

Cross-cultural Study of Avatars' Facial Expressions and Design Considerations within Asian Countries

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Abstract. Avatars are increasingly used to express our emotions in our online communications. Such avatars are used based on the assumption that avatar expressions are interpreted universally among any cultures. However, our former study showed there are cultural differences in interpreting avatar facial expressions. This paper summarizes the results of cross cultural evaluations of avatar expressions among five Asian countries. The goals of this study are: 1) to investigate cultural differences in avatar expression evaluation and apply findings from Psychological study in human facial expression recognition, 2) to identify design features that cause cultural differences in avatar facial expression interpretation. The results confirmed that 1) there are cultural differences in interpreting avatars' facial expressions among Asian countries, and the psychological theory that suggests physical proximity affects facial expression recognition accuracy is also applicable to avatar facial expressions, 2) use of gestures and gesture marks may sometimes cause counter-effects in recognizing avatar facial expressions.

Key words: avatar, character, facial expression, cross-culture, network communication

1 Introduction

Since instant messenger and chat services are frequently used in our daily communication beyond nationality and languages, emoticons and expressive avatars are widely used to provide nonverbal cues to text-only messages [1, 2, 3]. Recent growth of virtual world [4] attracts worldwide attention to avatar mediated communication both from entertainment and businesses. Studies on emoticons and avatars report positive effects on computer-mediated communication. Those studies indicate that emoticons and avatars improve user experiences and interactions among participants [5, 6, 7] and build enthusiasm toward participation and friendliness in intercultural communication [8, 9].

However, these avatars are used based on an implicit assumption that avatar expressions are interpreted universally across cultures. Since avatars work as graphical representations of our underlying emotions in online communication, those expressions should be carefully designed so that they are recognized universally. We need to closely examine cultural differences in the interpretation of expressive avatars to avoid misunderstandings in using them.

However, few studies have compared the cultural differences in interpreting avatars. One of those studies compared interpretations of avatars' animated gestures between the Netherlands and Japan [10]. Their results showed that there are cultural differences in perceived valence in animated characters between the two countries. Japanese women perceived stronger emotions in some animated gestures of an avatar, i.e., bowing, than the Dutch subjects, although there were no overall differences in interpretation of the presented gestures. In our former study, we conducted a cross-cultural experiment in the form of a series of discussions on a multilingual BBS with expressive avatars between China and Japan [8]. The results show some facial expressions used in the experiment were interpreted completely differently and used for different purposes between Chinese and Japanese. Those "misinterpreted" expressions are "sweat-on-the-face," "wide-eyed," and "closed-eyes." For example, the "wide-eyed" expression was interpreted as "surprised" by the Japanese subjects, while the Chinese subjects interpreted it as "intelligent" and used it when presenting a novel idea or asking questions. We observed that the Japanese subjects tried to confirm the meaning of the Chinese subject's message with the "wide-eyed" expression. This is one example of communication gaps caused by different interpretations of avatar expressions between the two countries.

The above two studies were each conducted between only two countries. We need to conduct an evaluation experiment among multiple countries in order to investigate cultural differences in avatar expression interpretation and what kinds of expressions are interpreted universally and what kinds are not. We believe the results would serve as a design guideline for universal avatar expression that would not lead to miscommunication.

In our previous study [11], we applied findings from psychological studies on human facial expressions, since there have been a much wider variety of studies in psychology on human expressions than on avatar expressions. The most widely accepted findings come from the work of Ekman. He states that seven emotions, namely, anger, fear, disgust, surprise, sadness, happiness and contempt, are universally expressed by all cultures. However, he also argues the implications and connotations of those facial expressions are culturally dependent, and the degree of allowance in showing or perceiving those expressions socially differs across cultures [12]. Recent psychological research found evidence for an "in-group advantage" in emotion recognition. That is, recognition accuracy is higher for emotions both expressed and recognized by members of the same cultural group [13]. Elfenbein et al. state, "This in-group advantage, defined as extent to which emotions are recognized less accurately across cultural boundaries, was smaller for cultural groups with greater exposure to one another, for example with greater physical proximity to each other [13]." Also, the decoding rule implies that we concentrate on recognition of negative expressions, since misinterpretation of negative expressions leads to more

serious social problems than misinterpretation of positive expressions would cause [15].

