An Effect of Gender in the Interpretation of Affective Cues in Avatars

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ABSTRACT

Many factors affect how people express emotion and affective messages, such as culture, gender, posture, etc. Many studies within neuroscience and psychology aim at evaluating if, and how, gender in particular affects emotion recognition. The majority of this research shows that females are better perceivers of emotion from facial expressions than males. However, there are few studies aimed at addressing the issue of which factors are important for recognizing emotion conveyed by body posture and avatars. In this paper we examine the effect of gender on the recognition of affect from whole body postures of 3D avatars. Our first results, indicating that females tend to be faster in recognizing affect from body posture seem to reinforce the results of studies on the recognition of affect from facial expression.

1. INTRODUCTION

Avatars are becoming a very important aspect in human-computer interaction. More and more, the role played by avatars will be to mediate the interaction between the human and the computer. Avatars must now be able to communicate with the user through an affective channel, as a way to personalize systems and to create more accurate and realistic affective user interfaces. Thus, we must ask, what factors should be taken into account for these systems, and how should they be applied? Many factors affect how people express emotion and affective messages, such as culture, gender, posture, age, context, etc [1].

There are numerous existing studies within neuroscience and psychology aimed at evaluating if, and how, gender affects emotion recognition when evaluating photos of human facial expressions. The majority of the results of these studies indicate that females are better perceivers of emotion from facial expressions than males [2] [3] [4] [5].

Why might women be more adept at assessing the emotional states of others? In general, women are considered to be more emotional and sensitive than men [6]. According to [7] [8] [9], the ability to empathize also may play a major role in women's ability to recognize and decode the emotions of others. Duration of gaze may be yet another possible factor. Hall [10] asserts that because women tend to gaze at others more than men do, they observe more nonverbal information, which results in a greater ability to decode emotional stimuli. Another, although controversial, reason may be due to what is known as *the subordination hypothesis*, which states that because women traditionally play a more subordinate role in society, their skills in emotion perception may be more advanced [11] [12], due to an inherent need to comprehend the emotions of their "superiors" [13].

A neurological study by Lee et al. [14] showed that different areas of the brain may be activated by males and females when viewing happy and sad faces, yet the difference was most noticeable when the faces represented a sad emotion. A psychological study by Thayer and Johnsen [15] on the recognition of facial affect demonstrated that facial expressions of emotion could be correctly classified by both genders, although the rate of correct classification was higher for females than for males. While the gender of the viewed face did not affect correct classification for females, males had a more difficult time seeing the difference between two emotions.

Few studies, however, have addressed the issue of which factors affect the recognition of emotion in avatars. In a cross-cultural study by [16], subjects from eight countries were asked to judge avatars' facial expressions of emotion. The results showed that there were cultural differences, especially in the interpretation of positive affect displays. Bartneck and colleagues [17] studied the effects of both culture and gender on the recognition of emotion from complex expressions of avatars. While they were unable to determine significant differences according to the culture of the subjects, they did find significant differences between the genders within the cultures.

A modality that has been examined only partially is emotion recognition from whole body postures displayed through avatars. Presented in this paper is our initial research exploring these two issues. In the next section we describe the method. We follow with a report on the results we observed,

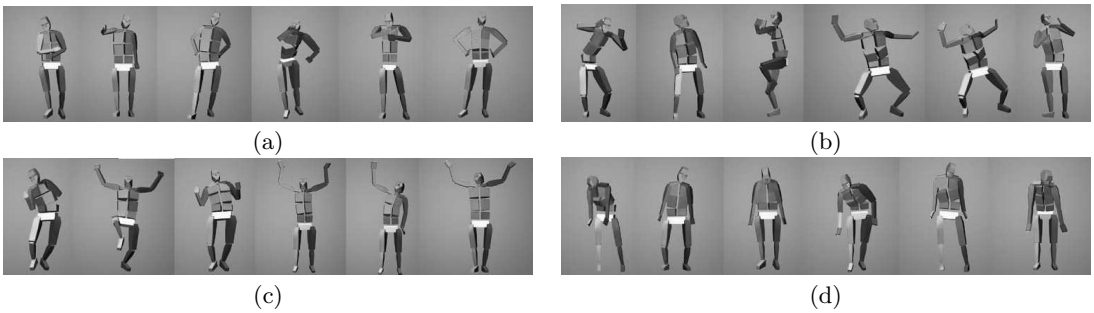

Figure 1: The static stimuli representing the four emotion categories. (a) Angry (b) Fear (c) Happy (d) Sad.

and we end with a discussion on some of the issues we intend to consider in future research.

