Can we encode emotional semantic information in written message?
- A basic study towards a development of a new miscommunication-free e-mail system -

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Abstract: The aim of this study was to develop a new e-mail communication system in which miscommunication can be deteriorated. A new system should be conveyed not only semantic verbal information but also emotional semantic information from the senders. In this context, a series of experiments were conducted to investigate the way of encoding sender's emotional state in written language communication to avoid miscommunication. Two hundreds and eighty-five undergraduate students participated in a series of experiments. In Experiment 1, it was demonstrated that the addressee effectively decoded prosody in the spoken language communication situation. In Experiment 2, the effect of pictograph use on the decoding of emotional semantic information was investigated and the effect of script type selection was examined in Experiment 3. The effects of selective font use on the decoding of emotional semantic information were evaluated in Experiment 4. The results showed that in written language, the use of pictograph was more effective than the selection of script type or font. It is evident that emotional semantic information can be conveyed by the selection of script type or font in written language communication. However, the selection of script type or font was not necessarily effective on avoiding miscommunication.

1. Introduction

It is well known that consultation or discussion by means of e-mail sometimes invites misinterpretation and gives rise to a quarrel between the sender and the addressee. One of the reasons why this type of miscommunication occurs relates to the unique characteristics of e-mail communication. E-mail communication usually consisted of short written sentences by the sender to the addressee without any decoration such as picture and color. More concretely, e-mail communication is the communication based simply upon the written language.

As you well know, human communication consists of two facets, verbal and non-verbal one. Verbal facet, in other words, language involves two facets, written language and spoken language.

When we compare the written language and the spoken language, we can realize the possible reasons why we sometimes fail in proper communication by e-mail. Spoken language can be divided into three components: verbal information (or neutral semantic information), para-linguistic information (or emotional semantic information), and non-verbal information in face-to-face communication situation such as discussion and consultation. When we communicate by telephone, the first two components are mostly engaged. Non-verbal information refers to attribution of speaker such as age or sex, which is not directly related to spoken contents.

Verbal information relates to the information, which includes words, syntax and meaning in discourse situation. Verbal information can be processed both in written language and spoken language communication.

However, para-linguistic information can be processed in spoken language communication but usually it is not necessarily processed in written language communication. Para-linguistic information can be expressed by prosodic elements (for example, prosody, speed or rhythm of speech) in spoken language. There is no disagreement on this point that para-linguistic information communicates intention or emotional state of speaker in spoken language communication. We well realize that it is not enough to communicate full and smoothly with the opponents by means of

written language. Therefore, we try to meet the opponents to inform information properly when the matter is important, even if it needs expensive travel fares and consume of times, not to fail in miscommunication.

There are sufficient evidences to support the above-mentioned claim in neuropsychological research. Studies with aphasic patients have demonstrated that both the prosody deficits and the syntax deficits in patients yield inappropriate communication in spoken language (Ross & Meslam, 1979; Yamadori, Osumi, Tabuchi, Mori, Yoshida, Ohkawa & Yoneda, 1990; Yamadori, 1998). Hatta and Hasegawa (2004) demonstrated that brain damaged patients tended to make errors in implicature understanding in communication because they have deficits in para-linguistic information processing.

As mentioned earlier, a communication by face-to-face contact or telephone depends mostly on spoken language. On the other hand, a communication by e-mail or letter is based on the written language. Therefore, we hypothesized that spoken language can use not only neutral semantic information by words and syntax, but also emotional semantic information by prosody to a listener. On the other hand, written language can transfer only neutral semantic information, but cannot convey emotional semantic information properly. These lead to more frequent miscommunication in written language situation than in spoken language situation and this is typical events in e-mail situation.

In order to solve this problem, we need to develop a new system in which emotional semantic information can be conveyed efficiently in written language situation. As several electric devices for communication have spread nowadays and e-mail has been a main means of communication, we should develop a new method to avoid miscommunication in e-mail situation.

Several attempts have already done though it might be implicitly. For example, to rely on the pictograph or emoticon use is shown to express emotional condition in e-mail situation. However, the use of these symbols is limited in private communication.

