

JAPANESE ONOMATOPOEIAS AND SOUND-SYMBOLIC WORDS IN DESCRIBING NONVERBAL INTERPERSONAL COMMUNICATION

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ABSTRACT

Nonverbal communications convey “Kansei” information that explicit verbal communications fail to transmit. In this study, we surveyed how people perceive nonverbal communications involving physical contact by using Japanese onomatopoeias and sound-symbolic words. In the experiment, various pictures depicting two persons making physical contact were presented. Participants then answered questions, including one that required them to select the words that were the most suitable for describing the communication. We found that two frequently selected words expressed the activity of the motion of the physical contact, while two other frequently selected words described the atmosphere of the communication scene. The communication associated with the words describing atmosphere tended to be perceived more desirable than those describing physical motion. This might indicate that positive impressions of interpersonal communications tend to be associated with the scene or atmosphere. We also applied a principal component analysis (PCA) using adjectives for describing the communication, and mapped the desirability and onomatopoeias onto the constructed multidimensional feature space of nonverbal communications. The present results and additional analyses will reveal the detailed relationship between desirable interpersonal communication and words used to describe communication. Further, it will provide useful starting ground for designing user-friendly Kansei-communication systems.

Keywords: Nonverbal Communication, Japanese Onomatopoeias and Sound-Symbolic Words, Principal Component Analysis, Experimental Psychology.

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1. INTRODUCTION

In social life, nonverbal communication is crucial for conveying “Kansei” information, which is too ambiguous and abstract to be verbally described, to others and for sharing it with others. When we communicate with others in our daily life, we use various nonverbal channels such as gestures, facial expressions or gaze. Among them, physical contact would be the most primitive communication channel, and it is widely seen in human infants and animals [1]. Although nonverbal communication involving physical contact has been less understood as compared to verbal communication, some researches have challenged the kinetic taxonomy of physical contact or the categorization based on the meaning of physical contact [2].

The sense of touch or haptics is complex [3], bidirectional, and interactive (e.g., active touch [4]). Therefore, what is conveyed in interpersonal communication involving physical contact cannot be determined straightforwardly. Instead, the perceptual process for physical contact itself, the cognitive process for understanding the intention of others, and the context (e.g., the social position of others) would interactively affect what is conveyed. The meaning of physical contact is loosely categorized on the basis of the types of motion. For example, stroking someone’s head may express affection and shaking hands may express amity. However, the meaning of physical contact is subject to the context of the communication [5]. Let us consider a handshake between politicians, that between a mother and a baby, and that between close friends at the time of farewell. Perhaps, the feelings of people are not identical in these contexts although the motions involved in physical contact are rather similar. To reveal “Kansei” conveyed in nonverbal communication, in addition to the objective and kinetic description of physical contact, it is important to investigate how people subjectively experience nonverbal communication in various contexts, and the type of physical contacts that is desired.

It is difficult to reveal the concept of each form of nonverbal communication using an analytic approach. This is because it is inherently impossible to verbally describe nonverbal communication, which consists of various factors such as motion, facial expressions, and context. In the present study, we tried to directly investigate the concepts and nuances (what we call Kansei here) of nonverbal communication by using Japanese onomatopoeias and sound-symbolic words¹ in a psychological experiment. An onomatopoeia is a word expressing the state of a sound, a mood, a feeling, a motion, and so on². Onomatopoeias and nonverbal communication may be similar in that they can express or convey a concept or nuance that is difficult to verbalize. In the case of onomatopoeias, however, the meaning is roughly defined and it can be categorized with explicit verbal labels. Therefore, identifying onomatopoeias describing the subjective impression of nonverbal communication may help to clarify the concept and nuance (Kansei) conveyed in the communication.

¹We did not distinguish between Japanese onomatopoeias and sound-symbolic words. Note that the term “onomatopoeias” refers to both these terms in this paper.

²For example, “tick tock” describes the sound of a clock, and “bling-bling (kira-kira in Japanese)” indicates that something is brightly shining.