2. METHOD

In this study, we begin to assess the role that user gender may have on recognizing emotion conveyed by the posture of a 3D humanoid avatar. In order to eliminate confounds, a non-gender, non-cultural avatar was used. Twenty-four animated avatars, representing four emotion categories, were created from original motion capture data. The duration of each animation was 2500 ms. Figure 1 shows the apex for each animation (refered to as static posture hereafter). Refer to [18] for details about posture collection.

We conducted two types of experiments to verify our hypothesis that females are better than males at recognizing emotion from avatar posture, and that time may play a significant role. In the first experiment, subjects were allowed to view each stimulus for as long as they felt necessary to make a judgment. We refer to this experiment as Experiment One hereafter. In the second experiment, each stimulus was presented for a fixed amount of time, 2500 ms. We refer to this experiment as Experiment Two hereafter.

Experiment One: There were 13 female and 12 male Japanese participants in Experiment One. Subjects were asked to choose an emotion label from an eight word list comprised of pairs of labels indicating two nuances of the same emotion: anger (*angry, upset*), fear (*fearful, surprised*), happiness (*happy, joy*), and sadness (*sad, depressed*). Only static posture stimuli were evaluated in this experiment, and subject evaluation times were not recorded.

Experiment Two: There were eight female and nine male Japanese participants in Experiment Two. Subjects were asked to choose one of four emotion labels representing the four basic emotion categories described for Experiment One, *angry, fear, happy*, and *sad*, plus a label indicating a *neutral* state. In this experiment, both static and motion stimuli were evaluated and subject response times were recorded. The animations were added to evaluate whether or not the use of dynamic/motion features helps to improve classification rates for fear, as has been indicated by [19] [20].

3. RESULTS AND DISCUSSION

As expected, in Experiment One, overall performance in recognizing affective postures was significantly better than in Experiment Two in all cases except for *sad* (see Table 1). The reason for this different pattern in *sad* is not clear and should be further explored. One possible reason could be that with more time to view the stimulus, both genders may begin to find similarities with other emotion categories, such as low-level anger (e.g., upset) as we discussed in two previous studies [21] [22]. In [22], our results indicated that *upset* postures seem to have the same level of arousal as both *sad* and *depressed* postures. In both experiments, differences were observed in terms of gender performance. In Experiment One, the females outperformed the males in recognizing *happy, fear*, and *angry* postures, while in Experiment Two, the females outperformed the males only in recognizing *happy* and *angry* postures.

Table 1: Performance in recognizing affective postures for females and males in both experiments (exp = experiment).

Emotion	Exp.	Stimulus type	Female	Male
Angry	One	Static	0.77	0.73
	Two	Static	0.5	0.426
	Two	Motion	0.417	0.444
Fear	One	Static	0.81	0.75
	Two	Static	0.604	0.685
	Two	Motion	0.833	0.852
Happy	One	Static	0.82	0.63
	Two	Static	0.583	0.315
	Two	Motion	0.5	0.5
Sad	One	Static	0.683	0.75
	Two	Static	0.895	0.907
	Two	Motion	0.938	0.926

Table 2: Testing differences in emotion label usage between females and males for Experiment One.

Experiment One		
Emotion	**Paired t test p-value**	**Gender differences**
Angry	p-value = 0.394	No significant differences
Fear	p-value = 0.419	No significant differences
Happy	p-value = 0.204	No significant differences
Sad	p-value = 0.011	Significant differences

To better verify the differences between females and males, a paired t-test ($\alpha = 0.05$) was applied to the participants' ratings to compare the percentage of use of each of the labels in classifying each posture. The results represented in Table 2 show that there is a significant difference between the genders in the frequency of use of the *sad* label for Experiment One, while in Experiment Two (refer to Table 3), differences between the genders were observed in the use of *angry* and *fear* labels.

In particular, the results showed that females, more than males, tended to misclassify *happy* postures as *angry*, while males, more than females, tended to misclassify these postures as *fear*. Our subjects were Japanese and as we discussed in [21], the Japanese used the fear label less than the other cultures we examined. Thus, we hypothesize that the more infrequent use of the *fear* label by Japanese females could be explained by the same dimension of "uncertainty avoidance" (as termed by Hofstede [23]). The idea is that people brought up in cultures that rank high in this dimension will feel more uncomfortable in uncertain situations, and attempt to avoid them as much as possible. The consequence of this may be that these individuals are less able to recognize these types of expressions, such as fear, since they have not been observed as often as other types of expressions [24]. This phenomenon could be even more extreme for Japanese females, as they may make more of a concerted effort to avoid uncomfortable situations.