Then, our aim is to develop a new hard/ soft-ware system in e-mail communication, which is able to convey not only neutral semantic information but also emotional semantic information properly. To develop such systems, we should accumulate empirical evidences, which suggest possible ways to transfer emotional semantic information in written language situation.

In this context, we demonstrated evidences that a sender tried to communicate emotional semantic information to an addressee by the selection of script type or print (Iwahara, Hatta, & Maehara, 2003; Iwahara & Hatta, 2004). Iwahara, Hatta, & Maehara (2003) showed firstly that modern Japanese people had strong emotional semantic associations with each type of script (Kanji, Hiragana, Katakana): for instance, Kanji was intellectual, Hiragana was feminine, and Katakana was exotic, secondly that Japanese people chose a particular type of script if there was compatibility between the semantic images associated with the script type and the target word. We also identified the same kind of effects in the task that subjects were asked to choose an appropriate font to correspond with the context (Iwahara & Hatta, in press). The diploma is printed in ornamental writing in every kind of different writing systems, so that we recognize from it a dignity or status. If a diploma is written in the pica-type font, we recognize from it feeble dignity, formality and status.

The purpose of this study is, firstly, to clarify the interaction between the content of correspondence and script or print that should be used in written language communication, and secondly, to examine how to express emotional semantic information to avoid miscommunication in written language. That is, we wish to examine that how sender express his/her feelings in writing message, e.g., e-mail when he/her wants to communicate properly, e.g., to tell his/her intentions that he/she was not anger.

2. Procedure

2-1 General procedure

Present series of experiments addressed the question that how to encode emotional semantic information in e-mail communication to avoid miscommunication. As mentioned earlier, we confirmed that senders encoded their emotional semantic information by their implicit attempts such as a selection of script type or font in written

language communication. Then, we tried to examine whether the addressee could decode senders' emotional intention properly from their expression when some attempts have been done. In other words, we tried to examine whether the (implicitly) used attempts were effective enough? We conducted four experiments to compare efficiency of four kinds of encoding attempts (control: prosody, pictograph, font and script type) in decoding. As the method of four experiments was generally similar except for the way to encode emotional semantic information, we introduce firstly the general procedure in these experiments.

2-2 Method

The experiments were conducted as a group experiment in the classroom. The experimenters distributed the booklet and gave instruction to subjects. The subjects made both tasks, evaluation of the emotional state of a sender (task A) and evaluations of the confidence (task B), basically at their own pace. It took about twenty-five minutes to complete both tasks.

Subjects. Two hundreds and eighty-five students participated in the four experiments and they were given course credits. They were all university students from four classes. Their aged ranged from 18 to 23 years and all were native Japanese. Two hundreds and thirty-two were female and fifty-three were male. These subjects were assigned to four experiments.

Experimental Design. In all four experiments, we used a three-way factorial design (2 ×3×3), with repeated measures. First factor related to the encoding of emotional semantic information (encoded or not encoded). Second factor related to the emotional states of the sender (pleasant, unpleasant and neutral). Third factor related to the sender's characteristics (i.e., from who the message was sent: sweetheart /family member, friend, and acquaintance). As to the first factor, we manipulated encoding strategies differently in the series of experiments. That is, prosody, pictograph, script type, and font type were manipulated in Experiment 1, 2, 3 and 4, respectively.

These manipulations were conducted by the preparation of the communication situation where the sender wished to convey his/her positive state such as delight to the addressee. For instance, in Experiment 1, we manipulated vocal message with and without a delightful tone. Likewise, in a Experiment 2, we prepared messages with and without a delightful mark (emoticon) as "(^_^)", and in Experiment 3, we prepared messages using Katakana script at the end of the sentence or not. In the Experiment 4, we prepared messages using Kraft print or not. These manipulations were based upon our previous findings (Iwahara et al., 2003; Iwahara & Hatta, in press), in which Katakana script use at the end of the sentence made addressee feel casual or modern, and Kraft print connoted feeling as feminine or tender, etc.