In the experiment, we presented pictures depicting nonverbal communication involving physical contact between two persons, and asked about (1) the subjective impression of the communication, (2) the person who is imagined to be involved in the communication, (3) the onomatopoeias most suitable for describing the communication, and (4) the appropriateness of the adjectives in describing the communication. We extracted the subjective impressions conveyed in the nonverbal communication, and investigated the types of communication that were desirable.

2. METHODS OF THE EXPERIMENT

2.1. Participants

Thirty observers (13 male and 17 female; mean and standard deviation of age were 24.4 and 5.0, respectively) participated in the experiment.

2.2. Materials

The stimuli used in the experiment were pictures depicting two persons making positive (e.g., hugging, shaking hands) or negative (e.g., grappling) physical contact. To begin with, three persons collected more than 500 pictures depicting interpersonal communication from web sites. Then, we selected 28 pictures depicting communication between two persons and involving various physical contact. The type of physical contact, and the gender and age of the person were varied among the pictures³. To choose the onomatopoeias, the three persons listed the onomatopoeias that could express the communication from the dictionary of onomatopoeias [6], and the 14 onomatopoeias listed by all the collaborators were used in the experiment (Table 1).

2.3. Procedure

The experiment was conducted on a web site. The web page consisted of a picture and a set of questions. On looking at the picture, the participants were asked to imagine making the depicted

Table 1: List of questions

Q1	Rate the extent to which you want to be involved in the depicted communication. (7-point scale)
Q2	Rate how frequently you have encountered such communication in everyday life. (7-point scale)
Q3	Rate the strength of impression of the depicted communication. (7-point scale)
Q4	Choose the person you imagined would participate in the communication. <i>Spouse, Father, Mother, Same-gender friend, Different-gender friend, Child, Son or daughter, Grandparent, Sibling, Same-gender celebrity, Different-gender celebrity, Character</i>
Q5	Choose the onomatopoeias that are the most suitable for describing the communication. <i>Sa, Zoku-zoku, Dara-dara, Su, Zime-zime, Hoka-hoka, Ziwa, Gui-gui, Donyori, Hono-bono, Beto-beto, Fura-fura, Jin-jin, Gaba</i>
Q6	Rate the 10 adjectives for appropriateness in describing the communication. (5-point scale) <i>Quiet, Active, Cold, Warm, Delicate, Insensitive, Formal, Casual, Mechanical, Human</i>

³The types of physical contacts were as follows: wrestling or messing around (10), hugging or hovering over (8), grasping a hand or a shaking hand (6), rubbing shoulders (2), and kissing (2).

Table 2: Correlation matrix of the rating scores of the subjective evaluations of the nonverbal communication (Q1, Q2, and Q3)

	Q1: Desirable	Q2: Frequent	Q3: Impressive
Q1	1		
Q2	0.709	1	
Q3	0.597	0.680	1

communication with another person, and then answered questions (Table 1). In Q1, Q2, and Q3, the participants responded by using a seven-point scale ranging from “thoroughly” to “not at all.” In Q4 and Q5, we listed the alternatives (Table 1), and the participants chose one of them or freely wrote if they imagined another person (Q4) or more appropriate words (Q5). In Q6, participants rated the 10 adjectives (Table 1) using a five-point scale. One practice trial was followed by 28 trials. The answers of the participants were automatically stored on the web server, and analyzed using the R statistical environment [7].

3. RESULTS

3.1. Subjective evaluation of nonverbal communication (Q1, Q2, and Q3)

Table 2 shows the correlation matrix among desirability, frequency of experience, and impressiveness of nonverbal communication. All pairs had a positive correlation ($R > 0.59$, $p < .001$), suggesting that the nonverbal communication that was more frequently experienced and had a stronger impression tended to be evaluated as more desirable. These correlations, however, cannot reveal a causal relationship. One possibility may be related to the widely known psychological phenomenon of “mere exposure effect [8].” The other is related to “directional forgetting [9].”

