

# The Effect of Facial Attractiveness on Micro-Expression Recognition

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## 2 ABSTRACT

3 Micro-expression (ME) is an extremely quick and uncontrollable facial movement that lasts for  
4 40-200 ms and reveals thoughts and feelings that an individual attempts to cover up. Though much  
5 more difficult to detect and recognize, ME recognition is similar to macro-expression recognition in  
6 that it is influenced by facial features. Previous studies suggested that facial attractiveness could  
7 influence facial expression recognition processing. However, it remains unclear whether facial  
8 attractiveness could also influence ME recognition. Addressing this issue, this study tested 38  
9 participants with two ME recognition tasks in a static condition or dynamically. Three different MEs  
10 (positive, neutral, and negative) at two attractiveness levels (attractive, unattractive). The results  
11 showed that participants recognized MEs on attractive faces much quicker than on unattractive  
12 ones, and there was a significant interaction between ME and facial attractiveness. Furthermore,  
13 attractive happy faces were recognized faster in both the static and the dynamic conditions,  
14 highlighting the happiness superiority effect. Therefore, our results provided the first evidence  
15 that facial attractiveness could influence ME recognition in a static condition or dynamically.

16 **Keywords:** Facial attractiveness; Micro-expression; Micro-Expression Recognition; Emotion recognition

## 1 INTRODUCTION

17 Micro-expression (ME) is an instinctive facial movement that expresses emotion and cognition. It is difficult  
18 for individuals to identify MEs since they are rapid (usually lasting for 40-200 ms), local, low-intensity  
19 facial responses (Liang et al., 2013). On the contrary, macro-expression is easily identifiable and lasts  
20 between 500 ms and 4 s (Takalkar et al., 2021). Ekman and Friesen (1969) indicated that the only difference  
21 between ME and macro-expression is their duration. According to Shen et al. (2012), the duration of the  
22 expressions influences the accuracy of ME recognition, the proper upper limit of duration of ME may be  
23 200 ms or less. Shen et al. (2016) utilized electroencephalogram (EEG) and event-related potentials (ERPs)  
24 and found that the EEG/ERPs neural mechanisms for recognizing MEs differ from those for recognizing  
25 macro-expressions. From their findings, the vertex positive potential (VPP) at the electrodes Cz and CPz  
26 were significantly different between MEs (duration of less than 200 ms) and macro-expressions (duration of  
27 greater than 200 ms), the VPP amplitude of negative expression was larger than that of positive and neutral

28 expression with duration of less than 200 ms, while when the duration were greater than 200 ms, there was  
29 no difference in VPP amplitude induced by different emotional expressions. Previous studies discovered  
30 that emotional contexts influence ME processing at an early stage. Zhang et al. (2018) found that early ERP  
31 differences in emotional contexts on ME processing, more positive P1 (an early component related to the  
32 visual processing of faces, peaking at approximately 100 ms) and N170 (peaking at around 160 ms) elicited  
33 by target ME followed negative and positive contexts rather than neutral contexts. Previous functional  
34 magnetic resonance imaging (fMRI) research found that emotional contexts reduce the accuracy of ME  
35 recognition while increasing context-related activation in some emotional and attentional regions (Zhang  
36 et al., 2020). Due to the additional monitoring and attention required for emotional context inhibition,  
37 the increased perceptual load of negative and positive contexts results in increased brain activation as  
38 well as decreased behavioral performance (Siciliano et al., 2017). Studies of emotion perception have  
39 demonstrated that ME recognition is similar to macro-expression recognition and that it is affected by  
40 variety of factors, such as gender (Abbruzzese et al., 2019), age (Abbruzzese et al., 2019), occupation  
41 (Hurley, 2012), culture (Iria et al., 2019), and individual psychological characteristics (Zhang et al., 2017).  
42 ME recognition is widely used in the fields of national security, judicial interrogation, and clinical fields  
43 as an effective clue for detecting deceptions (Ekman, 2009), as MEs occurred too quickly and are very  
44 difficult to detect, scholars have long endeavored to explore and improve individuals' ability to recognize  
45 MEs. Previous studies have typically focused on how facial attractiveness moderates macro-expression  
46 recognition. To the best of our knowledge, no previous study on macro-expressions has employed facial  
47 expressions of 200 ms or less as their stimuli, it remains unclear whether the durations of facial expressions  
48 are able to modulate the effects of facial attractiveness on facial emotion recognition (FER).

