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Beyond Empathy: Unveiling the Co-Creation Process of Emotions through a Wearable Device

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Abstract: Emotions fluctuate during the process of social interaction. Although the co-creation of emotions through organizational behavior has been discussed theoretically in existing research, there is no method to demonstrate how emotions are co-created. Instead, previous studies have paid much attention to empathy, in which a person's emotions are contagious. In contrast to self-report, which is a traditional method that can only assess emotions at a single point in time and adapts to empathy, biometric technology has made it possible to analyze emotional fluctuations over time. However, previous studies have focused only on understanding the emotional fluctuations of individuals separately. In the present study, we developed a system to measure the co-creation of emotions using a wearable device. The pulse rate was converted into valence as a positive–negative emotion, and the fluctuations in valence were analyzed by cross-correlation. We demonstrated the feasibility of the proposed system through triangulation by integrating biometrics with observation and self-report. The proposed system was verified to measure the co-creation of pair and group emotions using real-world data beyond laboratory settings. The present study contributes to business administration by proposing a critical concept for measuring the co-creation of emotions based on a constructionist approach.

Keywords: biometric; emotion; co-creation; valance; heart rate; wearable device; empathy; constructionism; emotional contagion; cross-correlation

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1. Introduction

Emotions directly affect work performance [1]. Emotion refers to an individual's mental state as experienced in a specific context [2–4] and is expressed as a biological response to environmental stimuli [5]. As emotion forms the context of interactions while being influenced by social structure [6,7], it is not confined to the individual, but always affects the relationships between people [8–10].

Previous studies have been dominated by analyses of emotions based on essentialism, where researchers categorize discrete emotions a priori and examine the extent to which emotions can be observed according to the categorization. The essentialist approach to emotion posits that discrete categories of emotions, such as anger or sadness, are innately common to all human beings, regardless of context [11]. In contrast, an approach based on constructionism has been proposed to understand emotions, which are considered person-specific "in-the-moment" constructions that are determined by the context in which they are experienced [12–14]. The constructionist approach to emotion posits that people construct their own emotional instances in each context based on their unique experiences [15], and provides useful insights into organizational behavior involving collaboration with colleagues.

Previous studies have focused entirely on empathy and emotional contagion, which represent the propagation of emotions toward others. Emotions are not only those that already exist and are contagious to others, but are often newly co-created through social interactions. While self-report has primarily been used in emotion research in business administration to measure the contagion of emotions, understanding the co-creation of emotions using only this technique is difficult. Consequently, the present study applies biometric technology to develop a system for measuring the process of emotion co-creation using sequential data. The present study focuses on the synchronization of fluctuations in emotions rather than on the synchronization of absolute values of emotion, as we understand constructionism to mean. Furthermore, we combined the developed biometric system with observation and self-report as triangulation to demonstrate the availability of the system using a case study of real-world conditions. The present study contributes to business administration by proposing a critical concept for measuring the co-creation of emotions.

2. Literature Review

2.1. Constructionist Approach to Emotions

The essentialist approach has long been espoused in emotion research. This concept divides emotions into basic types and attempts to capture the degree of each emotion. Ekman argued that the facial expressions caused by emotions are universal across cultures [16]. Plutchik proposed a multidimensional model of the eight basic emotions [17,18]. The approach involving the capture of discrete emotions has been incorporated into organizational research [19]. Positive discrete emotions foster individual and social resources and improve work performance [20].

However, a constructionist approach came to be proposed in which emotions are constructed through experiences rather than basic types. As emotions depend on the context in which an experience instance occurs [21], the constructionist approach to emotions introduces an axis of core affect that measures pleasure–displeasure [22]. The degrees of pleasure and arousal axes provide an estimate of the emotions that a person experiences in a given context [23,24]. In other words, emotions are interpreted according to a combination of a few axes.

The constructionist approach is rooted in the social construction view, which states that instances of emotion are derived from social ingredients [21]. The ingredients of emotion are psychological processes [21]. Therefore, emotional instances should be comprehended from the process of social interaction. The constructionist approach has gradually been incorporated into marketing and management research. For example, Service-Dominant Logic presents the perspective that people co-create value and experience through social interactions [25], including the co-creation of emotions.

2.2. Co-Creation of Emotions

Regarding social interactions involving emotions, previous studies have focused primarily on empathy and emotional contagion. Empathy refers to the estimation of others' emotions and snuggling up to those emotions [26]. Emotional contagion is the transmission of emotions to others [27]. The emotional contagion of positive emotions encourages cooperation within an organization, reduces conflict, and improves task performance [28]. The transmission of negative emotions hurts the affective and trust climates of organizations [29]. While previous studies have analyzed the propagation of emotions, these concepts focus solely on the involvement of one's emotions and overlook the co-creation of emotions. Rather than simply propagating one's emotions, people can co-create emotions in their interactions possessed by no one initially; therefore, it is imperative to elucidate the process of emotional co-creation. However, previous studies have only theoretically discussed the co-creation of emotions [30], and few have empirically analyzed the co-creation process of emotions.

