# Analysis of Utilization in the Message Card Production by Use of Fusion Character of Handwriting and Typeface

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**Abstract.** Many Japanese people hope to receive handwritten messages from others even though they have resistance to handwrite messages for them. In previous studies, we have revealed that fusion character with handwriting and typeface could reduce the resistance toward handwriting. However, the system used in the previous studies did not allow users to change the type of typeface and the fusion rate, so it was not clear how our fusion method can be utilized. In this paper, we implemented a prototype system to create message cards with a fusion method which enables users to control the fusion rate and to select the typeface. Then, we conducted experiments on whether writers change the way to use the system according to their relationship with the reader or the effect of the message card's design. The results of the experiments revealed that the writer changed the way to use the system depending on card designs and their relationship with the reader.

Keywords: Handwriting, Typeface, Fusion character, Message card, Analysis.

## 1       Introduction

In Japan, people often have opportunities to write messages at scenes such as their friends' birthdays and weddings, farewell at school and workplace, and seasonal greetings. Here, they can type letters easily with computers or smartphones and create message cards. However, many Japanese people think it is desirable to create such message cards with their handwriting especially when they want to convey their feelings more strongly since handwriting can express the warmth and personality of the writer. In fact, according to a public opinion poll by Japanese Agency for Cultural Affairs [1], 90% of Japanese people answered they preferred cards such as New Year's cards to be handwritten rather than to be typed.

In the past, Zitnick [2] et al. and Niino [3] et al. conducted researches on how to help writers produce beautiful handwriting. However, most Japanese people still have resistance to handwriting messages themselves. Zebra Corporation [4] found that 90% of Japanese people are aware that they are bad at handwriting. In fact, according to the Zebra survey, more than half of Japanese people have a negative impression on their own handwriting.

To solve these problems, Saito [5] et al. proposed a method to fuse handwriting and typeface easily to design texts in comics. Then, we applied this method for generating message cards and conducted an experimental test on whether the fusion character of handwriting and typeface can reduce resistance and shame toward one's handwriting [6]. The results of the experiments revealed that fusion character of handwriting and typeface could reduce resistance to one's handwriting, while it keeps characteristics of handwriting in that it expresses warmth and personality of the writer. In addition, we found that both the writers and the readers had a positive impression of the fusion character, and the usefulness of the fusion characters for messages cards was verified. However, this previous study of ours did not allow users to change the type of typeface and the fusion rate when they generated a message card. In addition, the experiments were conducted only for the situation where the writer and the reader are close friends. Thus, it was not clear whether message cards with fusion characters are useful for such situations as they are written to the writer's boss, teacher, or small children. In addition, Kato [7] [8] et al. conducted a study that focused on the emotions between the writer and the reader in communication. However, they did not reveal how the differences in the relationship between the writer and the reader in communication were influenced by the fusion of handwriting and typeface. Furthermore, Andrew [9] et al. suggested the system of online educational videos that dynamically changes from handwriting to typeface. However, they have not suggested the system using a character that has advantages of handwriting and typeface on digital devices.

In this paper, we implement a system to create message cards with fusion characters with which users can change the type of typeface and the fusion rate. Then, we reveal how the utilization of the system is changed according to the relationship between the writer and the reader and the difference in card designs. Specifically, we examine changes in typeface selection and fusion rate due to difference in types of the reader (i.e. superior, close friends or children) and differences in card designs.

The contributions of this paper are as follows.
- We realized a prototype system to create message cards with fusion character.
- We clarified that the writers changed their usage behavior of the system in response to their relationship with the reader and the card design.

## 2 Message Card with Fusion Character

### 2.1 Method to Generate Fusion Character of Handwriting and Typeface

We used Saito et al.'s method [5] to generate fusion characters. This method represents type characters as a numerical formula that parameterizes "$t$" by performing Fourier series expansion to change the character's core and thickness. It also uses the weighted average of the typed character's numerical formula and the handwriting's numerical formula. The generation of the character at the fusion ratio between handwriting and type character of 0.0 (handwriting) ~ 1.0 (type character) at intervals of

0.2 using this method is given in Fig. 1. Moreover, handwriting is emphasized close to 0.0, and the typeface is emphasized close to 1.0.

Also, we set the fusion ratios of the core and the thickness separately this time. Here, the core is a portion of the character's skeleton.



**Fig. 1.** Japanese character "あ" of the fusion ratio between handwriting and type character at intervals of 0.2 between 0.0 and 1.0.