Table 3: Testing differences in emotion label usage between females and males for Experiment Two.

Experiment Two		
Emotion	**Paired t test p-value**	**Gender differences**
Angry	p-value = 0.047	Significant differences
Fear	p-value = 0.010	Significant differences
Happy	p-value = 0.667	No significant differences
Sad	p-value = 0.325	No significant differences
Neutral	p-value = 0.077	No significant differences

As expected, the addition of the motion animations increased the recognition rate for *fear* in both females and males. In the case of males, there was also an increase in performance in the *happy* stimuli as they were most often misinterpreted as *fear* by males. Could these results indicate that males require more cues before they are able to judge affective states?

Finally, the most interesting results we observed were the differences in the evaluation response times recorded for Experiment Two. Figure 2 shows the distribution of the response times for the four types of stimuli for both females and males. For both genders, the y-axis shows the response times in milliseconds and each of the emotion categories, represented by its first letter (e.g., A = angry, etc.) is shown along the x-axis. Here we can clearly see that the median response time for the females is much lower than the males. As shown in Table 4, the males take almost twice as much time

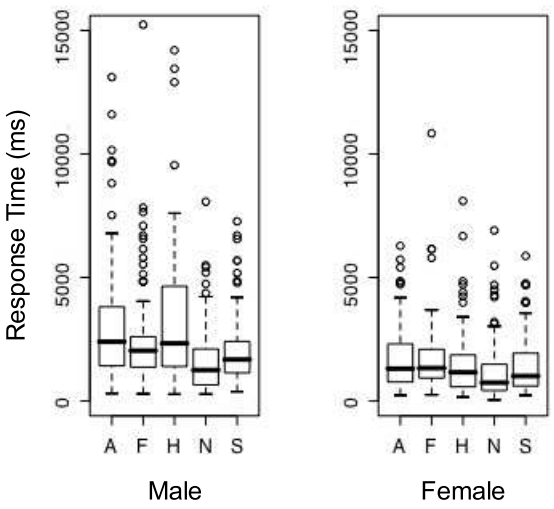

Figure 2: The reaction times in milliseconds for males and females in judging emotion from avatar body posture.

to respond with no significant difference in within-group performance (refer to Table 1). We can also see the difficulty that the males had in classifying both *happy* and *angry* postures. In fact, the inter-quartile ranges for these categories are quite large. These strong differences in response times could be explained by Lee et al's results [14], indicating that different areas of the brain may be activated by females and males. Females seem to empathize more with the avatar, and they may use a lower cognitive process for this task, while males' responses to others' emotional states may rely on more of a judgment, based on a longer termed visual evaluation corresponding to a more high-level cognitive process.

Table 4: The evaluation response time in seconds for females and males (median values are reported).

Evaluation response times (sec)		
Emotion	**Females**	**Males**
Angry	1.3	2.4
Fear	1.3	2.1
Happy	1.2	2.3
Sad	0.7	1.3
Neutral	1.0	1.7

Another explanation for these results could support Hall's study [10], suggesting that women are more practiced at interpreting the emotional state of others due to the amount of time they spend gazing at others. Therefore, the amount of time required by females to determine another's emotional state may be considerably less than it is for males.

4. CONCLUSIONS

While our results seem to suggest the existence of some differences between females and males in recognizing affective postures, we have identified some issues that should be considered for future research. The first issue is the small num-

ber of subjects recruited for participation in each of the experiment settings. Currently, we are planning to repeat the study using a larger number of subjects. A second issue is due to how the experiment was conducted. Due to design constraints (the experiment was associated with an experiment using fMRI scanning), it was necessary to use a different set of subjects for each of the two sessions. This could provide a partial explanation for the fact that performance was much lower in the case of sad for Experiment One. To further extend our study, it would be interesting to record the response times in Experiment One for which stimulus presentation is not fixed, in order to examine if females really do use a different type of process (low-level reaction vs. high-level judgment). A future step in our study would be to see if the observed differences could be grounded into a set of low-level posture features, as indicated by our previous study on examining cross-cultural differences in emotion recognition from avatar body posture [21].

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