

原著論文

The influence of vibration on users' impression of smartphone messages

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モバイル端末のメッセージ送受信時における振動の付加が
使用者の印象に与える影響について

久保雅義

Abstract

In this research, we verified that we can transmit richer information by adding vibration during speech and message transmission using increasing mobile terminals (i.e., smartphones).

When adding vibration to information in this context, the user's impression of the information varies depending on the pattern of vibration, so the impression of 'no vibration' (i.e., an interval of <1000 to 100 ms) gives a positive impression, and the most negative impressions are reported by participants at an interval of 1000 ms. In text message transmission, it was shown that adding a positive vibration that became clear during voice transmission gives a more positive impression and can mitigate a negative impression. However, it was also shown that in one scenario, adding vibration had no effect. As a result, the addition of vibration is largely confirmed, and it is expected that additional effects will be developed by users.

Key words: Communication by vibration (Haptics), Intelligent Personal Assistant System, Computer-Mediated Communication

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INTRODUCTION

In this research, we verify whether communication with rich information is possible by adding vibration to smartphone communication in two scenarios. First, vibration is added to voice communication. Then, whether more rich communication can be achieved by adding vibrations at the time of sending the message is determined. The verification that adding vibration addition gives

an impression to users during voice transmission using an intelligent personal assistant system. By adding vibrations under a certain voice transmission condition called IPA, changes in impression as the information transmission modality changes is investigated. Our hypothesis is that we can present information in a simple sentence in an easy-to-understand manner and verify that smooth information transmission is possible. We also consider whether rich communication similar to computer-mediated communication

(CMC) can be achieved as an effect of adding vibration during message transmission.

1. EVALUATION USING AN INTELLIGENT PERSONAL ASSISTANT SYSTEM

1-(1) Influence of the combination of vibration pattern components on impressions conveyed by vibration patterns

It is believed that the length and interval of vibration constituting the vibration pattern affect each other, in terms of the impression the vibration conveys as a whole. In Experiment 1, we focused only on the influence of either the length of the vibration or on its interval and the positive and negative effects they elicited. In contrast, in Experiment 2, our purpose was to clarify how these elements interfere with each other. We combined the lengths and intervals of vibrations (i.e., 100 ms, 500 ms, and 1000 ms) to generate nine vibration patterns, and then asked subjects to evaluate them. By doing this, we clarified the relationship between elemental combinations of vibrations and the degree of positive and negative emotions they elicited.

1-(2) Survey summary

Implementation period:

October 30 – November 29, 2016.

Subjects: Male and female students between the ages of 20 and 24(N=10). Experimental specimens were ergonomically sampled and approved by the Institutional Review Board.

Investigation method: Completion of Positive and Negative Affect Schedule (PANAS) survey forms.

1-(3) Vibration patterns

The vibration patterns we used in this experiment are as follows. The length of the vibration was designed to be longer than 100 ms, and the difference in length for each vibration pattern was 250 ms or longer, which is generally considered an interval recognizable by humans.

1-(4) Results

Fig. 2 is a graph showing the results our investigation of the differences between positive and negative degrees of feeling, as reported by PANAS scoring, associated with each of the nine vibration patterns.

The experiments showed the following.

- 1) As the interval of vibration shortened, the degree of positive feelings increased.
- 2) As the vibration lengthened, the degree of positive feelings increased.
- 3) Differences in vibration intervals had a