49 Facial attractiveness is the extent to which a face makes an individual feel good and happy, and how  
50 much it makes them want to get closer to it (Rhodes, 2006). Attractiveness is a strong signal of social  
51 interaction, reflecting all facial features (Rhodes, 2006; Li et al., 2019). Attractive faces are commonly  
52 connected with good features such as personal attributes (Eagly et al., 1991; Lindeberg et al., 2019) and  
53 higher intelligence levels (Jackson et al., 1995; Mertens et al., 2021). Abundant evidence showed that  
54 facial attractiveness affects the ability to recognize facial expressions (e.g., Dion et al., 1972; Cunningham,  
55 1986; Otta et al., 1996; Hugenberg and Sczesny, 2006; Krumhuber et al., 2007; Zhang et al., 2016). For  
56 example, Lindeberg et al. (2019) asked participants to recognize happy or angry expressions and rate the  
57 level of attractiveness of the faces, the results show that attractiveness has a strong influence on emotion  
58 perception. According to Lindeberg et al. (2019) facial attractiveness moderates expressions recognition,  
59 participants showed the happiness superiority effect for the faces with higher attractiveness levels but  
60 not for the unattractive ones, that is, people tend to recognize happiness faster in attractive faces than in  
61 unattractive faces, while there is no such effect in other emotions recognition (i.e., anger, sadness, surprise,  
62 Leppänen and Hietanen, 2004). Li et al. (2019) also observed that facial attractiveness moderates the  
63 happiness superiority effect, participants could identify the happy expression faster in higher attractive  
64 faces, which is consistent with the findings of Lindeberg et al. (2019). Furthermore, in the study by Golle  
65 et al. (2014), the authors utilized two-alternative-forced choice paradigms, which required participants to  
66 choose one stimulus above the other. The result revealed that facial attractiveness affects happy expression  
67 recognition. When happy faces were likewise more attractive, identifying them was easier. Mertens et al.  
68 (2021) employ the mood-of-the-crowd task to compare attractive and unattractive crowds. According to  
69 the research, participants were more quick and accurate when rating happy crowds. Attractive crowds  
70 were perceived as happier than unattractive crowds, that is, people in crowds with unattractive faces were  
71 regarded to be in a negative mood, which supports the assumption that attractiveness could moderate  
72 emotion perception.

73 However, a few studies failed to demonstrate that facial attractiveness influences facial emotion  
74 recognition (e.g., Jaensch et al., 2014). For example, Taylor and Bryant (2016) asked participants to classify  
75 happiness, neutral, or anger emotions at two attractiveness levels (attractive, unattractive), according to  
76 the findings of their study, the detection of happiness or anger is not significantly influenced by facial  
77 attractiveness. It should be noted that Taylor and Bryant (2016) used anger as the negative expression,  
78 however, anger is often mistaken for those of other emotions (Taylor and Jose, 2014), which may have  
79 contributed to the masculinization of attractive female faces that made them seem less attractive (Jaensch  
80 et al., 2014) and lead to unreliable results. Thus, this study used disgust expression as experimental material  
81 which extends the existing research. Furthermore, previous research on recognizing facial expressions has  
82 employed static stimuli, while human faces in real life are not static. As humans utilize dynamic facial  
83 expressions in everyday conversation, the ability to accurately recognize dynamic expressions makes more  
84 sense (Li et al., 2019). In contrast to static facial expressions, previous studies shows that dynamic facial  
85 expressions are more ecologically valid and could induce more obvious behavioral responses, such as  
86 emotion perception (Recio et al., 2011), emotion elicitation (Scherer et al., 2019), and imitation of facial  
87 expressions (Sato and Yoshikawa, 2007). This evidence suggests that dynamic stimuli are better identified  
88 than static ones, according to face processing literature (Zhang et al., 2015). In this study, we showed  
89 participants static and dynamic stimuli to recognize MEs.

90 To this end, we aimed to explore whether facial attractiveness moderates ME recognition processing.  
91 In Experiment 1, static expressions of disgust, neutral, and happiness were presented. Furthermore,  
92 Experiment 2 replicated and extended Experiment 1's results by using dynamic stimuli (happy, disgust).  
93 We hypothesized that attractive faces could be judged faster overall in a static condition or dynamically;  
94 participants could recognize happiness more accurately in attractive faces than in unattractive faces.