3.2. Imagined person (Q4)

Table 3 shows the frequency of choosing a person who is imagined to be involved in the depicted communication. The persons chosen frequently were a same-gender friend, a spouse, and a sibling. These results suggested that the participants tended to choose persons who were around the same age, and the order of frequency was consistent with that of the opportunity to communicate in real life [10]. Figure 1 (left) shows the rating score of desirability (Q1) for the pictures associated with the persons. A one-way ANOVA revealed a significant main effect of the persons ($F(12, 827) =$

Table 3: Frequency and rate of choosing the imagined person (Q4)

Item	Frequency	Rate	Item	Frequency	Rate
Same-gender friend	231	0.28	Spouse	188	0.22
Sibling	92	0.11	Others	65	0.08
Child	50	0.06	Different-gender friend	46	0.05
Mother	43	0.05	Different-gender celebrity	36	0.04
Same-gender celebrity	29	0.03	Son or daughter	26	0.03
Father	21	0.02	Character	8	0.01
Grandparent	5	0.01			

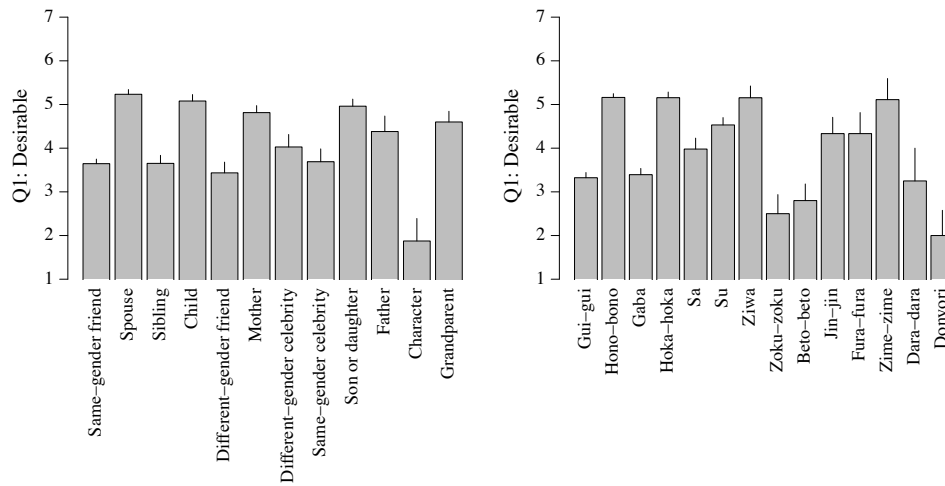


Figure 1: Rating scores for desirability of the communication (Q1) as a function of the person who is imagined to be involved in the communicate (Q4, left) and the chosen onomatopoeias (Q5, right). The error bars indicate the standard errors of means.

21.4, $p < .001$). The persons chosen for the desirable communication were a spouse, a child, a mother, a son or a daughter, a father, and a grandparent. Thus, the communications recalling a family are more desirable.

3.3. Onomatopoeias (Q5)

Table 4 shows the frequency of the onomatopoeias being the most appropriate for describing the nonverbal communication depicted in the stimulus picture. The 4 most frequently chosen onomatopoeias were “Gui-gui,” “Hono-bono,” “Gaba,” “Hoka-hoka.” Figure 1 (right) shows the rating score for desirability (Q1) for the pictures associated with the onomatopoeias. A one-way ANOVA revealed a significant main effect of the onomatopoeias ($F(14, 825) = 18.5, p < .001$). A post-hoc multiple comparison (Tukey’s method) showed no significant difference between “Gui-gui” and “Gaba,” and also between “Hono-bono” and “Hoka-hoka,” however, the differences between “Gui-gui” or “Gaba” and “Hono-bono” or “Hoka-hoka” were significant ($p < .001$). Thus, the nonverbal communication associated with “Hono-bono” or “Hoka-hoka” tended to be evaluated as desirable. We offer a more detailed discussion of the results obtained for the onomatopoeias in the “Discussion” section.

