

Generation Dynamics of Sympathetic Embodied Awareness in Hand Contact Improvisation

Yoshiyuki Miwa*, Shiroh Itai*, Takabumi Watanabe*, Hiroko Nishi**

* Waseda University, miwa@waseda.jp, itai@aoni.waseda.jp, takabumi@aoni.waseda.jp

** Toyo Eiwa University, hiroko@toyoeiwa.ac.jp

Abstract: This study conducted an analysis of bodily movements during Hand Contact Improvisation with hand movements restricted to one degree of freedom back and forth, to investigate the creation dynamics of sympathetic embodied awareness, which is intimately related to co-creative expressions. The results showed that when sympathetic embodied awareness emerges, a chaos attractor was generated by the movements of the joined hands. Also, it was discovered that when this occurs, there are many times when subconscious full-body movements together precede hand movements. In addition, it was found that a cycle variation rhythm of hand movements was spontaneously generated. These results indicate that the creation and sustainment of co-creative expression necessitate to change the self's internal space-time construction through the actions of the implicit and explicit domains of the self.

Key words: *Co-creative Expression, Sympathetic Embodied Awareness, Ba of expression*

1. Introduction

At the actual field of an inclusive dance, where people with various backgrounds and values gather and create improvisational bodily expressions, they overcome differences such as physical challenges, generation, and gender, and share and deepen their thoughts and dreams by “meeting through expression, connecting through expression”. Each individual's bodily expression gives rise to a “*Ba*^{Note1} of expression”, and the “my expression” of the individual is reborn as “our expression” through the “action of the *Ba*”. In these co-creative expressions, the expressions of various individuals are united and spun into a single narrative. To study these dynamics, one of the authors, Yoshiyuki Miwa, has already proposed a duality cycle model of expression as a working hypothesis, in which a “*Ba* of expression” is created in the boundary zone where the implicit and the explicit domains interpenetrate to each other [1]. Then, through resonance of this “*Ba* of expression” between the self and others, the mutual existence is placed in the “*Ba* of expression” common to both the self and others, forming the synchronicity, complementarity, and equality of expression necessary for co-creative activity (Figure. 1). Also, the equality of expression mentioned here means acceptance of others' expression with a sense of equivalence, regardless of differences such as physical challenges and generation.

One of the authors, Hiroko Nishi, phenomenologically explains that as the relationship between two people deepens through the experience from the actual field of the inclusive dance, there is an emergence of a sense of co-existence where the self and others are non-separable, as intrinsic frameworks such as “my movements” and

Note1: The Japanese word “*Ba*” is defined as a type of space not just physical, but also a shared space where relationships emerge. The action of *Ba* allows a person to recognize subconsciously his/her situation in relation to his/her perception of time and space.

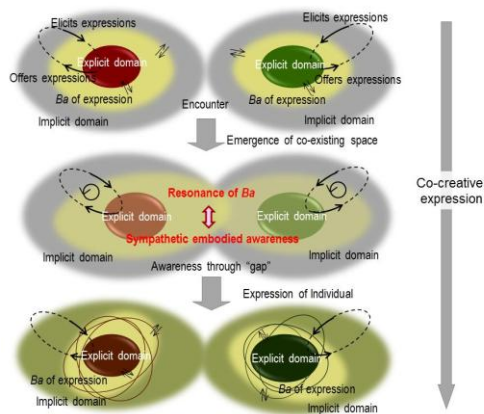


Figure.1 Model of co-creative expression (working model)



Figure.2 Hand contact improvisation

“your movements” become thinner, and instead they are sensed as “our movements”. She calls this “sympathetic embodied awareness”. Nishi expresses this sense of co-existence with the phrase, “embracing while being embraced, being embraced while embracing” [2]. This seems to show that sympathetic embodied awareness can be intimately related to the generation of co-creative expressions. Also, the actual field of the inclusive dance uses Hand Contact Improvisation (Figure. 2), in which expressions are extemporarily created with direct contact between palm and palm. Moreover, it has been indicated that the hand contact improvisation attains the emergence of sympathetic embodied awareness most simply without a special technique. Based on the above, the authors decided to investigate the dynamics of the generation of sympathetic embodied awareness in Hand Contact Improvisation.

