

New Mobile Adaptation System for Better Avatar-mediated communication; Facial Expressions in Memoji

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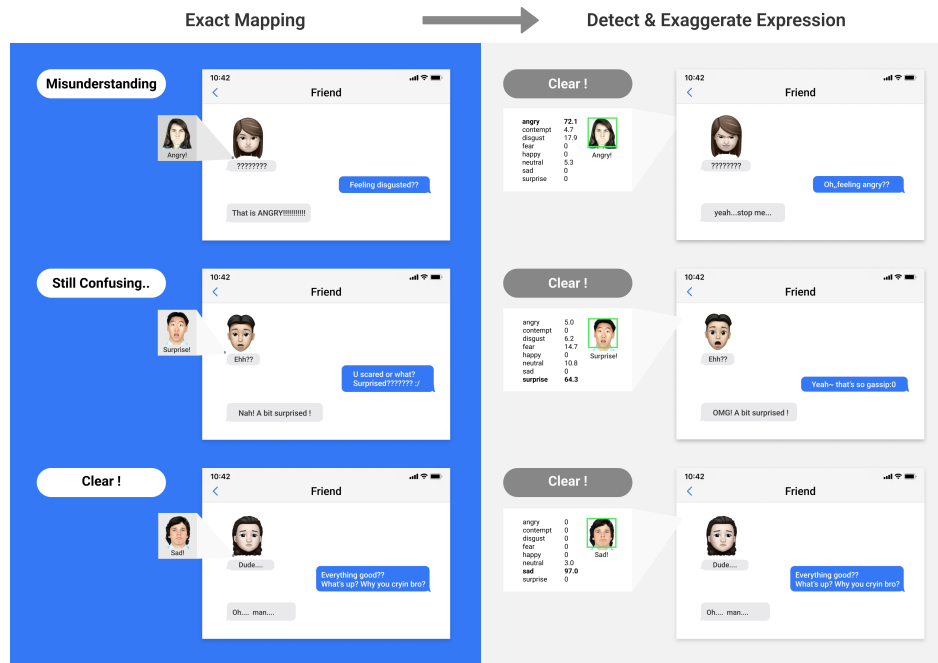


Figure 1: (Left)When users express emotion with Memojis, misunderstanding, confusion, and (sometimes) clarity can be the result. (Right)Suggesting an adaption system that detects the intended emotion and expresses an exaggerated Memoji.

ABSTRACT

Avatars, including Apple’s Memojis, represent users on digital platforms, and future investigations will address questions beyond computer-mediated communication, such as group communication, non-verbal communication, and organizational communication. Currently, Memojis’ emotional conveyance is receiving much attention. We investigated how people perceive and judge the emotional quality of the Memojis. An online survey collected user assessments of emotional expressions in Memojis. We created Memojis of seven emotions based on 28 images from the Japanese and Caucasian facial expressions of emotion (JACFEE) database using an iPhone running iOS 15.2. The emotional appeals of individual Memojis were judged. In general, Memojis were insufficient to communicate

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emotions. Happiness and sadness are the most robust, while fear and disgust had a low level of conveyance, and anger, contempt, and surprise were relatively inaccurately perceived. The results suggested developing an adaption system that detects the intended emotion and expresses it in the exaggerated way that cartoon-like characters convey emotions. The limitations and challenges of the proper use of Memojis for better figure-based and non-verbal communication are also discussed.

CCS CONCEPTS

• Human-centered computing → Empirical studies in interaction design; Empirical studies in HCI.

KEYWORDS

Computer-Mediated Communication, Avatar-Mediated Communication, Avatar, Memoji, Facial Expression, Emotion, JACFEE

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1 INTRODUCTION

Avatars are a unique non-verbal communication channel that represents the users [12]. Both personal style and emotion can be expressed through avatars [16][11]. To convey these features, users can customize avatars to better represent their own situation. In the process of customizing, some users would replicate their exact facial features, but other users tend to make more attractive avatars [18]. For example, some users customize their avatar to their taste (e.g., hat, hairstyle, make-up, accessories) and express their virtual identity rather than their real-world identity [11]. While more attractive physical features are needed, a more honest and accurate conveyance is required with facial expressions and emotion [15]. However, few studies have assessed the level of emotion conveyed by the avatars. Additionally, systemic design guidelines to prevent misunderstanding in computer-mediated communication are still lacking.

In this study, we were motivated to confirm **the level of emotional conveyance through avatars**. An online survey was conducted, and Memoji, Apple's animated avatar, was used. We collected empirical evidence to understand the emotional conveyance of Memojis. For the emotional norms of facial expressions, we used the Japanese and Caucasian facial expressions of emotion (JACFEE) [10] database as the photographic basis for the Memojis.