With the development of measurement technologies, wearable devices have enabled the collection of sequential biometric data that can be used to interpret motions [31–33]. Wearable devices enable the estimation of fluctuations in emotions in the real world beyond laboratory settings [34]. Hara et al. [23] developed a method for analyzing emotional fluctuations in sequential services in the real world over several hours. Kim and Fesenmaier [35] used electrodermal activity technology to indicate the emotional fluctuations of individual tourists over time. Shoval, Schvimer, and Tamir [36] developed a technology that can simultaneously show tourists' emotions, along with an individual's time-series changes and location information. Nevertheless, previous studies have focused on emotional fluctuations in individuals. The present study proposes a system for measuring the co-creation of emotions among multiple people.

3. Materials and Methods

3.1. Condition of the Target Case

Considering the need to have a certain amount of sequential data to analyze emotional fluctuations, we targeted interactions that were repeated for a certain amount of time, rather than a single interaction that took place over a few minutes. In addition, the present study collected longitudinal data from the same group over a month because emotions are more likely to appear between acquaintances than between strangers [37–39]. This also helped overcome the difficulty of recruiting participants, which is one of the disadvantages of using biometrics [40].

The target case was a weekly meeting for the development of new services in the information and communication services development of an electronics company. Data were collected at four meetings over a period of one month. There were nine group members, with a maximum of eight participants and a minimum of six participants in each meeting. They joined together to develop ideas for new services that would exploit sensing technology in the retail sector. The team is a cross-functional team consisting of experts in various sensing technologies and experienced developers in the retail sector. The participants' demographic information is presented in Table 1. This group showed no specific bias in terms of age, gender, or expertise.

Table 1. Demographic information for the participants.

Participant	Gender	Age	Role	Expertise	First Meeting	Second Meeting	Third Meeting	Fourth Meeting
1	Male	51	Leader	Semiconductor	Present	Present	Present	Present
2	Male	44	Sub-Leader	Voice Analysis	Absent	Present	Present	Present
3	Female	58	Member	Information Network	Present	Present	Absent	Present
4	Female	34	Member	User Experience	Present	Present	Absent	Absent
5	Male	46	Member	Video Analysis	Present	Present	Present	Present
6	Male	37	Member	Robotics	Present	Present	Present	Present
7	Male	30	Member	Physics	Present	Present	*Absent*	Present
8	Male	50	Member	Electronics	Present	*Absent*	Present	Present
9	Female	29	Member	Psychology	Present	Present	Present	Present

3.2. Data Collection

Data that included biometrics, self-reports, and observations were collected through triangulation, which is a mixed-method design that enhances the validity of research findings by combining quantitative and qualitative research [41,42]. Self-report is widely used as a quantitative method in business administration, but captures only the subjective perceptions of the respondent. Biometrics, another quantitative method that objectively

measures psychophysiological data, cannot describe the context of the interaction behind the measured data. Observation, a qualitative method, can be used to describe the context of interactions; however, the interpretation of the results depends on the researcher's subjectivity. By integrating these three methods, the disadvantages of each method were compensated for [43].

Biometrics were used to measure the emotional fluctuations of the participants in the real world. While neuroscience tools are difficult to use outside laboratory settings because of hardware limitations [44], techniques for estimating emotions from heart rate have been developed, making it relatively easy to collect biometric data under real-world conditions [45,46]. The present study used Silmee W20 Connect, a smart wristband device, to collect data [47].

Self-reports were used to evaluate the meetings. After each meeting, the participants evaluated performance, trust, empathy, and helping behavior, which have been highlighted in previous studies as meeting outcomes [38,48–51]. Three items were adapted from the employee performance at the workplace scale [50] to assess performance during each meeting. Three items were adapted from the scale of interpersonal trust at work [48] to assess trust in meetings. Three items were adapted from multi-item scales of multidimensional empathy [49,52] to assess empathy among the participants. Three items were adapted from the altruism scale [51] to assess the participants' helping behaviors. All items were modified to fit the context of the meeting and rated on a 5-point Likert scale (1 = totally disagree to 5 = totally agree). The questions are described in Appendix A.

Observations were used to document the context of the interactions. The authors observed each meeting and recorded the topics of discussion, the sequence and tone of the conversations, and the reactions to the conversations in field notes. Before each meeting, all participants were informed of the research purpose, and that the collected data would be anonymized. Informed consent was then obtained from all participants.