To begin with, the authors attempted to classify the deepening processes of self-other relationships that occur during Hand Contact Improvisation based on changes in body motion modes and spatial positioning between the self and the other. Objectively, this was done by cross-checking body movement results, based on video recordings and measured in 3D by motion capture, with a skilled person’s episode description [3]. As a result, it was found that Hand Contact Improvisation can be classified in stages by the following five modes, as shown in Figure 3. 1) Wiping my own window. 2) Feel out the space between us. 3) Draw an abstract painting with a single brush. 4) Become streamlined, enveloped in a cocoon. 5) Metamorphose from the reverberation of inside and outside. It was found that out of these, all modes up until mode 3 are processes of collaboration from a state of a separation of the self and the other, but sympathetic embodied awareness emerges in mode 4 and 5, and co-creative expression is achieved.

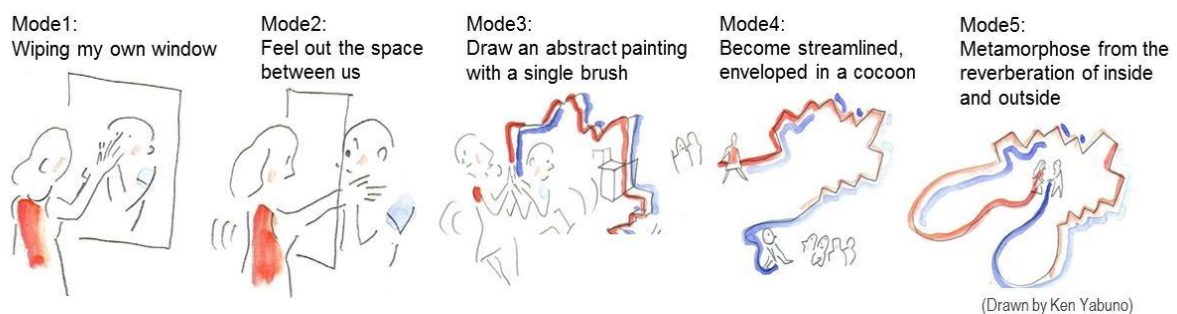


Figure.3 Classification of hand contact improvisation

To study the dynamics of sympathetic embodied awareness generation in more detail, this study conducted an analysis of the body motions of Hand Contact Improvisation. As the high degree of freedom in the motions of Hand Contact Improvisation would make analysis complex, hand motions were restricted to one degree of freedom either back or forth. Then, the conscious hand movements were measured simultaneously to the subconscious full-body movements, and the differences between when sympathetic embodied awareness was occurring and not occurring were compared and analyzed. The results are reported below.

Some research has already studied joint actions that two or more persons perform together. For example, previous research focused on activities, such as finger tapping [4] and a mirror game in which two players imitate each other and produce coherent motion extemporarily [5]. In addition, other studies have measured and evaluated entrainment between a speaker's speech and a listener's nodding during a face-to-face conversation [6]. However, our study deals with the co-creative expression and is considered to be essentially different from the above studies in which the subject is tasked to simply focus on the coherence of the synchronization of actions.

2. Measurement and Experimental Methods of Hand Contact Improvisation

Hand Contact Improvisation done on an actual field is complex as the high degree of freedom causes expansion of measurement objects. Therefore, as seen in Figure 4, each subject sat facing the other, and their hand movements were restricted to one degree of freedom back or forth, by using a board set up to slide back or forth (sliding board). In addition, it has previously been confirmed that co-creation of expression is possible even when restricted to back-and-forth movements [7].