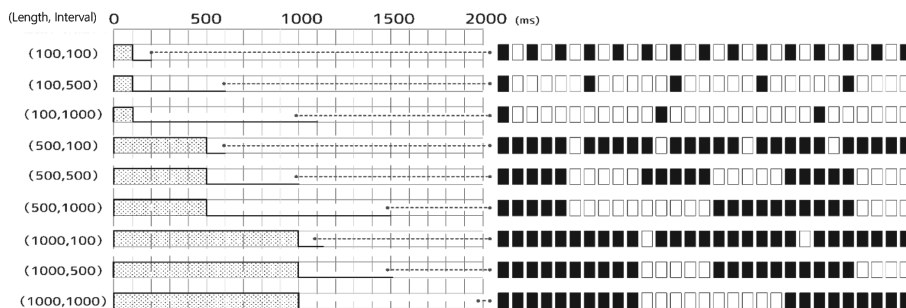


Fig. 1. Nine kinds of vibration patterns used in the experiment

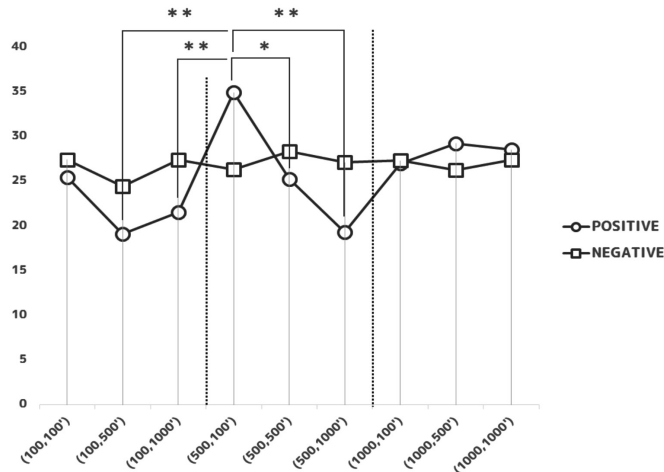


Fig. 2. Positive and negative degrees reported for each vibration pattern
(The asterisks (* and **) indicate that the coefficients are statistically different from zero at the five and percent levels, respectively.)

Table 1. Degree and rank of emotional value for each vibration pattern

Positive			Negative		
Order	Vibration Pattern	Degree of Emotion	Order	Vibration Pattern	Degree of Emotion
1	(500,100)	34.9	1	(500,500)	28.3
2	(1000,500)	29.2		(100,100)	27.4
3	(1000,1000)	28.5	2	(100,1000)	27.4
4	(1000,100)	27		(1000,1000)	27.4
5	(100,100)	25.4	3	(1000,100)	27.3
6	(500,500)	25.2	4	(500,1000)	27.1
7	(100,1000)	21.5	5	(500,100)	26.3
8	(500,1000)	19.3	6	(1000,500)	26.2
9	(100,500)	19.1	7	(100,500)	24.4

(Length,Interval)

greater influence on the reported degree of positive feeling than differences in vibration lengths.

The lengths of vibrations and intervals influence each other in terms of changes in users' positive responses to the vibration pattern. When the length of vibration is longer (1000 ms), it becomes difficult, to some extent, to recognize the difference in vibration intervals. We found that the length of the vibration interval's influence on positive impressions (i.e., as the interval of vibration shortened, the degree of positive feelings

increased) is difficult to interpret. In consideration of these effects, we adjusted the length of vibration to 500 ms and found that changing the vibration interval can change the degree of positive impressions dramatically.

1-(5) Influence of vibration patterns on information impressions

To clarify the relationship between impressions elicited by the vibration and the impressions conveyed by information, we asked subjects to use Google Now, an intelligent personal assistant system, to search for information, and then created

a vibration while the information was presented. The information presented was concerning the user's local weather. We prepared a task calling for subjects to search the weather forecast for a specific destination so that they could evaluate it. Subjects searched the weather for each area, from 1st through 9th Streets, all of which were candidate destinations, using a map in any order. We opted to use the weather for the search parameters because weather queries were the most common queries made in 2015 and 2016. The information presented for the following three types of weather is shown in Fig. 4 (Sunny and 18°C, Cloudy and 8°C, and Rainy and 0°C). The

combination of vibration and weather data were prepared for nine combinations of these three weather forecasts and three types of vibration patterns (vibration intervals of 100 ms and 1000 ms, as well as no vibration).