## 2 EXPERIMENT 1

95 We adopted a recognition task modified from the Brief Affect Recognition Test (BART) to simulate a ME  
96 (Shen et al., 2012). In BART paradigm (Ekman and Friesen, 1974), one of the six emotions (happiness,  
97 disgust, anger, fear, surprise, and sadness) was presented for 10 ms to 250 ms. In Experiment 1 we  
98 presented static stimuli with a duration of 200 ms (happiness as positive ME, disgust as negative ME,  
99 and neutral as a control condition) to investigate the effects of facial attractiveness on the processing of  
100 MEs. We hypothesized that participants could judge attractive faces faster overall in static faces, and facial  
101 attractiveness moderates the happiness superiority effect, participants could identify the happy expression  
102 faster in higher attractive faces but not for the unattractive ones.

103

### 104 2.1 Methods

#### 105 2.1.1 Participants

106 The number of participants was similar or larger than previous research examining the effect of facial  
107 attractiveness on expression recognition (e.g., Taylor and Bryant, 2016; Li et al., 2019). Based on a post  
108 hoc power analysis by using G\*Power 3.1 (Faul et al., 2007) and calculating power analysis for the main  
109 effect of ME (a partial  $\eta^2$  equal to 0.349, an alpha of 0.05, and a total sample size of 38) and attractiveness  
110 (a partial  $\eta^2$  equal to 0.535, an alpha of 0.05, and a total sample size of 38), we observed that this sample  
111 size generated a high power of  $1-\beta$  equal to 0.978 and 0.999 separately. Thus, thirty-eight right-handed  
112 participants from Beijing Normal University, Zhuhai ( $M = 20.24$  years,  $SD = .675$  years, 20 females)  
113 were recruited and received remuneration for completing the experiment. All participants had normal or  
114 corrected-to-normal vision and no psychiatric history. This study adhered to the Declaration of Helsinki  
115 and was approved by the Institutional Review Board of the Institute of Psychology, Chinese Academy of

116 Sciences.

117

### 118 2.1.2 Design

119 The Experiment 1 adopted a 3 (ME: happy, neutral, disgust)  $\times$  2 (Attractiveness: attractive, unattractive)  
120 within-subject factors design. The dependent variables were the participants' mean accuracy score (%) and  
121 the mean reaction times (ms) for participants to accurately detect MEs.

122

### 123 2.1.3 Materials

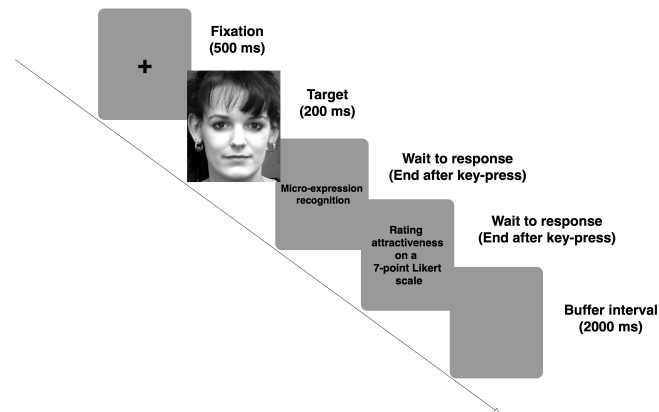
124 The Extended Cohn-Kanade Dataset (CK+) face database was used to choose images of faces (Lucey  
125 et al., 2010). CK+ is the most frequently used laboratory-controlled facial expression classification database  
126 that conforms to the Facial Action Coding System (Ekman and Friesen, 1978). At the individual (within-  
127 culture) level, Matsumoto et al. (2007) observed consistent and dependable positive connections among the  
128 response systems across all seven emotions (happiness, disgust, sadness, contempt, fear, anger and surprise).  
129 These associations indicated that the response systems were coherent with one another. According to  
130 Ekman (1992), the response systems for anger, fear, happiness, sadness, and disgust are coherent across  
131 cultures which is based not only on a high level of agreement in the labeling of what these expressions  
132 signal across literate and preliterate cultures, but also on studies of the actual expression of emotions,  
133 both deliberately and spontaneously, as well as the association of expressions with social interactive  
134 contexts. Therefore, Caucasian faces can be used to measure Chinese college students (Zhang et al., 2017).  
135 From the CK+ face database, we picked 120 pictures of 40 different models whose facial expressions  
136 included disgust, happiness, and neutral. Twenty-two additional Chinese participants rated each neutral  
137 expression's level of attractiveness on a 7-point Likert scale (1 = very unattractive, 7 = very attractive). A  
138 paired sample t-test confirmed that the attractive faces ( $M = 4.18$ ,  $SD = .152$ ) were significantly higher  
139 than unattractive faces ( $M = 2.23$ ,  $SD = .148$ ),  $t(4) = 15.764$ ,  $p < .001$ . The five faces with the highest and  
140 lowest average attractiveness ratings were chosen for the research, resulting in a total of 60 trials. In these  
141 trials, ten different model faces were used for each emotion: five attractive models representing the three  
142 emotions (happiness, neutral, and disgust) and five unattractive models expressing the same emotions. All  
143 photos were 350 $\times$ 418 pixels in size and shown on a white background. A Lenovo computer (23.8-inch  
144 CRT monitor, resolution 1920 $\times$ 1080 pixels) and E-Prime (version 2.0) was used to present the stimuli and  
145 collect the data.

