

How Interpersonal Coordination Can Reflect Psychological Counseling: An Exploratory Study

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Abstract

This study showed how interpersonal coordination between a psychotherapist and client changes during a psychological counseling session and how it reflects it. We aimed to evaluate psychological counseling sessions and understand psychotherapists' embodied skills. Recently, it is considered that bodily coordination between a therapist and a client as well as psychotherapists' embodied skills is important. We conducted an exploratory case study with quantitative analysis and a qualitative analysis. One female student and one female psychotherapist participated in our experiment. The student had a counseling session for 50 minutes in a session, which was video recorded. After quantifying both participants' bodily activities by video image processing, the data were analyzed using nonlinear time series analysis in terms of the degree of coordination and the direction of influence. The data were also analyzed qualitatively by multiple researchers observing the video and by interviewing the psychotherapist. We identified the critical points of the session when the state of the client's mind and the relationship between the therapist and client qualitatively changed. The results of qualitative and quantitative analyses were then compared. The results of the quantitative analysis showed that the degree of bodily coordination between the client and therapist was relatively high in three characteristic scenes: 1) building rapport, 2) clinical intervention, and 3) summarizing and closing the session. These results suggest that bodily coordination can highlight clinically important scenes. Moreover, the direction of influence also changed drastically in the clinical intervention scene. This case study suggests that interpersonal coordination between the client and therapist in a counseling session can partly reflect the quality of counseling (e.g. client-therapist relationship, clinical intervention).

Keywords

Embodiment, Mind-Body Relationship, Interpersonal Coordination, Quantitative and Qualitative Analyses, Video Image Processing

1. Introduction

1.1. Embodiment and Complex Systems

Recently, the concept of *embodiment* has become an important key concept in research in psychology, cognitive science, and philosophy of mind (e.g., Chemero, 2011; Gibson, 1979; Varela, Thompson, & Rosch, 1992). Although traditional psychology supposes that mind is independent of the body, recent studies have revealed theoretically and empirically that we cannot separate mind from the body and its environment, which rather are interdependent (e.g., Anderson, Richardson, & Chemero, 2012; Riley, Shockley, & Van Orden, 2012). From the viewpoint of embodiment, cognitive processes (perception, memory, thinking, emotion, the psychological self) interact with motor action and behavior. Cognitive aspects related to language and communication are also embodied (e.g., Richardson, Dale, & Shockley, 2008; Shockley, Richardson, & Dale, 2009). In line with this approach, the body can be regarded as an interface between the mind and its environment including social environment (e.g., others). In other words, we can consider mind and cognition as a complex phenomenon that emerges from body-environment interaction (e.g., Fowler, Richardson, Marsh, & Shockley, 2008; Richardson, Dale, & Marsh, 2014).

Another key concept is that of a *complex system*, which we refer to here as a self-organizing system. Self-organization theory has been well established in physics (Haken, 1978; Nicolis & Prigogine, 1977). According to this theory, a complex system consists of mutually interacting components and emerges through such interactions at the micro level of the system, while a specific pattern or structure is observed at the macro level. The human body also consists of many components (degrees of freedom) (Bernstein, 1967; Turvey, 1990). Human communication is also regarded as an emergent phenomenon of a complex system because it is multi-modal, multi-dimensional, and multi-agentive (e.g., Dale, Fusaroli, Duran, & Richardson, 2013; Richardson, Dale, & Marsh, 2014). A complex system cannot be studied and understood by separating it from its interactions with its environment (including other individuals), situation, or context. Rather, these interactions are important for studying a complex system (Riley, Richardson, Shockley, & Ramenzoni, 2011). Such a systemic approach is applied not only to fundamental scientific research on human communication (Dale et al., 2013; Marsh, Richardson, Baron, & Schmidt, 2006; Richardson et al., 2014; Riley, Richardson, Shockley, & Ramenzoni, 2011; Schmidt, Carello, & Turvey, 1990) but also to applied research such as clinical psychotherapy (e.g., Goudsmit, 1989; Tschacher, Schiepek, & Brunner, 1992).

