousal levels of the participants sharply increased, were chosen for further qualitative analysis. The first moment of such synchrony was between Mart and Therapist 2, during Mart's speech:

> **Mart:** There is such a huge tangle of these problems. And then there's this thing of Mary's on top of it. So sometimes, during the darkest moments, it feels like [I want to be] somewhere six feet underground. It would be easier to be… ((said with a slight laugh)) but…

It is possible that Mart tried to downplay these powerful words with his chuckle. Mary was the first participant to smile and utter a laugh; then Therapist 1 also showed a brief smile. Therapist 2 appeared concerned, and she was the last participant to smile briefly. In her Stimulated Recall Interview, Therapist 2 said she had been worried about Mart's words, as she felt they indirectly referred to suicidal thoughts. Hence, Mart's and Therapist 2's EDA sharply increased during this moment, while the EDA of Mary and Therapist 1 remained steady (thus also being in synchrony). The second moment of synchrony occurred between all the participants during a humorous exchange, when Mary interrupted Mart's speech by commenting that the therapists needed to have their (reflective) conversation before the end of the session. Everyone was smiling and

laughing, exhibiting Duchenne smiles, which are connected with positive emotion.

The highest moment of stress during the couple therapy session was located for each participant individually using the Absolute Stress Vector (calculated from heart rate data). It was interesting that one specific phrase was mentioned in the stress peaks of both clients: "a life left unlived". Mary's stress started to rise high after Mart commented that his life had been very difficult "even before Mary" and that it had "almost been left unlived." One can speculate that she reacted to hidden criticism in Mart's speech. On the other hand, Mary's reaction might reflect empathetic concern, since she had had experiences of loneliness similar to those of her spouse. The "life left unlived" phrase was not discussed any further during the session, but towards the end of the therapy Mart had his highest moment of stress, when Therapist 2 said that she would like to return to Mart's experience of an "unlived life" in future sessions.

The mirroring of clients' sayings can be a powerful tool in therapy, and in this study it was also observed to activate the body physiologically. It can be suggested that the clients' moments of high stress actually reflected important issues for them, as the life-left-unlived theme later became a focal point in the therapy process of Mary and Mart.

Intriguingly, the participants' highest stress peaks mostly occurred while they were listening to someone else, and not when they were speaking themselves. Contrary to the expectation that all four participants would tend to have frequent simultaneous synchrony, the actual situation turned out to show much more variation. In fact, dyadic and triadic moments of synchrony were more common than synchrony between all the participants.

3.2 Study II

Sympathetic nervous system synchrony in couple therapy

This study focused on the start of couple therapy, that is, the first ANS recording session. The analysis was carried out in relation to ten couple therapy cases. The aim was to test whether there was statistically significant EDA synchrony between the participants. According to the analysis, 85% of the dyads (n = 60) exhibited a statistically significant EDA concordance index, meaning that their SNS attunement with each other was better than what could be expected by chance. The first hypothesis, concerning the finding of statistically significant synchrony, was thus supported. Overall, the participants synchronized to each other very rapidly, since 72% of the highest concordance indices occurred when the other person reacted simultaneously (0 s lag) or within one second of the other (±1 s lag).

The highest EDA concordance indices of each dyad were divided into three groups for further statistical analyses: couples, co-therapists, and client-therapist dyads. The three groups were found to differ from each other in their

level of synchrony. The co-therapists had the highest synchrony (M = 0.65), followed by the client–therapist dyads (M = 0.41). The couple dyads exhibited the lowest synchrony (M = 0.22). Hence, the hypothesis (based on previous research) that the couples would show the highest synchrony, was not supported. Indeed, the opposite turned out to be the case in a couple therapy setting.

Both the Monte Carlo shuffled EDA concordance indices (M = 0.18) and the hypothetical case indices (M = 0.22) were found to be lower than the actual concordance indices (M = 0.42). There were no differences between the Monte Carlo shuffled indices and the hypothetical case EDA concordance indices, meaning that there was no specific "therapy effect" which would explain the SNS synchrony (such as higher arousal at the start of the session for everyone, followed by a decrease towards the end of the session). Altogether, these analyses supported the notion that the participants had to be physically present with each other in the same room in order to have high SNS synchrony (Palumbo et al., 2017).

The study also presented a case example involving uncharacteristically low EDA synchrony between one dyad. Thus, the couple, Lisa and Paul (pseudonyms), actually had more negative than positive synchrony with each other during the therapy session. This meant when one spouse started to become more alert, the other relaxed, and vice versa. The couple came to therapy because of problems with their reconstituted family, concerning Lisa's sons. Paul also felt that Lisa's previous traumatic experiences (of being bullied, and of life in an abusive relationship) were affecting their current relationship. Lisa wept several times during the session as she recalled experiences of bullying; at these times her arousal increased while Paul's arousal decreased. The SRIs shed light on the clients' experiences during these moments:

> **Lisa:** I'm surprised how deep that came from. It [talking about bullying] has not previously caused this kind of reaction. How did this feel so hard now. I felt like a very, very little girl. Hiding there behind the school. - - I feel it in my larynx, it squeezes. Kinda feels like hunching my shoulders. Even now I'm thinking about that school yard.
>
> **Paul:** What should I say. I feel like Lisa has kinda stuck with the role of a victim. No matter what happens, she explains many things with similar issues. This was a familiar thing for me so I didn't think any more about it.

Paul described having heard the victim story many times, so in all likelihood he was not empathetically attuned with Lisa while she was reliving her painful memories, thus explaining the couple's negative EDA synchrony. A contrary interpretation might be that Paul's bodily reaction was complementary, in order to soothe Lisa; however, the verbal report points to a more passive, neutral position, or even boredom/frustration. Lisa's EDA synchrony with Therapist 1 (male) was not statistically significant, but there was slight synchrony with Therapist 2 (female). In the SRIs, Therapist 1 said he was eager to move on from the bullying to relationship issues, while Therapist 2 said she thought the topic was important, and she asked further questions about it. These differences in

the therapists' agendas might have been reflected in their SNS synchrony with Lisa.

3.3 Study III

Sympathetic nervous system synchrony: its relationship with the therapeutic alliance and outcome in couple therapy

The aim of the study was to analyze whether EDA synchrony between couple therapy participants changed during the therapy process, and how the possible changes might have been related to the evaluations of the therapeutic alliance (Session Rating Scale; SRS), and the outcome of therapy (Outcome Rating Scale; ORS, Clinical Outcomes in Routine Evaluation – Outcome measure; CORE-OM).

The final data pertaining to the Relational Mind research project were obtained from twelve couple therapy cases, out of which nine therapies continued long enough to have a second ANS recording in or near to the sixth session. 86% of the dyads (n = 72) had statistically significant EDA synchrony at the start of the therapy, and 93% (n = 54) showed such synchrony at the end of the therapy.

When two cases were added to Study II**,** and a more thorough procedure was adopted for analyzing the possible nesting of the data (though ultimately a multilevel model was not required), the couples, the co-therapists, and the client-therapist dyads were still found to differ in their level of EDA synchrony at the start of therapy. The mean EDA concordance indices were 0.25 for the couples, 0.63 for the co-therapists, and 0.42 for the client-therapist dyads. Towards the end of the therapy, no change was observed between the co-therapists (M = 0.66) or client-therapist dyads (M = 0.40), but the couples had increased their EDA synchrony to a more similar level as that of the client-therapist dyads (M = 0.34). This meant that the changes in the spouses' arousal levels started to resemble each other more, and it is therefore likely that their emotional reactions, too, became more similar. The effect size of the change was medium (Cohen's d = .57). The hypothesis concerning changes in synchrony levels during the therapy process was thus supported for the couples, but not for the co-therapists, or for the client–therapist dyads.

Figure 3 shows how the changes in the EDA synchrony between dyads correlated with the questionnaire data for the therapeutic alliance (SRS) and the wellbeing of clients (ORS, CORE-OM). These results should be regarded as illustrative because of the small sample sizes, and it should be noted that the correlations had to be strong ($r \geq .77$) to become statistically significant. The co-therapists were the only dyad whose change in EDA synchrony was not in some way connected to either the alliance or the outcome measures (likely because their synchrony remained the most stable); hence, their change data were excluded from Figure 3. Concerning the connection between alliance (SRS) and

the change in EDA synchrony, statistically significant correlations were found for the evaluations made by the female clients and the male therapists.

Often the increased EDA synchrony was related to a better outcome, but there were some instances in which decreasing synchrony seemed more beneficial – such as the synchrony between the male clients and the female therapists. Hence, the hypothesis about increased EDA synchrony being connected to a better alliance and to the clients' wellbeing was only partly supported. The changes in EDA synchrony were most prominently connected with the changes in female clients' evaluations of the alliance and of their wellbeing.

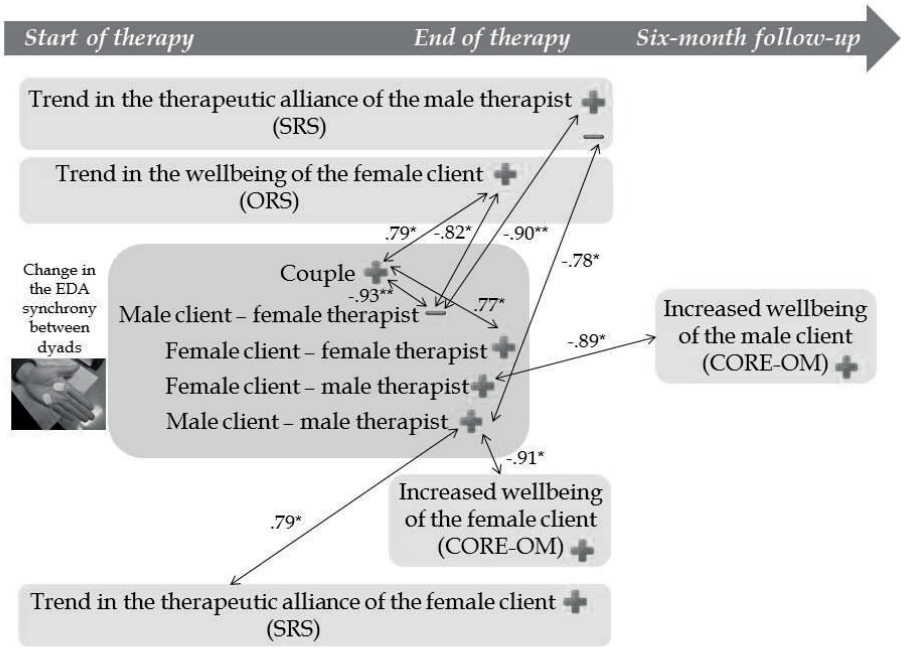

FIGURE 3 Statistically significant correlations between increased (+) and decreased (-) electrodermal activity (EDA) synchrony between dyads and (i) the wellbeing of clients (Outcome Rating Scale; ORS) (Clinical Outcomes in Routine Evaluation – Outcome measure; CORE-OM) and (ii) evaluations of the therapeutic alliance (Session Rating Scale; SRS). Increasing vs. decreasing trends in the questionnaires are also marked with + and – symbols. The width of the text bars represents the time period applying to a given process (within the total duration, extending from the start of therapy to the six-month follow-up). Note that higher scores in CORE-OM equal worse wellbeing (i.e., the direction is reversed). *Correlation is significant at the .05 level and **Correlation is significant at the .01 level.