Table 4: Frequency and rate of choosing the onomatopoeias (Q5)

Item	Frequency	Rate	Item	Frequency	Rate	Item	Frequency	Rate
Gui-gui	186	0.22	Hono-bono	179	0.21	Gaba	150	0.18
Hoka-hoka	77	0.09	Sa	50	0.06	Others	49	0.06
Su	47	0.06	Ziwa	26	0.03	Zoku-zoku	18	0.02
Jin-jin	15	0.02	Beto-beto	15	0.02	Fura-fura	12	0.01
Zime-zime	9	0.03	Dara-dara	4	0.00	Donyori	3	0.00

Table 5: Results of the multiple linear regression analysis for the desirability of the communication (Q1) based on the rating scores of the appropriateness of the adjective (Q6), and the loadings of the adjectives for the first (PC1) and second (PC2) component in principal component analysis (PCA). Estimate indicates the standardized partial regression coefficient and S.E. indicates the standard errors.

Adjective	Multiple linear regression				PCA	
	Estimate	S.E.	t value	P value	PC1	PC2
Quiet	0.07	0.03	2.13	0.03	0.38	-0.69
Cold	-0.14	0.03	-4.37	0.00	-0.76	-0.19
Delicate	0.10	0.03	3.63	0.00	0.39	-0.61
Mechanical	0.00	0.03	0.04	0.97	-0.37	-0.72
Formal	0.00	0.03	0.12	0.91	-0.40	-0.68
Active	0.03	0.03	0.94	0.35	-0.32	0.65
Insensitive	-0.24	0.03	-7.24	0.00	-0.74	0.29
Casual	0.05	0.04	1.41	0.16	0.81	0.17
Warm	0.34	0.04	7.62	0.00	0.90	-0.02
Human	0.06	0.03	2.18	0.03	0.68	0.19

3.4. Subjective rating using the adjectives (Q6)

Nonverbal communication involves multiple and complicated components; hence, we investigated the aspects of nonverbal communication that contribute to the subjective impression of the communication. For this purpose, we conducted a multiple linear regression analysis with the dependent variable of the rating score in Q1 (desirability) and the ten independent variables of the rating scores in Q6 (adjectives). Table 5 shows the estimated coefficients of the adjectives. The adjectives that had a significant positive effect were warm, delicate, quiet, and human, while the adjectives that had a significant negative effect were insensitive and cold.

3.5. Feature space representing nonverbal communication

Finally, we investigated the relations among the subjective impression (desirability) of communication, the onomatopoeias describing the communication, and the adjective describing the communication. We constructed a multidimensional feature space representing nonverbal communication by a principal component analysis (PCA) using the rating scores in Q6 (adjectives), and mapped the desirability (Q1) and the onomatopoeias (Q5) onto the feature space (Figure 2). The eigenvalues of the first (3.75) and second (2.44) component were greater than 1.0, but those of the others were not. Further, the contribution ratio of the first and second component were 0.38 and 0.28, respectively. Therefore, nonverbal communication with physical contact appears to be represented in a two-dimensional feature space using the adjective ratings we adopted.

Table 5 shows the first and second component loadings of the adjectives, and Figure 2 (left) presents a visual representation of the eigenvector of the adjectives in the feature space. The adjectives located along the first dimension ranged from warm, casual, human to cold and insensitive, and those located along the second dimension ranged from active to mechanical, quiet, and formal. These results imply that the first component represents the atmosphere (e.g., “warmness”)