3.3. Data Analysis

The collected biometric data were converted into valence using heart-rate variability analysis. Valence is a rating axis for irreducible emotions that ranges from pleasant to unpleasant, and is a measure used to evaluate whether an experience is positive or negative [53,54]. Given that the present study was based on a constructionist approach to emotion, biometrics alone were used to estimate whether an emotion was positive or negative, and the meaning of the emotion was interpreted within a context described by observation. For the heart-rate variability analysis, an application called the NEC Emotional Analysis Solution [55] was used to calculate the sequential data of valence from the heart rate. Sequential data of pulse peak intervals (PPI) were extracted from the data collected by the smart wristband device, and the data were cut out every five seconds from the continuous output PPI data to calculate features such as the low-frequency (LF) and high-frequency (HF) components of heart rate variability. The valence value was estimated by substituting the calculated features into an algorithm created using machine learning. This application can also measure fatigue, sleepiness, and stress, and has been used in practice and research as a biometric method [56,57].

Moreover, cross-correlation analysis was used for the valence fluctuations for all combinations of pairs among the participants. We calculated the cross-correlation coefficients for the sequential fluctuations of valence for each pair and for the entire group, which was the sum of the values of all combinations of pairs. That is, the valence co-created by a pair fluctuates between -1.0 and 1.0, and the valence of the group is the sum of all combinations of pairs. For example, there were 15 pair combinations when the number of participants at the meeting was six. The cross-correlation is an arithmetic function used to confirm the similarity of fluctuations between two input signals [58]. Our core idea was to regard *the synchronization of fluctuations* of valence as the degree of co-creation of emotions, not *the synchronization of absolute values* of valence (Figure 1). As biometric data are prone to individual differences in default values and the degree of fluctuation, focusing on the

absolute values of data does not necessarily reflect the biometric response as a co-creation of emotions, even if it reflects empathy or emotional contagion. The advantage of this idea is that it is less dependent on the individual's prior condition because it focuses on fluctuations rather than absolute values. For example, even if a participant is depressed, our system focuses on the degree to which emotions are simultaneously fluctuating in a positive (or negative) direction due to the stimuli occurring at the interactions; thus, the system concentrates only on the reaction to the stimuli and eliminates other influences as much as possible. From the viewpoint of the constructionist approach, even the same person will respond differently to biometric measurements depending on the interaction context. Therefore, it is more appropriate to consider the process of simultaneously increasing or decreasing the valence between participants in the process of the co-creation of positive or negative emotions.

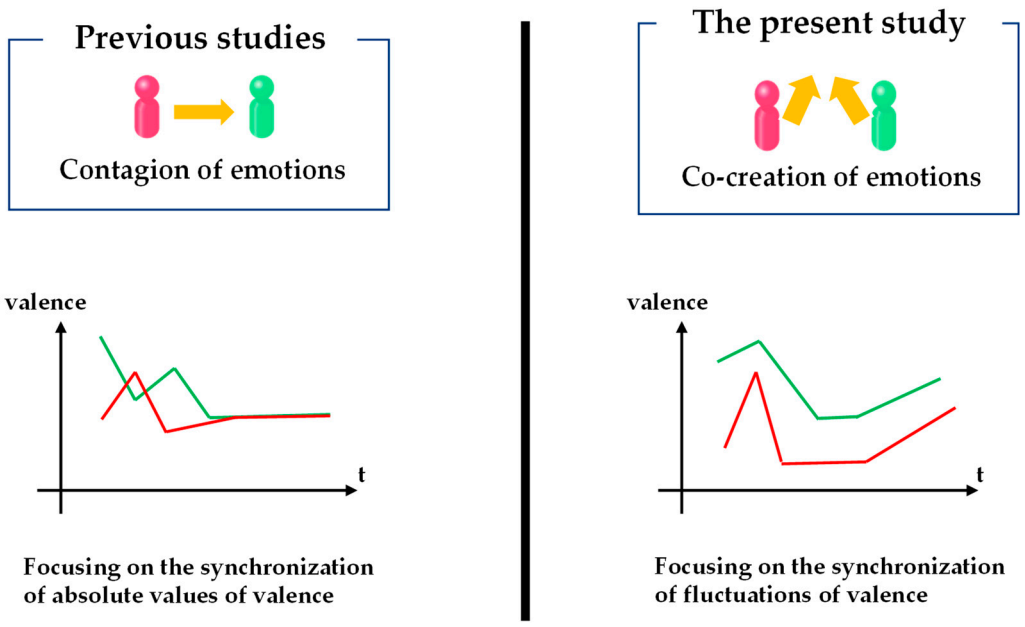

Figure 1. Core idea of the present study regarding biometrics analysis.

The observational field notes were reviewed by all the authors after each meeting, and descriptions of the rough flow of the entire meeting and the featured interactions were confirmed. Using observation data in the analysis, we described the context of the interaction for the featured biometric data. To protect the intellectual property of the target company, video recording was not permitted.