We conducted an open web experiment to compare interpretations of avatars' facial expressions among 8 countries, namely, Japan, South Korea, China, United States, United Kingdom, France, Germany, and Mexico in our previous study [11]. The results indicated that there are cultural differences in interpreting avatars' facial expressions, and the in-group advantage was found in interpreting avatar expressions. The next step is to validate each avatar's graphical design and find the design features that would lead to cultural difference in interpretation.

In this paper we summarize the results of a further experiment within 5 Asian countries using a more controlled experiment set than the one used in the previous experiment. The reason for conducting the experiment within Asia is to validate the cultural differences found across Asia, Europe, and North America in the previous experiment are again applicable within Asian countries, which have less geographical distances.

The goal of this experiment is: 1) to investigate cultural differences in avatar expression evaluation and apply findings from Psychological study in human facial expression recognition, namely the "in-group advantage", within Asian countries, 2) to identify design features that might cause cultural differences in avatar facial expression interpretation.

2 Experiment Overview

2.1 Experimental Procedure

The experiment was conducted in 2005 as part of the Intercultural Collaboration Experiment (ICE2005), jointly hosted by Chinese, Japanese, South Korean, Malay, and Thai universities and research institutes. The experiment was set on WWW, which was accessible only to pre-registered participants from the participating countries.

The experiment was developed using the application of Macromedia Flash. Participants first answer a brief questionnaire on their background profile such as their nationality and mother tongue. The main experiment starts after the questionnaire, which is presented as a matching puzzle game as shown in Fig. 1. Participants are requested to match 12 facial expressions to 12 adjectives. The 12 facial expressions are displayed in a 4 x 3 matrix and the 12 adjectives as buttons below the matrix. As shown in Fig. 1, participants can drag/drop the adjective buttons to/on the 12 expressions and continue changing the location of each button until they are satisfied with their answer. One avatar representation is chosen randomly from 10 avatars, and facial expression images are randomly placed in the 4 x 3 matrix. The adjective buttons are always displayed in the same order, and the 12 adjectives are always the same (see sec. 2-2 for the adjectives used in the experiment).

Participants' answers to the puzzle game and questionnaire, as well as their background profile including gender, age, county of origin, and native language, are logged in the server for later analysis. Participants are required to continue the experiment until they finish evaluating all the 10 avatar designs.

The adjectives can be shown in English, Chinese, Korean, and Japanese (all validated by native speakers). Participants from countries where the above languages are primarily spoken can see the adjective selections in their native language according to the background profile. Japanese, Chinese, Korean participants are shown the adjectives in their native language, and Thai and Malay participants in English. The participants from Thailand and Malaysia are fluent in English.