## 2.2 Prototype System

We implemented a prototype system of message card with fusion character of handwriting and typeface (see Fig.2) based on the algorithm of subsection 2.1.
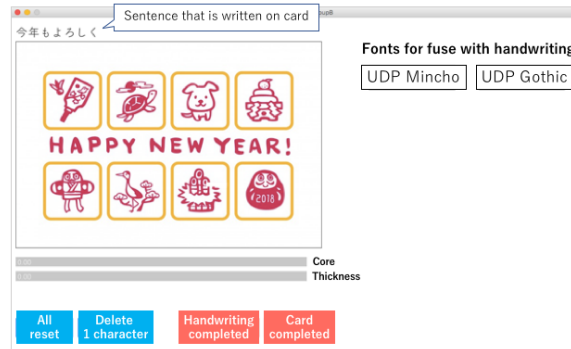


**Fig. 2.** Prototype System

First, a user presets the design and the content of the message. Then, they handwrite a sentence that is presented at the upper left of the screen on the message card. They can freely adjust the position and the size of the character and handwriting direction. Moreover, they can delete a character by pressing "Delete one character" button and delete all characters by pressing "All reset" button.

When they finish writing the specified sentence, they press the button of "Handwriting completed," and then they can select the type of typeface that is going to be fused with their handwriting at the upper right of the screen. In the system, we prepared two fonts for fusion with the handwriting: "BIZ UDP Mincho" and "BIZ UDP Gothic," both of which were generated by Morisawa [10] (Fig. 3). It is possible for the users to create their favorite fusion character by pressing the button of the type of typeface that is to be fused with their handwriting, and adjusting the fusion ratio of

"core wire" and "thickness" with the slider at the bottom of the message card, the left side of the screen. The value of the slider is from 0% to 100%, in which handwriting is more emphasized when it is adjusted closer to 0% and the typeface is more emphasized as it is adjusted closer to 100%. Furthermore, because the fusion characters are generated in real time, it is possible for the users to see the change of the characters by changing the slider's value.

BIZ UDP Mincho  BIZ UDP Gothic

**Fig. 3.** The typeface used in the experiment

## 3      Usage Experiment of the System

As mentioned in section 2, we carried out experiments on how the creation behavior was changed in the use of the system to create message cards in response to the relationship between the writer and the reader and the card designs when the type of typeface and the fusion ratio can be adjusted freely.

### 3.1     Experimental Procedure

To analyze the differences of the creating behavior due to the relationship between the writer and the reader and the card designs, we asked participants to create a message card by using our prototype system with a tablet PC. The input device was Surface Book (Microsoft Corporation), and New Year's card was selected as the card to be created since Japanese people often handwrite it.

First, to clarify the relationship between the writer and the reader, we set three relationships as follows.
- The reader is a child who is younger than the writer.
- The reader is the writer's close friend.
- The reader is a boss or teacher who is older than the writer.

As for the sentence to be written, we selected "kotoshi mo yoroshiku" which is a common phrase used in New Year's card in Japanese and could be translated as "thank you in advance for this year. " In the experiments, the expressions of the sentence end were changed in response to the relationships since Japanese people change the expressions of the phrase according to their relationship with the reader (e.g., Japanese people use the polite expression for elder readers).

In addition, we assumed that the usage behavior of the system would change more by using the card designs suitable for the relationship between the writer and the reader. For this reason, the experimental participants were divided into two groups of ten people. We asked the participants in one of the groups to use the same card design [11] (Fig.4) for all types of relationship, and we asked the participants in the other group to use different card [12][13][14] designs (Fig.4) in response to the relationship. The participants were asked to create message cards in the order of ones for a younger person, one for a close friend and one for an older person, and to press the

button of "Card complete" after they finished creating the message card. While the user is creating the message card, we kept record of the user's usage behavior such as working hours, the type of typeface fused with handwriting, the fusion ratio of the core wire and the thickness, the image of the message card before typeface was fused with handwriting, and the image of the completed message card.

In addition, after each of the message cards was completed, the participants were asked about the message card that they created and the utilization of the system. The participants of the same card design group were ten people (six males, four females), and the participants of the different card design group were ten people (four males, six females).



**Fig. 4.** Templates of the message card that we used in the experiment.

## 3.2 Results

The graphs in Fig. 5 summarized the mean of the ratio of the core wire and the thickness for every three types of relationships.



**Fig. 5.** Mean of the ratio of the core and thickness when the card was completed.
Left: Group of the same design, Right: Group of the different design

From Fig. 5, it can be seen that, for the message cards with the same design, the mean of the ratio of the core wire and the thickness at the time when the message card was completed was equal regardless of the relationships between the writer and the reader. Also, we performed an analysis of variance in the ratio of the core wire and the thickness but did not find significant statistical differences.

It can also be seen in Fig. 5 that the mean of the ratio of the core wire and the thickness at the time when the message card was completed for the message cards with different designs had the lowest value on the occasion where the relationship between the writer and the reader was close friends. Also, we performed an analysis of variance for the ratio of the core wire and the thickness and found the only significant statistical difference for the ratio of the core wire in the different design ($p < 0.05$).

