The Ingroup Disadvantage in the Recognition of Micro-Expressions

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***Abstract*—Micro-expressions, as fleeting facial expressions which last no longer than 0.5 s, are of great application potentials in the fields of security, national defense and medical treatment. Previous studies have indicated that there is a robust ingroup advantage in macro-expression recognition. However, it remains unclear whether the social category of the target influences micro-expression recognition. To address this question, the present study employed facial images from White or Asian models to investigate whether there is also an ingroup advantage for micro-expression recognition. The JACBART paradigm was used for the presentation of micro-expressions. The results of the experiment on Chinese participants showed that, there was no ingroup advantage and actually there was an ingroup disadvantage for the Chinese participants: The recognition accuracy of micro-expressions of outgroup members (White targets) was actually higher than that of ingroup members (Asian targets). And the results also showed that such an intergroup bias was unaffected by the duration of micro-expressions and the ingroup disadvantage remained the same even after the participants had received the training of Micro Expression Training Tool. These results demonstrated that individuals spontaneously use the social category information of the targets as a clue to recognize micro-expressions.**

Keywords—micro-expression, recognition, intergroup bias

I. INTRODUCTION

As a fleeting expression which lasts no longer than 0.5 s, micro-expression is a reliable cue for lies and danger demeanor detections [1]. Micro-expressions usually occur when people are trying to suppress or hide their true emotions, and they are barely perceptible to untrained observers [2][3][4]. Due to their great application potentials in national security, medical treatment, education, and other fields, scientists have made long endeavors to train people to better recognize micro-expressions [1]. However, evidence indicates that the validity of the current micro-expression recognition training programs is quite limited [5][6][7]. It is the prime necessity for us to have a more complete knowledge about the micro-expression recognition process before we can have more efficient recognition tools or training programs.

Previous studies have revealed that the difficulty of micro-expression recognition task may not only be caused by the short duration of micro-expressions [5][7]. Researchers have found that the process of micro-expressions recognition is different from the recognition process of typical facial expressions (usually be referred as macro-expressions, that can be easily noticed and typically last for more than 0.5 s, up to 4 s) [1][4][8]). For example, researchers found that while the sensorimotor simulation enhances the recognition of macro-expressions [9], the recognition accuracy of micro-expressions was significantly impaired when facial feedback from one's face was enhanced [10] [11]. Studies also suggested that the neural mechanisms underlying the recognition of micro-expression and macro-expression are different. The brain regions responsible for the differences might be the inferior temporal gyrus and the frontal lobe [12]. In sum, these studies suggested that the deteriorated psychological process of micro-expression recognition is the main cause for our deficits in micro-expression recognition.

Mainstream psychology has long documented our proficiency in macro-expression recognition [13] [14] [15] [16] [17] [18]. However, a large number of studies also showed that recognizing the facial expressions of our ingroup members (i.e., people who belong to the same social group as you) will be much easier than recognizing the facial expressions of outgroup members (i.e., people who belong to a different social group). That is, there is a widespread ingroup advantage in macro-expression recognition. For example, previous study employed meta-analysis to analyze the data from 87 articles, including 183 different samples around the world. The results showed that there was a robust ingroup advantage in macro-expression recognition [19]. Furthermore, studies also showed that ingroup advantage in macro-expression recognition exists in various kinds of social groups (e.g., cultural groups, racial groups, religious groups, and etc.) [19] [20] [21] [22] [23] [24] [25]. Researchers even found that the ingroup advantage exists in arbitrary social groups that are created in the lab by using minimal group paradigm, and self-identifying with a particular group already could lead to better recognition of macro-expressions posed by members of that particular group [20] [23]. In sum, previous studies have indicated that the ingroup advantage in macro-expression recognition is a ubiquitous feature among human societies.