4 DISCUSSION

This research was conducted to study the kinds of physiological reactions and synchrony observable between participants in couple therapy, whether the levels of SNS synchrony might change throughout the therapy processes, and whether possible changes in SNS synchrony were related to the therapeutic alliance, or to the outcome of the therapy. As far as I know, this represents the first attempts to study how physiological synchrony between people develops during the therapy process, and how these changes may relate to the working relationship and to the wellbeing of clients.

Physiological synchrony emerged as a more complex phenomenon than what was assumed. The results of the three studies showed direct support for some hypotheses, and supported other hypotheses in part. However, some results ran counter to what had been expected.

4.1 The findings and their implications

4.1.1 Significant SNS synchrony can be observed in couple therapy

One important aim of this research was to study whether there is statistically significant SNS synchrony between people during couple therapy. Because of autocorrelation issues, it was seen as crucial to take the utmost care in comparing our results with what might be obtained as a result of chance level synchrony. New methods were developed to achieve this aim. The results lent support to the hypothesis that people exhibit the highest synchrony when they are in the physical presence of each other (Palumbo et al., 2017). There was no effect from a specific therapeutic "flow" (such as high arousal at the start of a session and decreasing arousal towards the end of a session), which would have explained the phenomenon. At the start of the therapy, 86% of the different possible dyad combinations exhibited statistically significant SNS syn-

chrony. On the whole, they synchronized to each other very rapidly, often within one second.

However, the idea that all four participants in couple therapy would tend to synchronize with each other as a group proved to be only true to a limited extent. In roughly half of the sessions, all the dyads did show significant synchrony, but in the other half of the sessions it was possible to identify a withdrawing or "cast-out" client. This individual did not attune with either one or two of the other participants. This was a new finding, differing from the findings in individual psychotherapy (Marci et al., 2007; Messina et al., 2013). It highlighted how there are several alliances to be established and maintained in couple therapy (Friedlander et al., 2006).

The findings emphasize how useful it is for the therapists to be aware of their own agendas, because these may affect how the simultaneous alliances are balanced. In the case example of Paul and Lisa in Study II, the therapist who wished to stay in the topic that Lisa was talking about had high synchrony with her, whereas the therapist who wanted to change the perspective did not have synchrony with Lisa. It can be claimed that in fact, herein lies the strength of co-therapist work: while one therapist attunes with one spouse, the other therapist can try to maintain a connection with the other spouse (Kykyri, Karvonen, Nyman-Salonen, et al., 2017). Co-therapy can sometimes produce even more positive outcomes than therapy conducted by a single therapist (Hendrix, Fournier, & Briggs, 2001).

The case example of Mary and Mart in Study I suggested that synchrony is often not an "all at the same time" phenomenon; indeed, it can be dyadic or triadic. When Mart jokingly comment that he sometimes wished he was dead, one therapist became worried, and both Mart's and the therapist's arousal levels sharply increased. At the same time, arousal was steady with Mary and the other therapist; thus, these two also displayed synchrony. During a shared humorous moment where everyone smiled and laughed, synchrony was observed between all four participants. Nevertheless, the video-assisted interviews after the therapy revealed that the participants had different thoughts concerning the moment (Hotakainen & Kärki, 2014). Hence, the humorous moment might have included emotional contagion, by which where mirroring mechanisms of the brain became activated (Gallese, 2009).

4.1.2 Couples had the lowest, and co-therapists the highest SNS synchrony at the start of therapy

Earlier research suggested that couples have a tendency to become synchronized (Chatel-Goldman et al., 2014; Helm et al., 2012; Liu et al., 2016; Timmons et al., 2015) – possibly even more so during conflict discussions (Levenson & Gottman, 1983; 1985). Thus the hypothesis in this research was that the couples would show the highest synchrony. However, this premise was not supported.

The couples did often exhibit synchrony which was statistically significant; however, at the start of therapy they had the lowest level of synchrony (as compared with the client-therapist dyads and the co-therapists). Hence it seems

that a feeling of emotional disconnection was also reflected as physiological disconnection between the spouses (Vall et al., 2017). The suggestion that problems in the relationship might cause a reduction in physiological synchrony is also supported by findings from a relationship enrichment program (set up to form a "control group" for the current research; Haltia & Jaatinen, 2016). Here, healthy and happy couples seemed to have higher EDA concordance indices during the sessions, as compared to the clinical data in the present research.

It may be that without the calming and constructive presence of the therapy setting, the clinical couples in this research could have escalated into "locked in" spiraling synchrony (Gottman, 1990), characterized by emotional reactivity (Chanel et al., 2012; Slovák et al., 2014). This idea is supported by the fact that when one couple was in clear conflict throughout the therapy session and the atmosphere was tense, they had slightly higher synchrony than in their previous ANS recording session (which was still lower than for the other dyads in the session). Hence, it can be concluded that synchrony cannot be directly defined as good or bad. Among couples in particular, it seems to depend on the valence of the situation. Physiological synchrony may either emerge to reinforce positive relational processes, or to support survival in conflict situations (Nelson et al., 2017).

Concerning the SNS synchrony between clients and therapists, the results were similar to what has been found in individual psychotherapy (Marci et al., 2007), with slightly lower concordances observed in the couple therapy setting. As there is no expectation that clients and therapists would spiral into escalating conflict, their synchrony most probably represents something related to empathy (Messina et al., 2013), feeling understood and respected (Bordin, 1979), or nonconscious bodily alliance (Safran & Muran, 2006). This idea was supported in the study of a case example within which the EDA synchrony between a male client and both of the therapists declined from the first ANS recording to the second ANS recording (Karvonen et al., 2016). In the video-assisted interviews, the therapists made empathetic remarks about the man when the SNS synchrony was higher, whereas both of them directly expressed irritation towards the man in the session with lower SNS synchrony.

A lack of empathy could have also affected the low SNS synchrony between Paul and Lisa in Study II, since in his interview Paul said he felt Lisa was stuck with the victim role, and had explained many issues through it. It is notable that the couple had the lowest synchrony in the entire research data, actually having more negative correlations than positive ones during the session. This meant that as one spouse started to become increasingly alert or emotional, the other one relaxed – or vice versa. While Lisa remembered and talked about traumatic events, weeping as she talked, she also turned inwards in body posture, and did not have eye-contact with others. The powerful experiences she was reliving might have caused the synchrony to be lower with other participants, meaning that she withdrew from the interaction and possibly shifted into hyperarousal while remembering the events (Bedi & Arora, 2007; van der Kolk, 1994). There is also the probability that the others tried to soothe Lisa in her dis-

tress by portraying complementary synchrony: *If I relax, she might also relax*. This would show up as momentarily negative synchrony.

Surprisingly, the co-therapists working together with the couples tended to show the highest levels of SNS synchrony. It is tempting to think that this synchrony represents a good working relationship between the therapists, but it is important to remember that synchrony can also be the result of similar responses to external stimuli (Butler, 2015), such as when the therapists are silently listening to the clients. The last hypothesis is supported by the time lags in which the therapists had their highest synchrony: it was often at the 0 s lag, i.e., simultaneous. If they had been reacting to each other, a lag of 1-3 seconds could have been expected, since that is the time frame of SCR after a stimulus (Boucsein, 2012). In line with this, Nummenmaa et al. (2012) found that when people watch the same emotional video, their brain networks work similarly, even though they are not in the presence of each other. Note also that changes in the SNS synchrony between therapists were not connected to changes in the alliance, or to the outcome measures, likely because their synchrony stayed on the same high level as in the beginning of therapy.

Nevertheless, in the couple therapy case with the lowest SNS synchrony between the co-therapists, it was observed that the therapists had somewhat different agendas and affiliations in relation to the clients (Kykyri et al., 2017b). Hence, it is possible that the co-therapists' SNS synchrony reflects a shared orientation, and that a low synchrony might be problematic for therapeutic work.

4.1.3 SNS synchrony between the couples increased from the start of therapy to the end of therapy

The hypothesis that synchrony would increase in the course of therapeutic work was partly supported, but only for the clients. There were no statistically significant changes in the SNS synchrony between the client-therapist dyads or between the co-therapists. Instinctively, one would expect that as the relationship of the couple, with concomitant marital satisfaction, improves, this will be manifested as higher SNS synchrony between the spouses. As noted above, satisfied couples did exhibit high SNS synchrony within a marital enrichment program.

Detailed explanations for the couples' increased synchrony lay beyond the scope of the present research, but some mechanisms can be speculated on here, and articulated in further studies. It could be that the power or dominance in the relationship became more equally distributed during couple therapy (Gottman et al., 1998), resulting in less need to demand or withdraw within the interaction (Heavey et al., 1993). The spouses could have also become more able to take each other's perspective into account (Nelson et al., 2017), to experience and show empathy (Marci et al., 2007; Messina et al., 2013), and to respond to each other's relationship bids (Gurman et al., 2015). High physiological synchrony has been suggested as reflecting the intensity of the interaction rather than a specific conflict (Chanel et al., 2012); hence, emotionally meaningful dis-

cussions could increase during therapy and contribute to a good outcome from the therapy.

More research is needed to find out what specifically happens during moments of high and low SNS synchrony in a couple's interaction, seeking thus to determine whether changes in synchrony reflect e.g., changes in emotional co-regulation (Butler, 2015). Increased synchrony may be associated with the situational becoming smoother, so that the overaroused partner calms down more easily and the underaroused partner becomes more involved in the relationship and the discussions (Eldridge & Christensen, 2002). In addition, work with maladaptive regulation strategies and attachment insecurities may ease the strain on the couple's relationship (Gross et al., 2006). Couple therapy may also enhance reflective abilities and psychological flexibility, thus also enabling increased physiological synchrony between spouses. These issues need to be clarified in the future, taking into account the individual characteristics of the spouses, such as personality.