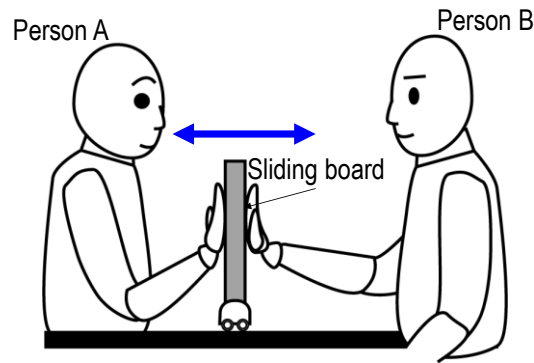


Figure.4 Hand contact improvisation using a sliding board

This study chose to measure full-body movements in addition to hand movements. As people are generally not conscious of full-body movements, and unlike the right hand, they are not directly affected by their partner's movements, they can be expected to express the body's implicit actions in the individual's expression. With respect to full-body movements, the focus was on changes in the center of pressure (COP), which is associated with the movements of the body's center of gravity, and this was chosen as a measurement.

The schematics of this system are displayed in Figure 5. Hand movements were measured using a linear encoder (made by Omron, 0.025[mm] resolution) attached to the sliding board. Full-body movements were measured by deploying load meters under the left hand, seat, and feet, which are the body's contact areas, and

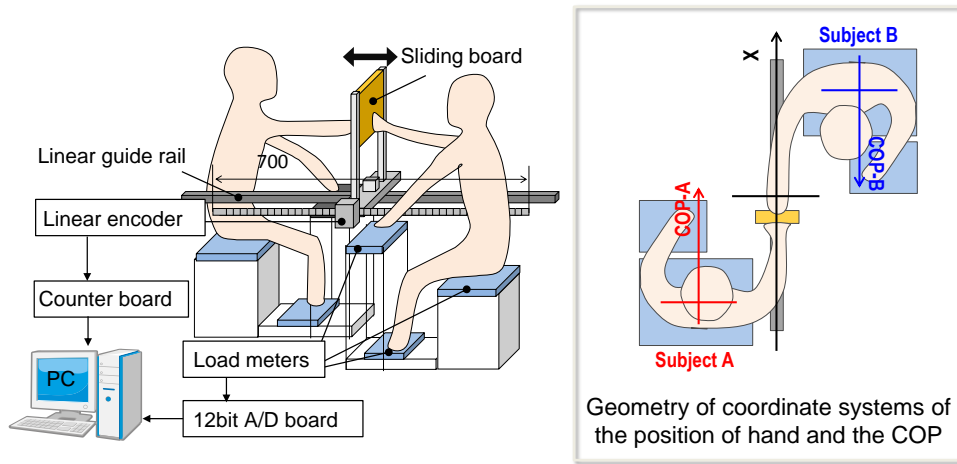


Figure.5 Overview of measuring system

calculating the COP from the relationship between position and load obtained from each load meters. Nintendo's "Wii Balance Board" was used as the load meter for the seat and feet, and a miniature load meter with load cells (made by Minebea, rating capacity 29.42[N]) deployed on each of the four corners, was used to measure the left hand's load motion. The load on the load cells attached to the four corners of the load meter was recorded on a PC (CPU: Core 2 Quad 2.66[GHz]) through an amplifier (made by Omega Electronics) and an A/D board (made by Interface, 12[bit] resolution). This system made it possible to measure hand movements and full-body movements simultaneously at a 200[Hz] sampling frequency. Also, the coordinate relationship between the right hand position and each subject's COP measured by this system is recorded on the right of Figure 5.

Two skilled persons (30s-50s, female, right-handed) and six beginners (20s, male, right-handed) participated as subjects in the experiment, and Hand Contact Improvisation was conducted, grouping subjects as pairs of skilled persons, pairs of beginners, and pairs of an skilled person and a beginner. Also for the purpose of this experiment, skilled person refers to a person who has been involved as an expresser or a supporter in an inclusive field where various people act together regardless of experience gap or physical difficulties, or in bodily expression activities using Hand Contact Improvisation in a therapeutic/treatment setting, for over ten years. Also, measurement was conducted without telling the subjects about the purpose of the experiment or the analysis methods. The experiment length was 90 seconds for each trial.