4. Results

4.1. Self-Report Results

The self-report results are presented in Table 2. A Cronbach's alpha value of 0.7 or higher for the reliability coefficient is deemed desirable [59], but 0.6 or higher is acceptable if the number of question items is small [60,61]. All four variables met the acceptability criteria.

Table 2. Results of the self-report.

Meeting	Performance (α = 0.729)	Trust (α = 0.764)	Empathy (α = 0.673)	Helping Behavior (α = 0.642)
1st (n = 8)	3.25	3.71	3.46	2.56
2nd (n = 7)	2.88	2.92	3.17	3.00
3rd (n = 6)	3.70	3.33	3.20	2.70
4th (n = 7)	3.33	3.33	2.94	2.17
Mean	3.30	3.39	3.21	2.57
SD	0.72	0.57	0.71	0.76
Correlation				
Performance		0.67	0.16	−0.09
Trust			0.43	0.24
Empathy				0.40

4.2. Group Level

There were significant results at the group level regarding biometrics in the first, second, and fourth meetings. The cross-correlation coefficients of valence for the entire group at the first meeting are shown in Figure 2. This figure indicates the overall degree of positive–negative emotions for all members along the timeline. From the start of the meeting until approximately 14:25, no significant opinion was expressed, and the total cross-correlation coefficients of valence for the entire group remained low with little co-creation of emotions. After that, the discussion gradually became more active, and at approximately 14:45, everyone laughed at the joke made by Participant 8. This positive group emotion was interpreted as joy through humor. Here, the total cross-correlation coefficient of the valence of the group was the highest among the meetings. The self-report results showed that the first meeting had the highest trust score among the four meetings.

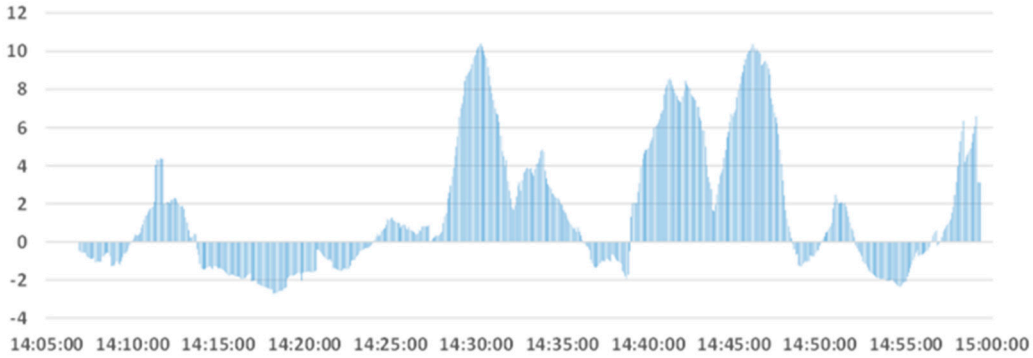

Figure 2. Sum of cross-correlation coefficients of the valence of all participants at the first meeting.

The cross-correlation coefficients of the entire group at the second meeting are shown in Figure 3. The assignments from the first meeting were reported at the beginning. Among several reports, the report by Participant 5 was outstanding, and the other participants praised it at approximately 10:15. The total cross-correlation coefficient of the valence of the group was the highest for the day at this time. This group emotion was interpreted as delight from the praise. Subsequently, the participants struggled to come up with ideas for making use of the report until approximately 10:55, when Participant 1 summarized and closed the meeting as a leader by building a consensus for the entire group. This positive group emotion was interpreted as contentment through consensus building. The self-report results showed that the second meeting had the highest score for helping behavior among the four meetings, whereas the scores of the other three variables were below average.

Although the results of the biometrics and observations implied that the participants experienced high performance and trust at some point in time, they rated these variables lower in the total evaluation of the meeting.

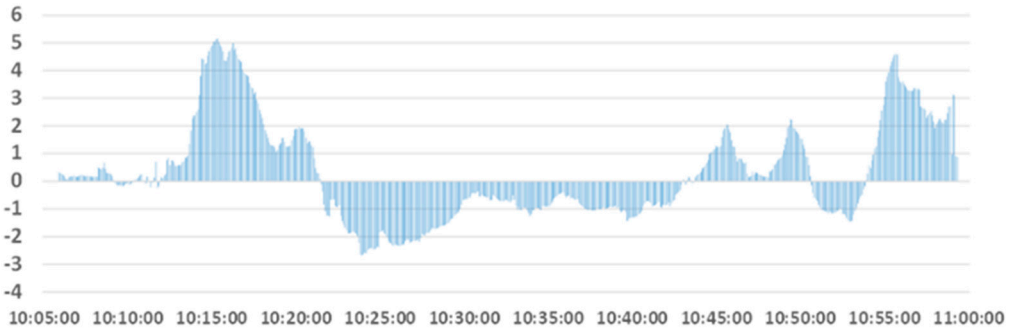

Figure 3. Sum of cross-correlation coefficients of the valence of all participants at the second meeting.