1.1 Facial Expressions in Avatars

Prior research suggests that users tend to convey their emotions more honestly and accurately in anonymous, digital situations [5, 15]. Derks found that users tend to feel less embarrassed or anxious about communicating their actual feelings in more anonymous settings. Additionally, in a cooperative context, facial expressions may serve as honest signals to all.

Avatars have a facial expression that helps people to communicate ideas and emotions in an emotional context [1, 7, 9]. Because of this effectiveness, studies about making avatars and examining the emotional assessment have been an interest of HCI researchers. For example, Suda created an avatar and confirmed the effect of imitating facial expressions in both avatar–avatar and human–avatar environments [16].

Therefore, an avatar is a unique communication channel to express the users' facial expressions, and an exploration of the avatar's facial expression delivery level would be worthwhile.

1.2 Memoji as Avatar-Mediated Communication

An avatar is a medium that conveys the facial expression efficiently in virtual environments [2, 8]. Identifying computer-mediated communication through avatars has been interesting to HCI researchers [12] in various communication contexts, such as group communication [17], non-verbal communication [3, 6], and organizational communication [14]. Many tech and social media companies have made their own avatars in various forms. Memojis by Apple (<https://support.apple.com/en-us/HT208986>), Facebook Avatar by Facebook

(<https://www.facebook.com/help/278747370042382>), LINE Avatar by LINE (<https://linecorp.com/ja/pr/news/ja/2020/3427>), Bitmoji by Snap (<https://www.bitmoji.com/>), MetaHuman by Epic Games (<http://www.makehumancommunity.org/>), Reality (<https://reality.app>), and open-source software MakeHuman (<https://www.live2d.com/>) are a few examples [16].

Among these avatars, Memojis are expected to effectively convey emotions through high-performance replication of facial expressions [16]. We conducted an online survey with Memojis to measure how accurately and reliably they express facial emotions.

2 ONLINE SURVEY

2.1 Method

2.1.1 Materials: Memojis from JACFEE. To create the Memojis, we used an iPhone 11 running iOS 15.2. In addition, we used verified JACFEE photography to generate the facial expressions. The JACFEE contains photographs of 28 Japanese and 28 Caucasian men and women displaying the seven basic emotions: anger, contempt, disgust, fear, happiness, sadness, and surprise. Each photograph in the JACFEE database has been evaluated for accuracy; the score ranged from 26.72% (fear) to 100% (happiness). Among the seven emotions, happiness achieved the highest accuracy, followed by surprise, sadness, anger, disgust, fear, and contempt. Except for contempt, both US-born Americans and Japanese Americans correctly identified the intended emotion when it was expressed by a Caucasian face more often than when it was expressed by a Japanese face [4]. Hence, we planned to analyze whether this trend also appears when the participants make judgments of the Memojis generated from the JACFEE photography. We reduced the survey duration to half of Memojis and used seven Japanese men, seven Japanese women, seven Caucasian men, and seven Caucasian women, one from each emotion category. Figure 2 presents the set of Memojis used in the survey.

2.1.2 Participants. For a more accurate assessment, we recruited participants from two countries, the United States and Korea. A total of 164 people between 18 and 37 years old (mean = 30.73, standard deviation = 4.88). Half of the participants were native Korean university students, consisting of 43 men and 39 women, and the remaining 82 were American, with 50 men and 32 women. They were paid 3.5 dollars for voluntary participation. Korean participants were recruited through the university portal website, and Americans were recruited by Amazon Mechanical Turk (<https://www.mturk.com/>).

2.1.3 Questionnaires. As shown in Figure 3, we presented one of 14 Memojis and asked participants to rate its emotional intensity with regard to the seven emotions using a 5-point (1–5) scale, labeled strongly disagree (–2), disagree (–1), neutral (0), agree (1), and strongly agree (2). We analyzed the responses to determine the accuracy of the Memojis' emotional conveyance.

2.1.4 Procedure. To proceed with the survey without losing participants' attention, we limited the stimuli to 14 of the 28 Memojis. We randomly selected the materials for the survey and made a total of 164 evaluations for each Memoji. Participants joined the survey remotely, and participants responded via a web-based survey platform.





























Ethnicity	Emotion						
Caucasian							
							
Japanese							
							

Figure 2: The Memojis used in the survey. From left to right, they signify anger, contempt, disgust, fear, happiness, sadness, and surprise.