3. Experiment Results

3.1 Chaoticity of Hand Contact Improvisation

From skilled person pair M-N, we have received comments such as "There was a sense of synchronization on a deep level throughout", "Both of their expressions were very harmonized", and "They created expressions based on various images", indicating that sympathetic embodied awareness was generated. To investigate whether some form of rule existed in the joined hand movements (Figure. 6) when sympathetic embodied awareness was occurring, the changes of hand positions were plotted on a Lorenz Plot. Surprisingly, the authors discovered a single-peaked structure that implied Lorenz Chaos (Figure. 7(a)). Also, this structure is not seen in cases when sympathetic embodied awareness was not occurring (Figure. 7(b)). From this, it can be assumed that this is a characteristic of co-creative expression, and is related to the emergence of and changes in the "Ba of expression".

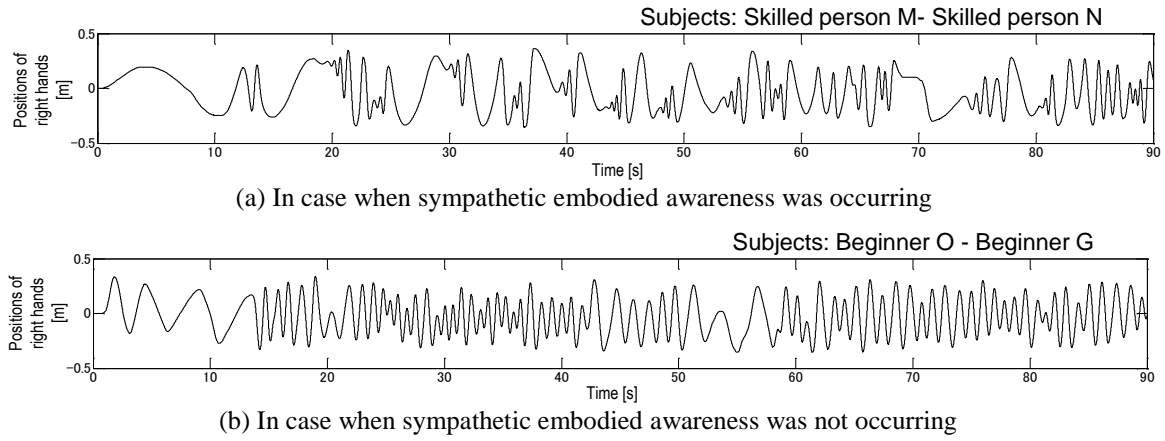


Figure.6 Motion of right hands

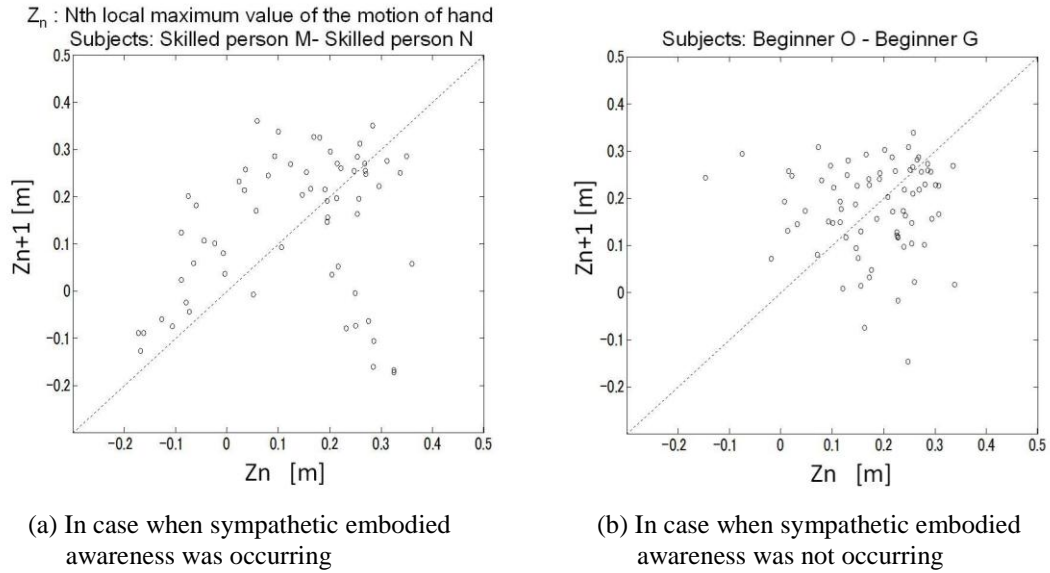


Figure.7 Lorenz plot of the motion of hand

Normally, skilled persons act while accepting thoughts (offering their hand to their partner), and conversely, send thoughts while accepting action (drawing their hand to themselves). By putting themselves out, skilled persons can elicit their partner's thoughts, and a new expression is generated through this meeting with a new self. This causes the "Ba of expression" to change. In this case, while the actions of the body and mind relate in mind-body unity with the gap between them, each partner leads the other into expression, causing a resonance in the "Ba of expression" between the self and the partner, causing the "Ba of expression" to emerge as a chaos attractor. As a result, it can be inferred that dramatic time (psychological time) is generated in the co-existing space known as "us", and this causes co-creative expressions to develop. Whatever the case, the crucial fact is that when the non-separation of the self and the other that accompanies sympathetic embodied awareness is formed, this also forms a chaotic attractor. This shows that the self is positioned inside this attractor in the non-separable manner, indicating the possibility of the formation of a dissipative structure.

3.2 Duality in Hand Contact Improvisation

Next, to determine if not only hand movements, as explained above, but full-body movements had some connection to the emergence of sympathetic embodied awareness, attention was paid to the relationship between hand and full-body movements, and analysis was conducted on full-body movements (changes in COP). Longitudinal data on COP, and temporal precedence of COP to hand motion, from the measurement results of skilled person pair M-N's trial, where sympathetic embodied awareness was reported to occur, and the beginner pair trial where sympathetic embodied awareness did not occur, are shown in Figure 8.