Considering these key ideas, embodiment and complex systems, studying interpersonal bodily coordination is one of the reasonable and possible ways to understand human communication, interpersonal relationships, and mental health. Moreover, the behavior of complex systems and the respective data often show complexity and noise because of its complex interactions with various components at multi-dimensional and multi-scale levels. Its data tend to show non-stationarity and nonlinearity, which means mathematically and statistically that researchers have difficulty in analyzing and assessing such data with traditional statistics and linear analysis (e.g., means, deviations). Faced with such analytical problems, the field of self-organizing theory and nonlinear dynamics has developed and proposed some mathematical methods and nonlinear analyses (e.g., [Kantz & Schreiber, 2003](#)), and these have been applied to psychology and cognitive science studies ([Holden, Riley, Gao, & Torre, 2013](#); [Van Orden & Riley, 2005](#)).

1.2. Social Relationships and Clinical Psychotherapeutic Studies

Interpersonal coordination or synchrony has been studied widely in human communication and social interaction research (for reviews, [Bernieri & Rosenthal, 1991](#); [Keller, Novembre, & Hove, 2014](#); [Schmidt & Richardson, 2008](#); [Vicaria & Dickens, 2016](#)). Qualitative studies have reported interpersonal coordination and synchrony in human communication (e.g., neonate-adult, student-teacher) that can be observed in bodily actions, voices, and gestures, ([Bernieri, 1988](#); [Bernieri, Reznick, & Rosenthal, 1988](#); [Condon & Ogston, 1966](#); [Condon & Sander, 1974](#); [Kendon, 1970](#)). Interpersonal coordination and synchrony are considered not to occur without a reason but to have some social function, such as building social relationships (rapport), affiliations, or empathy ([Bernieri, 1988](#); [Bernieri, Gillis, Davis, & Grahe, 1996](#); [Hove & Risen, 2009](#); [Maurer & Tindall, 1983](#)). They also relate to facilitating and promoting communication ([Wiltermuth & Heath, 2008](#)). In clinical psychology, interpersonal coordination is regarded as an important factor and a relevant element of therapeutic skills ([Tschacher & Bergomi, 2011](#); [Tschacher & Pfammatter, 2016](#)). We thus suppose that interpersonal bodily coordination might reflect some aspects of a social relationship and be involved in clinical practice and mental health.

Previous studies have investigated the effects of interpersonal coordination and synchrony in clinical psychology and psychotherapy (for reviews, [Koole & Tschacher, 2016](#); [Ramseyer & Tschacher, 2006](#)). Some researchers have reported that nonverbal synchrony is associated with session-level process and therapy outcome ([Ramseyer & Tschacher, 2011](#)). They suggest that higher nonverbal synchrony characterize psychotherapies with higher symptom reduction ([Ramseyer & Tschacher, 2011](#)). They have also examined nonverbal synchrony between participants during psychotherapy sessions and compared the synchrony of head and body movements ([Ramseyer & Tschacher, 2014](#)). They revealed that head-synchrony predicted the global outcome of therapy (overall therapy suc-

cess), while body-synchrony did not, and body-synchrony predicted session outcome (immediate session-level success), while head-synchrony did not (Ramseyer & Tschacher, 2014). Other research groups have shown that embodied synchrony (e.g., bodily coordination, similarity of voice strength and coordination and smoothness of response timing) have a cooccurrence relation (Nagaoka, Yoshikawa, & Komori, 2006). They argue that embodied synchrony can act as an indicator reflecting the mental process of a client or counselor (Nagaoka et al., 2006). In other studies, they compared high- and low-evaluation psychotherapy sessions group, and reported that interpersonal synchrony between the client and the therapist were higher in the high-evaluation group than in the low-evaluation group (Nagaoka & Komori, 2008). They also found common temporal patterns in the high-evaluation sessions (Maeda, Nagaoka, & Komori, 2007). These previous studies suggest the importance of embodied communications in psychological counseling and psychotherapy.