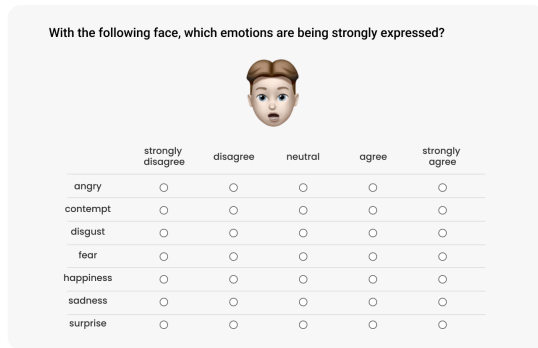


Figure 3: Online Survey: Judgements of facial expressions of emotion from the Memojis. The emotional intensity was assessed across seven emotions.

3 RESULTS AND ANALYSIS

We have analysed the results in two ways: 1) summarize the central tendency across the seven emotions, and 2) compare the impact nationality on the interpretation of the seven emotions. Each Memoji was assessed in aspects of seven emotions, and determined whether participants agreed about whether it conveyed the intended emotion.

3.1 Central Tendency Across the Seven Emotions

Table 1 shows the summarized results as the averaged assessments of four categories: Caucasian men and women and Japanese men and women. The assessment scores confirmed that happiness and sadness were assessed as intended; the agreement scores were equal to or greater than 1.00, between -2 (strongly disagree) and

+2 (strongly agree). Furthermore, the scores for happiness and sadness were distinctively higher than those for other emotions. This result indicates these two emotions are well reflected in their Memojis. Disgust and fear emotions were also assessed as intended. However, with scores of 0.21 and 0.30, respectively, they were much closer to 0 (neutral).

The remaining three emotions, anger, contempt, and surprise, showed a different tendency. Participants tended to confuse anger with contempt. With angry expressions, the scores on anger and contempt were 0.75 and 0.79. Participants confused surprise with fear, and the scores of both emotions were over 1.00. The contempt Memojis were scored as disgust (0.28), anger (0.13) and contempt (-0.26). In summary, the results implied that Memojis might have inaccurately communicated all emotions except happiness or sadness.

3.2 Compare the Impact of Seven Emotions by Participant Nationality

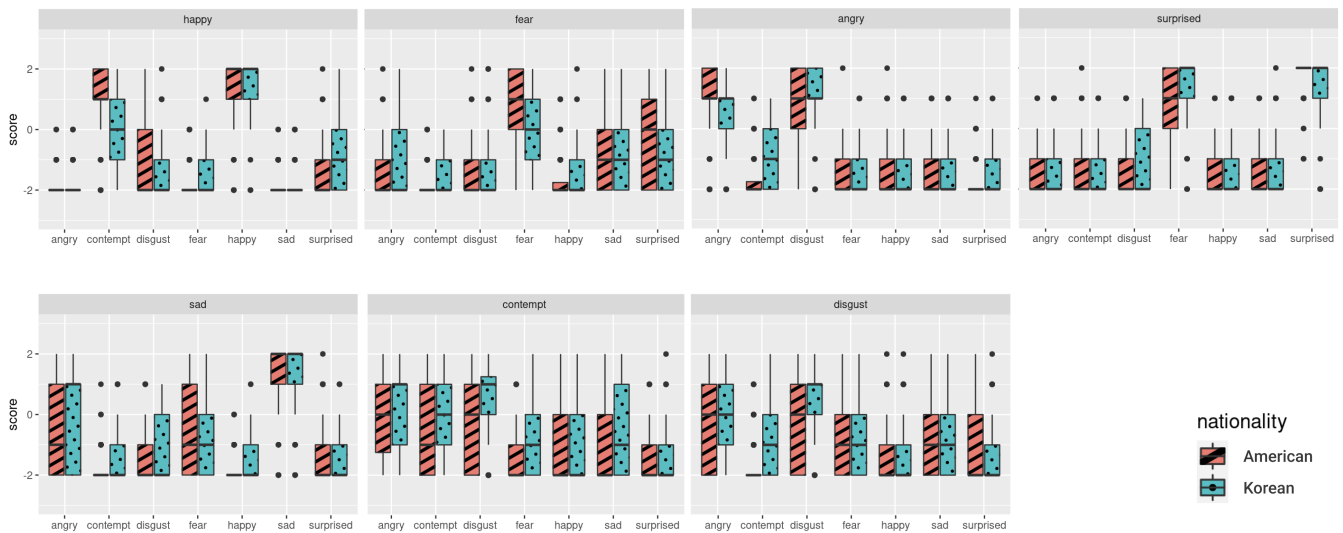
We compared the impact of emotional conveyance of Memojis according to participants' nationality. Americans showed more variability than Koreans, and Americans perceive the emotional conveyance of Memojis as more divergent. As a result, we investigated happiness, fear, surprise, and anger further (Figure4).