One cannot rule out the possibility that some factor other than therapy might have enhanced the couple's situation and synchrony. Such factors might include reduction of stress because of changes in work or in the financial situation. It could also be that for the couple, the start of therapy is structurally different from the end phase of therapy, and that this is reflected in the SNS synchrony. Thus, the clients might initially start to frame longer monologues, talking about their life history. Later on, the discussion would naturally become more dialogical and focus on the couple's relationship. Nevertheless, dialogicality can indeed be thought of as one aim of couple therapy, and might well result from therapy practices.

Even though some case examples were used to illuminate the findings, this research focused more on the broader population level. This means that the variation between cases was not extensively discussed. Couple therapy helps about 60-75% of couples (Gurman & Fraenkel, 2002), and in this research three out of twelve cases did not continue long enough to conduct the second ANS recording session. This suggests that the least motivated couples, or those who felt that the therapy was not beneficial, dropped out. It may also have been the case that one spouse was motivated and wanted change, but that the other one did not want to continue therapy. Drop outs included both low and high SNS synchrony levels between couples in the first ANS recording session (CIs = 0.13, 0.44 and 0.50). Out of the nine cases where changes in SNS synchrony could be compared, there were two couples whose synchrony did not increase; in fact, it seemed to stay the same (or even decrease; CI differences -0.03 and -0.02). At least one of these couples discussed divorce, and the mood was fairy negative in the second ANS recording session.

4.1.4 Changes in the SNS synchrony were connected with changes in the alliance, and with the therapy outcome

The hypothesis that increasing synchrony would be manifested as higher evaluations of the alliance and as the better wellbeing of clients (Ramseyer &

Tschacher, 2011; 2014) was mostly supported. The couple's increasing SNS synchrony was connected with increasingly higher evaluations by female clients of their own wellbeing, as the therapy progressed (ORS). Surprisingly, the same pattern was not found for the male clients. However, it is important to note that the results are illustrative rather than conclusive because of the small sample.

It may be that the SNS synchrony of the couple is more important for the wellbeing of women than it is for men, or alternatively, that the SNS synchrony of the couple tends to be more affected by the women's wellbeing than by the men's wellbeing (bearing in mind here that causality cannot be determined from correlation). There is some support for the first interpretation, since female clients have been found to experience more negative emotions after conflict discussions if they are not able to synchronize well with their partner physiologically (Nelson et al., 2017). This might relate to the demand/withdraw pattern (Heavey et al., 1993), in the sense that women want their partner to become emotionally more involved, and at the same time to accept their influence without withdrawing or becoming defensive (Gottman et al., 1998). Insofar as this actually occurs, this could, in turn, show up as higher physiological synchrony between the spouses. In the study of Nelson et al. (2017), ANS synchrony decreased in demand/withdraw behaviors, when males employed control and showed less support, and when females used verbal aggression and negativity. In contrast, instructions to take the partner's perspective into account increased ANS synchrony – especially with females who already had some abilities in perspective taking.

One outcome measure in this research was the linear trend in the wellbeing of clients during therapy (ORS), as mentioned above. The other was the change in wellbeing from the beginning of therapy to the end of therapy, and to the six-month follow up (CORE-OM). In the latter questionnaire, unexpected connections were found regarding SNS synchrony between the clients and the male therapists. When the synchrony between the male clients and the male therapists increased, the female clients made increasingly better evaluations of the alliance during the therapy process, and their wellbeing improved from the start of therapy to the end of therapy. On the other hand, when the SNS synchrony between the female clients and the male therapists increased during the therapy process, the male clients showed improved wellbeing from the start of therapy to six-month follow-up.

These patterns are intriguing, since they suggest indirect outcomes concerning the physiological synchrony with therapists in couple therapy. One way of expressing the matter would be that it is not *my* synchrony with the therapist that leads to a good therapy outcome in the long run, but rather how my *spouse* attunes with him. The results highlight the importance of maintaining alliances with both spouses, and the importance of how these alliances are monitored by the clients (Friendlander et al., 2006).

The fact that therapy outcome was related to the synchrony with the male therapist deserves further consideration. It might not only have to do with the gender, but (for example) the fact that the male therapists often had the most

extensive experience and training in family therapy. Thus, they might have naturally become the "leading therapists," with the main responsibility for the therapy flow. Since most of the co-therapist pairs were of the opposite sex, this would have left the female therapists in a supporting role, even though no oral agreements of this kind were made. All but one of the male therapists was also working in the research project; by contrast, there were more female therapists from outside the clinic, further highlighting the differences in positions and formal qualifications.

The therapeutic alliance has been found to have a moderate effect on the outcome in individual psychotherapy (Miller et al., 2013; Orlinsky et al., 2004), but the novelty of the present research was to show that changes in SNS synchrony could be reflected differently as regards the alliance and the outcome. For example, among female clients, increasing wellbeing during therapy was connected with the SNS synchrony of the couple, but an increasing alliance was associated with SNS synchrony between their spouse and the therapist. Evaluations of the alliance could also be in contradiction between the clients and the therapists: when the synchrony between the male clients and the male therapists increased, the female clients evaluated the alliance as increasingly better, but the male therapists evaluated it as increasingly worse. These ambiguities highlight the problems in assessing the alliance. Are clients evaluating the bond aspect of the alliance in relation to the empathy they feel (Messina et al., 2013), whereas the therapists evaluate agreement concerning goals and how to achieve them (Bordin, 1979)? These two aspects could function as different things in relation to the nonconscious, automatic physiological synchrony of the participants. In a study by Glebova et al. (2011), the therapists differentiated between a bond-related and a goal/task-related alliance, whereas the couples thought of the alliance as a uniform construct.

As a final point, there was one exceptional dyad, in relation to which *decreasing* SNS synchrony seemed to be more beneficial than increasing synchrony. This was the SNS synchrony between the male clients and the female therapists. Their decreasing synchrony during therapy was related to the couple's increasing SNS synchrony, the increasing wellbeing of the female clients, and an increasing alliance according to the male therapists. In a similar way to the results concerning the male therapists, it may be that a factor beyond gender was affecting these results. On the other hand, it could be that in the presence of a female therapist, female clients have positive feelings if the female therapist starts to direct more empathy towards them – that is, to the person who has often suggested couple therapy and wants change (Delaney, 2006; Heavey et al., 1993; Jacobson, 1989), and who is sometimes even a survivor of violence – rather than towards their spouse. While a client's predisposition to wanting a certain gender of therapist does not predict the therapy outcome, clients can also think that female therapists form more effective therapeutic alliances than male therapists (Jones & Zoppel, 1982).

It seemed that a relational pattern was in play in the four-person situation, in which the SNS synchrony of the couple was able to increase when female

therapists decreased their synchrony with male clients, but increased synchrony with female clients. From a systemic point of view, when a system is under stress, the usual balance is disturbed and the system moves to a state of imbalance (Gurman & Kniskern, 2014). The system then tries to adjust to this with adaptive mechanisms, but if the stress stays too high and resources become low, overload can happen. It is therefore the task of the therapists to facilitate the adaptive mechanisms of each spouse, and assist in moving the couple's relationship into balance. Even though something other than gender might affect the results, and there could be moderating or mediating factors, it may well be that in couple therapy, the gender of the clients and therapists does indeed play roles in the therapeutic process (Knobloch-Fedders et al., 2007; Päivinen, 2016). If therapists are aware of the factors that influence alliance development, they may better use alliance-building strategies during the therapy processes (Knobloch-Fedders et al., 2004).

4.2 Limitations of the research

There are several limitations in this research, some of which were already discussed in relation to the findings, and are thus not repeated here. One of the most prominent restrictions is undoubtedly the small sample (twelve couple therapy cases) for the purposes of a population-level analysis. This most probably resulted in type II errors, meaning that there were effects which the analyses were unable to detect. Any changes had to be large, and correlations high, in order to produce statistically significant results. However, in calculating EDA concordance indices, the number of dyads was 54–72, while in calculating the trends for alliance and wellbeing the number of therapy sessions was 79–93. Hence, the data were in some instances quite rich.

It is also possible that with the small sample, some false findings were obtained and some effect sizes inflated (Button et al., 2013). Because of this, the correlation results obtained from combining SNS synchrony with alliance and outcome measures should be viewed as illustrative. Further research with larger samples would be needed to study the replicability of the findings.

The natural setting in this research brings both advantages and weaknesses to the analyses. The strength is that the observed phenomena are very close to the actual situation faced by practitioners, since the clients were not selected on the basis of strict diagnoses, and the procedures (except for the ANS recordings) were the normal practices of the clinic. Most previous research on interpersonal synchrony has been done in controlled laboratory settings in relation to specific tasks or stimuli. These do generate significant information on mechanisms, but it can be argued that the ecological validity and replicability to real life is relatively low. The demand characteristics of the experimental situations may cause participants to behave in unusual ways. People coordinate their movements because they want to establish and maintain social bonds; if this possibility disappears in the experimental context, so also does synchrony

(Cornejo, Cuadros, Morales, & Paredes, 2017). Social attunement is also fundamentally affective, even though this aspect is often neglected in experimental designs. The current research setting facilitated the emergence of intersubjective, relational, and dialogical humans in ecologically valid situations. Most of the participants said that they did not pay much attention to the ANS recording devices once the session started, and this has also been documented in similar research using video recording and ANS equipment (Levenson & Gottman, 1983).

The drawback of the natural settings is that there can be several confounding factors affecting the results. Many of these might have to do with the spouses' or the couple's history, their interactional styles, and their reasons for seeking therapy. Because of the small sample, what the spouses reported as reasons for wanting couple therapy was only qualitatively described and categorized. One should also take note of the three cases in which intimate partner violence had occurred in the relationship. EDA reactivity has been associated with aggression (Lorber, 2004); hence, the perpetrators could in theory exhibit different physiological synchrony profiles from the other participants. A history of traumatic events might also affect SNS activity, due to hyperarousal and strong responses to trauma reminders (Bedi & Arora, 2007). However, in our recent study using the same data as in the present research, no differences were found in mean level EDAs between the victims, the perpetrators, and the therapists (Paananen et al., 2017).

Personality traits or attachment styles were not assessed in this research. These might, if studied, have explained some of the variance in the results. For example, anxiety, avoidance, or a narcissistic interpersonal style could affect synchronization with others (Diamond & Fagundes, 2010; Roisman, 2007; Tschacher et al., 2017). Situational factors might also be in play: it is possible that the second ANS recording session was exceptionally good or bad in comparison to the previous and following sessions, and hence not very representative of the actual changes from the first ANS recording session. This could be avoided by organizing the ANS recording sessions more often during the therapy; however, such procedures would be more time-consuming, and could interfere more with the natural flow of the therapy. Furthermore, skin conductance can reflect the extent to which individuals are practiced in confronting the assigned topics (Pennebaker, Hughes, & O'heeron, 1987); hence, the clients' SCRs might also reflect reflexes involving orientation to topics which they had not previously discussed (Sokolov, 1960).