Material. We selected 15 situations that gave rise to miscommunication from the results of our pilot study. In the pilot study, we asked 525 undergraduate students to remember their experience of miscommunication in the written language communication, and to write down their cases in the answer sheet of the questionnaire. The questionnaire consisted of 4 questions: contents of miscommunication, relationship between the sender / the addressee and subject, emotional state of the sender / the addressee, and the ways to avoid miscommunication. Based on these pilot studies, we made 90 stimulus materials (15 situations × 2 encoding conditions × 3 senders). We printed these on the two kinds of booklets in which the order of 90 materials were randomized. The sample materials are presented in Figure 1.

Task. The subjects were given two kinds of tasks: evaluation of the emotional state of a sender (task A) and judgment's confidence (task B).

(Task A): Judgment on emotional state of a sender. The subjects were asked to evaluate the content of intention of the sender and to choose an appropriate emotion type among 9 alternatives of emotions (delight, happiness, joy, anger, anxiety, sadness, disgust, apathy, neutral). This nine emotion types were prepared based on the Ekman's theory (1972) and added other emotional types based on our pilot study. Ekman proposed six primitive emotion, anger, fear, sadness, happiness, disgust, and surprise. Therefore, six emotions of nine emotions used in our experiment were identical with those of the Ekman's theory. According to the results of our pilot study, we changed "fear" and "surprise" in

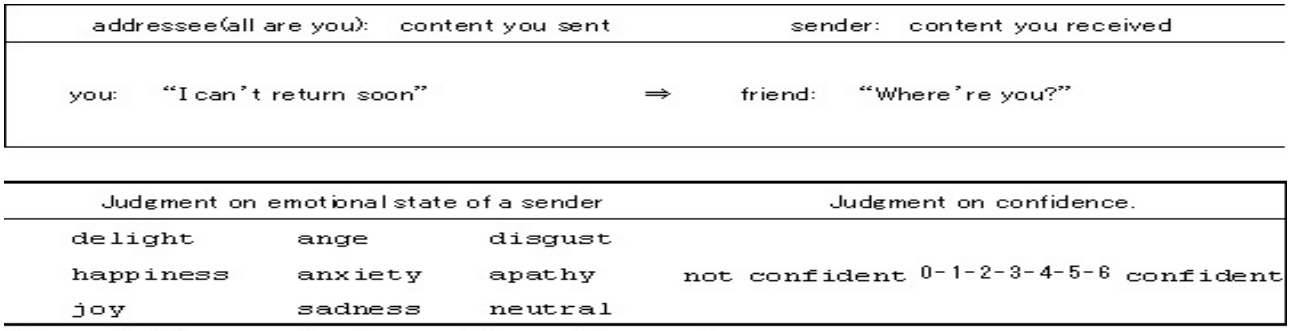

Figure 1 The sample of materials used in experimet

Ekman's theory into "anxiety" and "neutral". This is because our subjects regarded these emotional labels (fear and surprise) inappropriate expression in e-mail communication. We added three emotions, "delight", "joy" and "apathy" to the above-mentioned six emotions types based on the results of our pilot study. Because the results of our study showed that subjects frequently conveyed these three emotions in e-mail communication.

For instance, as to the sample presented in Figure 1, assuming that subject sent a message such as 'I can't return soon' to his friend and then received such a message as 'Where're you?' from his friend, the subjects was asked to guess friend's intention in sending the message (e.g., whether he was angry or not) and to choose friend's emotion type among alternatives mentioned above. We assumed that there are differences as to how subjects felt, depend on the intimacy, even if they received the same message. Therefore, we established three levels in sender: sweetheart / family, friend, and acquaintance. We also hypothesized that the difference of encoding strategy effects on the accuracy of decoding of the sender's emotional semantic information.

(Task B) Judgment on confidence. The subjects were asked to evaluate the confidence of their choice. A seven-point scale was used in rating confidence.

2-3 Experiment 1 (control experiment: spoken language communication)

The purpose of this experiment was to examine whether prosodic information could facilitate decoding of the sender's emotional semantic information.