1-(6) Survey summary

Implementation period: January 6–15, 2016.

Subjects: Male and female students between the ages of 20 and 24 (N=20). Experimental specimens were ergonomically sampled and approved by the Institutional Review Board.

Investigation method: Completion of PANAS survey forms.

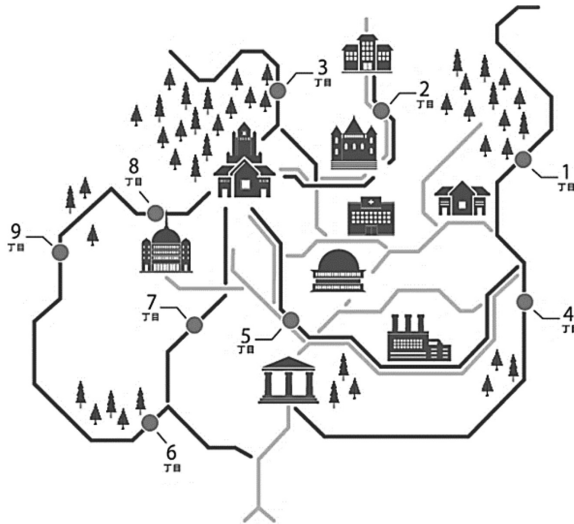


Fig. 3. The virtual map used to search for weather data



Fig. 4. Weather information presented in the survey

1-(7) Results

Figure 3 are graphs showing the results of our investigation, via PANAS data, of the difference between negative and positive degrees of information added with vibration. In this experiment, we clarified the following:

- 1) The vibration pattern affects changes in the users' impressions in the same way, regardless of the information conveyed, such as sunny, cloudy, or rainy.
- 2) When a vibration pattern is added to the information, the impression is an increasingly positive one for the following results: no vibration and intervals of 1000 ms and 100 ms.

This trend was observed across all weather descriptions (sunny, cloudy, and rainy).

- 3) The impression of the information to which a vibration pattern was added was affected in the same way that the impression was affected by vibration patterns. If we add a vibration pattern with a more positive impression to the information, the user's impression of the information will be positive.

These results suggest that vibration patterns influence how users receive information and that we can manipulate impressions, such as voice tone and expressions, when conveying information.

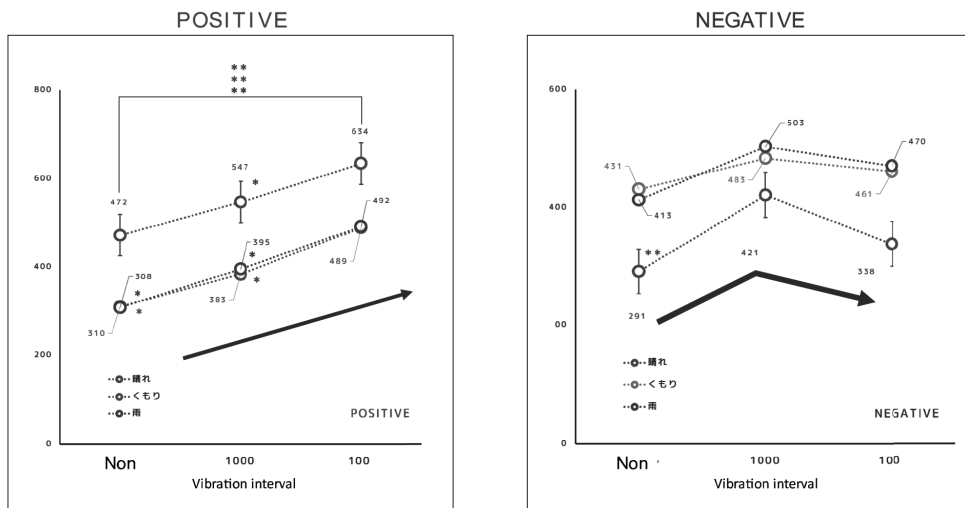


Fig. 5. Relationship between vibrations and changes in impressions of information

Table 2. Relationship between vibration patterns and the impression of conveyed information (The asterisks (* and **) indicate that the coefficients are statistically different from zero at the five and one percent levels, respectively.)