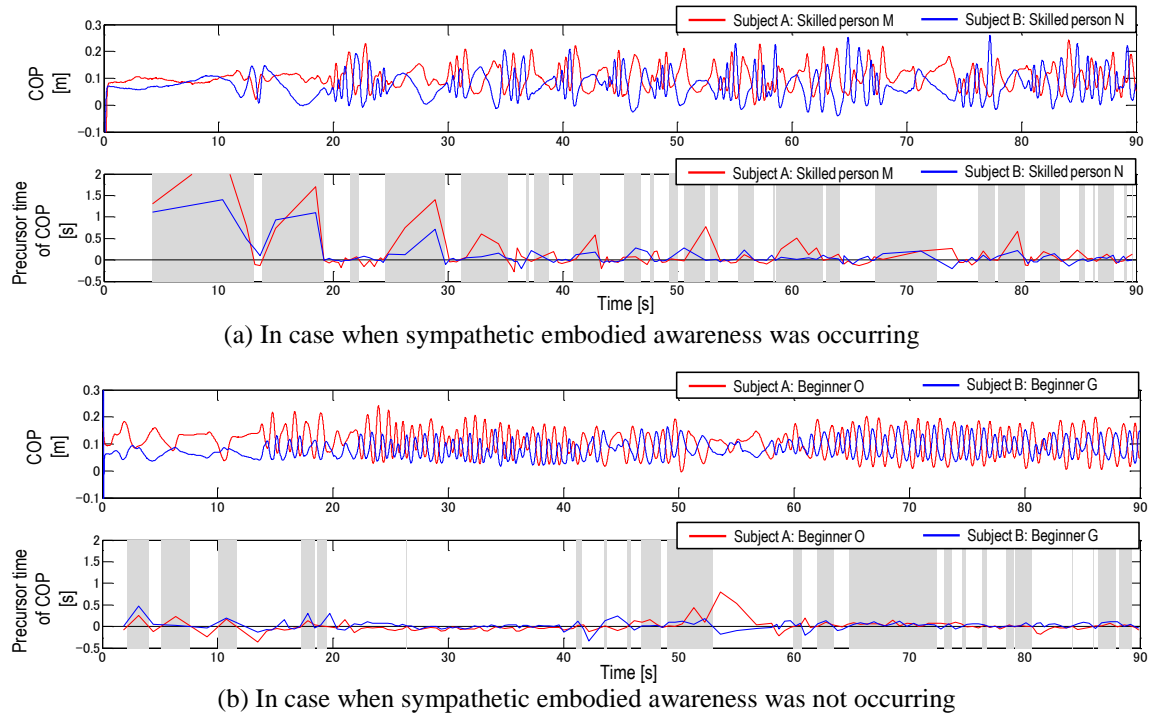
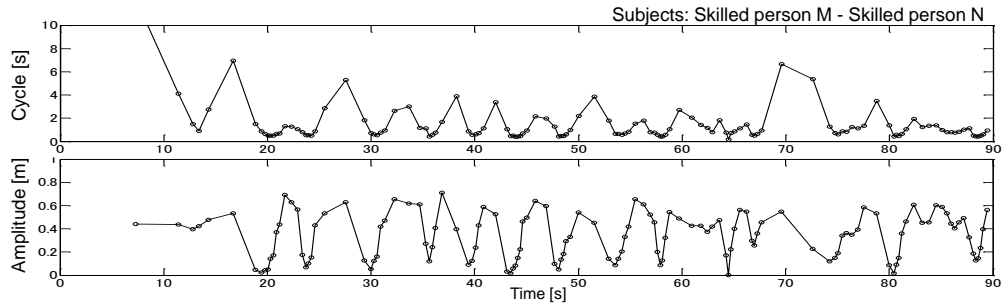
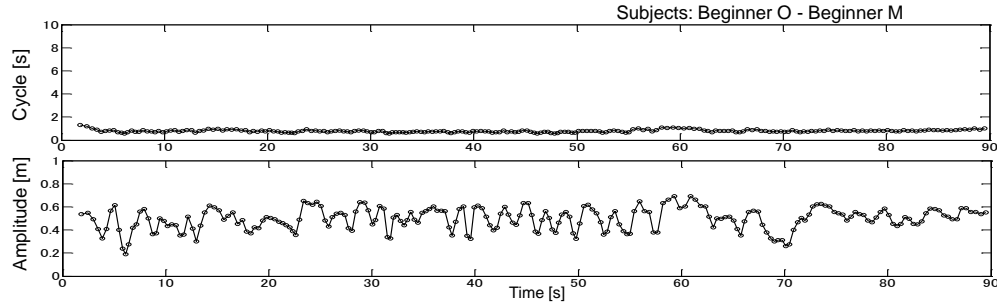


Figure.8 Results of measuring COP

When skilled persons create expressions in a state near sympathetic embodied awareness, not only do their full-body movements chronologically precede their hand movements, but the times in which this state synchronizes between two skilled persons is frequently noted (Grey zone of Figure. 8(a)). In contrast, in the Hand Contact Improvisation between beginners, the precedence of full-body movements is restrained, and they do not coincide (Figure. 8(b)). This is because they are not able to create an expression with each other, and are not moving towards sympathetic embodied awareness. Generally, the focus during Hand Contact Improvisation is on hand movements, and full-body movements remain below the level of consciousness. Therefore, the above conclusions show that subconscious implicit processes exist preceding conscious explicit processes in a body co-creating expressions, and the “*Ba* of expression” is shared by the dual interaction whereby the relationship between these two processes itself is synchronically interchanged with another. In other words, this indicates that the actions of this implicit domain are necessary for “my” expression to become “our” expression. This also suggests that by implicit processes preceding explicit processes, what will likely to happen in the next moment is shared, making unison of expression possible.