As is usual in developed countries, some clients had taken medication or caffeine before the ANS recording. Many common medications, such as allergy medicines, have anticholinergic side effects that affect SC (Boucsein et al., 2012). Experimenters cannot ethically prohibit medically prescribed medication, but in the current research the clients reported any medication they had taken near the ANS recording times. Because the sample would, in practice, have disappeared by excluding the clients with medication, these clients were kept in the analyses. Hence, the results might have been altered by the medication taken by the client.

However, anticholinergic medication is known to affect individual tonic SCL, whereas the focus in this research was on phasic SCR synchrony between persons, decreasing the possibility that medication confounded the results.

One limitation of the study has to do with how the participants evaluated the alliance (SRS). The clients could not evaluate their individual alliance to one therapist, but rather to the co-therapist team. In a similar way, the therapists assessed the alliance in relation to the couple, and not to individual clients. This was carefully considered before the data gathering began, but it was decided that dyadic evaluations might have unforeseen consequences for the therapy process. Unfortunately, there is a possibility that the triadic assessments performed masked some possible connections with dyadic SNS synchrony in Study III. In the future, there should be consideration of how to obtain dyadic assessments from the participants without too much interference in the therapy process.

Assessments of marital satisfaction (which are often used in research on romantic relationships) were not used in this research. However, some studies have failed to find a link between marital satisfaction and ANS synchrony (Nelson et al., 2017), suggesting that the ANS might be more connected with fast-changing conflict dynamics than with long term relationship satisfaction. In the individual evaluations of wellbeing at the start of every therapy session (ORS), the clients did mark how they felt about their family or close relationships, but this could include people other than the spouse. It is also worth noting that even though the therapists did not discuss the clients' ORS and SRS questionnaire scores, the mere use of these instruments might result in larger treatment gains and in attendance in more sessions than occurs in usual treatment (Duncan & Reese, 2015).

It is possible that progress in couple therapy could best be described via something other than the linear model used in this research with the ORS and SRS scores. Since associations between linear trends and changes in EDA synchrony were only found for the alliance of the female clients and the male therapists, and for the wellbeing of female clients, it may be that male clients and female therapists had different trends in these variables during the therapy processes. Clients who attend fewer than five sessions of individual therapy have change which is adequately modeled by linear and log-linear models (Owen et al., 2015), and clients who benefit from therapy usually show it before the sixth session (Duncan, 2014). In this research the change was analyzed between session two and session six.

The fact that no connections were found for male clients' and female therapists' ORS and SRS scores, and the changes in EDA synchrony, might also have to do with their ORS and SRS changes being smaller, and thus not becoming statistically significant in correlation analysis with a small sample. Because the aim of the research was to study how the *changes* in synchrony, alliance and outcome are related to each other, if some of these variables remained steady throughout the treatment, it could have prevented high correlations. This might

be especially true for the EDA synchrony between the co-therapists, as well as the alliance evaluations.

As a final point, it is worth noting the opinion of Gregory Bateson, who believed that there are no articulated messages which would not be affected by the observer (Oliveira, 2013). In this regard, the author acknowledges that even though she tried to remain neutral and objective while conducting her studies, her life experiences, beliefs, and training would inevitably affect her research. In concrete terms, given that she was responsible for attaching the ANS recording equipment, her behavior before the start of the sessions might have had an influence on the degree of safety and comfort experienced by the participants. Totally objective observation is not possible in social science, and all research is selective in collecting evidence using particular methods, each with their limitations and strengths (Mays & Pope, 1995). The author would in any case claim to have had the aim of precision in distinguishing physiological findings from verbal analysis when describing the results.

4.3 Future directions and clinical relevance

As noted by Palumbo et al. (2017), ANS synchrony is currently an underexplored area, despite the vast implications it may have for understanding human sociality. Terminological ambiguities will have to be cleared up, and pieces of individual research should be brought together to build a more comprehensive model on synchronization in human interaction. In addition to natural settings, parallel controlled laboratory designs will be needed in this endeavor. To the best of my knowledge, the research reported here represents the first attempt to study longitudinal trends in relation to physiological synchrony in a natural setting; hence, more research should be directed at understanding how the various synchrony patterns emerge and affect interactions over time. The use of multiple measures of ANS, such as both EDA (SNS) and HRV (PNS), is likely to provide richer information on physiological synchronization and its relevance than any single measure.

In addition to replicating the findings of this research with larger samples, the focus in future research should be on the quality of the interaction during moments of strong positive and negative physiological synchrony. This can be achieved by focusing on shorter moments of statistically significant synchrony, and by analyzing the previous, current, and future interaction via observational and discursive methods, for example, by coding specific behaviors. Phenomena related to emotional co-regulation, soothing, and conflict escalation have been suggested as important components for relationship satisfaction and for couple therapy (Butler, 2015; Gottman, 1990; Gottman et al., 1998; Levenson et al., 1994). Thus, it would be interesting to study the possible co-regulation of emotions in relation to physiological synchrony in natural settings – for example, looking at what happens when people try to calm someone down, or when a conflict between people spirals into escalating negativity.

Recent developments in signal processing and in quantifying synchrony have the potential to advance the study of physiological synchrony. The methods in question include, for example, automated time-frequency analyses (Liu, 2012), and joint sparse representations of EDA ensembles (Chaspari et al., 2015). New methods will still be needed to study multi-person synchrony, as occurs in couple and family therapy, due to the fact that dyadic analyses do not necessarily capture the complexity of the systems. To circumvent this, one could use, for example, a round-robin network approach, or hierarchical methods with multilevel indistinguishable dyads (e.g., Reed et al., 2013). Granger causality (Granger, 1969) also appears to be a promising method to study physiological synchronization.

Lastly, I return to the dilemma presented in the introduction, where it was observed that psychotherapy is an effective treatment, but that there is no comprehensive answer as to what the actual healing mechanism consists of (Miller et al., 2013). Most of the variance in therapy outcome remains unexplained, with the research focus in recent years having been on the therapeutic alliance, or on therapist factors. However, it is a matter of concern that – according to Duncan and Reese (2015) – the therapists often overestimate their abilities and the clients' progress, and that the therapists' previous work experience or training in the alliance are not good predictors of therapist effectiveness.

The answer as to why therapy helps, or why certain therapists achieve better outcomes, may partly lie in embodiment, that is, in how the clients and therapists attune with each other during the therapy process by means of multiple modalities of interaction. In line with this, Ramseyer and Tschacher (2011, 2014) found that body movement synchrony between clients and therapists was related to the therapy outcome. As Safran and Muran (2006) have claimed, it may be time to focus more broadly on the relational context, and for example on affect regulation, in studying psychotherapy.

Physiological reactions cannot directly indicate what a participant is feeling (for example in the case of leg cramp or a stomach pain, which the researcher might interpret as arousal arising from the discussion). Hence, information on the participants' thoughts and feelings is crucial in making conclusions from the data. The SRIs can give rich information on the participants' experiences, whether by validating physiological findings or, on occasion, giving conflicting information. This implies that physiological data, behavioral observations, and verbal descriptions should be used in combination, in order to study the convergence between different interactional modalities. It was observed that the SRIs in themselves work as a powerful interventional tool, even if here they were only set up for research purposes. In the present research, the participants had often gained new kinds of awareness about themselves, their partner, or their relationship while watching the video extracts.

In conclusion, there seems to be good reason to study both the individual embodied reactions of participants and the embodied synchrony between them, when one is seeking to gain knowledge on how therapy actually works. Furthermore, this new understanding will not only be useful for therapy settings,

but may be applied with diverse occupations such as social workers, day care instructors, teachers, nurses, and physicians. In the future, it may thus be possible to apply knowledge of embodied synchronization in a wide range of domains, using it to better understand and manage conflicts, and to prevent crises from escalating.

YHTEENVETO (SUMMARY)

Sympaattisten hermostojen synkronia pariterapiaan osallistuvien henkilöiden välillä

Samanaikaisuus eli synkronia ihmisten välisessä vuorovaikutuksessa koetaan usein miellyttävänä, ja se voi jopa lisätä kiintymystä toista kohtaan. Ihmisillä on taipumus tiedostamatta matkia muiden ilmeitä, äänensävyjä ja eleitä. On havaittu, että esimerkiksi asiakkaan ja terapeutin kehonliikkeiden synkronia psykoterapiassa voi vaikuttaa terapian tuloksellisuuteen. Synkroniaa tahdosta riippumattomassa, autonomisessa hermostossa, ihmisten välillä ei kuitenkaan ole tutkittu laajalti, vaikka sillä arvellaan olevan merkitystä vuorovaikutukselle. Suurin osa tästä tutkimuksesta on tehty laboratorioissa antaen koehenkilöille erilaisia tehtäviä.

Tämä tutkimus on tiettävästi ensimmäinen laatuaan, jossa fysiologisen synkronian kehittymistä tutkittiin pitkittäisesti terapian edetessä. Aiemmissa tutkimuksissa ei myöskään ole tutkittu useamman kuin kahden osallistujan terapiaa, eikä yhdistetty fysiologista tietoa terapiasuhteen ja terapian tuloksellisuuden ymmärtämiseen. Tutkimus keskittyi autonomisessa hermostossa erityisesti vireystilasta ja tunnereaktioista kertovaan sympaattiseen hermostoon, joka vastaa muun muassa taistele tai pakene -reaktiosta. Sympaattisen hermoston aktivaatiota mitattiin istuntojen aikana ihon sähkönjohtavuudella (electrodermal activity, EDA) sekä asiakkailta että terapeuteilta pariterapian alku- ja loppuvaiheessa. Lisäksi ensimmäisessä osatutkimuksessa tutkittiin osallistujien sydämen sykettä.

Tutkimuksen tavoitteena oli selvittää, millaisia fysiologisia reaktioita ja synkroniaa voidaan havaita pariterapiaan osallistuvien henkilöiden välillä, miten sympaattisten hermostojen synkroniatasot osallistujien kesken muuttuvat terapian edetessä ja ovatko nämä muutokset yhteydessä muutoksiin terapeuttisessa yhteistyösuhteessa tai asiakkaiden hyvinvoinnissa. Osatutkimuksissa siirryttiin tapaustutkimuksesta kohti koko aineiston analyysia sitä mukaa kun aineistoa kerättiin lisää. Lopullinen aineisto *Relationaalinen mieli* -hankkeessa ja tässä tutkimuksessa koostui 12 pariterapiatapauksesta sisältäen 24 asiakasta ja 10 terapeuttia (työskennellen työpareina). Siten jokaisessa terapiaistunnossa oli paikalla neljä henkilöä.