Weather	POSITIVE			NEGATIVE		
	None-1000	1000-100	None-100	None-1000	1000-100	None-100
Sunny		*	**	**		
Cloudy	*	*	**			
Rainy	*	*	**			

**2. OBSERVE THE EFFECT OF
ADDING VIBRATION DURING
MESSAG TRANSMISSION**

2-(1)

We focus on CMC, which is effective for message transmission. CMC adds emoticons (such as pictograms) to complement the lack or lack of non-verbal information in the text. It is also known that emoticons affect the impression of a message. This research verified, with the purpose of expanding the possibilities of richer communication by adding a vibration pattern to text, such as emoticons, to examine the influence of adding vibrations (and specific vibration patterns) to a text message on the receiver’s impression of the message, we created a message application on the device. We estimated our subjects’ impressions of several messages under different conditions.

2-(2) Evaluation method

The respondents’ average age was 22.2 years. Experimental specimens were ergonomically sampled and approved by the Institutional Review Board.

Similar to Kimura and Yamamoto’s (2017) study, positive feelings were measured according to ‘desirability,’ ‘ease of enjoyment,’ and ‘joy’; negative feelings were assessed according to ‘unpleasant feelings,’ ‘anger,’ and ‘grief.’ We also used seven stages of evaluation (0 = it was not felt at all; -6 = it was felt very much). Vibration b is the commonly used vibration pattern and is used in this experiment. As for Vibration c, the vibration pattern that gives the most positive impression is used in this experiment from Experiment 1.

Table 3. The conditions of the experiment.

Vibration a	No vibration
Vibration b	The vibration that is generally used is added
Vibration c	The vibration that gives a positive impression is added

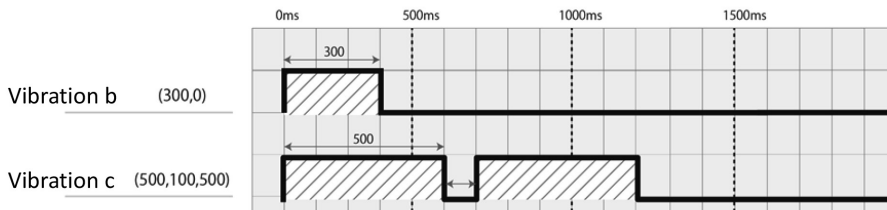


Fig. 6. Vibration patterns used in the experiment.

2-(3) Results

We found that a vibration’s influence on a message’s impression differs depending on the message’s contents. Figure 7 shows the mean of people’s impressions of messages; the impressions were recorded for each condition when people received a “Happy birthday!”(a) message from the friend.

This figure indicates that the positive vibration produced more positive reception than the general vibration.

For the message “Now a 1000-yen discount coupon is available!” (ka), a similar result occurred. Figure 8 shows the participants’ average impression of ka.

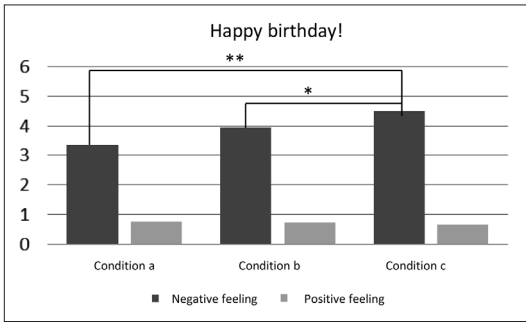


Fig. 7. The impression of *a* for every condition.