(a) In case when sympathetic embodied awareness was occurring



(b) In case when sympathetic embodied awareness was not occurring

Figure.9 Variations of the cycle and the amplitude of the motion of hand

3.3 Space-time Rhythms Inherent in Hand Contact Improvisation

To obtain a clue to the requirements to maintain co-creative expression, the time series changes in the cycle and amplitude variation of the back-and-forth motion of the hand during Hand Contact Improvisation was investigated. An example of the results is shown in Figure.9 This figure shows that when sympathetic embodied awareness is not occurring, rhythmicity is only seen in amplitude variation, while when sympathetic embodied awareness is occurring, a rhythm of a few seconds to ten-odd seconds is seen not only in amplitude variation but in cycle variation. Also, Figure 10 shows the results of two beginners who could not create expressions in Hand Contact Improvisation, and were hardly noted to have a cycle variation rhythm, as seen in Figure 9(b), were each paired up

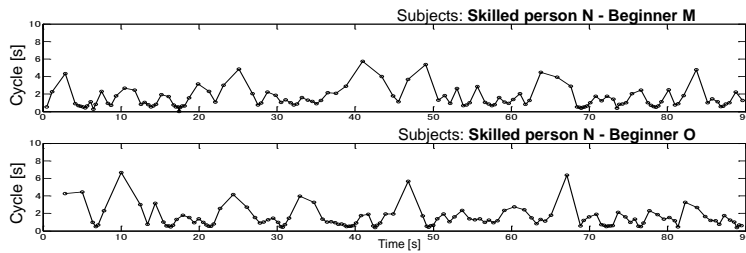


Figure.10 Variation of the cycle of the motion of hand

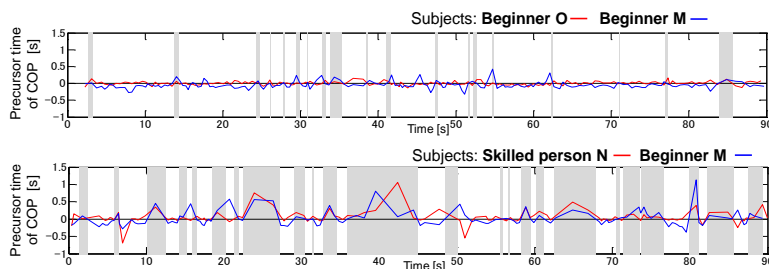


Figure.11 Time which the changes in COP precede the motion of hand

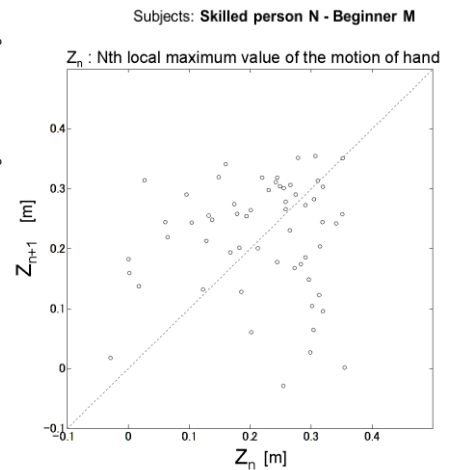


Figure.12 Lorenz plot

with an skilled person. It was found that rhythmic changes in cycle variation emerged in both by pairing with a skilled person. In addition, the beginners reported that they gained a sense that they were creating an expression with the skilled persons. In addition, when focusing on the aforementioned temporal precedence of full-body movements compared to hand movements, the times in which this synchronized between the beginner and skilled person clearly increased compared to the pair of beginners (Figure.11). In addition, plotting the hand movements on a Lorenz Plot shows the existence of something like a construct (Figure.12). These results, as will be stated below, imply that a creation in a rhythmic variation is related to the sustainment of co-creative expression.