Ensimmäisessä osatutkimuksessa tavoitteena oli esitellä vasta käynnistyneen tutkimusprojektin ideaa sekä havainnollistaa fysiologisia ilmiöitä tutkimalla ihon sähkönjohtavuutta ja sydämen sykkeeseen liittyviä muuttujia yhdessä pariterapiaistunnossa. Sykemuuttujien perusteella muodostetusta stressivektorista havaittiin, että usein stressaavimmat hetket terapiaistunnossa eivät osuneet omaan puheenvuoroon, vaan muiden kuunteluun. Oli mielenkiintoista, että molempien asiakkaiden korkeimman stressin aikana mainittiin teema ”elämä jäänyt elämättä”, joka myöhemmin terapiaprosessissa muodostui tärkeäksi käsittelyn aiheeksi. Osatutkimuksessa havaittiin, että osallistujat eivät usein synkronoituneet ihon sähkönjohtavuudessa samaan aikaan ja samalla tavalla, vaan

synkroniaa saattoi olla kahden tai kolmen henkilön kesken. Esimerkiksi terapeutin huoli asiakkaan kommentista sai heidän sympaattiset hermostonsa samankaltaiseen tilaan.

Toisessa osatutkimuksessa selvitettiin kymmentä pariterapiatapausta tutkimalla, voidaanko osallistujien ihon sähkönjohtavuudessa havaita tilastollisesti merkitsevää synkroniaa terapian alkuvaiheessa, vai johtuuko synkronia esimerkiksi sattumasta, signaalien ominaispiirteistä tai terapiaistuntojen samankaltaisuudesta. Signaaleja käsittelemällä tai poimimalla eri terapioista henkilöitä samaan analyysiin ei kuitenkaan saavutettu yhtä korkeaa synkroniaa kuin silloin, kun henkilöt olivat fyysisesti läsnä keskenään samassa istunnossa. Tulosten mukaan ihon sähkönjohtavuuden synkronia oli kaikista matalinta puolisoiden välillä, sitten asiakkaiden ja terapeuttien välillä, ja yllättäen korkeinta yhdessä työskentelevien terapeuttien kesken. Toisin sanoen, terapeuteilla oli eniten samankaltaisia ja samanaikaisia reaktioita vireystasossa. Puolisoiden välisen matalan synkronian tutkiminen tapausesimerkin kautta osoitti, että esimerkiksi traumaattisten kokemusten muistelu ja uudelleen eläminen saattavat johtaa matalampaan synkroniaan muiden kanssa.

Kolmannessa osatutkimuksessa tutkittiin koko aineistolla, muuttuvatko ihon sähkönjohtavuuden synkroniatasot terapian alkuvaiheesta kohti terapian loppua. Mielenkiinnon kohteena oli myös selvittää, liittyvätkö mahdolliset synkroniamuutokset muutoksiin asiakkaiden hyvinvoinnissa tai asiakkaiden ja terapeuttien terapeuttisessa yhteistyösuhteessa. Tuloksena oli, että ainoastaan puolisoiden välinen sympaattisten hermostojen synkronia muuttui terapian aikana: synkronia kasvoi, ja tämä kasvu oli yhteydessä naisasiakkaiden hyvinvoinnin lisääntymiseen terapian aikana. Sympaattisten hermostojen synkronian lisääntyminen terapiaan osallistuvien henkilöiden välillä oli enimmäkseen yhteydessä terapian kannalta hyödyllisiin ilmiöihin, kuten parempiin arvioihin yhteistyösuhteesta sekä asiakkaiden hyvinvoinnin lisääntymiseen. Yllättäen miesasiakkaiden ja naisterapeuttien välinen synkronia oli kuitenkin poikkeus tähän, sillä kyseisen synkronian lasku näytti johtavan parempiin arvioihin kyselylomakkeissa. Mielenkiintoinen tulos oli myös se, että asiakkaiden oman hyvinvoinnin lisääntyminen liittyi siihen, että puolison synkronia terapeutin kanssa kasvoi terapian alusta terapian loppuun.

Tästä tutkimuksesta voidaan tehdä johtopäätös, että pariterapian osallistujien sympaattiset hermostot useimmiten synkronoituvat keskenään. Synkronia oli aluksi matalinta puolisoiden välillä, mutta heidän synkroniansa kuitenkin kasvoi onnistuneen terapiaprosessin aikana – toisin kuin muilla osallistujilla. Synkroniamuutokset olivat myös yhteydessä muutoksiin terapeuttisessa yhteistyösuhteessa ja asiakkaiden hyvinvoinnissa. Tulokset auttavat ymmärtämään sitä, miten terapia itse asiassa auttaa asiakkaita. Terapeuttinen yhteistyösuhde ja terapeuttiin liittyvät tekijät selittävät aiempien tutkimusten mukaan jonkin verran lopputulosta, mutta voi olla, että ruumiillisuuden (embodiment) ja fysiologisen synkronoitumisen tutkimus luo täysin uutta tietoa näistä prosesseista.

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ORIGINAL PAPERS

I

THE EMBODIED ATTUNEMENT OF THERAPISTS AND A COUPLE WITHIN DIALOGICAL PSYCHOTHERAPY: AN INTRODUCTION TO THE RELATIONAL MIND RESEARCH PROJECT

by

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Family Process, *54*, 703–714.

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The Embodied Attunement of Therapists and a Couple within Dialogical Psychotherapy:

An Introduction to the Relational Mind Research Project

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The research has been supported by the Academy of Finland

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The Embodied Attunement of Therapists and a Couple within Dialogical Psychotherapy: An Introduction to the Relational Mind Research Project

Abstract

In dialogical practice, therapists seek to respond to the utterances of clients by including in their own response what the client said. No research so far exists on how, in dialogues, therapists and clients attune themselves to each other with their entire bodies. The research program *The Relational Mind* is the first to look at dialogue in terms of both the outer and the inner dialogues of participants (clients and therapists), observed in parallel with Autonomic Nervous System (ANS) measurements. In the ANS, the response occurs immediately, even before conscious thought, making it possible to follow how participants in a multi-actor dialogue synchronize their reactions and attune themselves to each other. The couple therapy case presented in this article demonstrates how attunement is often not a simple "all at the same time" phenomenon, but rather a complex, dyadic or triadic phenomenon which changes over time. In the case presented there was strong synchrony between one therapist and one client in terms of their arousal level throughout the therapy session. It was also observed that high stress could occur when someone else was talking about something related to the participant, or if that person mirrored the participant's words. Overall, it seems that in evaluating the rhythmic attunement between therapists and clients it is not enough to look at single variables; instead, integrated information from several channels is needed when one is seeking to make sense of the embodiment.

Keywords: couple therapy; dialogical investigations; Autonomic nervous system; rhythmic attunement

Dialogue has been seen as one of the basic orientations in family therapy (Anderson & Goolishian, 1988; Andersen, 1991; Bertrando, 2007; Rober, 2005; Seikkula & Arnkil, 2007; 2014). In dialogical practice therapists focus on responding to the utterances of their clients by including within their own response what the client has said. In so doing therapists synchronize their linguistic movements to those of the clients, and the participants become attuned to each other within the spoken dialogue. Recently, interest has emerged concerning the embodied component of the dialogue, for example, in the work of Tom Andersen (1992; 2007), who looked at the breathing of the client and the therapist. For Mikhail Bakhtin (1984) dialogue is, in its origin, embodied action; thus he noted that a human being "participates in dialogue wholly and throughout his whole life: with his eyes, lips, hands, soul, spirit, with his whole body and deeds" (Bakhtin, 1984, 293). Despite this, there has been very little concrete description and almost no research concerning how we participate in dialogue with our bodies in everyday clinical practice. The aim of this paper is to give new background on embodiment in therapeutic dialogues, with particular reference to the multi-actor dialogues that occur in couple and family therapy. Thus we describe the *Relational Mind* research project, in which our aim has been to analyze the function of the Autonomic Nervous System (ANS) as an element in therapy dialogue within a multi-actor setting. In what follows we shall first introduce the embodied and relational quality of the human mind to set out the framework from which the study emerged. Thereafter we describe the origins of the research project, presenting a couple therapy case. We have focused on spoken dialogue in our previous publications (Seikkula et al, 2002; 2008; 2013), but here we also take into account the biological aspect of synchronization.

According to Cromby (2010) an "affective turn" is now taking place – an turn to which various scholars have contributed, including Antonio Damasio (Damasio & Carvalho, 2013), Daniel Stern (2001), and Alan Schore (2009). It may be just as accurate to say that we are facing the "corporeal turn" in the human sciences (Sheet-Johnstone, 2010). In the mid-twentieth century, Birdwhistell (1952) estimated that no more than 30 to 35 percent of the social meaning of a conversation or an interaction is carried by the words in it. After the recent era of the linguistic turn (which focused on the significance of language in the construction of reality), researchers and practitioners have become more aware of the comprehensive embodied quality of human life including in descriptions of reality the embodied presence of those persons actually constructing the descriptions.

Intersubjectivity research has widened understanding of the origins of the human mind. Instead of thinking that the newborn baby is "empty" as a psychological being, and that psychological birth takes place from approximately the age of six months (Mahler et al., 1973), we have become aware that she is an active respondent and initiator in communication, right from the very first breath (Bråten & Trevarthen; 2007; Stern, 2004; Trevarthen, 2001). She is born with an innate capacity for dialogical relationships, one in which she attunes her actions to the adult in a rhythmic way, and it is this that forms the basis of the developing mind (Trevarthen, 2001). This "jazz-like" rhythmic engagement consists of body movements and mental activities that are present in discussion and social cognition (Gallagher, 2011). Sheet-Johnstone (2010) sees body movements as the basic language that precedes spoken language. We learn to communicate through movements and through responses to these movements. Thus, we are born as humans through body movements and by attuning to each other in a musical, rhythmic way. During the

secondary phase of intersubjectivity, the child learns to read the mind of others, not as some independent quality of another person, but rather as something existing within interactive engagement with others (Gallagher, 2011). In this sense, the human mind is, in origin, a relational phenomenon.

The synchronization of body movements thus becomes one of the basic elements of life that adults later use while working together to achieve shared goals (Wiltermuth & Heath, 2009). Referring to mirror neurons, Knox (2009) speculates that during the early stages of development, when the separation between primary and secondary sensory-motor areas is not yet complete, imagination and thoughts are inherently intertwined with physical action and emotional states. Panksepp (2008) maintains that the evolutionary transition to language involved social-affective brain mechanisms, the urge to communicate, and cross-modal cortical processing.