With Happiness emotion, Koreans correctly identified; however, American results showed participants confused happiness with contempt. Fear showed a low level of emotional conveyance. In this case, Americans perceived fear accurately, while Koreans confused fear with surprise emotion.

Anger and surprise were confused with other emotions: anger with disgust and surprise with fear. American participants were still easily confused between anger and disgust, while Korean participants perceived anger inaccurately. In the case of surprise, Koreans

Table 1: Emotional assessments of Memojis (N = 164): The averaged estimates are horizontally displayed regarding the seven intended emotions arrayed vertically. The most robust agreement is in underlined bold text.

Intended Emotion	Aspect Emotion						
	anger	contempt	disgust	fear	happiness	sadness	surprise
<i>anger</i>	<u>0.75(1.25)</u>	-1.36(0.91)	<u>0.79(1.3)</u>	-1.48(0.81)	-1.34(0.94)	-1.36(0.92)	-1.59(0.70)
<i>contempt</i>	0.13(1.34)	-0.26(1.46)	<u>0.28(1.40)</u>	-1.16(0.97)	-0.95(1.28)	-0.84(1.27)	-1.38(0.88)
<i>disgust</i>	-0.16(1.31)	-1.19(1.08)	<u>0.21(1.37)</u>	-0.87(1.17)	-1.42(0.95)	-0.82(1.18)	-1.23(0.97)
<i>fear</i>	-1.28(0.97)	-1.68(0.60)	-1.41(0.88)	<u>0.30(1.35)</u>	-1.60(0.76)	-0.87(1.20)	-0.57(1.32)
<i>happiness</i>	-1.84(0.43)	0.45(1.21)	-1.21(1.19)	-1.66(0.60)	<u>1.34(0.93)</u>	-1.82(0.46)	-1.19(1.08)
<i>sadness</i>	-0.14(1.45)	-1.62(0.72)	-1.36(0.90)	-0.65(1.22)	-1.70(0.60)	<u>1.29(1.09)</u>	-1.42(0.88)
<i>surprise</i>	-1.45(0.84)	-1.52(0.81)	-1.23(0.98)	<u>1.03(1.16)</u>	-1.40(0.86)	-1.37(0.94)	<u>1.50(0.85)</u>

**Figure 4: Box plot of Memojis compared by participant nationality over the seven intended emotions. For an explanation of the box plot, refer to Table 1. (N = 164)**

confused surprise with fear as an overall tendency. However, surprisingly, Memojis accurately delivered the intended fear emotion to American participants. The other three emotions, contempt, disgust, and sadness, showed similar tendencies.

4 DISCUSSION

This study aims to determine the expression level for seven basic Memoji emotions. The participants recognized the intended emotion from the Memojis for happiness and sadness. The other five emotions remain challenging. Disgust and fear have low levels of emotional conveyance, which participants recognized as neutral. Anger Memojis were interpreted as both anger and contempt and confused participants. Surprise Memojis were also confusing and recognized as either surprise or fear. Ironically, the contempt Memojis failed to deliver any distinctive emotions. Because of their inaccurate emotional conveyance, these three Memojis can give a negative reliability to users.

The results imply inaccurate or vague communication when a Memoji tries to express emotions using facial expressions. While expressing a facial expression with the avatar in the mobile system, the system uses actual mapping of the user's emotion and expression into the Memoji. However, this can sometimes cause users to make exaggerated facial emotions, and our research showed that exact mapping still has a low level of accuracy. Oh also stated that enhancing the smile on one's avatar can lead to more positive outcomes than using a smile that is accurately mapped[13].

Through our findings, we suggest developing an adaption system that detects the intended emotion and expresses it in an exaggerated way similar to that used by cartoon-like characters. However, we admit the study was limited to Memoji, Apple's avatar character. Future studies may investigate diverse avatar characters to derive a more robust conclusion.

The study may also motivate designers to develop the better Memojis for specific emotions. The empirical evidence of this study could be utilized to advance emotional communication in avatar-mediated conversation.

5 CONCLUSION

We investigated the Memojis' emotional conveyance level and determined their accuracy and reliability. In particular, we confirmed whether the intended emotions were reliably expressed using Memoji. We conducted an online survey with two sets of 14 Memojis generated from the JACFEE data set. One hundred sixty-four participants assessed one of the survey sets. The survey was statistically analyzed; Memojis convey happiness and sadness as intended, while disgust and fear show a low level of recognition. Memojis might inaccurately deliver anger, contempt, and surprise. Furthermore, these emotions showed different aspects depending on participant nationality, and they both offer vague conveyance, which can cause misunderstanding in Avatar-mediated communication. We suggest a new mobile adaptation system for conveying emotion through avatars.

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