Then, we performed an independent t-test for the ratio of the core wire and the thickness between the groups for the same relationship but did not find any significant statistical differences.

As for the type of typeface fused with handwriting, it was observed that Gothic was often used for younger readers, and Mincho was often used for older readers. The difference was particularly striking for message cards with different designs.

Fig. 6 shows the results of the questionnaire on what the participants cared the most about when creating the message cards. As shown in Fig. 6, the participants answered that they cared "Fusion ratio" the most on the occasion when the reader is younger than the writer. On the occasion when the reader is a close friend to the writer, two participants selected "Other" as their answer to the question, and they both commented that they cared about whether the character is funny or not. One of the participants selected "Other" for the occasions that the reader is the writer's close friend or younger than the writer, and explained that they tried to make sure the character is easy to read and matches the card design when creating a card for a younger reader and tried to make the characters look beautiful while it keeps some characteristics of their handwriting since the original handwriting looked ugly. Note that for the occasions where the reader is an older person than the writer, many participants from both groups selected items about handwriting such as "Politeness of handwriting" and "Shape of handwriting," and "Balance of character" as their answer to the question.
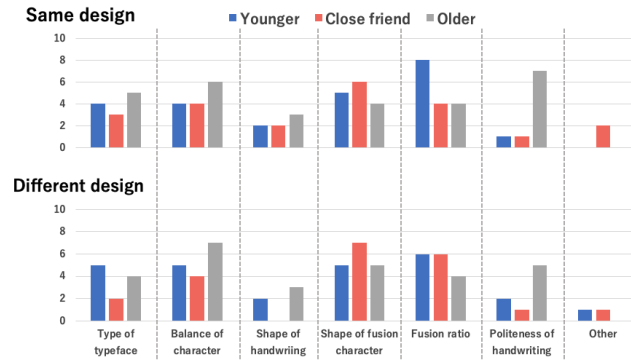


**Fig. 6.** What was emphasized when creating?

Also, the results of the questionnaire reported that fifteen participants answered that they want to use the system in the future. This means that 75% of the participants were thinking about using the system in the future.

Fig. 7 and 8 respectively show examples of cards created with the same design and with the different designs. They show that the fusion ratio of handwriting and typeface and the type of typeface were different in response to the writer's relationship with the reader. Also, although the three cards in Fig. 7 and in Fig. 8 were created by a different person respectively, the writing direction and the thickness of the fusion character were changed in response to the relationships.

**Fig. 7.** Example of products with the same design



**Fig. 8.** Example of products with different design

### 3.3 Discussion

The experimental results revealed that the usage behavior of the system was changed in response to the relationship between the writer and the reader. The difference of the types of the typeface in response to the relationship was particularly remarkable, and we found that the writers tend to change the type of typeface in response to their relationship with the reader, as they use Gothic for the younger, and Mincho for the older.

In Fig. 5, there are significant statistical differences in the ratio of the core in the different design. From this result, the difference in the relationship affects the shape of the character. However, there was no significant statistical difference in the ratio of the core wire and the thickness between the groups in the same relationships. This result shows that it was not the card design but the relationship between the writer and the reader that influenced the fusion ratio.

In addition, we found that the difference in the card design also changed the usage behavior of the system. Specifically, the type of typeface fused with handwriting was changed for the cards with the same design in response to the relationship, but the difference of the type of typeface appeared more in the cards with the different designs. For this reason, we assumed that the writer was influenced by the characteristics of the characters originally written in the message card, and consciously changed the type of typeface fused with handwriting. Therefore, when our prototype system is realized as a service to create message cards, it should have a function of the automatic recommendation of the types of the typeface to be fused with handwriting in response to the relationship with the reader.

In the results of the questionnaire, we observed that participants in the different card design group had more difficulty in creating their ideal message cards compared to the participants in the same designs. This might be because the card designs were

more formal for the different card design group, so it was difficult for many of them to create message cards that match the formal designs. Then, it needs to be examined in the future experiments whether this problem can be solved by preparing appropriate fonts for the designs or there is no way to solve it.

In addition, we showed from the record of the users' usage behavior through the experiments and the results of the questionnaire that the mean of the ratio of thickness was the highest and the fusion ratio was the most cared about during the creation when the reader is younger than the writer. This would suggest that the writers might have tried to make the card easy to read since the card receiver was assumed not only to be younger than the writer but also to be small children. In addition, when the relationship between the writer and the reader was close friends, the creation time of the message card was the shortest and it was observed that two of the participants cared the most about whether the characters look funny on not when creating. These might suggest that the writers strongly wanted to create message cards with less editing since the writer and the reader know each other very well.