From Dyadic to Collaborative Intersubjectivity

For the new-born baby it is not the relationship with the mother alone which makes the difference, but the multiplicity of relationships in which she participates from the very start of life (Reis, 2010). Fivaz-Depeursinge & Corboz-Warnery (1999) note that the decisive step is taken in the movement from the dyadic to the triadic, which means a movement from doing joint tasks with one adult to a situation in which (at least) three persons participate in a mutual situation. Here, arousal comes not from the task undertaken but from the participants interacting with each other. For the baby, what is important is not just the mother-baby interaction but rather an entire “village” of relationships (see Hrdy, 2009). The embodied experiences of the relationships are stored within the memory of her body. When these embodied memories are

formulated into words (either outer or inner words), they become the voices of the life, voices that are always activated in relational situations. The human mind is polyphonic.

The embodied quality of this basic experience encompasses the formation of the human brain, which develops in dialogue within the relations offered by human beings (Tomasello et al., 2005). The development of the neocortex is closely associated with the human mind's "hypersocial" characteristics, which include increases in co-operation, intersubjective capacities, language, and culture. These aspects seem to involve in particular the right hemisphere of the brain, which primarily processes implicit knowledge in a relational and embodied way (Porges, 2011; Quillman, 2011; Schore, 2009).

The relational mind first includes the relationships in which we live at the present moment. Secondly, our mind is constituted out of all the relationships ("voices of the mind) of our life. Both aspects (the outer relationships and the inner voices) are present in every interactional situation. The relational mind (Bateson, 1972) is formed by all participants. It is active, first of all, in the synchronization of the actions of participants, in relation to both the autonomic and the central nervous system, and to language. In the second place, it is active when inner embodied implicit memories are aroused; these receive their meaning in a responsive moment that is unique to each participant, the situations, and the subject that is referred to. William James (1890) and Maurice Merleau-Ponty (1962) saw the human mind, not as a "thing" hidden away inside people's brains, but as a "relational thing," having its existence more in time than in space (Shotter, 2011). The happenings of people's lives and people's human experiences cannot be

separated out or put into stable categories, since they interact as part of a continuous stream (James, 1910).

In summing up the information available, we may note that humans are connected to each other in such a way as to generate the human mind. In order to manage this, human beings must constantly attune themselves to each other on many levels:

(i) within the autonomic nervous system, in the sympathetic and parasympathetic systems, especially in electrodermal activity and blood pressure, but also in heart rate variability;

(ii) in the central nervous system, especially in the mirror neurons through which humans notice the affecting stance of others;

(iii) in bodily movements, prosody and facial expressions, in the manner in which the participants in a conversation synchronize their movements, vocalizations, and gestures. Smiling is particularly important as both a regulator of one's affects and as a form of communication and connectedness with the listener;

(iv) in dialogues, when participants give utterances that wait for an answer and thus jointly co-author stories that are generated in the present moment (Author, 2002; 2014).

Rhythmic Attunement in Psychotherapy

In psychotherapy the embodied experience of clients has been studied by some researchers. Quillman (2011) conducted research on individual psychotherapy on right-brain-to-right-brain communication. In this study, the therapists actively disclosed their own implicit experiences in the present moment. Lapides (2011) proposed similar ideas as applicable to couple therapy. She referred to this in terms of dealing with the sympathetic nervous system (SNS). On the whole, patients respond more to how the therapist says something than what the therapist says. Patients attend primarily to (i) prosody – pitch, and the rhythm and the timbre of the voice – and also to (ii) body posture, (iii) gesture, and (iv) facial expression.

In couple therapy, Atkinson (2005), Fishbane (2011), Gottman (2011), Johnson (2013) and Solomon & Tatkin (2011) have all included embodied actions as an element in therapeutic processes, for instance in relation to attachment theories (Johnson and Solomon &Tatkin) or Mindfulness (Atkinson). Fishbane (2011) attempted to use neurobiological information to help couples to gain power both in regulating their inner emotional arousals ("power to") at the same time as learning to be more empathetic to the spouse's emotional arousal ("power with"). Patterson & Vakili (2014) gave an outline for family therapists about how they could use the information of modern neuroscience in developing new practices. John Gottman (2011) focused on affective arousal as a part of marital and family interaction. He and his group have published research on affects in relation to marital conflict (Driver & Gottman, 2004), divorce (Gottman & Levenson, 2000), and partner violence (Jacobson, Gottman, Gortner, Berns & Short, 1996). They also developed the Specific Affect Coding System (SPAFF) (Coan & Gottman, 2007), which makes it possible to analyze affects emerging in couple communication by looking at e.g. facial expressions. An interesting point here, in relation to our own research, is that Gottman's group

used a large variety of ANS measures in laboratory situations in which couple communication was examined. From these measurements it was found, for example, that the husband's physiological arousal was one of six factors predicting the couple's divorce. These studies did not include the autonomic or central nervous system activity of the therapists.

In studies in which the therapists have been included as subjects, there have been some conceptualizations of psychotherapy as a process of mutual embodied synchronization. Ramseyer & Tschacher (2011) noted a strong relationship between the synchronization of body movements and client's experience of therapeutic alliance.. Fuchs & Koch (2014) described how body movements appear to be connected to emotions and to the relational situation, and noted how this may become visible in psychotherapy. Bänninger-Huber and Widmer (1999) examined repetitive affective relationship patterns in the context of specific emotions (of guilt) enacted in ongoing psychoanalytic therapy. They developed the Facial Action Coding System (FACS) of Ekman & Friesen (1978). Prototypical Affective Microsequences (PAMs) are mainly expressed nonverbally, and characterized by frequent smiling and laughter from both client and therapist. They serve as a means of regulating relationships.

Darwiche et al. (2008) found mutual smiling episodes (MSEs) during therapist-couple triadic interactions to be a key element within the affective exchanges that serve to regulate the therapeutic relationship. In their MSE Coding System (MSE-CS), they distinguished between supporting, mutual binding, sharing miseries, repairing, and confronting. The number of MSEs was positively correlated with the triadic therapeutic alliance. In relation to nonverbal behavior

in couples' interactions, Benecke et al. (2005) noted a connection between simultaneous smiling in conflict situations and perceived relationship satisfaction.

Focusing in particular on what happens in therapists' ANS, Kleinbub et al. (2012) compared the ANS reactions of a therapist, a psychologist, and a person without psychological training. When measured by Electrodermal Activity (EDA), the therapist showed a positive correlation with the observed therapist-client dyad arousal, while the psychologist showed a negative correlation, and the untrained person no correlation at all. The authors' interpretation was that in the course of their training, therapists can adopt skills for slower and consequently richer cognitive processing. Decety & Jackson (2007) argued that empathetic experience includes feeling the same affect as the other, plus cognitive reasoning concerning the experience and regulation of one's own emotional arousal.

The Relational Mind

The aim in the *Relational Mind Project* has been to increase our understanding of the embodied quality of therapeutic dialogues and of the attunement between the participants. An underlying concept in the project is that, by means of psychophysiological recordings within therapy, it may be possible to detect bodily events reflecting mental states that are not observable in overt behavior, or in verbal reports. The Autonomic Nervous System is also called the involuntary nervous system, because it functions largely below the level of consciousness (Kreibig, 2010). The two subsystems of the ANS are the sympathetic nervous system (SNS), which prepares the organism to take action in states of emergency ("fight-or-flight"), and the parasympathetic

nervous system (PNS), which has restorative functions ("rest-and-digest")[1]. Since the ANS is both an activating and a protecting system, our bodies react immediately to events in the immediate surroundings of our bodies. This would seem to be an obvious aspect to investigate when the aim is to know how we react to each other in interactional situations.

The research project *The Relational Mind in Events of Change in Multi-actor Therapeutic Dialogues*, is conducted by the University of Jyväskylä in collaboration with four other universities in Europe. The intention is to examine (i) how participants in multi-actor dialogues synchronize their behavior – and especially their body movements – with each other; (ii) whether change events in the session involve emotional arousal on the part of the clients and the therapists; (iii) what is happening, implicitly, in the important moments of dialogue when things are not said aloud; (iv) how any change for the better is related to mutual attunement and synchronization of movements in all of the aspects mentioned above.

Design and Methods

The data for the project are gathered in a natural setting within couple therapy sessions. In the Psychotherapy Training and Research Centre in the University of Jyväskylä, this means having co-therapists conducting the sessions as a pair. The style of the therapy applied mainly includes narrative, dialogical, and reflective forms of non-manualized therapy. The therapists often encourage clients to speak of the issues that are most salient at the moment. The aim is to respond to these issues in a way that will elicit new elements in the stories, consequently allowing new voices to be generated. In addition, two of the sessions (most often the 2nd and 5th

[1] In his polyvagal theory, Stephen Porges (2011) suggests that there are in fact three responses to threat: fight, flight, and freeze.

or 6th) include ANS measurements and Stimulated Recall Interviews. The progress of the therapy process is monitored by the CORE-OM (34) questionnaire at the outset, after the last session, and six months after the therapy has ended. Progress is further monitored by the Outcome Rating Scale (ORS), given to the clients before each session, and the Session Rating Scale (SRS) (Miller, Duncan & Stanton, 2002), given to both clients and therapists after each session.

All the therapy sessions are video recorded, with two cameras taking in the entire setting, plus four cameras giving a precise facial image of every participant.

In the ANS measuring sessions, measuring equipment is worn by the therapists as well as the clients. The measurements in question cover:

(i) skin conductance: measured with two electrodes attached to the non-dominant palm;

(ii) respiration: via a belt fastened around the lower chest;

(iii) heart rate: via monitoring for three days (starting the day before the therapy session, continuing during the therapy session, and ending after the stimulated recall interview).

In this paper our aim is to give a case example, showing how the research methods are used to see how affective arousal is related to the topics of dialogues. Participants empathetically attune to each other and this is seen in the synchronization of their ANS. As regards heart rate monitoring, the Firstbeat Bodyguard (Firstbeat Technologies) recording device permits the calculation of second-by-second indices of stress and relaxation. These reflect the activity of the SNS (via the Absolute Stress Vector, ASV) and also the PNS (via the Absolute Relaxation Vector, ARV) (Kinnunen et al., 2006). The ASV is calculated from (i) the heart rate, (ii) high

frequency power (HFP), (iii) low frequency power (LFP), and (iv) respiratory variables derived from heart rate variability (HRV). ASV is high when the heart rate is elevated, when HRV is reduced, and when the respiration rate is low, relative to heart rate and HRV.