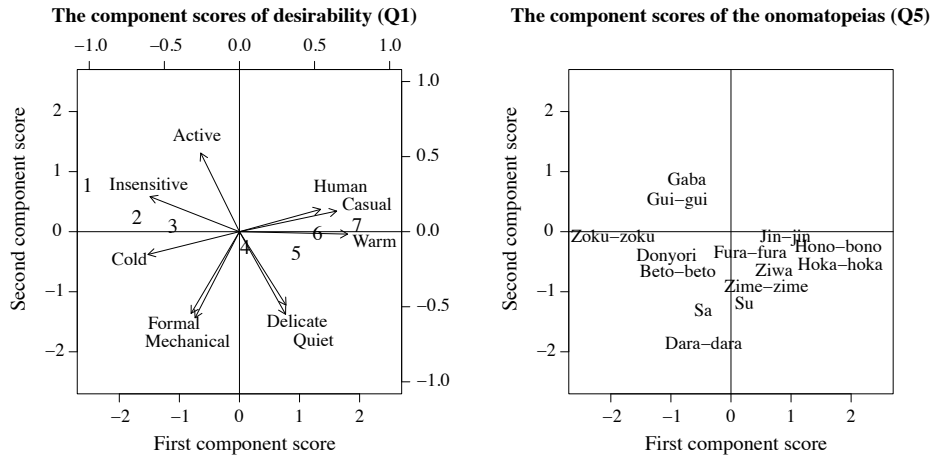


Figure 2: Feature space of nonverbal communication derived from a PCA using the rating scores of the adjectives (Q6). The horizontal and vertical axes represent the first and second component scores, respectively. The arrows and the labels of the adjectives in the left figure represent the characteristic vectors of the adjectives (they were omitted in the right figure in the interest of clarity). The mean component scores of each rating score (1-7) of desirability (Q1, left) and each onomatopoeia (Q5, right) were mapped onto the feature space.

of nonverbal communication and the second component represents the “activity” of the physical contact in the communication.

We mapped the rating score of Q1 (desirability) onto the feature space (Figure 2, left). We found that the first dimension could predict the desirability of the communication, whereas the second dimension could not. Figure 2 (right) shows the onomatopoeias mapped onto the same feature space. The onomatopoeias such as “Hono-bono,” “Hoka-hoka,” and “Zoku-zoku” were located along the first dimension and “Gaba,” “Dara-dara,” “Sa,” and “Su” were located along the second dimension. The onomatopoeias that were frequently chosen in Q5 and desirable (“Hono-bono” and “Hoka-hoka”) were located close to each other in the feature space. The onomatopoeias that were frequently chosen in Q5 but not desirable (“Gaba” and “Gui-gui”) were also located close to

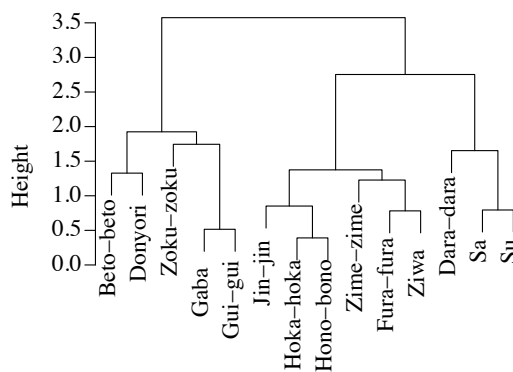


Figure 3: Result of hierarchical cluster analysis of the onomatopoeias using the component scores in the PCA (Figure 2)

each other. These two groups were, however, placed far from each other in the feature space. The result of the hierarchical cluster analysis of the onomatopoeias using the component scores also supported the geometrical localization in the feature space (Figure 3).

4. DISCUSSION

4.1. Onomatopoeias describing nonverbal communication

We found that the 4 onomatopoeias were frequently chosen to describe nonverbal communication (Table 4). The definitions of these onomatopoeias [6] were as follows:

Gaba: Describes something making a sudden and large motion.

Gui-gui: Describes doing something forcefully and continuously, such as gulping down a drink or pulling someone by the hand.

Hoka-hoka: Describes something comfortably warm, such as comfortable bedclothes or warm delicious-looking food.

Hono-bono: Describes something making one's heart warmed.

These onomatopoeias seem to be contrastive: two of them (“Gaba” and “Gui-gui”) describe the kinetic characteristics of a motion of physical contact in nonverbal communication, whereas the others (“Hono-bono” and “Hoka-hoka”) describe the atmosphere or mood of the scene in which the communication was conducted. The two onomatopoeias of these two groups were located close to each other in the feature space (Figure 2), and also displayed high similarities in the clustering analysis (Figure 3), implying that they were used with similar meanings when describing nonverbal communication.

We found that the probabilities of associating the same onomatopoeias with the same picture were quite high (data not shown) among different participants, and that the onomatopoeias with similar meanings were located close to each other in the feature space. The onomatopoeias would help to reveal the concept or nuance of the complicated nonverbal communication and enable the placement of verbal labels on the Kansei of the communication. On the other hand, it is unclear what part of the nonverbal communication depicted in the picture induced impressions such as “Hono-bono” and “Gui-gui.” Further research, for example, the analysis of participants' eye movements while looking at pictures or the identification of the common component in the pictures associated with the same onomatopoeias, will shed light on this point.