The cross-correlation coefficients of the valence of the entire group at the fourth meeting are shown in Figure 4. Several participants developed a business idea to solve a problem related to the topic under discussion at approximately 14:20. The total cross-correlation coefficient of the valence of the group was the highest for the day at that point. One participant said, "This looks promising" when the idea was developed. Therefore, this positive group emotion was interpreted as hope. No other significant co-creation of emotions was recorded from the observation of the entire group after that. The self-report results showed that the fourth meeting had a high performance score.

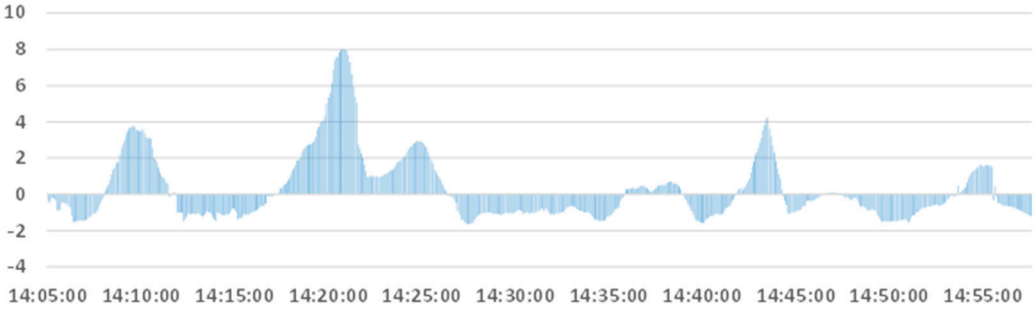

Figure 4. Sum of cross-correlation coefficients of the valence of all participants at the fourth meeting.

4.3. Pair Level

There were significant results for biometrics at the pair level in the third and fourth meetings. In the third meeting, Participant 9 proposed a new idea at approximately 13:55, and Participant 1 enthusiastically agreed with the idea as the leader. In this scene, the valence of both participants rose after a consensus was reached (see approximately 13:55–14:00 in Figure 5), and their cross-correlation coefficients were high (Figure 6). However, the merits of the idea were not immediately conveyed to the other participants at this time, and a group consensus was formed after 14:00, as Participant 9 continued to explain. After a time lag of approximately five minutes following the co-creation of emotions between Participants 1 and 9, the emotion of excitement was co-created by the entire group (Figure 7). In Figure 6, the rise in the cross-correlation coefficient between Participants 1 and 9 after 14:00 reflects the pleasure of being able to convey the merits of the idea to the entire group. Figure 7 shows that the cross-correlation coefficient for the entire group was negative from approximately 13:55 until after 14:00, reflecting the frustration of those participants who did not understand Participant 9's idea. The self-report results showed that the third meeting had the highest performance score among the four meetings.

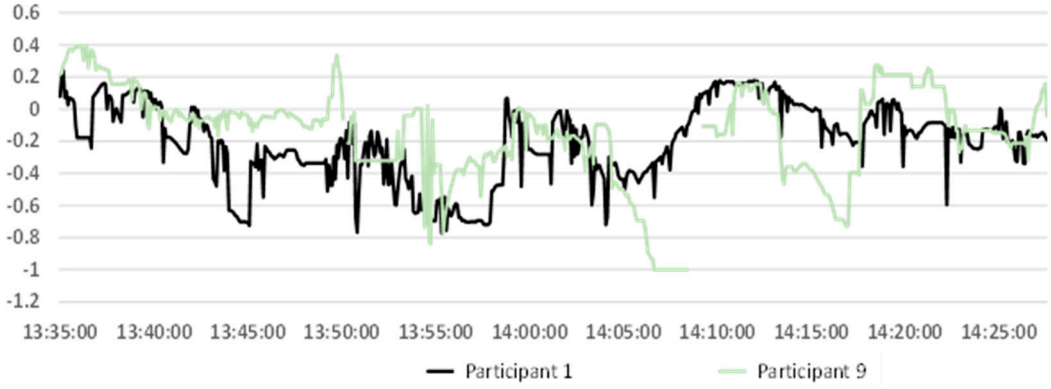

Figure 5. Individual fluctuations in the valence of Participants 1 and 9 at the third meeting.