Most previous studies have performed only quantitative analyses of large samples with linear analysis (e.g., Ramseyer & Tschacher, 2011, 2014). Although such an approach can reveal the overall trends or effects of interpersonal bodily coordination on psychotherapy, important factors or skills in detail have not been clarified. Moreover, although some other previous studies have combined quantitative and qualitative analysis of case studies (Maeda et al., 2007; Nagaoka & Komori, 2008; Nagaoka et al., 2006), their experiments did not involve real clinical cases but rather role-play counseling. These previous studies also applied only linear analysis but not nonlinear analysis. Therefore, we earlier employed both quantitative and qualitative analyses of a single case study as a first step (Kodama, Hori, Massaki, & Matsui, 2017). This article reports such an exploratory case study of a real clinical case. We supposed that interpersonal bodily coordination during psychological counseling is a very complex phenomenon. Additionally, because our data were derived from only a single case and its time series was non-stationary and noisy, we also applied nonlinear time series analyses (Kantz & Schreiber, 2003).

2. Method

2.1. Participants

One female university student (20 years old) and one female psychotherapist (64 years old) participated in our experiment. The student was recruited as a client, while the psychotherapist was one of the coauthors, who has more than 10 years of clinical psychotherapy experience. The client was counseled for 50 minutes in the counseling session (Figure 1). The client reported some troubles with her family. She stated that she had a troubled parent-child relationship and felt lonely and alienated from her family.

The procedures were approved by the research ethics committee of Kanagawa University, where the experiment was conducted. Each participant provided written informed consent to participate in this study. The student was paid 1000 JPN yen/hr for her participation.

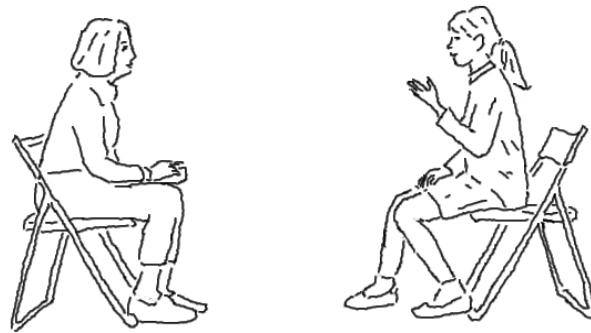


Figure 1. Experimental setting (left: Therapist, right: Client).

2.2. Apparatus

The participants faced each other and were seated 1 meter apart (**Figure 1**). A video camera (Handycam HDR-PJ540, Sony) and two microphones (4071 Miniature Omnidirectional Microphone, DPA microphones) were used to record and collect audio-visual data. Two microphones were separately connected to the audio mixer (R-26 Portable Recorder, Roland). The left and right microphones were used for the therapist and the client, respectively. For data processing and analysis, a personal computer (LET'S NOTE CF-SX2, Panasonic), software (MATLAB R2014a, MathWorks) (R, 3.1.2) and programs (*Cross Recurrence Plot Toolbox for MATLAB*[®], Ver. 5.22 (R32.2); Marwan, Carmen Romano, Thiel, & Kurths, 2007) (R “*TransferEntropy*” package; Ghazaleh, Torbati, & Lawyer, 2016) were used. To quantify how much each participant moved, a video image processing technique was performed on a laptop computer (MacBook Pro 13-inch, Apple) with *Motion Energy Analysis* software (MEA 3.10; Ramseyer & Tschacher, 2011).

The data were qualitatively analyzed by several researchers who observed the video and interviewed the psychotherapist. We also identified the critical points of the session when the state of the student’s mind or the relationship between participants qualitatively changed (i.e., clinical intervention). At the same time, we quantitatively analyzed how their bodily activities and interpersonal coordination changed. Finally, the results of the qualitative and quantitative analyses are compared and discussed.

2.3. Procedure: Data Collection and Analyses

In the experimental room (3 meters square), a video camera was positioned at the viewpoint shown in **Figure 1** at a distance of 3 meters from the participants. The therapist was seated waiting for the client in the room before the client entered. She was asked for psychological counseling for 50 minutes, and the experimenter told her that the client was a female university student. She was not informed of the client’s problem before the session. In another room, the client was informed that she could have a free counseling session for 50 minutes. After the client arrived at the room, she sat down in the chair facing the therapist (**Figure 1**). This was the first contact between them. The experimenter left the

room after attaching microphones to them and started recording. The counseling session then started and was videotaped by the camera for about 50 minutes. After the session finished, the therapist called the experimenter into the room and he stopped the recording.