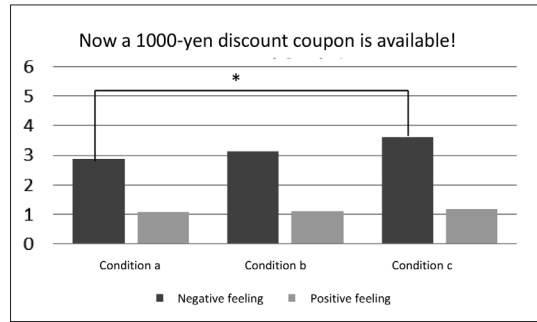


Fig. 8. The impression of *ka* for every condition.

Apologies, which could be considered an emphasized feeling, were also paired with vibrations that give; this was done in the cases of messages *u* and *ki*. We found that positive feelings tended to increase when the messages were combined with positive vibrations.

The message “Sorry. Can’t go today.(*u*)” As for *u*, it was from the friend, and “I’m sorry. It’s sold out now(*ki*).” As for *ki*, it was from the enterprise of EC where it is being used.

For *a* and *ka* (*a* from the friend; *ka* from the EC site), the vibration that gives a positive impression was added to show that there is the possibility that they have a similar influence (regardless of the sender’s category).

It was shown that *ki* can amplify a positive impression in the absence of vibration than in the case of adding general vibration. As for *u*, it is suggested that adding vibration pattern giving positive im-

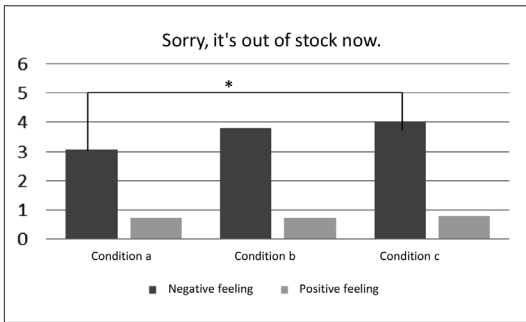


Fig. 9. The impression of *ki* for every condition.

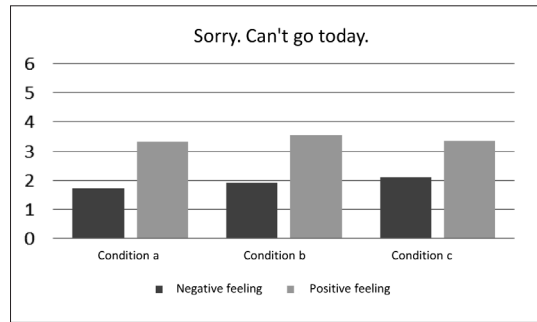


Fig. 10. The impression of *u* for every condition.

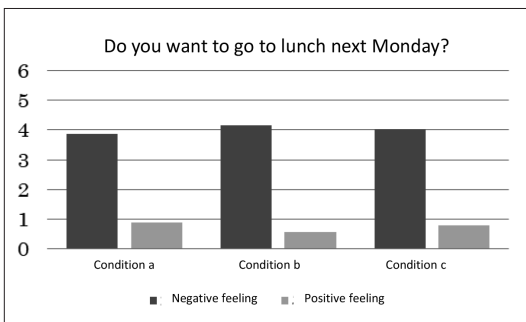


Fig. 11. The impression of *i* for every condition.

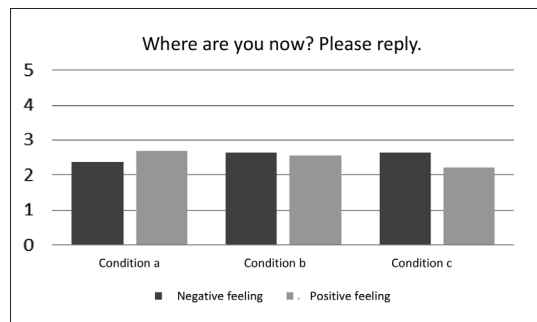


Fig. 12. The impression of *e* for every condition.

pression may increase positive emotion more than without vibration. That time was to add vibrations to positive impression as a result, and it was indicated that there is the possibility that the negative feelings can be reduced.