However, as we have mentioned above, the process of micro-expression recognition may be different from the recognition process of macro-expressions. Is there also an ingroup advantage in the recognition of micro-expressions? To our knowledge, currently no study has ever investigated this issue. Investigating the potential factors that affect the recognition of micro-expressions would help us to develop more efficient micro-expression recognition training programs and more efficient automatic recognition tools.

In many contemporary societies, group membership is often indicated by one's race [21] [26] [27]. Race is linked with patterns of association and cooperation. Hence, race is a prominent cue for social group membership. In the current

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study, we employed the facial images from White or Asian models for micro-expression recognition through one behavioral experiment. To rule out the possibility that such an intergroup bias in micro-expression recognition is caused by the differences in macro-expression recognition accuracies between these two kinds of models, we matched these models on the recognition accuracies of their macro-expressions. Previous studies have showed that the training of Micro Expression Training Tool (METT) can significantly improve the recognition accuracy of micro-expressions for participants from various backgrounds (i.e., university students, school teachers, business persons, Coast Guard personnel, and etc.) [6] [28] [29] [30] [31] [32] [33] [34] [35]. Hence, in the current study, we also explored whether the training of METT could affect the intergroup bias in micro-expression recognition. Since the study was conducted in China, we mainly focused on the intergroup bias among Chinese.

II. METHOD

A. Participants

Eighty-four Chinese undergraduates students (40 males, 44 females), aged 18-25 years (M_{age} = 19.5, SD = 1.86), participated in this experiment.

B. Design

A 2 (target: ingroup, outgroup) × 2 (duration: 100 ms, 333 ms) × 2 (training: training group, control group) × 2 (test: pretest, posttest) mixed-model experimental design was used, with target, duration, and test being the within-subjects factors, while training being the between-subjects factor.

C. Micro-Expression Recognition Tasks

Facial images were employed from the BU-3DFE database [36] for the stimuli of our micro-expression recognition tasks. This database contains 100 models (56 female, 44 male), with ages ranging from 18 to 70 years old, and a variety of ethnic origins including White, Black, Asian, Indian and Hispanic. Each model posed seven facial expressions, which include neutral and six universal facial expressions (sadness, happiness, fear, surprise, anger, disgust) with four different intensity levels in generalized facial actions (low, middle, and high, very high). We selected 12 White and 12 Asian models from this database. For each of these selected models, the images of his /her six facial expressions and the image of his/her neutral face were selected as the stimulus materials for this experiment. Therefore, a total of 168 facial images were selected, and we only selected the facial expressions (excluding the neutral faces) that were rated to be "very high" in the intensity level of facial expressions. All facial images were converted to gray-scale images and their gray values were normalized to grand mean.

In a pilot study, we asked 30 Chinese college students to recognize the facial expression images of these 24 models (excluding the neutral faces) by presenting them as macro-expressions (i.e., each of the facial expression images was randomly showed on the screen, participants were instructed to choose an expression labels from a list to describe the facial expression; the participants were required to be as accurate as possible, with no time limit). Based on these data, the 12 White models were further equally divided into two groups, W1 and W2 respectively, with 50% men and 50% women in each group. Then, the 12 Asian models were also equally divided into two groups (i.e., A1 and A2), also with 50% men and 50% women in each group. Then the facial images of group W1 and A1 formed the stimuli set A, and the group W2 and A2 formed the stimuli set B. A 2 (stimuli set: A, B) × 2 (race: White, Asian) repeated-measures analysis of variance (ANOVA) showed that the main effect of stimuli set, the main effect of race, and the interaction between stimuli set and race, were all not significant (Fs < 0.12, ps > 0.73). Therefore, the results of the pilot study indicated that there were no significant differences between the recognition accuracies of macro-expressions of White and Asian models and the recognition accuracies of macro-expressions from different stimuli set were not significantly different from each other.