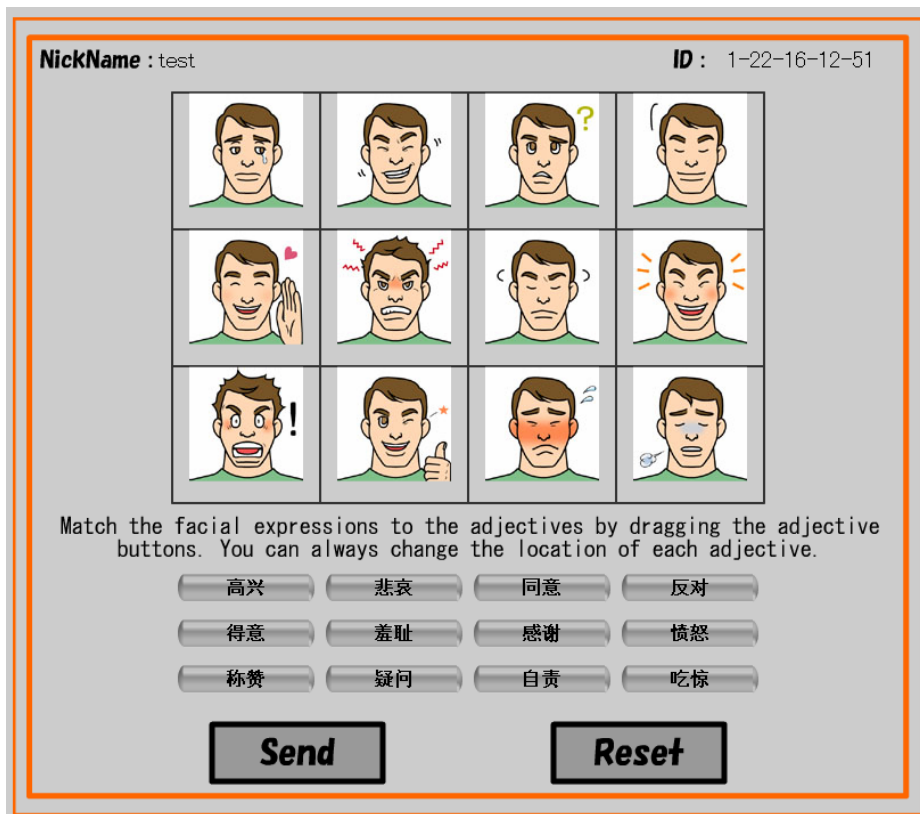


Fig. 1. Experiment screen shown as a matching puzzle game (Example screen for Chinese participants).

2.2 Avatar and Expression Design

Commercially used avatars are represented not by photo-realistic images but as caricatures or comic figures. We prepared 10 avatar representations drawn by three Japanese designers using Japanese comic/anime drawing style. By using avatars drawn

with techniques from one culture, we can use those avatars as “expressers” and subjects as “recognizers” as in [15]. Accordingly, comparing the answers between Japanese users and those of other countries made it easier to validate the in-group advantage. Fig. 2 shows three examples from the 10 avatar representations.

The 12 expressions used in the experiment are “happy,” “sad,” “approving,” “disapproving,” “proud,” “ashamed,” “grateful,” “angry,” “impressed,” “confused,” “remorseful,” and “surprised” as shown in Fig. 3. Those expressions are selected from Ortony, Clore and Collins’ global structure of emotion types, known as the OCC model [16]. These are commonly used expressions in chat and instant messenger systems [1, 2, 3], and they reflect those emotions desired by the subjects for intercultural communication in [11].



Fig. 2. Examples of avatar representation.



Notes: From top left, happy, sad, approving, disapproving, proud, ashamed, grateful, angry, impressed, confused, remorseful, and surprised, drawn in Japanese comic style.

Fig. 3. Twelve facial expressions of one of the avatars.

These 12 expressions are paired as valanced expressions as defined in the OCC model, that is, negative/positive emotions that arise in reacting to an event or person. “Happy,” “approving,” “proud,” “grateful,” and “impressed” are positive expressions, while “sad,” “disapproving,” “ashamed,” “angry,” “confused,” and “remorseful” are negative expressions, leaving “surprised” as a neutral expression.

The experiment procedure and the matching puzzle game was the same as the one conducted in the previously except the following. These changes are made to control the experimental conditions more strictly.

1) Only the pre-registered participants can access the experiment site, while the participants in the previous experiment were freely access the experiment site.

2) The number of avatar design used in this experiment is limited to 10 instead of 40. The 10 avatar designs are selected according to the design features to express emotions in order to clarify difference in interpretations. The designs are categorized

into three groups, namely, expression only, expression with a gesture mark, and expression with gesture.

3) Participants evaluate all the 10 avatar designs in this experiment, while the participants could stop evaluating the avatar designs any time in the previous experiment. Thus, the avatar designs and the number of avatars each participant evaluates are the same across participants in this experiment.

3 Results

The web experiment was conducted in July, 2005. The participants are gathered through research collaboration members among Japan, South Korea, China, Malaysia, and Thailand. Participation was not mandatory, but strongly encouraged among participants. The numbers of questionnaire answers are 19 from Japan, 12 from South Korea, 30 from China, 16 from Malaysia, and 15 from Thailand. The participants who answered the questionnaire are in their 20's and 30's, and the ratio of male and female was 1:1.