A video image processing technique, the frame-differencing method, was used to quantify how much each participant moved (i.e., *Motion energy*; Ramseyer & Tschacher, 2011) (for details see Paxton & Dale, 2012; Ramseyer & Tschacher, 2011). After smoothing by low-pass filter (4th-order Butterworth filter, cut-off frequency: 10 Hz), nonlinear time series analyses were performed. The reason that nonlinear methods were applied instead of linear methods (e.g., cross-correlation) was because complex time series data, such as whole-body movements, in a psychological counseling session are difficult to analyze with linear methods owing to their non-stationarity and complex noise, as mentioned in the introduction. Nonlinear methods can be applied to such non-stationary and noisy data with relatively few data assumptions. After removing the video scenes of the experimenter setting the microphones and participants chatting after finishing the session, we analyzed 48 minutes of phases in total. We then applied the following nonlinear methods to our time series data.

To quantify the degree of coordination, we calculated the mutual information (Fraser & Swinney, 1986) between the time series of the two participants. Mutual information is a nonlinear measure of dependency based on the Shannon entropy (Shannon, 1948) that indicates a reduction in uncertainty (i.e., the gain in information about one of the random variables after observing the other) (Ragert, Schroeder, & Keller, 2013). It can quantify the amount of uncertainty about a random variable (X) reduced by the observation of another variable (Y) (Kostrubiec, Dumas, Zanone, & Kelso, 2015). Previous studies have applied mutual information to quantify the degree of synchrony, coordination, or coupling between the body movements or sounds of participants (Papiotis, Marchini, Maestre, & Perez, 2012; Ragert et al., 2013). In this study, the mutual information between the body movements of the participants was calculated to quantify interpersonal bodily coordination. It was computed for each minute of the session.

To quantify the direction of influence, we calculated the transfer entropy (Schreiber, 2000) between the time series of the two participants. This is a nonlinear and non-parametric statistical measure to capture the amount and direction of information flow exchanged between time series regarded as random processes (Schreiber, 2000). Transfer entropy from a process X to another process Y quantifies how much the past of X conditions the transition probabilities of Y. Although mutual information can quantify the amount of uncertainty (the degree of coordination), transfer entropy can distinguish how much X influences Y and how much Y influences X because it is asymmetric under the exchange of X and Y. If the next state of Y depends on the previous states of Y but not the previous states of X, the transfer entropy would be null (X and Y are independent), and it will be positive if including information about the past states

of X improves the prediction of the next state of Y beyond the prediction based on past states of Y (Kostrubiec et al., 2015). Previous studies have applied transfer entropy to quantify the direction of influence during interpersonal coordination or interactions (Kojima, Froese, Oka, Iizuka, & Ikegami, 2017; Kostrubiec et al., 2015). In the current study, we calculated the transfer entropy both from the client to the therapist and from the therapist to the client to quantify how much their body movements influenced each other. We computed it using the R “*TransferEntropy*” package ($d = 5, k = 1$) (Ghazaleh et al., 2016). After computing it for each minute of the session, we calculated the ratio of each transfer entropy to total entropy (%TE) for each phase. A value of 0% means that the client’s movements perfectly depended on the therapist’s movement, while 100% means that the therapist’s movement perfectly depended on the client’s movement, and 50% means that the therapist and client influenced each other equally.

We also performed a qualitative analysis of the video data from the psychological/clinical viewpoint and a qualitative description of how participants moved and behaved during the session. First, from the psychological/clinical viewpoint, clinical psychologists observed and assessed the session, and they analyzed the data by interpreting the psychological/clinical meaning of each phase through the session. They identified the important points when the therapist tried a clinical intervention. Next, we also performed a qualitative behavior analysis of the phases highlighted by the quantitative analysis. We observed and analyzed the video data and described how participants moved and behaved during these phases. Finally, we compare and discuss the results of the quantitative and qualitative analyses.