The emotion people wanted to alleviate most when sending message was “anger.” This meant

that people didn’t look unnecessarily angry. Therefore, in order to investigate whether the addition of vibration has better effect on the impression, it is suggested that the sender was angry about the fact that the receiver himself was the cause and the meeting was delayed without contact. As a message that can be done, “Where are you now?”(e).

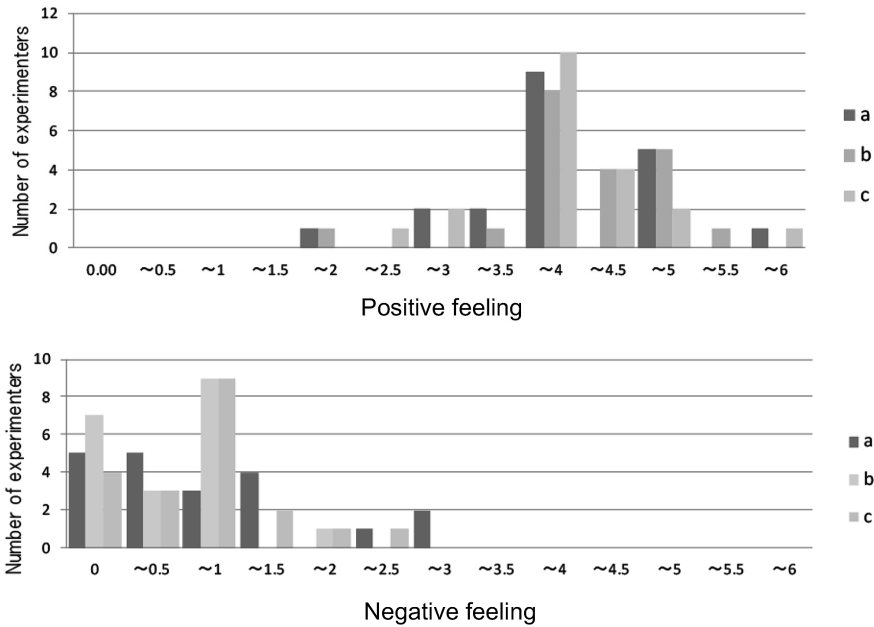


Fig. 13. Classification of the numerical values of positive feelings negative feelings

	Phrase	Sending person	Contents	Positive feeling ab ac bc	Negative feeling
a	Happy birthday!	Friend	Delight	** *	
i	Shall we launch next Monday ?	Friend	Delight Invitation		smallest at b
u	I can not go sorry today.	Friend	Apology	a < b < c increased tendency	biggest at b
e	You're where now, please contact me.	Friend	Anger	Without vibration < with vibration	a > b > c, it decreases
k a	1,000 yen discount coupon is delivered now.	Company	Delight	*	
ki	I'm sorry. There is no stock now.	Company	Exoneration	*	
k u	Thank you very much .The receipt of reservation collect	Company	Understanding	biggest at b	

Fig. 14. Summary of results

As a result, it was shown that there is possibility that negative emotions can be alleviated by adding vibrations, especially vibrations that give positive impression.

However, there was also the message that the addition of vibration had almost no effect on the impression. Message including solicitation, “Would you like to go to lunch next Monday?” (i). This is an invitation message, asking for response. Fig. 11 shows the average value of positive emotions and negative emotions for each condition. From this figure, it was shown that the addition of vibration had no effect on the impression.

The average positive and negative feelings for every condition are indicated in Figure 13 upper. All numerical scores for positive feelings in the conditions are indicated in Figure 13 lower.

Equal dispersion was not seen; however, this figure indicated that the vibrations had no influence on the participants’ impressions.

In addition, regarding the solicitation message, the addition of the vibration pattern did not affect the questions regarding the willingness to respond, “I want to respond”, and “I want to consent”.