3.1 Difference in Interpretation of Avatar Facial Expression

This section aims to investigate whether there are cultural differences in interpreting avatar facial expressions.

The participants' answers to the puzzle game are analyzed by calculating matching rates between expressions and adjectives. There is no correct answer to the matching puzzle, but the avatar designers' original intention can be used as an expresser's "standard" answer. Each expression and adjective is assigned a number (1-12) within the system. The designer's intended pairs are described as (1,1), (2,2), (3,3), (4,4) reflecting (expression number, adjective number). We calculated each country's number of "expression-adjective" pairs that are the same as the designers' pairs. Consequently, here, "matching rate" means the percentage of pairs of expressions and adjectives that match the avatar designer's intentional pairs. For example, the matching rate of answer pairs (1,5), (2,1), (3,3), (4,9) is 25%. We use this "expression-adjective matching rate" in comparing the answers to the 12 facial expressions.

Fig. 4 shows the matching rates shown by expression and country. When we focus on the matching rates by country, Japan's matching rates are the highest in the five countries in all expressions. This means the degree of matching the expresser (avatar designer)'s intention and the answers of the recognizers (participants) is high. Hence the in-group advantage within the same country is identified in this experiment. This result further confirms the results of the previous experiment, in which Japan's answers had significantly highest matching rates among the eight countries, namely, Japan, South Korea, China, the United States, the United Kingdom, Germany, France, and Mexico. Thus, this result suggests that there are cultural differences among the five Asian countries which geographical distance is smaller.

When we focus on the matching rates by facial expression in Fig. 4, we again observe that the negative expressions have higher matching rates than the positive ones. Thus, as found in [11], the result suggests that the decoding rule is applicable to the answers to the five Asian countries.

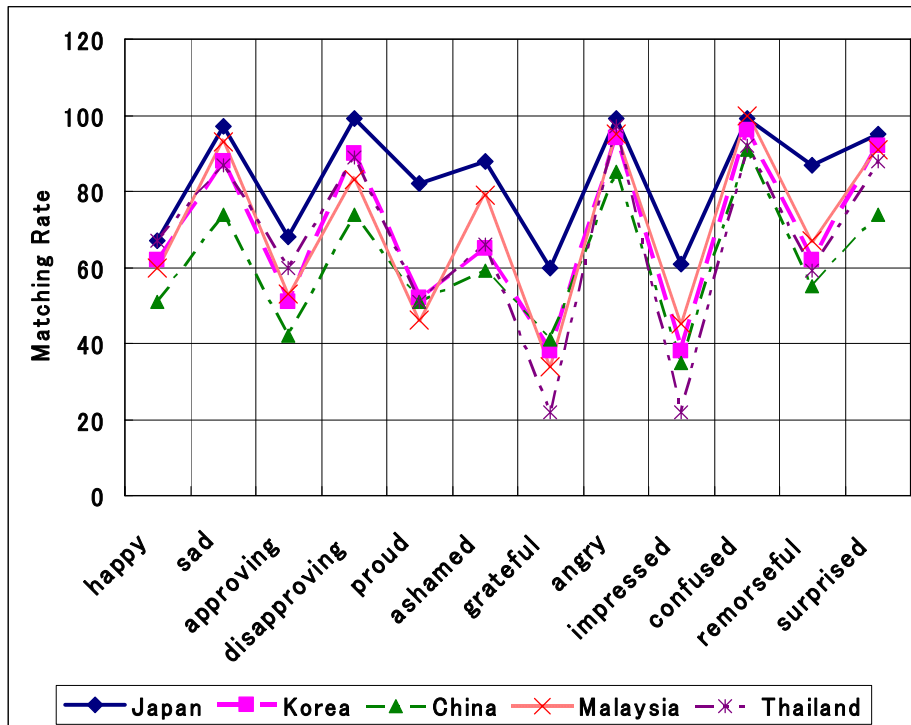


Fig. 4. Matching rate of each expression by country within Asia.