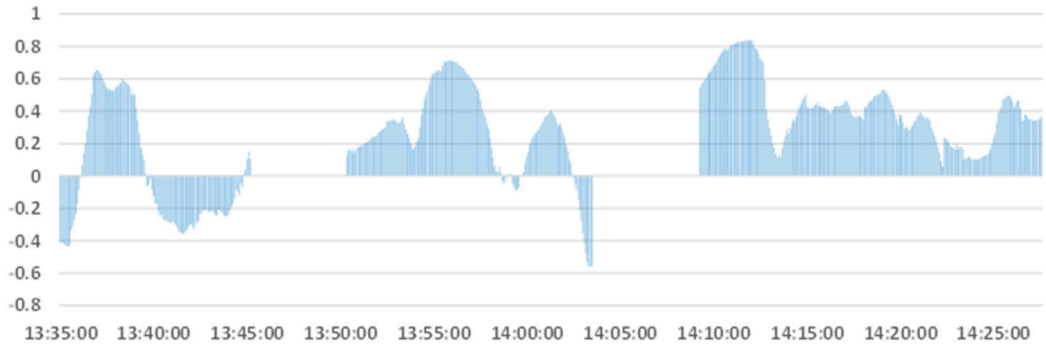

Figure 6. Cross-correlation coefficients of the pair of Participants 1 and 9 at the third meeting.

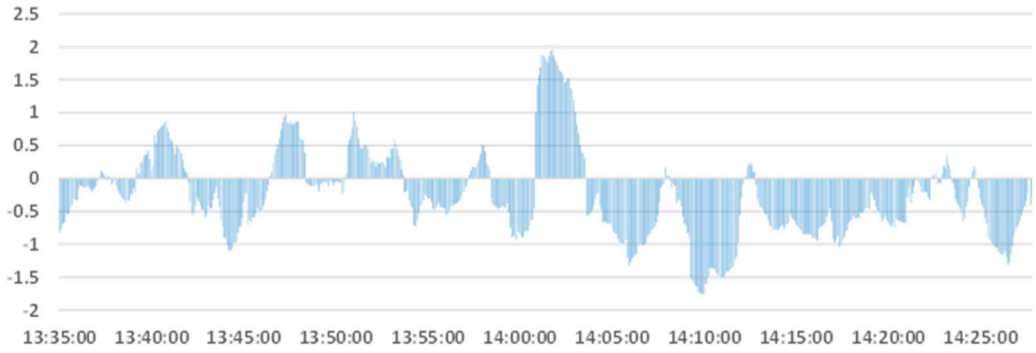

Figure 7. Sum of cross-correlation coefficients of the valence of all participants at the third meeting.

At the fourth meeting, Participants 2 and 5 quarreled about a technical topic at approximately 14:35. Participant 2 asked questions about the idea presented by Participant 5, and the discussion lasted approximately five minutes. At this time, the valence of Participant 5 fell significantly and rose again after completing the explanations, whereas that of Participant 2 remained stable (Figure 8). The cross-correlation coefficients of both participants also exhibited a strong negative correlation at approximately 14:00 (Figure 9). They co-created negative emotion as frustration at this time. However, when other topics were discussed afterward, both became calm and talked to each other, showing high positive correlation coefficients in approximately 10 minutes (Figure 9). The "fair weather after rain" phenomenon was demonstrated by biometrics and observation. The cross-correlation coefficients of the entire group were not high at approximately 14:50, as shown in Figure 3. Therefore, the proposed system distinguished the co-creation of emotions only between the two participants at this time.

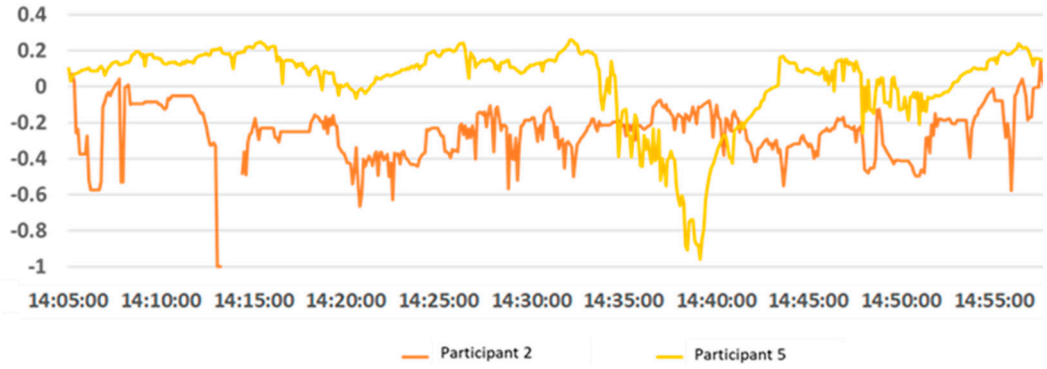

Figure 8. Individual fluctuations in the valence of Participants 2 and 5 at the fourth meeting.