Further, when the reader is older than the writer, the number of times when handwriting was rewritten was the largest and points related to handwriting were the most cared about when creating the message cards. In addition, the average creation time was the largest for this relationship. These results imply that the writers wanted to create their message cards for an older reader with beautiful characters, which made them write the message carefully.

## 4 Conclusion and Future Work

In this paper, we implemented a prototype system which enables users to create message cards with the fusion method and conducted an experimental test to investigate how the utilization of the system to create message cards is changed when there are differences in the relationship between the writer and the reader and the card design. Then, we clarified that the writers changed the type of typeface fused with handwriting in response to the relationship and were influenced by the card designs.

In the future, we will update the system so that handwriting can be fused with more variety of typeface because only two fonts were available in the experiment of the current study. By doing so, we will utilize not only existing fonts but also typeface generating by using the method of Xia [15] et al. and Lin [16] et al.

In addition, it was pointed out in the questionnaire on the utilization of the system that the size of character differed depending on a character so that we will improve the system for this point. Moreover, we will allow the utilization of the system on the smartphone by making it an application or a service. Also, we will develop the system so that people can use fusion characters not only for message cards but also for other things such as lyrics on music videos, cartoon captions, text illustrations or movie subtitles.

# References

1. The Agency for Cultural Affairs. The Public Opinion Poll on Japanese, http://www.bunka.go.jp/tokei_hakusho_shuppan/tokeichosa/kokugo_yoronchosa/pdf/h26_chosa_kekka.pdf, last accessed 2019/04/05.
2. C. Lawrence Zitnick.: Handwriting beautification using token means. In: ACM Special Interest Group on Computer Graphics and Interactive Techniques, vol. 32 （SIGGRAPH2013）, Anaheim (2013).
3. Shinjiro Niino, Nanae Hagiwara, Satoshi Nakamura, Masaaki Suzuki, Takanori Komatsu.: Analysis of Average Hand-drawings and Its Application. In: 9th International Conference on Intelligent Technologies for Interactive Entertainment (INTETAIN2017), Funchal (2017).
4. Zebra Corporation. Attitude Survey on the Handwriting, http://www.zebra.co.jp/press/news/2014/0918.html, last accessed 2019/04/05.
5. Junki Saito, Satoshi Nakamura.: Fontender: Interactive Japanese Text Design with Dynamic Font Fusion Method for Comics. In: 25th International Conference on MultiMedia Modeling (MMM2019), Thessaloniki (2019).
6. Mikako Sasaki, Junki Saito, Satoshi Nakamura.: Improving visibility and reducing resistance of writers to fusion of handwritten and type characters. In: The 10th International Conference on Collaboration Technologies (CollabTech2018), Costa de Caparica (2018).
7. Yuuki Kato, Shogo Kato, Kanji Akahori.: Effects of emotional cues transmitted in e-mail communication on the emotions experienced by senders and receivers. Computer in Human Behavior 23(4), 1894-1905 (2007).
8. Yuuki Kato, Shogo Kato, Kanji Akahori.: Influences of self-disclosure and styles of writing messages in e-mails of recipients' emotional aspects: A case study focusing on female university students. Journal of Science Education in Japan 30(4), 216-228 (2006).
9. Andrew Cross, Mydhill Bayyapunedi, Edward Cutrell, Anant Agarwal, William Thies.: TypeRighting: combining the benefits of handwriting and typeface in online educational videos. In: SIGCHI Conference on Human Factors in Computing Systems (CHI2013), Paris (2013).
10. Morisawa. MORISAWA BIZ+, http://bizplus.morisawa.co.jp/, last accessed 2019/04/05.
11. brother at your side, https://online.brother.co.jp/ot/dl/Contents/nenga/nenga_casual/nengajoucd_h0063/, last accessed 2019/04/05.
12. brother at your side, https://online.brother.co.jp/ot/dl/Contents/nenga/nenga_character/animalnenga_02/, last accessed 2019/04/05.
13. brother at your side, https://online.brother.co.jp/ot/dl/Contents/nenga/nenga_casual/etonengajoucd_h0011/, last accessed 2019/04/05.
14. brother at your side, https://online.brother.co.jp/ot/dl/Contents/nenga/nenga_basic/etonengajoubd_h0010/, last accessed 2019/04/05.
15. Xinghua Zhu, Lianwen Jin.: Calligraphic Beautification of Handwritten Chinese Characters: A Patternized Approach to Handwriting Transfiguration, Semantic Scholar (2008).
16. Jeng-Wei Lin, Chian-Ya Hong, Ray-I Chang, Yu-Chun Wang, Shu-Yu Lin, Jan-Ming Ho.: Complete font generation of Chinese characters in personal handwriting style. In: 34th Computing and Communications Conference (IPCCC2015), Nanijing (2015).