3. Results and Discussion

3.1. Summary of Session

The client lived with her parents and elder sister. She had some troubles with her family. She stated that she had a troubled parent-child relationship and felt lonely and alienated from her family. For example, her parents often got angry with her and only blamed her but not her sister. She felt that her parents showed a special preference for her sister but not for her, which caused her to feel alienated and lonely. In addition, she thought that the problem was due to herself (e.g., her behavior, attitude, or personality). When talking about this problem, she began to cry. This summarizes the first part of the session.

In the current session, the therapist applied a solution-focused approach (Berg, 1994). She listened closely to the client’s report and expressed empathy with her emotions. She then intervened by changing the client’s viewpoint of her parents and the problem (i.e., *reframing*). The hysteric personality of her mother was derived from her childishness, not from the client’s issue (the middle part of the session). Finally, the client was able to accept and agree with the viewpoint suggested by the therapist. After that, they talked in a relaxed manner about the client’s family and her future, and they finished the session smiling.

3.2. Mutual Information

The black dots (solid line) in **Figure 2** show the mutual information for each one-minute phase. The dashed line represents mean value during the 48 minutes. The three blue-highlighted phases were the three with the highest values of mutual information. In other words, in these phases, the therapist and client were highly coordinated. The most coordinated phase was the ending scene (Scene 3, 44:00 - 45:00; mutual information of 5.47 bits). The second coordinated phase was the middle scene (Scene 2, 24:00 - 25:00; mutual information of 5.08 bits). The third coordinated phase was the beginning scene (Scene 1, 1:00 - 2:00; mutual information of 5.06 bits). The values of mutual information in these scenes were relatively higher than the mean value of all 48 phases (mean = 3.35 bits, $SD = 0.86$). We compared the former part (2:00 - 22:00) and the latter part (25:00 - 43:00) after excluding these highly coordinated phases, and found that the former part was less coordinated (mean = 2.75 bits, range: 1.91 - 3.80 bits) than the latter (mean = 3.51 bits, range: 1.95 - 4.31 bits). This implies that the bodily coordination between the therapist and the client gradually increased during the session. It might be interpreted as showing that their interpersonal relationship became closer and improved during the session. In other words, this may imply a rapport building process (Ramseyer & Tschacher, 2006).

3.3. Transfer Entropy

The black dots (solid line) in **Figure 3** represent the percent transfer entropy (%TE) for each one-minute phase. While 0% means that the client's movement

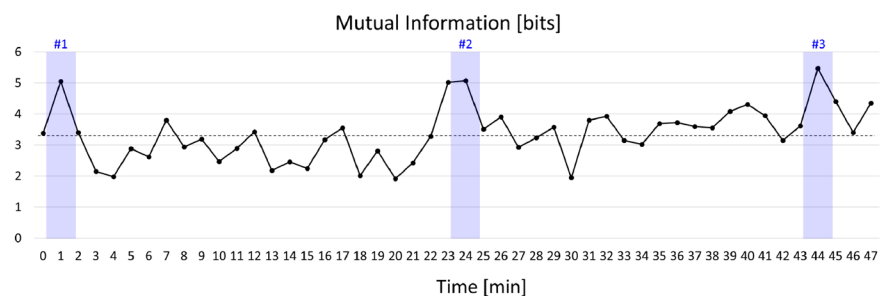


Figure 2. Mutual information (Solid: Mutual information, bits; Dashed: Mean; Blue: Top three phases of MI).

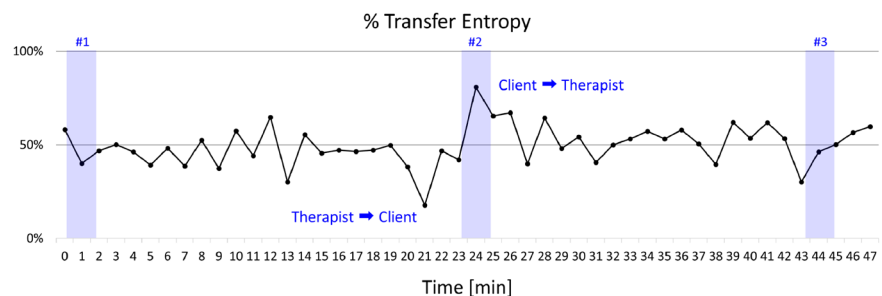


Figure 3. % Transfer entropy (0% - 50%: the therapist was more influential, 50% - 100%: the client was more influential; Blue: Top three phases of MI).