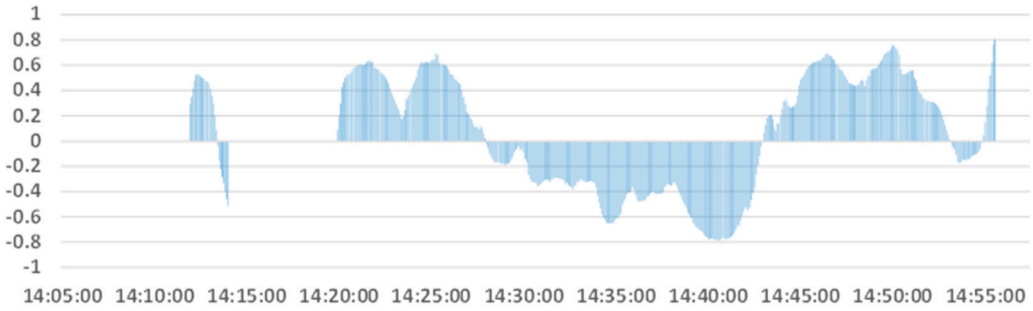

Figure 9. Cross-correlation coefficients of the pair of Participants 2 and 5 at the fourth meeting.

5. Discussion

5.1. Theoretical Implications

Although many attempts have been made to understand emotions, most have analyzed the emotions of each person separately, and most studies involving multiple persons have been limited to conceptual studies [30,39]. Few empirical studies have dealt with multiple persons, and those limited to self-report and observation failed to adequately account for instantaneous changes in emotions [52,62,63]. However, most studies using neuroscience tools to capture emotional fluctuations have been limited to analyzing individuals in laboratory settings, because it is difficult to capture the emotional fluctuations of multiple persons in real-world conditions [44,64–66]. The present study overcame this methodological limitation by integrating biometrics from a wearable device with self-report and observation and made three main theoretical contributions to the literature.

First, the present study applied a constructionist approach to substantiate the impact of the co-creation of emotions on the evaluation of work performance. Existing research has applied an essentialist approach, specifying categories of emotions beforehand and then measuring the extent to which people recognize those emotions using traditional methods, such as self-report [67,68]. Although emotions may seem similar, they can differ from context to context [12–14]. Analyzing the interaction context is necessary to measure emotions accurately. The present study used triangulation to interpret interaction contexts through observations. Furthermore, we developed a biometric system to analyze the synchronization of fluctuations of emotions between multiple persons rather than focusing on the absolute values of each person's emotions and demonstrated the co-creation of emotions based on constructionism.

Second, we advanced the understanding of the concept of the co-creation of emotions by analyzing processual fluctuations using biometrics. As emotions last for only a short period, it is necessary to consider not only a snapshot of a moment in the interaction, but also continuous changes throughout the entire interaction process [69–71]. Biometrics can also reveal unconscious physiological responses [72]. In the co-creation of emotions, facial or verbal expressions do not always reflect emotions in interactions [40,73], and traditional

methods, such as self-report and observation, have difficulty measuring unconscious emotions [65]. The essentialist approach of measuring emotions at a single point in time, as applied in previous studies, may help grasp the "remembering self" [74], which evaluates outcomes in retrospect after the interaction process has been experienced. However, grasping the "experiencing self" [74], which evaluates the experience itself immediately, is also crucial for a better understanding of the co-creation of emotions and social interactions. The present study advanced knowledge about the concept of the co-creation of emotions by analyzing the dynamic fluctuations of emotions in the social interaction process with a processual analysis using sequential data beyond empathy, which was evaluated by measuring only a single point in time.

Third, we developed a system to examine the differences in emotional fluctuations between individual pairs and the entire group. Interest in collective interactions is growing, and capturing the co-creation of emotions at different levels, such as between individuals and in a collective, is an emerging issue [68,75]. However, traditional techniques have difficulty separating the emotional fluctuations of pairs and the entire group. In contrast, the present study developed a biometric system to measure the co-creation of emotions in each pair and to calculate the co-created emotions of the entire group. The proposed system can substantiate the time lag for an individual emotion to spread as a group emotion, which has only been discussed theoretically [76]. Analyzing the difference between group emotions and the emotions of individuals in a group is of wide concern in emotion research [4,77], and our findings improve our knowledge of the difference between individual and collective emotions.

5.2. Managerial Implications

Managers tend to evaluate workers based on a single point in time [78]. However, collecting sequential data can provide useful feedback, as indicated by our findings. The social interaction process is a sequential event [79], and workers do not always evaluate performance or outcomes based on post-interaction or average emotions throughout the process [74]. Managers can improve their organizations by using sequential data to identify the processes that result in the co-creation of positive and negative emotions. By being able to evaluate not only the conclusions but also the work processes of employees, managers can determine useful actions for employee behavior, even if they are not profitable as a result. In other words, managers will be able to evaluate work processes more accurately as a management strategy and can expect an effective return on investment.