3.2 Analysis of Recognition Accuracy by Facial Expression Design

This section analyzes the design features that would cause cultural differences in interpretation of avatar facial expressions. Among the facial expressions that have lower matching rates than others, we analyze the answers to the “proud”, “grateful”, and “impressed” expression by country.

The design features that are used in the above three expressions are categorized into three groups, namely, “facial expression only”, “facial expression with a gesture mark”, “facial expression with gesture.”

Analysis of the design that uses facial expression only

Firstly, we analyze the answers to the avatar design that uses facial expression only, by using the “proud” expression. As in Fig. 4, the difference in the matching rate of

Japan and other countries is the biggest in the “proud” expression. Fig. 5 shows the design examples of the “proud” expression, and Fig. 6 shows the answers to the “proud” expression shown by country. As shown in Fig. 5, “chin-up” expression is used to express “proud” in the avatar design. The detailed answers by country to the proud expression in Fig. 6 shows that more than 90% of answers to the “proud” expression were “proud” in Japan, while other countries’ answers has only about 50% accuracy. The expressions that are mixed up with “proud” are “grateful”, “impressed”, and “happy”, which all categorized as positive expressions.



Fig. 5. Design samples of “Proud” expression.

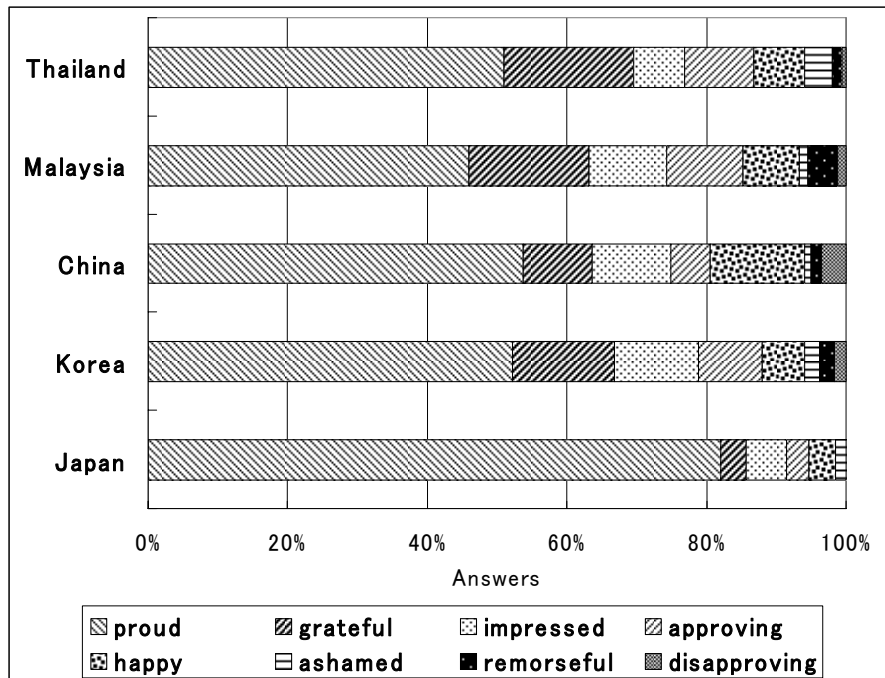


Fig. 6. Detail answers to “proud” expression shown by country.

Analysis of the design that uses facial expression only and facial expression with a gesture mark

Secondly, we analyze the answers to the avatar design that uses both “facial expression only”, and “facial expression with a gesture mark”, using “grateful” expression. As in Fig. 4, the “grateful” expression has one of the lowest matching rates among positive expressions.

Fig. 7 shows the design examples used to express “grateful” expression. There are two designs used to express “grateful” expression. The first used facial expression only to express “grateful”, and the latter used facial expression with a gesture mark (heart mark) as shown in Fig. 7.