All participants were instructed to complete two micro-expression recognition tasks in this experiment. That is, the pretest and the posttest. In each task, only one set of stimuli (i.e., stimuli set A or set B) was presented. The order of the combination of micro-expression tasks and the stimuli sets was counterbalanced across participants. Similar to previous studies [10] [11], we employed two different settings of duration for the presentation of micro-expressions (100 ms and 333 ms). For each micro-expression recognition task, each model from the assigned stimuli set was randomly assigned to one of the two duration conditions. All of the six categories of micro-expressions of the models (sadness, happiness, fear, surprise, anger, disgust) were presented according to his/her assigned condition. Therefore, 3 White models and 3 Asian models were assigned to each duration condition, and for our Chinese participants, the micro-expressions from the Asian models constituted the targets of ingroup members while the micro-expressions of White models constituted the targets of outgroup members.

These two micro-expression recognition tasks all adopted the well-accepted JACBART paradigm [5] [10] [11] [29] [30] [31] [37] [38] [39] for micro-expression presentation, in which the expression image (presented for 100 or 333 ms) was sandwiched in between two 1s presentations of the same expresser's neutral face (see Fig.1). After that, participants were asked to choose one of seven emotion expression labels (i.e., sadness, happiness, fear, surprise, anger, disgust, and a label of "none of the above") to describe the expression just displayed. The presentation order of the stimulus was completely randomized, and each micro-expression of each model was presented only once. Therefore, there were 72 trials in each of the micro-expression recognition tasks. The accuracy data were recorded in these tasks.

D. Micro-Expression Recognition Training Task

The Japanese and Caucasian Brief Affect Recognition Test was the first rigorously validated test of micro-expression recognition accuracy [37]. This test was further evolved into a self-instructional training program, called METT [28] [29] [30] [31]. This training program has been shown to be able to improve the recognition accuracy for university students, school teachers, business persons, Coast

Guard personnel, and even patients diagnosed with schizophrenia [6] [29] [32] [33] [34] [35].

The METT consists of five sessions—pre-test, training, practice, review and post-test. In this experiment, we only used three parts of this training program. More specifically, in our micro-expression recognition training task, participants were instructed to finish the training, the practice, and the review session of METT. The training and review session involved training viewers how to read emotions on the face. They mainly emphasized quick changes in parts of a face. In the practice session, participants were instructed to practice the recognition skills that they acquired during the training session. To make sure the participants could understand the training content of METT, we also explained the contents of METT in detail to all participants during the micro-expression recognition training task.

E. Procedure

The experiment was divided into three phases, which included the pretest, the micro-expression recognition training, and the posttest.

After providing informed consent, participants were randomly assigned to a training or a control group. Then, the participants were instructed to read the experimental instructions on the computer screen carefully and to follow these instructions. Then all participants were instructed to finish the pretest of micro-expression recognition task. After the pretest, participants of the training group were asked to finish the micro-expression recognition training task, while participants in the control group were instructed to rest in the lab for 25 minutes, which was approximately the length of time that the training task would take. After the training task, participants in the training group were then asked to rest for 5 minutes. Then all participants were asked to finish the posttest of micro-expression recognition task.