The Stimulated Recall interviews (SRI) are conducted within one day after the therapy session. Four video extracts from the important moments of the therapy session are selected to be shown in the interviews. Each participant is interviewed individually concerning the thoughts and feelings they had during the session[2].

Case

Mart and Mary wanted to have couple therapy because of mental health problems they experienced, as well as problems in their daily living. They did not report any specific marital problems. The total CORE-OM score for the female client was 85, indicating severe psychological distress, and the score for the husband was 66, indicating moderate distress.

In the first session, Mary and Mart described their current life situation and the events of their life. They also gave the history of their illnesses, plus their relationships with their families of origin and with their neighbors. From viewing the face image video recordings, it became clear that in general the therapists had a close match with the facial expressions of the clients. This included smiling episodes, which contributed to an adequate working alliance, as confirmed also by the Session Rating Scale scores (SRS; Miller & Duncan, 2002) at the end of the session. On SRS Mary scored 35 and Mart 36, while Therapist 1 scored 27 and Therapist 2 scored 31.

[2] The ethical board of the University of Jyväskylä has approved the research, and all participants give their written consent.

According to the SRS manual, a score of 36 or more illustrates an optimal working alliance in the session. For the therapists' evaluations there are no validated data, so the scores should only be seen as informative for this specific study.

In the second session, the ANS measurements were conducted. The conversations during this session concerned the important life events of the couple. In particular two dramatic episodes were discussed. The first of these concerned Mart, and involved the time when he heard how his mother had died in an accident. The second concerned Mart's conflict with his brother. In this session, the SRS scores were 38 for Mart, 31 for Mary, 29 for T1, and 29 for T2. This illustrates a small decline in Mary's experience of the alliance.

/Figure 1. here

Figure 1. shows the electrodermal activity of the clients and therapists. Mary and Therapist 1 (T1) in particular shared a similar arousal level throughout the therapy session. Inspection of the time lag of the synchronization indicates that during most of the session, T1's EDA followed Mary's EDA (increased or decreased together) one second later. Also T2's EDA followed Mary's EDA after one second, but synchrony was not as strong as with T1. The latency of a skin conductance response is in the vicinity of 1–2 seconds (Hugdahl, 1995). Mart's EDA, on the other hand, tended to follow the therapists' EDA (1 s later) and Mary's EDA (3 s later). This could in part be explained by Mary's expressive manner; thus, whereas Mart spoke in a quiet voice with little variation in pitch, pace, volume, or stress, Mary's prosody varied considerably, and she sometimes she spoke with a very loud voice, drawing attention to herself. She also

showed considerable irony in her verbal expression, in addition to being nonverbally expressive. By contrast, Mart seemed quite unchanging in his few facial expressions.

Altogether, synchrony appeared to be a complex phenomenon, with fluctuations in the course of the therapy session. There were occasions when the synchronization was dyadic, triadic, or extending to all four participants. For example, at 32 min 40 s, at a point of dyadic synchrony between T2 and Mart, Mart said: *"There have been so many rough issues in my life and then this thing of Mary's on the top of it. Sometimes, during the darkest moments, it feels as if it would be easier to be a couple of meters under the ground"* (uttering a laugh on top of the sentence). Mary smiled and uttered a laugh, after which T1 also showed a brief smile. T2's seemed to be worried and she was the last one showing a short smile. In EDA Mary and T1 were relaxed, but Mart's and T2's arousal level rose. T2's sudden concern was visible in her rapid and high rise in EDA. Stimulated Recall interview also confirmed these observations; during the interview T2 said that she was concerned by Mart's words, since they seemed to refer indirectly to suicidal thoughts. One example in which all four participants appeared to be synchronized occurred at 56 min 6 s, when Mary interrupted Mart, suggesting that they should rest a little and then leave. Mart said that there were still five minutes left of the session, to which Mary replied *"Yeah but they* (gesturing towards the therapists) *have to have a conversation."* The moment seemed positive and humorous, with everyone smiling and laughing. This happened at the point when the reflective conversation between therapists began.

Throughout the session, the stress levels of both therapists remained lower than those of the clients, with some inner variation according to the themes of the dialogue (Figure 2). Mary's

stress seemed significantly higher than that of any other participant. The average ASV level was 780 for Mary, 476 for Mart, 79 for T1, and 181 for T2. The amplitude of the reactions differed from each other: the highest ASV was that observed with Mary (3411), whereas the highest peak for T1 was merely 77. Both the average stress and the stress range during the therapy session were related to recovery during sleep at home, to self-reported physical activity, and to BMI (calculated from self-reported height and weight). There are no certain levels describing e.g. "low" or "high" stress in ASV because participant's basic level depends on overall physical fitness level. While looking at different couple therapy cases recorded so far, ASV levels seem to be somewhere around 200 during the ANS measuring sessions.

Figure 2 about here/

For Mary, the highest ASV occurred quite early in the session, when Mart was speaking:

> Mart: I would say that I make do but um (sniff) (.) sometimes I've wondered that (1) when life even before Mary was so difficult (1) that It's been a bitter pill to swallow (.) um ◦like◦ ((**Mary's ASV starts to rise**)) life has almost like been left unlived… that… I was 42 years old before the first dating (sneers) relationship appeared and (2) and well.. [my] family haven't quite understood, I have got like (2) bad feedback.. from everyone… no, my mom and brother have understood me the least, my sister has now, during the last ten years understood what the situation is because she herself went through a, very bad time, she had to leave work because of, well, burnout and (2) that, muscle rheumatism and… she had to go through many treatments for example see a psychiatrist and… she got the disability pension after making lots of complaints (.) she has now been calling pretty often and asking how I'm doing and (.) my niece is also um (.) a very warm person so we call to each other sometimes (2) talk pretty openly about things so not everything but .hhh - -

For Mart, the highest peak occurred during the therapists' reflections with each other. T2 was talking about how she got the impression that Mart had been left to deal with his mother's death alone, and that they had not talked about it in the family:

> T2: ((**Mart's ASV starts to rise**)) yeah (2) so that felt like a very, meaningful thing (2) then if I heard correctly, um, so, (3) and this is something I hope we can, in the next meetings maybe, return to, so, so well, Mart said at some point that, that there was a feeling that life had been left unlived
>
> T1: mm, mm, yes (nodding).

The "life left unlived" theme appeared in both of the clients' highest ASV . Interestingly, this theme was not discussed during the therapy session itself: it was only mentioned three times, the first two of these occurring as in the transcriptions above. Mary's stress started to rise after Mart's reference to her, in *"life even before <u>Mary</u> was so difficult,"* placing an emphasis on her name. Mart then explained his loneliness, and how he felt that he had not fully lived his life. Mary's stress might actually be an indicator of empathy, since later in the session she said that she felt that there were people close to her who had not helped her. Mary also started to cry when Mart talked about the death of his mother. When Mart's speech turned away from the loneliness, with the mention that he did have friends/family who understood, Mary's stress decreased.

As regards, Mart's ASV peak, his phrase *"life has almost like been left unlived"* was not itself a particularly stressful moment for him. However, when T2 repeated his words much later on in the session, during the reflective conversation, his ASV rose. This may be related to the hidden

criticism of Mary in the phrase. During the session, Mart told two very important stories: one concerned the death of his mother, and the other was about his poor relationship with his brother. There was no high stress during these issues, but the unlived life theme caused a physiological reaction in Mart. Later, during the SRI interview, Mart commented that he had told the story of his mother's death countless times to different people, making it understandable that it did not cause a large response at this point. However, the "unlived life" theme appeared to be very important to Mart, and it became a focal point during the 24 sessions therapy process.

It is interesting to note that T1's highest ASV occurred when Mart suddenly changed the current topic back to the previously mentioned death of his mother. T1 confirmed the importance of this topic during the reflective conversation, saying. *"one of the most touching issues - - was .hh this (.) de- tragic death of the mother,"* thus giving validation to the physiological finding.
T2's highest ASV was right at the start of the reflective conversation. We can suspect that this involved anticipation of what T1 would say, in addition to the cognitive effort of understanding what T1 meant.

Discussion

In this paper we first described the framework for notions of embodiment and the relational mind. We noted that the phenomenon of mutual attunement includes not only the spoken dialogue but also bodily action, in terms of the synchronization of movements and of facial expressions with the autonomic nervous system. As far as we are aware, the Relational Mind research project is the first to conduct an analysis of embodied attunement within psychotherapy

practice in a real-world multi-actor situation that includes looking at the responses of the therapists.

The case example illustrated how ANS synchrony between humans is a multifaceted phenomenon. Not all of the persons present will attune to each other automatically; moreover, synchrony can often be dyadic or triadic, and it can change from moment to moment. In a co-therapist setting, dyadic attunement can imply that one therapist will synchronize more with one client; thus, to some extent, two client-therapist pairs may come into being. This could have a positive result in so far as the views of both clients may then be better taken into account. When Mart said at one point in therapy that *"Sometimes, during the darkest moments, it feels as if it would be easier to be a couple of meters under the ground."*, both Mart's and T2's arousal level rose while Mary and T1 were calm. Even though the remark was softened by utters of laughter, the overall mood during the moment portrayed more sadness than humor. The expression of concern was very clear on T2's face and her EDA showed a rapid rise during this remark.

One can see a possible risk of one client and the two therapists forming a triadic synchronization, leaving one client out of this attunement. Embodied ANS synchrony may have the potential to facilitate a better alliance and consequently better outcomes in therapy; nevertheless, we do not yet know whether this is the case, or how much synchrony is needed to enhance the alliance. There are occasions when desynchrony in a therapy setting may actually be justified, for example in situations when a client's anxiety increases, and the therapist serves the client better by remaining calm. In relating ANS reactions to dialogue, it is important to check from the video that the participants are not merely clenching the fist in which the EDA electrodes are attached,

or touching their face or hair. Furthermore, it is crucial to combine different channels of information in order to see whether the increase in EDA reflects a happy moment or an anxious moment, given that both emotions can increase skin conductance (Kreibig, 2010).

The paper also introduced a way of looking at stress during a therapy sessions, based on calculations of different heart rate variables. This technique has previously been used mainly with athletes, or in work environments, to study the rate of recovery. A point of interest here is that the highest stress could occur when a participant was listening to another person's talk, not when talking himself/herself. Thus, Mary's highest ASV peak was during Mart's talk, and Mart's highest peak was during the therapists' reflective conversation, when T2 repeated Marts previous words. Stress might increase through this kind of mirroring of client's sayings due to activation of thoughts and feelings attached to the moment when the words were spoken in the first place.