4.2. Feature space representing nonverbal communication

The PCA using the rating scores of the adjectives revealed that nonverbal communication with physical contact could be represented in a two-dimensional feature space. The first dimension seems to represent “warmness,” which reflects the atmosphere of the communication scene, and the second dimension seems to represent the “activity” of the motion of physical contact. In the experiment, we presented pictures of natural scene, and the nonverbal communication consisted of many factors such as the genders or ages of the person or the location of the communication. Hence, it is interesting that two dimensions were enough to represent diverse nonverbal commu-

nications.

The feature space observed here was similar to that involved in perceiving affect from a biological motion stimulus [11]⁴. However, the first and second dimensions in perceiving affect were “activation” and “pleasantness,” respectively. Thus, the first and second dimensions were reversed as compared to those involve in describing nonverbal communication. In nonverbal communication with physical contact, the atmosphere (“warmness”) was more important as compared to the characteristics of the motion itself. For example, a handshake may induce different impressions depending on the context including the location, intention, social position of the person, and facial expression.

Almost all daily nonverbal communications with physical contact consists of both the atmosphere and the characteristics of the motion, and it would be difficult to qualitatively dissociate these two aspects. In the present study, we successfully extracted the onomatopoeias describing the atmosphere and those describing the characteristics of motion. These approaches would enable qualitative categorization, which is difficult on the basis of feature space alone, for example, revealing which aspect is vital for communication.

4.3. Desirability of nonverbal communication

The results of the ratings of the subjective impression for nonverbal communication showed that more impressive and more frequent communication was more desirable (Table 2). The persons imagined for desirable communication were those who were close to the participants in daily life (Table 3), which also suggested that the impression and frequency made communication more desirable.

Moreover, we related the desirability of nonverbal communication to feature space and onomatopoeias. Mapping the rating score of desirability onto the feature space (Figure 2) revealed that the first dimension (“warmness”) suitably predicted desirability, that is, desirability was located along the first dimension. The second dimension, however, could not predict the desirability of the communication. In the analysis using the onomatopoeias, desirable communications were associated with “Hoka-hoka” and “Hono-bono,” which express the warm atmosphere of a scene. On the other hand, the communications associated with “Gaba” and “Gui-gui,” which express the activity of the motion, were less desirable. These results imply that the atmosphere of the communication, rather than the motion of physical contact, was focused on first, and communication has a desirable impression only when people feel warmness in the atmosphere. With regard to perceiving affect from a biological motion, the local motion energy determines the activity of the motion, while the holistic synchronization of the motion determines the pleasantness of the motion [11]. Although it is unclear how the atmosphere of nonverbal communication emerges, perhaps the desirability of the communication should be associated with the holistic information of the

⁴In biological motion, a motion is presented using a set of light points indicating the joint position. The types of motion or gender and emotion of the performer can be perceived irrespective of the other materials such as face, clothes, or background.

scene rather than the local motion of physical contact.

We used only pictures of a natural scene involving nonverbal communication. Hence, the pictures contained a lot of contextual information representing, for example, a background, a facial expression, a location, the character of the person. This may lead to a biased focus on the atmosphere of the communication as compared to the motion of physical contact itself. To clarify the determinants of desirability of communication, we need to investigate what is conveyed in nonverbal communication with physical contact in the absence of contextual information (e.g., biological motion).

5. CONCLUSION

In the present study, we identified the Japanese onomatopoeias and sound-symbolic words describing nonverbal communication with physical contact. Desirable communications were associated with words expressing the atmosphere of the communication scene, implying that a positive impression of communication emerges from holistic information rather than local information. Moreover, we successfully constructed a multidimensional feature space representing nonverbal communications, and mapped the desirability and onomatopoeias onto the feature space. These days various communication media are being used; however, their effectiveness is unclear. The empirical findings here would provide a useful starting ground for designing user-friendly Kansei-communication systems.

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