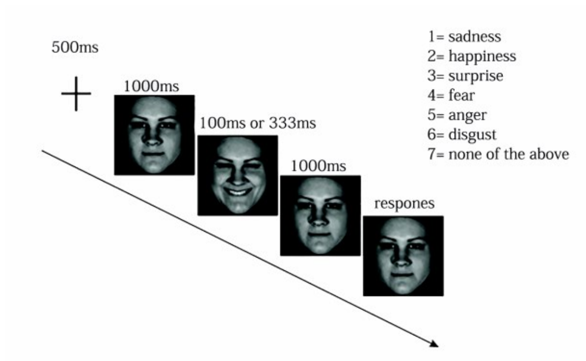

Fig.1. The procedure of micro-expression recognition task

III. RESULTS

We conducted a 2 (target: ingroup, outgroup) × 2 (duration: 100ms, 333ms) × 2 (training: training group, control group) × 2 (test: pretest, posttest) mixed-model ANOVA on the recognition accuracy data of micro-expression recognition tasks. The degrees of freedom, *F*-value, *p*-value, and the effect size were reported for this analysis. The main effect of test [F (1, 82) = 21.97, p < 0.001, η_p^2 = 0.21], and the main effect of duration [F (1, 82) = 156.70, p < 0.001, η_p^2 = 0.66] were all significant,the recognition accuracy under 333 ms condition was higher than that of 100ms condition (see Fig. 2). The main effect of training was also significant, F (1, 82) = 5.84, p = 0.02, η_p^2 = 0.07; and the interaction between test and training was also significant, F (1, 82) = 4.49, p = 0.04, η_p^2 = 0.05. Most importantly, the results showed that, the main effect of target was significant, F (1, 82) = 6.34, p = 0.01, η_p^2 = 0.07. That is, for the Chinese participants, there was no ingroup advantage but an ingroup disadvantage for the recognition of micro-expressions. The recognition accuracy of micro-expressions of outgroup members was actually higher than that of ingroup members. And the results also showed that such an intergroup bias was unaffected by the training and the duration of micro-expressions: The interaction between target and training was not significant, F (1, 82) = 0.28, p = 0.6, η_p^2 = 0.003; the interaction between target and test was not significant, F (1, 82) = 2.27, p = 0.14, η_p^2 = 0.003; the interaction between the duration and test was not significant, F (1, 82) = 1.06, p = 0.31, η_p^2 = 0.01; the interaction between target and duration was not significant, F (1, 82) = 0.05, p = 0.83, η_p^2 = 0.001; and the interaction between duration and training was also not significant, F (1, 82) = 0.09, p = 0.77, η_p^2 = 0.001. And there were no significant interactions of target × duration × test, target × training × test, duration × training × test, and target × duration × training, (*Fs* < 3.4, *ps* > 0.07). Meanwhile, the interaction of all these four independent variables was not significant, F (1, 82) = 0.22, p = 0.64, η_p^2 = 0.03.

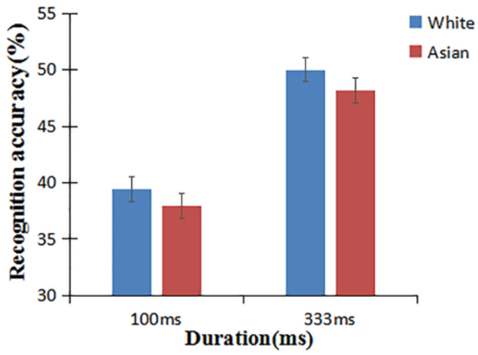

Fig.2. Mean recognition accuracies of micro-expression of White and Asian targets. Error bars represent standard errors.

Further simple effects analysis showed that, there were no significant differences in recognition accuracies between pretest and posttest for participants in the control group, F (1, 82) = 3.3, p = 0.07, η_p^2 = 0.04. However, the recognition accuracy in posttest was significantly improved for participants in the training group, F (1, 82) = 23.16, p < 0.001, η_p^2 = 0.22 (see Fig. 3). Furthermore, for the pretest, there were no significant differences in recognition accuracies between the training group and the control group F (1, 82) = 1.36, p = 0.25, η_p^2 = 0.02. For the posttest, the recognition accuracy of the training group was better than that of the control group F (1, 82) = 9.73, p = 0.003, η_p^2 = 0.11. These results indicated that micro-expression training program significantly increased the recognition accuracy for Chinese participants and such an effect was not caused by differences in baseline levels between different groups.

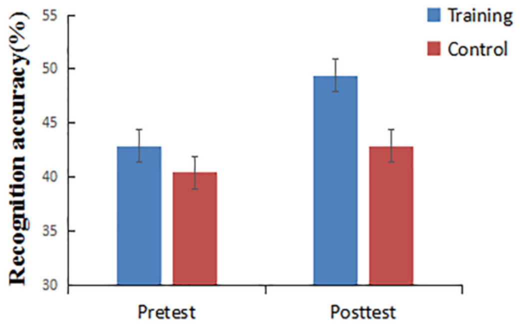

Fig.3. Mean recognition accuracies of micro-expression of training and control group. Error bars represent standard errors.