146

### 147 2.1.4 Procedure

148 In a quiet environment, participants were tested individually. First, they were given a practice block  
149 consisting of nine trials to begin with so that they could get familiar with the task. It was requested of the  
150 participants that they maintain their gaze on a center fixation cross that was shown on the screen for a  
151 duration of 500 ms, then one of the three basic expressions was shown for the duration of 200 ms in the  
152 middle of the screen. Participants were told to press the appropriate key according to the micro-expression  
153 they considered the face revealed (the "J" key for happy, "K" key for neutral, or the "L" key for disgust)  
154 and rate each face on attractiveness using a 7-point Likert scale (1 = very unattractive, 7 = very attractive),  
155 each trial only displayed a single image. After 2000 ms, the reaction screen vanished automatically. The  
156 participants were instructed to complete the task in as little time as possible while maintaining the highest  
157 level of accuracy. The experimental blocks didn't utilize the practice block's images. Each experimental  
158 block included all 30 photographs, one of each face shown twice in random order. Testing took about 15  
159 min. (see Fig. 1).

160



**Figure 1.** The procedure of the micro-expression recognition task and 7-point Likert rating task.

## 161 2.2 Data processing

162 The average accuracy and mean reaction times for each combination were calculated in both experiments.  
 163 To deal with the reaction time outliers, we adopted an approach suggested in (Ratcliff, 1993) and set up a  
 164 cut-off point of 1.5 standard deviations above the mean. After that, the reaction time was processed in the  
 165 same way as the accuracy. We utilized Greenhouse- Geisser correction for heterogeneity of covariances (if  
 166 sphericity could not be assumed) and Bonferroni correction for post hoc pairwise comparisons. SPSS 26.0  
 167 program was used for the data analysis.