So far, our data do not permit any firm conclusions for clinical practice. Based on the sessions analyzed for this specific couple, we can see that when clients spoke of painful issues their physical reactions were intense, thus representing an embodied process. This was the case especially with the wife who spoke using variation of tone and intensity in their utterances. These are aspect that therapists in particular need to take into account. A reflective conversation can also be a stressful event and one with notable embodied consequences for clients. On some occasions, the therapists experienced arousal (as shown by EDA) in synchrony with the clients, which may illustrate that we naturally sense in our body the responses of our clients.

As mentioned previously, positive feelings such as laughter cause an increase in EDA, and cognitive effort, too, can be manifested as stress, in terms of ASV measures. Both measures tell us about arousal, which is a sign of our body becoming ready for action, and this may as easily be initiated by excitement as by threat. We do not yet know much about stress in relation to the therapy setting; however, one can think that too much stress may cause us to block outside stimuli or information, and this could be harmful in therapy. Overall – in a similar manner to there being an optimal arousal level for learning – there could be an optimal window of stress in therapy. If there is no arousal at all in the body, it will be harder for meaningful information to "stick" to us and give us new insights.

Our very preliminary observations suggest that embodied attunement does indeed take place in couple therapy sessions. Participants can vary greatly in terms of the topics they react to, and in terms of which participants react simultaneously. So far, we have not found that the rhythmic attunements occur in a systematic way. We do not yet know to what extent the embodied reaction**s** are connected to the bodily information present, or to what degree they are related to issues that are expressed in words. Affective arousal can occur in the absence of spoken words, which was seen when T2 became worried about Mart's comment "being under the ground". In future research it will be interesting to see if reactions in the autonomic nervous system can shed light on what is important for the person – even when the person is not (yet) consciously aware of it. This could help in adapting therapy to suit individual needs.

These first preliminary observations have already enlarged our understanding of the complexity of the mutual attunement between the therapists and the spouses in couple therapy sessions. It

shows that therapists as well as clients participate as fully embodied human beings, and therapy is much more than an exchange of words and idea. Further, Synchronization has emerged as a more complex phenomenon than we first thought. It is evident that it is not enough to look only at the ANS information, or at any other single source of data. We need to integrate fully all the measured information if we are to make more precise hypotheses and observations on the ways in which the therapist and the client synchronize their embodied reactions in dialogue. These are major questions which will require extensive study in the future.

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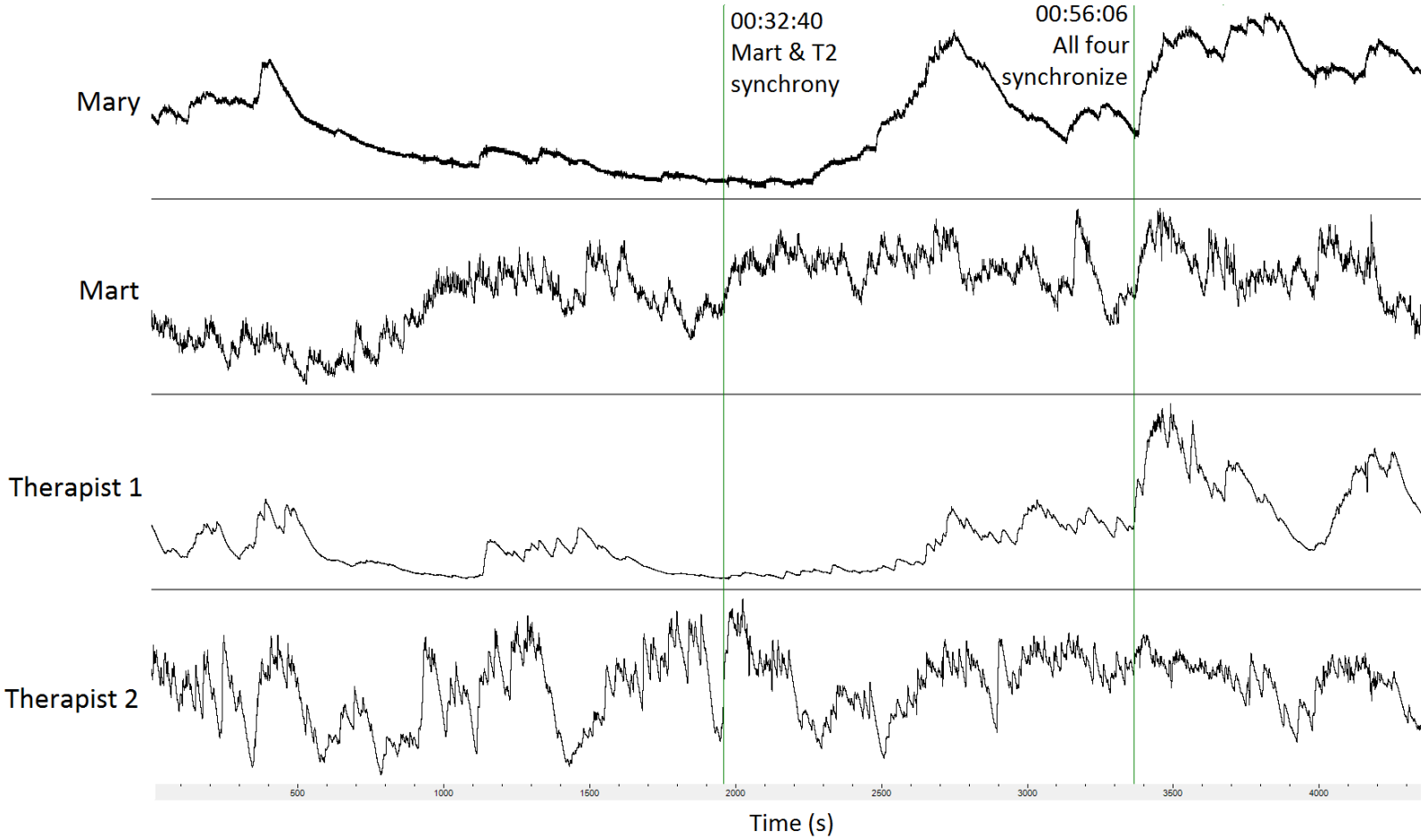

Figure 1. EDA of the four participants from the entire session, range scaled for each participant separately. Two vertical lines point out an example of dyadic synchrony, as well as when all four participants attune to each other during a shared humorous moment.

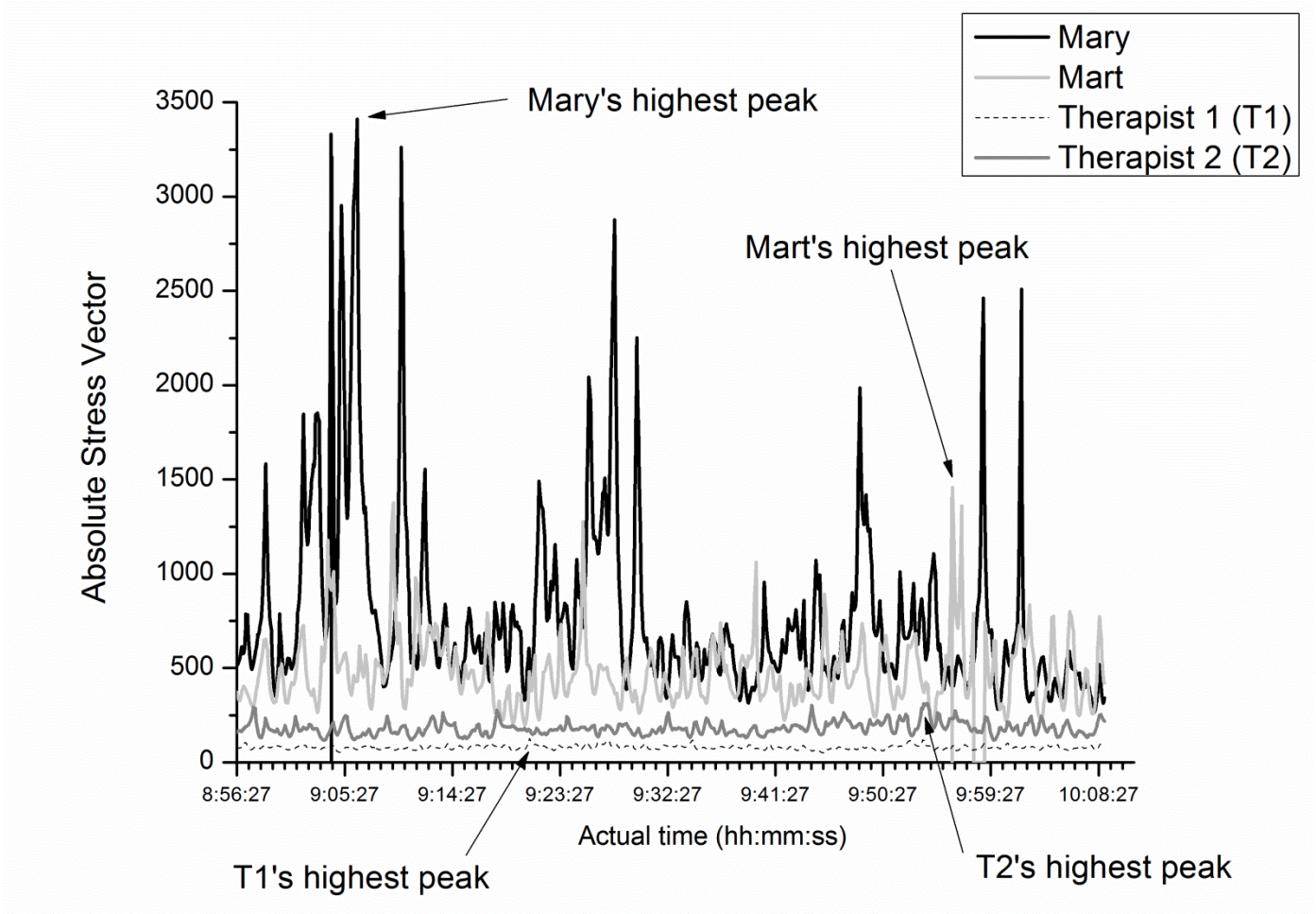

Figure 2. Absolute Stress Vectors (ASV) of the four participants during the entire therapy session

II

SYMPATHETIC NERVOUS SYSTEM SYNCHRONY IN COUPLE THERAPY

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Journal of Marital and Family Therapy, *42*, 383–395.

http://urn.fi/URN:NBN:fi:jyu-201607183633

III

SYMPATHETIC NERVOUS SYSTEM SYNCHRONY: ITS RELATIONSHIP WITH THE THERAPEUTIC ALLIANCE AND OUTCOME IN COUPLE THERAPY

by

Anu Karvonen, Virpi-Liisa Kykyri, Jukka Kaartinen, Jaakko Seikkula, Asko Tolvanen, & Markku Penttonen, 2017