The proposed system can also be applied to frontline employees. In terms of employee education, previous studies have demonstrated the need for education regarding emotional competence and emotional intelligence [62,65]. However, these dimensions focus on showing empathy toward customers and satisfying their emotions. Emotions are co-created through social interactions that go beyond empathy and do not require employees to self-sacrifice to satisfy customers' emotions. The competency of the co-creation of emotions is different from conventional competencies, such as emotional competence or emotional intelligence, in that it provides customer delight by co-creating emotions and experiences that exceed customer expectations [80]. Employees must be flexible and creative in response to customer service [81]. Additionally, employees can enhance their well-being by gaining positive emotions through the co-creation process. Analyzing employees' behavior in the co-creation process using biometrics is a useful way to measure their competency in the co-creation of emotions.

Analyzing the co-creation of emotions in pairs and groups using biometrics will allow organizations to gauge the strength of relationships among employees. Stronger relationships increase job satisfaction and reduce turnover intentions [82]. Previous studies have mainly used interviews and self-reports to measure relationships among employees [83,84]. However, traditional methods may reaffirm employees' evaluations of their colleagues by eliciting their perceptions, which may further reinforce negative relationships. The proposed biometric system can be useful for organizational management because it allows

for the collection of psychophysiological data of which employees are unaware, allowing managers to understand the strength of relationships among employees without the influence of intervention.

5.3. Limitations and Future Research Directions

Similar to any other study, the present study has some limitations that suggest directions for future research. First, the research targets were limited to indoor meetings. Although the present study analyzed real-world data, future research focusing on initial relationships, such as service conditions, is needed to deepen our understanding of the co-creation of emotions. In addition, increasing numbers of studies targeting the interaction processes between people with diverse roles, such as service mechanics research, are desirable [85]. Second, the present study targeted only face-to-face interactions. Online interactions have rapidly increased in society since 2020. Our proposed system can be applied to online interactions by simply aligning the time settings of the wearable devices. In the future, the field of management and marketing research should be developed by increasing the number of studies that use biometrics to analyze online interactions. Third, we measured only valence as an index of emotions using a cross-correlation analysis. In emotion research, arousal is often used as an index in addition to valence [53]. Developing a technique to analyze the co-creation of emotions by integrating both indices would promote the interpretation of the contexts of emotions. Furthermore, the sample size of the present study was limited, as is the case in other biometric studies. To improve the understanding of the mechanism of emotional fluctuations in the co-creation process, more research based on a constructionist approach is needed to inductively accumulate insights, in addition to the development of techniques.

6. Conclusions

Research based on the constructionist approach has become widespread in marketing, where value is seen as co-created rather than provided [25]. The present study uses biometric measurements in the domain of emotions to deepen our understanding of the concept of value co-creation. Our proposed system measures synchronic changes in emotion with the person with whom one interacts rather than absolute changes in the individual and is therefore unlikely to be affected by the state of the individual, such as health. Furthermore, it is not device dependent, and its key idea can be reproduced with any device that can sequentially evaluate emotions or other values. The system uses simple cross-correlations and is robust even as the number of interactions increases. We hope that measurements based on the constructionist approach will increase in the future, advancing our understanding of human and social interactions with this study as a foothold.

Author Contributions: Conceptualization, B.Q.H.; methodology, B.Q.H., K.S., and M.Y.; software, K.S. and M.Y.; validation, B.Q.H., K.S., and M.Y.; formal analysis, B.Q.H.; investigation, K.S. and M.Y.; data curation, K.S. and M.Y.; writing—original draft preparation, B.Q.H.; writing—review and editing, B.Q.H., K.S., and M.Y.; visualization, B.Q.H.; supervision, B.Q.H.; project administration, B.Q.H.; funding acquisition, B.Q.H. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: Around 2019 when the data was collected, ethics review was not mandatory in Japanese institutions except for medical departments.

Informed Consent Statement: Informed consent was obtained from all participants involved in the study.

Data Availability Statement: Data are unavailable due to privacy or ethical restrictions.

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Appendix A

Table A1. Question Items for Self-Report.

Performance	1. I had meaningful discussions at the meeting. 2. I concentrated on the meeting. 3. I made progress in the meeting.
Trust	1. My colleagues can be trusted as discussion partners. 2. I feel I am trusted by my colleagues. 3. My colleagues are reliable.
Empathy	1. I know what my colleagues are thinking without having to put it into words. 2. I am happy when my colleagues are happy. 3. When my colleagues are depressed, I feel sad too.
Helping Behavior	1. I could add productive ideas to my colleagues' opinions. 2. Colleagues' explanations helped me better understand my own. 3. I could help out a colleague when he/she was in trouble.

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