perfectly depended on the therapist's movement, 100% means the opposite and 50% means that the therapist and client influenced each other equally. The three blue-highlighted phases were the three with the highest mutual information. In other words, in these phases, the therapist and client were highly coordinated as mentioned above. On the other hand, %TE seemed to be relatively constant except during the transition observed around the middle part of the session, where we find a drastic change or transition from the Therapist-Client direction to the Client-Therapist direction (21:00 - 25:00). This part overlaps the second highlighted scene of mutual information (Scene 2). Although the other highlighted scenes (Scenes 1 and 3) were not so clear, %TE seemed to change direction (from the Client-Therapist direction to the Therapist-Client direction in Scene 1: from the Therapist-Client direction to the Client-Therapist direction in Scene 3). This might reflect some change or transition in the interpersonal relationship. Again, we compared the former part (0:00 - 20:00) and the latter (27:00 - 47:00) with the transition excluded. %TE was on average less than 50% in the former part (mean = 46.83%, $SD = 8.09\%$, range: 30.12% - 64.74%). While %TE was on average greater than 50% in the latter part (mean = 51.55%, $SD = 8.57\%$, range: 30.16% - 64.37%). These results might suggest that the therapist influenced the client more in the former part, while on the other hand, the client influenced the therapist more in the latter part. This suggests that transfer entropy can measure information transfer and direction of influence between interacting participants (Hasson & Frith, 2016).

3.4. Behavioral Analysis

In the first highlighted scene (1:00 - 2:00), after a brief greeting, the therapist asked the client some questions and the client made a short self-introduction. This was considered as an ice-breaker. After that, the therapist asked what the client wanted to talk about. During this scene, they repeated the question-answer turn-taking behavior with their body synchronized (e.g., gesturing and nodding; **Figure 4(a)**). This scene can be regarded as a rapport-building phase. After this their bodily coordination increased and synchronization occurred, as their interpersonal relationship improved.

In the second highlighted scene (24:00 - 25:00), after a clinical intervention (i.e., *reframing*; Franklin, 2012) by the therapist, she sympathized with the client's emotions and repeatedly encouraged her. The client also nodded deeply with whole-body motion. We observed deep whole-body synchronization between participants (**Figure 4(b)**). After that, the client cried and wiped her tears. We suppose that such an empathic interaction led to the high bodily coordination in this scene (Ramseyer & Tschacher, 2006).

Before the second scene (22:00 - 24:00), the therapist tried a clinical intervention, *reframing*, in which she suggested the client change the viewpoint of her family and herself. These clinical behaviors might be interpreted as a psychological influence from the therapist to the client. Thus, the %TE was less than 50% (i.e., Therapist-Client direction of influence). After *reframing*, the client herself