4. Discussion

It can be inferred from the above results that the beginners tried to create an expression by changing only the amplitude, or the spatial position relationships, while keeping a rigid cycle, as if they existed in a limit cycle orbit. In this case, the “*Ba* of expression” itself does not change. In contrast, the skilled persons can be said to change not only the spatial position relationship, but the cycle, or temporal relationship, to generate sympathetic embodied awareness. Through this, it can be said that the skilled persons generated a new space-time, and changed the “*Ba* of expression” itself. In short, the results of this study predicts that co-creative expression becomes possible not through a closed “*Ba* of expression” in a closed orbit as typified by a limit cycle, but through a sustained and constructive emergence of an open “*Ba* of expression” as a chaos attractor. The authors, after the example of Hiroshi Shimizu, call this the “attractor of the *Ba*” [8]. As the “*Ba* of expression” is closed for beginners, for whom co-creative expression is difficult, dramatic time is not generated, and story creation does not occur. In comparison, the “*Ba* of expression” is open for skilled persons, and it can be predicted that by the creation of a chaotic attractor, a new space-time is generated, and a dramatic co-creative expression accompanied by a narrative is actualized. If that is the case, there is a possibility that the changing pattern of the cycle variation rhythm is deeply tied to the restraint condition that is necessary to create a co-creative drama (narrative) from the *Ba* of expression. The above discussion does not contradict the comments of the skilled persons that when sympathetic embodied awareness occurs, images and thoughts are in unison with each other, while there are some gaps, and through these experiences connection is deepened.

5. Conclusion

This study conducted an analysis of bodily movements during Hand Contact Improvisation with hand movements restricted to one degree of freedom back and forth, to investigate the creation dynamics of sympathetic embodied awareness, which is intimately related to co-creative expressions. The results showed that when sympathetic embodied awareness emerges, a chaos attractor was generated by the movements of the joined hands. Also, it was discovered that when this occurs, there are many times when subconscious full-body movements together precede hand movements. In addition, it was found that a cycle variation rhythm of hand movements was spontaneously generated. These results indicate that the creation and sustainment of co-creative expression necessitate to change the self’s internal space-time construction through the actions of the implicit and explicit domains of the self, and this can be expected to be a useful clue in explaining the dynamics of “*Ba* of expression” during co-creative expression.

Acknowledgment

We would like to thank Prof. Yoji Aizawa (Waseda University) for their valuable suggestion. This study was conducted under EU FP7 ICT FET SIEMPRE (Social Interaction and Entrainment using Music PeRformance Experimentation), Artifacts/Scenario/Human Institute in Waseda University, Project Research "Principal of emergence for empathetic “Ba” and its applicability to communication technology" by RISE Waseda University, and the GCOE program “Global Robot Academia.”

References

- [1] Yoshiyuki Miwa (2012) *Co-creative Expression and Support for Communicability*, Journal of the Society of Instrument and Control Engineers, Vol.51 No.11 ,pp 1016-1022 (In Japanese)
- [2] Hiroko Nishi (2012) *Sympathetic body Awareness: From Harmony of Body Movement to a Creative State of Joint Being*, Annual of the Institute of Thanatology, Toyo Eiwa Univ., pp 87-108 (In Japanese)
- [3] Hiroko Nishi, Hiroki Yanagisawa, Yoshitatsu Tsuji, Takabumi Watanabe, Yoshiyuki Miwa (2012) *Co-creation of Bodily Expression -Study on Creation Process of Bodily Motion in Hand Contact Improvisation-*, In Proceedings of the 13th SICE System Integration Division Annual Conference, pp 111-112 (In Japanese)
- [4]H. Kon, Y. Miyake (2005) *An Analysis and Modeling of Mutual Synchronization Process in Cooperative Tapping*”, Journal of Human Interface Society, Vol. 7, No. 4, pp. 477-486 (In Japanese)
- [5] L. Noy, E. Dekel, and U. Alon (2011) *The mirror game as a paradigm for studying the dynamics of two people improvising motion together*, Proceedings of the National Academies of Sciences, USA, 108(52):20947-52.
- [6] T. Watanabe, M. Okubo and H. Ogawa (2000) *An Embodied Interaction Robots System Based on Speech*, Journal of Robotics and Mechatronics, Vol. 12, No. 2, pp 127-135
- [7] Takabumi Watanabe, Yoshiyuki Miwa (2012) *Duality of Embodiment and Support for Co-creation in Hand Contact Improvisation*, Journal of Advanced Mechanical Design, System, and Manufacturing, Vol.6, No.7, pp.1307-1318
- [8] Hiroshi Shimizu (2003) *The Thoughts of “Ba”: Creative Stages of Life*, University of Tokyo Press (In Japanese)