IV. Discussion

In the present study, by controlling the discrepancies in the recognition accuracy of macro-expressions for Asian and White models, we found that there was no ingroup advantage and actually there was an ingroup disadvantage for the Chinese participants in the recognition of micro-expressions. And the results also showed that such an intergroup bias was unaffected by the duration of micro-expressions and the training experience of participants. That is, the ingroup disadvantage remained the same after the participants had received the training of METT. These results cannot be attributed to the differences in skin colors or in textures between different racial targets since we had all images converted to gray-scale and they were all normalized according to grand mean value. In addition, these results cannot be attributed to possibility that the facial expressions of Asian targets were more difficult to be recognized given that this factor has been controlled as we have showed in our pilot study. However, we dropped the factor of emotion category (i.e., sadness, happiness, fear, surprise, anger, disgust) in our analysis considering there were only three trials for each category of emotion in our experiment and thus the statistical power of this analysis would be greatly undermined if it was performed [10] [11]. Previous studies employing similar trial numbers in micro-expression recognition task also didn't include this factor into their analysis or simply found the null results [10] [11]. This factor of emotion category should be explored by employing more sufficient trial numbers in the future. Furthermore, other social groups, such as the minimal group [20] [23], also should be employed in the future.

Why is there an ingroup disadvantage for micro-expression recognition? Is it a peculiar phenomenon in micro-expression recognition for participants from all cultures or is it a special phenomenon that only exists for Chinese participants? Previous studies on macro-expressions showed that there is a consistent ingroup advantage in macro-expression recognition for participants from Western cultures [19] [20] [21] [22] [23] [24] [25], but such a phenomenon was reported to be unstable for Chinese participants [21] [27] [39] [40] [41]. Therefore, these results suggest that the ingroup disadvantage in micro-expression recognition may only exists among Chinese participants. In fact, some recent studies showed that Chinese participants even harbor an ingroup derogation attitude toward their ingroup members and such a response may be evolutionarily based [42]. Nevertheless, some studies found that during the recognition of subtle or weak expressions, neither the Chinese nor the White participants showed the ingroup advantage [41]. These results suggested that the ingroup disadvantage may be a unique phenomenon for the recognition of micro-expressions. Future research needs to employ cross-cultural samples to investigate this issue.

Previous studies suggested that the ingroup advantage in macro-expression recognition is mainly caused by differential motivation to process ingroup versus outgroup faces [23] [43]. Previous studies also showed such motivated encoding of ingroup faces could be constrained by restraining the time that perceivers encode faces [23] [27]. Therefore, in the present study, the results cannot be explained by the motivational differences between ingroup and outgroup faces since that in our experiment the durations of micro-expressions were both very short (i.e., only 100 ms or 333 ms) which would constrain the motivated processing [23] [27]. In addition, our results also showed that the METT training could not affect the ingroup disadvantage, which also ruled out the possibility that the ingroup disadvantage was caused by motivation, since in METT participants were trained to pay attention to the micro-expressions of different ethnic individuals [28] [29] [30] [31]. These results suggest that ingroup disadvantage found in the present study was caused by the perceptual processing disadvantages for ingroup faces among Chinese participants. These results were consistent with the evolutionary hypothesis of ingroup derogation mechanism [42] [44], which proposed that such mechanism should be operating on the perceptual level.

V. Conclusion

The current study offers novel evidence for the intergroup bias in the recognition of micro-expressions among Chinese. Although strong evidence has shown that there is an ingroup advantage in both real social groups and minimal groups during the recognition of macro-expressions, the current study demonstrates that, regardless of the duration of micro-expressions, there is an ingroup disadvantage in the recognition of micro-expressions for Chinese participants and such a bias still exits even after the training of micro-expression recognition training program.

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