Subjects. Fifty-nine students participated in this experiment and were given course credits. They were all university students and female. Their aged ranged from 18 to 20 years and all were native Japanese.

Task and procedure. In this experiment, we manipulated prosody (encoded or not encoded) in this experiment, so the stimulus sentence was given by a female voice recorded on tape.

Results and discussion

For the analyses, nine kinds of emotions were divided into three categories such as pleasant, unpleasant, and neutral. The "delight", "happiness", and "joy", belonged to the category of pleasantness. The "anger", "anxiety", "sadness", and "disgust", classified to the category of unpleasantness. The "apathy" and "neutral" belonged to the category of neutral. Frequency of responses to each category was calculated. Table 1 shows the frequency of response to each category as a function of encoding condition. The frequency results was analyzed by a three-way logarithm linear analysis (2(prosody encoded or not-encoded), × 2 (emotional state of sender: pleasant, unpleasant, and neutral)×3 (type of sender: sweetheart / family, friend and acquaintance)). Only the interaction between encoding of prosody and emotional state of a sender was significant [χ^2 (2) = 1689.03, $p < .001$]. However, an analysis of variance of three factors to the confidence with repeated measure revealed

Table 1. Frequency (proportion) of response to each category as a function of encoding condition in Experiment 1

	prosody encoded	not encoded
pleasant	1104 (.21)	29 (.00)
unpleasant	800 (.15)	1794 (.35)
neutral	739 (.13)	825 (.16)

that none of effects was significant.

These results showed that the frequency of pleasant category was higher in the prosody (encoded) condition than the control (not encoded) condition, and the frequency of unpleasant category was higher in the control than the prosody condition. These results indicated that the addressee could correctly decode sender's emotional state that the sender encoded by prosody. That is, vocal speech can easily convey emotional semantic information.

It is also evident that, in comparison with frequency of each category in the prosody condition, the frequency of the pleasantness was higher than that of the unpleasantness and the neutral. Likewise, it is evident that, in comparison with frequency of each category in the control condition, frequency of unpleasantness was higher than that of neutral and pleasantness, and frequency of neutral was higher than that of pleasantness. These results suggest that the addressee could decode sender's emotional semantic information as not unpleasant but pleasant when sender's emotional state was encoded by prosody.

These things make it clear again that emotional semantic information of a sender could be conveyed to an addressee correctly in spoken language.

2-4 Experiment 2 (pictograph's effect)

The purpose of this experiment was to examine whether pictograph could facilitate decoding of a sender's emotional semantic information in written language communication situation.

Subject. Eighty students participated in this experiment and were given course credits. They were all university students. Sixty-two were female and eighteen were male. Their aged ranged from 18 to 22 years and all were native Japanese.

Task and procedure. The experiment was conducted according to procedure mentioned earlier in general procedure

Results and discussion

Table 2 shows the frequency of response to each category as a function of encoding condition. The frequency results of the effect of encoding of emotional semantic information (pictograph encoded and not encoded), emotional state of a sender (pleasant, unpleasant, and neutral), and type of sender (sweetheart / family, friend and acquaintance) were analyzed by a three-way logarithm linear analysis (2 × 2 × 3). Only interaction between encoding of emotional semantic information and emotional state of a sender was significant [χ^2 (2) = 296.62, $p < .001$]. However, an analysis of variance of three factors with repeated measure to confidence revealed that none of the effects was significant.

Table 2. Frequency (proportion) of response to each category as a function of encoding condition in Experiment 2

	pictograph encoded	not encoded
pleasant	1145 (16)	570 (.08)
unpleasant	970 (13)	1455 (.20)
neutral	1522 (21)	1617 (.22)

It is apparent that the frequency of pleasant category was higher in the pictograph condition than the control condition, and the frequency of unpleasant category was higher in the control than the pictograph condition. These results show that the addressee could correctly decode sender's emotional state that the sender encoded by using pictograph.