Fig. 8 shows the detailed answers to the “grateful” expression presented by facial expression only, and the ones with a gesture mark. The answers of Japan to the design with a heart mark has higher matching rate (the percentage of answers that answered “grateful”) than the ones to the design that used facial expression only. While in other countries, using a heart mark does not necessarily result in higher matching rate. Especially in South Korea and Thailand, answers to the design used “facial expression only” have higher matching rate (the percentage of answers that answered “grateful”) than the ones to the design that used “a heart mark”. Adding a heart mark to the “grateful” expression design increased the number of answers that answered “impressed” in South Korea and Thailand.



Fig. 7. Design samples of "Grateful" expression with a heart mark.

Analysis of the design that uses facial expression with a gesture mark, and facial expression with gesture

Lastly, we analyze the answers to the avatar design that uses “facial expression with a gesture mark”, and “facial expression with gesture”, by using the “impressed” expression. As in Fig. 4, the “impressed” expression has one of the lowest matching rates among positive expressions.

Fig. 9 shows the design examples used to express “impressed” expression. There are two designs used to express “impressed” expression. The first used “facial expression with a gesture” (“clapping hands” gesture) to express “impressed”, and the latter used “facial expression with a gesture mark” (exclamation mark “!”) as shown in Fig. 9.

Fig. 10 shows the detailed answers to the design that used facial expression with a clapping hand gesture, and Fig. 11 shows the detailed answers to the design that used facial expression with “!”. The detailed answer of Japan shows the highest matching rate, about 80% (percentage of answers that answered “impressed”) among the five countries. While in other countries, detailed answers vary according to the design used to express “impressed”. Especially in China, the “impressed” expression with clapping hands gesture is interpreted as “approving” more often as “impressed”. In Thailand, the “impressed” expression with a “!” mark is interpreted as “grateful” rather than “impressed”.

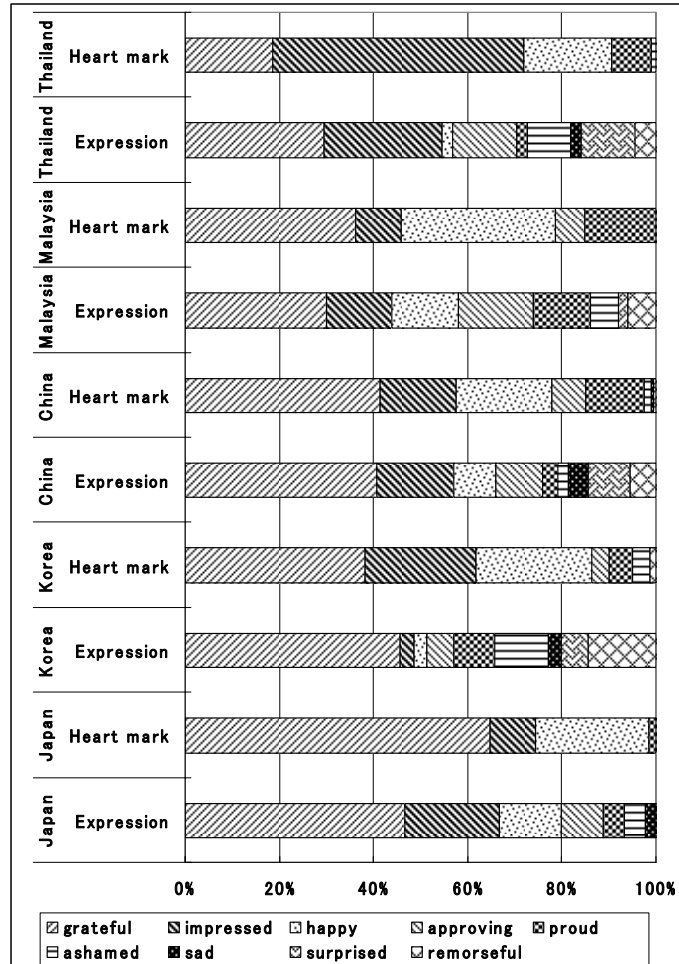


Fig. 8. Detail answers to the “grateful” expression (comparison of answers to the design that used facial expression only and with a heart mark).



Note: Right: with “clapping hands” gesture, Left: with “!” mark)
 Fig. 9. Example of the designs for “impressed” facial expression.