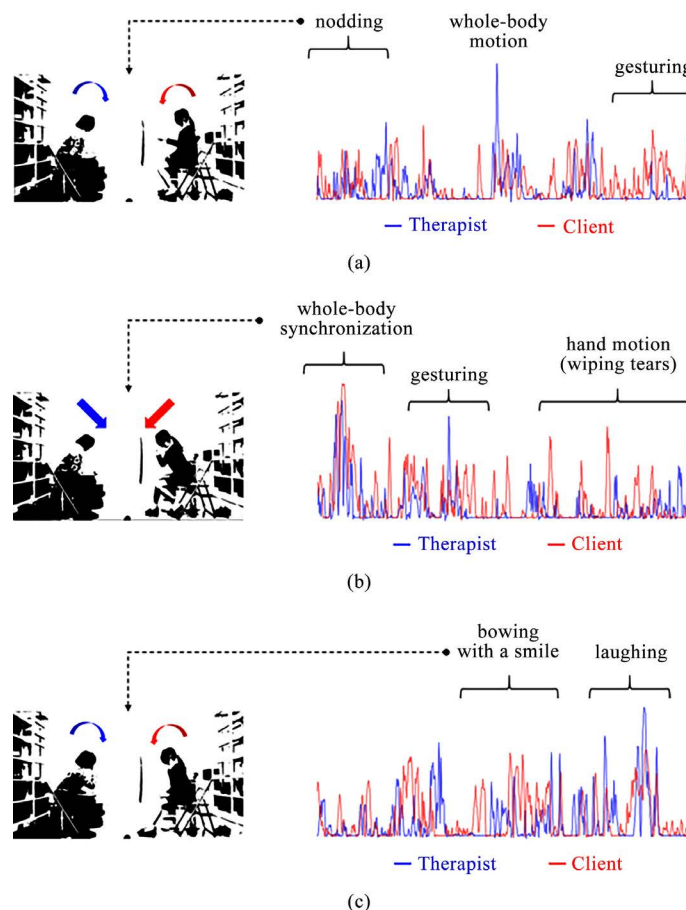


Figure 4. Highlighted scenes and motion energy raw data of each participant (a) [1:00 - 2:00]; (b) [24:00 - 25:00]; (c) [44:00 - 45:00]).

also seemed to change her view and accept her family again, and then %TE increased to greater than 50% (i.e., Client-Therapist direction of influence). This transition in %TE might reflect the psychological state of the client and effect of the clinical intervention.

In the third highlighted scene (44:00 - 45:00), the therapist reviewed and summarized the session. She encouraged the client again and the client seemed to gain self-confidence. After the therapist concluded the advice and the client showed her appreciation, they had a little chat, and smiled and laughed (**Figure 4(c)**). When they bowed to each other, their body movements were synchronized and coordinated well. Thus, high interpersonal coordination might be observed in the last scene.

3.5. Future Directions

In this article, we reported a single case study of a psychological counseling session in terms of embodied communication. The results of the quantitative and qualitative analyses seem to suggest that changes in interpersonal bodily coordination might reflect some aspects of the psychological state of the client's mind, the relationship between the therapist and the client, and the effect of the clinical

intervention (e.g., Nagaoka et al., 2006; Ramseyer & Tschacher, 2006). In the future, we should collect more data to examine other possibilities. Furthermore, it is important to analyze the data qualitatively in more detail from the clinical/psychological viewpoint. Quantitative analyses of not only the body movement but also speech and verbal data, facial expressions, gaze, and so on are important because human communication comprises multi-modal and multi-dimensional domains (Dale et al., 2013).

These investigations will lead to some practical applications in clinical psychology and psychotherapy: Reflection and feedback of counseling sessions for therapists, objective assessments of counseling sessions and therapists' skill, and training/education of therapists. To do so, we propose a cyclic interplay between a qualitative approach (e.g., generating hypotheses) and a quantitative approach (e.g., testing hypotheses) (Kodama et al., 2017). In the case of interdisciplinary and practice-motivated studies, it is also necessary to combine academic studies with practical issues.

4. Conclusion

To evaluate psychological counseling sessions and understand psychotherapists' embodied skills, the present study investigated how interpersonal coordination between a psychotherapist and client changes during a session and how it reflects it. As a first step to achieve our goal, we conducted an exploratory case study. One student and one psychotherapist participated in our experiment. The student was counseled for 50 minutes in a session, which was video recorded. A video image processing technique was used to quantify both participants' bodily activities. The data were analyzed using nonlinear time series analysis in terms of the degree of coordination and the direction of influence. The data were also analyzed qualitatively by several researchers observing the video and by interviewing the psychotherapist. The results of qualitative and quantitative analyses were then compared. The results of the quantitative analysis showed that the degree of bodily coordination between the client and therapist was relatively high in three characteristic scenes: 1) building rapport, 2) clinical intervention, and 3) summarizing and closing the session. These results suggest that bodily coordination can highlight clinically important scenes. Moreover, the direction of influence also changed in the clinical intervention scene. The current case study implicates that interpersonal coordination between the client and therapist in a counseling session can partly reflect the quality of counseling (e.g., client-therapist relationship, clinical intervention). Further investigation will make it possible to deeply understand and evaluate psychological counseling and therapists' skills.

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