It is also evident that, in comparison with frequency of each category in the pictograph condition, frequency of neutral was higher than that of pleasantness and unpleasantness. Likewise, it is evident that, in comparison with frequency of each category in the control condition, frequency of unpleasantness and neutral was higher than that of pleasantness. These results suggest that the addressee could decode sender's emotional semantic information as not unpleasant but pleasant when sender's emotional state was encoded by pictograph.

All these things showed that emotional semantic information of a sender could be conveyed to an addressee correctly in written language, if a sender encoded his/her emotional state by using pictograph.

2-5 Experiment 3 (effects of script type)

The purpose of this experiment was to examine whether the selection of script type could facilitate decoding of a sender's emotional semantic information.

Subject. Eighty students participated in this experiment and were given course credits. They were all university students. Sixty were female and twenty were male. Their aged ranged from 18 to 23 years and all were native Japanese.

Task and procedure. The experiment was conducted according to the procedure mentioned earlier in general procedure.

Results and discussion

Table 3 shows the frequency of response to each category as a function of encoding condition. The frequency results of the encoding effect of emotional semantic information (script type encoded and not encoded), emotional state of a sender (pleasant, unpleasant, and neutral), and sender (sweetheart / family, friend and acquaintance) are analyzed by a three-way logarithm linear analysis (2 × 2 × 3). Only the interaction between encoding of emotional semantic information and emotional state of the sender was significant [χ^2 (2) = 23.63, $p < .001$]. However, an analysis of variance of three factors to confidence with repeated measure revealed that none of the effects was significant.

It is evident that, in comparison with frequency of each category in the script condition, frequency of neutral was higher than that of the unpleasantness and the pleasantness, and frequency of the unpleasantness was higher than that of the pleasantness. Likewise, it is clear that, in comparison with frequency of each category in the control condition, frequency of the unpleasantness and the neutral was higher than that of the pleasantness. These results suggest that the addressee had a tendency to decode sender's emotional semantic information as not unpleasant but neutral when sender's emotional state was encoded by the selection of script type.

In the written language communication, the selection of script type did not absolutely effect on decoding emotional semantic information, because of the slightly less probability that sender's delightful state was decoded as unpleasant. However, the selection of script type could not convey the pleasant emotion of a sender more correctly than prosody or pictograph.

Table 3. Frequency (proportion) of response to each category as a function of encoding condition in Experiment 3

	script encoded	not encoded
pleasant	523 (.07)	538 (.07)
unpleasant	1262 (.18)	1441 (.20)
neutral	1812 (.25)	1618 (.22)

2-6 Experiment 4 (effects of font type)

The purpose of this experiment was to examine whether the selection of font could facilitate decoding of a sender's emotional semantic information.

Subject. Sixty-six students participated in this experiment and were given course credits. They were all university students. Fifty-five were female and fifteen were male. Their aged ranged from 18 to 21 years and all were native Japanese.

Task and procedure. The experiment was conducted according to procedure mentioned earlier in general procedure.

Results and discussion

Table 4 shows the frequency of response to each category as a function of encoding condition. The frequency results of the effect of the encoding of emotional semantic information (font type encoded and not encoded), emotional state of a sender (pleasant, unpleasant, and neutral), and sender (sweetheart / family, friend and acquaintance) are analyzed by a three-way logarithm linear analysis (2 × 2 × 3). Only the interaction between the encoding of emotional semantic information and the emotional state of a sender was significant [χ^2 (2) = 23.63, $p < .001$]. However, an analysis of variance of three factors to confidence with repeated measure revealed that none of effects was significant.

It is evident that, in comparison with frequency

Table 4. Frequency (proportion) of response to each category as a function of encoding condition in Experiment 4

	font encoded	not encoded
pleasant	436 (.07)	488 (.07)
unpleasant	1057 (.18)	1173 (.20)
neutral	1469 (.25)	1295 (.22)

of each category in the font condition, frequency of neutral was higher than that of unpleasantness and pleasantness, and frequency of unpleasantness was higher than that of pleasantness. Likewise, it is clear that, in comparison with frequency of each category in the control condition, frequency of unpleasantness and neutral was higher than that of pleasantness. These results suggest that an addressee had a tendency to decode sender's emotional semantic information as not unpleasant but neutral when sender's emotional state was encoded by the selection of font type.