3. CONCLUSION

We investigated element combinations. As a result, it was found that when the length of vibration was set to 500 ms, the effect on the degree of positive vibration was the most significant. Therefore, the vibration pattern used in 2 - 2 - 1 was set to 500 ms in length, and two types of vibration patterns with vibration intervals of 100 ms and 1000 ms were prepared and used for the experiment. In 2-3, we investigated the influence of vibration patterns on participants’ impression of information. As a result of the experiment, we found that by chang-

ing the vibration pattern presented simultaneously, it is possible to manipulate the impression of information even when the same information is used. For example, it was found that adding a vibration pattern with an interval of 100 ms promotes a positive impression of the information than a vibration interval of 1000 ms if the weather is the same for sunny weather.

In text message transmission, it was shown that adding a positive vibration that became clear during voice transmission gives a more positive impression and can mitigate a negative impression. However, it was also shown that in some scenarios, the addition of vibration had no effect. As a result, the addition of vibration is largely confirmed, and additional effects are expected to be developed by users.

4. THE NEXT DEPLOYMENT

In this research, we verified that we can transmit richer information by adding vibration during speech and message transmission using increasing mobile terminals (smartphones).

In text message transmission, it was shown that adding a positive vibration that became clear during voice transmission gives a more positive impression and can mitigate a negative impression. We also verified that the same rich communication, such as CMC, can be made as the effect of adding vibration when message transmission. In the future, we will verify the effect of adding vibration on senior citizens and visually impaired people, who have begun to use smartphones recently. Although visually impaired people only use voice features on smartphones, we can expect to realize richer communication by adding vibration to voice. Elderly people who are anxious about visual hearing can expect similar effects by adding vibration.

REFERENCES

- [1] Brown, L.M., Brewster, S.A., and Purchase, H.C. (2005). A first investigation into the effectiveness of tactons. First Joint Eurohaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator. *First Joint Eurohaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems. World Haptics Conference, 2005*, pp. 167-176.
- [2] Brown, L.M. (2006). Feel who's talking: Using tactons for mobile phone alerts. *CHI EA '06: CHI '06 Extended Abstracts on Human Factors in Computing Systems April 2006 Pages 604-609*.
- [3] Saket, B., Prasajo, C., and Huang, Y. (2013). Designing an effective vibration-based notification interface for mobile phones. *CSCW '13: Proceedings of the 2013 conference February 2013 on Computer supported cooperative work February 2013 Pages 1490-1504*.
- [4] Shota Shirakami Kinoshita Yuichi Akira Kentaro Go. (2016). Design of the feedback which considered an impression of vibration in smart phone. *CHI EA '16: Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems May 2016 Pages 3190-3196*.
- [5] Takehara, T. and Katsukyou, R. (2006). In case of the effect the e-mail to which various amity conditions were added exerts on recipient's impression formation-thanks and an apology situation. *Japanese Sensitivity Engineering Meeting Study Collected Papers*, 6, 83-90.

要旨

スマートフォンが急激に普及し、コミュニケーションのあり方も多様化してきた。

本研究はスマートフォンを用いたコミュニケーションの際、テキスト通信に振動パターンを付加することで、より豊かなコミュニケーションの可能性を広げることができるかを目的とし、ハプティクスの効果を2つの実験を通して検証した。

検証1. 日常の情報伝達に対し、IPAS用いた場合のほうがテキストだけによる伝達よりよりポジティブな感情を抱くかどうかということを検証する。

検証2. 日常の情報伝達について振動を付加することで、ポジティブは増幅されネガティブは軽減されることを検証する。

結果として、よりポジティブな印象を持つ振動パターンを、情報に付加すると、その情報に対してよりポジティブな印象を抱く。振動パターンを付加することで、より豊かなコミュニケーションの可能性を広げることが示された。また、謝罪のメッセージの際も、ポジティブな印象を与える振動を付加することでポジティブ感情が増加しうることがわかった。またネガティブ感情を緩和できる可能性があることが示された。