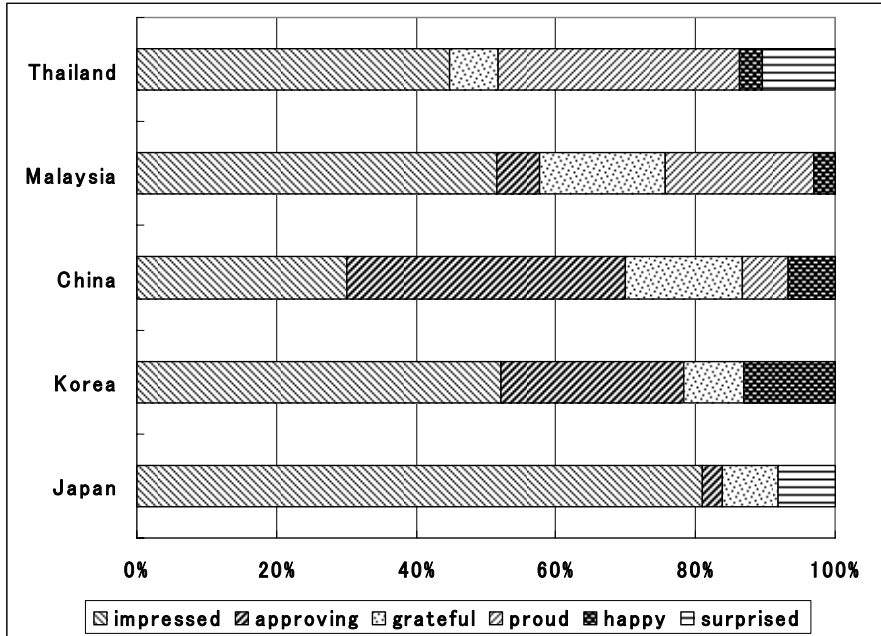


Fig. 10. Detail answers to “Impressed” expression with a clapping gesture shown by country.

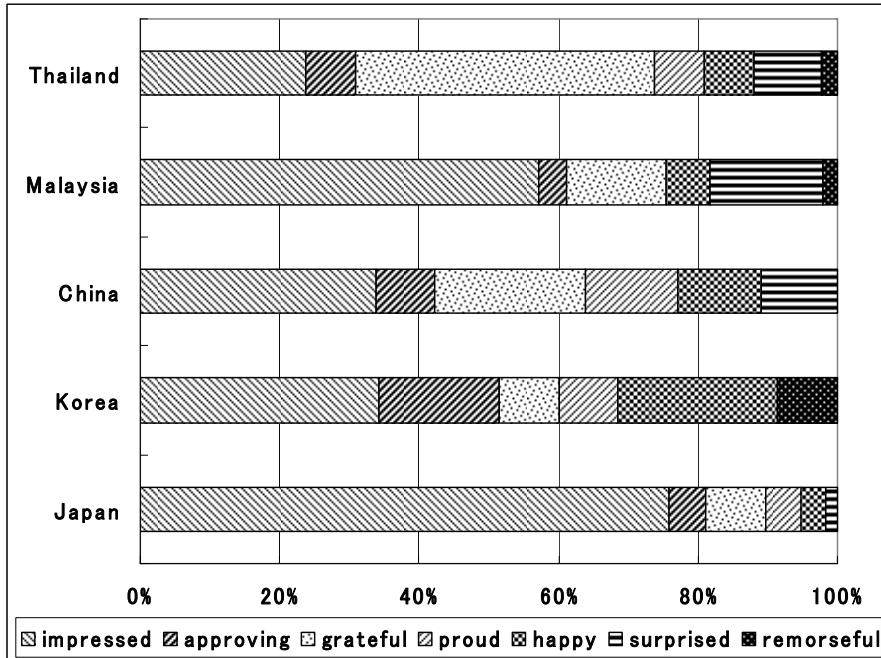


Fig. 11. Detail answers to “Impressed” expression with “!” shown by country.