In the written language communication, the selection of font did not influence on the decoding emotional semantic information absolutely, because of the slightly less probability that sender's delightful state was decoded as unpleasant. However, the selection of font could not convey the pleasant emotion of a sender more correctly than prosody or pictograph.

3. General discussion

In the present series of experiments, we tried to examine if a sender encodes his/her emotional semantic information without miscommunication in written language communication. The results of Experiment 2 show that encoding pictograph in written language communication can convey sender's emotional state to an addressee correctly. In fact, many people try to use pictograph or "Smiley" in their message and transmit their emotional state today. Moreover, all cellular phone companies have developed several kinds of tools for e-mail communication for a few years, and it suggests that people recognize the value in encoding emotional semantic information by pictograph as the effective means to avoid miscommunication. However, pictographs make people childish, so the use of them is limited in the private communication situation at least in Japan.

On the other hand, people possess the feeling that the selective use of script or font type must be effective to decode emotional semantic information. Then, people do select script or font in written language communication situation to convey their emotional state (Iwahara et al., 2003; Iwahara & Hatta, in press). In spite of these people's awareness, the results of Experiment 3 and 4 did not support the people's awareness in writing situation. The results showed firstly that the selection of script or font type can not convey sender's emotional semantic information more clearly than prosody or pictograph, and secondly that an addressee cannot decode sender's delightful emotion encode by the selection of script or font type as pleasant.

However, the possibility that the effects of selection of script or font type on decoding sender's emotional state should not be entirely ruled out, because an addressee can decode as not unpleasant, emotional semantic information which a sender encoded by selecting an appropriate script or font type. It seems to us that there are two proper reasons why we could not obtain clear results in Experiment 3 and 4.

First, it relates to an inconsistency or an incompatibility of the rules of "encoding-decoding" between a sender and an addressee. That is, an addressee cannot decode sender's emotional state that he/she encoded by means of the selection of script or font type, because sender's encoding rules are different from addressee's ones.

And second, it may relate to the use of an inappropriate measure in the present series of experiments. In the previous studies, we tried to examine the effects of script type and font type on the slight related imagery feelings as for nuance not on the strong emotional feelings. In other words, it might be plausible that the selection of script or font type can convey nuance such as feminine or exotic, but cannot transmit emotional states like pleasant or unpleasant. In that point, the selection of script or font type is different from prosody or pictograph, but we used it as measure of not nuance but emotional state nevertheless. More concretely, in Experiments 1 & 2, the emotional encoding ("delightful" prosody or emoticon) is clearly affective, and related to the emotions that the subjects were asked to consider ("delight" in particular). However, Experiments 3 & 4 are a bit strange. Our previous work suggests that Katakana is perceived as "casual or modern", and that Kraft print is perceived as "feminine or tender". However, these are not necessarily appropriate for expressing emotional state (although these have an affective sense), and are not directly related to any of the emotions the subjects were asked to consider ("delight" etc.). Therefore, the cases in Experiment 3 & 4 might not be perfectly parallel to those in Experiment 1 & 2.

However, there is clear evidence that many Japanese try to select unusual script type to convey their emotional state in e-mail communication (Iwahara et al., 2003; Iwahara & Hatta, in press). As they believe that violation of general rule in selecting script type can convey their emotional state, so they tend to use Katakana at the end of a sentence. In other word, they try to use Katakana to convey their casual sense (not angry or serious). However, how to use this kind of violation is not certain, so an addressee cannot decode a sender's intention correctly. Therefore, we need to investigate the effect of selection of script type more systematically to avoid miscommunication in e-mail communication. Actually, this tendency can be regarded as similar to the punctuation and the capitalization in English ("You have the car." vs "YOU have the car?!?!?"), and might be universal in written language communication.

These considerations invite the needs for further accumulation of the empirical evidences. The request for a new system to avoid miscommunication in written language communication such as e-mail message seems to be increasing more and more. In future trial, we wish to focus on encoding strategies that both a sender and an addressee can understand easily.

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