4 Discussion

The results shows the avatar facial expressions designed using the Japanese comic drawing techniques have higher recognition accuracy within Japanese participants than the participants in other countries within Asia. Thus this is another indication that the in-group advantage within the same country, which is found in recognizing human facial expressions, is also applicable to avatar expressions, when compared to the answers among the five Asian countries. We again found results that support the decoding rule, that negative expressions are more accurately recognized than positive ones in human facial expression, in avatar expressions.

Next analyses were made using different avatar expressions designs in the four facial expressions that had the lowest recognition accuracy. There are three different designs used in the experiment, namely, 1) facial expression only (i.e., “proud” expression), 2) facial expression with a gesture mark (i.e., a heart mark in the “grateful” expression, an exclamation mark in the “impressed” expression), 3) facial expression with a gesture (i.e., a clapping hand gesture in the “impressed” expression).

The results showed that Japan’s recognition accuracy is the highest in all the three designs (facial expression only, facial expression with a gesture mark, and facial expression with a gesture) among the five Asian countries, and adding a gesture mark increases the recognition accuracy of Japan compared to the one to the designs that use facial expression only. While other countries than Japan, using a gesture mark tend to decrease the recognition accuracy compared to the one to the design that use facial expression only. Thus using a gesture mark does not necessarily improve the recognition accuracy in other countries than the expresser’s country. Using a gesture with facial expression caused varied answers in other countries than Japan. Thus avatar expression designs with gesture do not lead to a better interpretation in this experiment.

Similar cultural differences in interpreting gestures in pictograms are reported in [17]. The survey was conducted using pictograms developed and used in NPO Pangaea’s communication software, which allows children all over the world to communicate online regardless of their mother tongues using pictograms [18, 19]. The survey was conducted between the United States and Japan to ask meanings of 120 pictograms used in the Pangaea’s communication software. The results suggested interpretations of gestures in pictograms vary according to culture [17]. Cho states the reason for these cultural differences can be explained by psychological studies by Efron [20] and Ekman [21]. [20] finds evidences for a human gesture to have different meanings according to culture, and [21] categorizes human gestures, among which “emblem” gestures (symbolic gestures) are cultural dependent. Both [17] and this study on avatar interpretation find “emblem” gesture (crossing arms to indicate “NO” in the former, clapping hands in the latter) has cultural differences in their interpretation. Thus, cultural differences in interpreting human gesture may be applicable to gestures in graphical representations such as avatars and pictograms.

Another reason for decreased recognition accuracy of the use of gestures and gesture marks in other countries may result in the unique comic culture in Japan, given the fact that avatars were drawn using Japanese comic drawing style. The comic culture has been developed in relative isolation in Japan [22], has grown in a different

way than other countries, by creating new drawing techniques, i.e., slashing gesture line style to express motion and dynamics, collages of faces and symbolic expressionistic effects, word-picture linkage, and iconic characters instead of caricatures) [23]. Example of such unique Japanese iconic expressions are “frames to express anger”, and “balloon from a nostril to express sleeping”. The avatar designs used in the experiment were designed by three Japanese designers to limit the expressers from one country, thus have unique comic drawing styles that is interpreted accurately only by Japanese, and lead to various interpretations from other countries. Further study should be done to evaluate avatars designed by artists of other cultures, e.g., European or American.

5 Summary

This paper compared the interpretations of avatars’ facial expressions among five Asian countries and analyzed the design features that would lead to misinterpretation of avatars’ facial expression. The goal of this experiment is: 1) to investigate cultural differences in avatar expression evaluation and apply findings from psychological study in human facial expression recognition within Asian countries, 2) to identify design features that cause cultural differences in avatar facial expression interpretation.

The results suggested that 1) there are cultural differences in interpreting avatars’ facial expressions among Asian countries, and the psychological theory that suggests physical proximity affects facial expression recognition accuracy is also applicable to avatar facial expressions, 2) use of gestures and gesture marks may sometimes cause counter-effects in recognizing avatar facial expression. Using gesture and gesture marks increase the recognition accuracy of the expresser’s country, while other countries’ recognition accuracy was not increased when compared to the one to the designs that uses facial expression only. This indicates that we have to be careful in adding a gesture or mark in designing avatars and avatar facial expression.

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