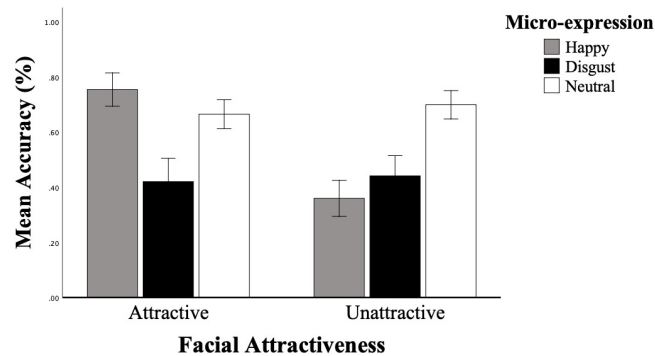
## 169 2.3 Results and Discussion

170 We launched a 3×2 repeated measures ANOVA with ME (happy, neutral, disgust) and Attractiveness  
 171 (attractive, unattractive) as within-subject factors, and with mean accuracy as dependent variables. The  
 172 mean accuracy of the three MEs is shown in Fig. 2. The results revealed a significant main effect of ME,  
 173  $F(2, 74)=19.823, p<.001, \eta_p^2=.349$ , a significant main effect of attractiveness,  $F(1,37)=42.519, p<.001,$   
 174  $\eta_p^2=.535$ . The interactions between ME and attractiveness were significant,  $F(1.580,2.019) =41.447, p$   
 175  $<.001, \eta_p^2=.528$ . Pairwise comparisons with Bonferroni correction show that for ME, mean accuracy  
 176 were significantly higher when responding to happiness compared to disgust ( $p= .011, 95\% CI [.024,$   
 177  $.228]$ ) neutral identified higher recognition accuracy than happiness ( $p= .002, 95\% CI [.041, .209]$ ),  
 178 and disgust ( $p<.001, 95\% CI [.139, .364]$ ). A simple main effect of ME was analyzed to examine the  
 179 interaction between attractiveness and ME. The results revealed a significant simple main effect of ME  
 180 under the attractive faces condition,  $F(2,36) = 27.777, p<.001, \eta_p^2=.607$ , and a significant simple main  
 181 effect of ME under the unattractive faces condition,  $F(2,36) = 38.731, p<.001, \eta_p^2=.683$ . Under the  
 182 attractive faces condition, happiness ( $M=.755, SD=.030$ ) identified higher recognition accuracy than disgust  
 183 ( $M=.666, SD=.026, t(36)=2.34, p=.023, d=.780, 95\% CI [.013, .166]$ ), and neutral ( $M=.442, SD=.036,$   
 184  $t(36)=7.45, p<.001, d=2.48, 95\% CI [.229, .397]$ ), disgust identified higher recognition accuracy than  
 185 neutral ( $t(36)=4.571, p<.001, d=1.524, 95\% CI [.125, .322]$ ). Furthermore, neutral ( $M=.700, SD=.025$ )  
 186 identified higher recognition accuracy than happiness ( $M=.421, SD=.042, t(36)=5.167, p<.001, d=1.722,$   
 187  $95\% CI [.169, .389]$ ) and disgust ( $M=.361, SD=.032, t(36)=8.692, p<.001, d=2.897, 95\% CI [.261, .418]$ )  
 188 under the unattractive faces condition, but no significant differences between happiness and disgust ( $p =$   
 189  $.242, 95\% CI [-.043, .164]$ ) (see Table 1).

190 Mean reaction times were submitted to a second repeated measures ANOVA with the same factors  
 191 described above, outliers (reaction times exceeding the mean of each participant by 1.5 SD) were not

**Table 1.** Mean accuracy of recognition of each Micro-expression in Experience 1

Micro-expression	Accuracy of recognition (%)	
	Attractive M±SD	Unattractive M±SD
Happy	0.775±0.184	0.361±0.199
Disgust	0.421±0.259	0.442±0.223
Neutral	0.665±0.159	0.700±0.156

**Figure 2.** Participants' mean accuracy of the static micro-expression recognition task in two facial attractiveness levels (attractive, unattractive). Error bars reflect the 95% confidence intervals for the mean accuracy.

192 included in the analysis. There were no significant main effect of ME,  $F(2, 56)=1.661$ ,  $p=.199$ , and  
 193 attractiveness,  $F(1, 28) = .453$ ,  $p = .507$ , no significant interactions between ME and attractiveness,  $F(2, 56)$   
 194  $= 1.363$ ,  $p = .264$ .

195 Attractiveness ratings were submitted to a third repeated measures ANOVA with the same factors  
 196 described above. The results revealed a significant main effect of ME,  $F(2, 74)=62.595$ ,  $p<.001$ ,  $\eta_p^2=.628$ ,  
 197 a significant main effect of attractiveness,  $F(1,37)=64.526$ ,  $p<.001$ ,  $\eta_p^2=.636$ . The interactions between  
 198 ME and attractiveness were significant,  $F(2, 74) = 7.786$ ,  $p=.001$ ,  $\eta_p^2=.174$ , indicating that the attractive  
 199 manipulation of the stimuli used in the current study is effective. Pairwise comparisons with Bonferroni  
 200 correction show that for ME, the score of attractiveness ratings were significantly higher when responding  
 201 to happiness compared to disgust ( $p<.001$ , 95% CI [.500, .939]), and neutral ( $p<.001$ , 95% CI [.427,  
 202 .737]), neutral were rated as more attractive than disgust ( $p = .027$ , 95% CI [.013, .264]). Further analysis  
 203 revealed a significant simple main effect of ME under the attractive faces condition,  $F(2,36) = 30.378$ ,  
 204  $p<.001$ ,  $\eta_p^2=.628$ , and a significant simple main effect of ME under the unattractive faces condition,  $F(2,36)$   
 205  $= 23.264$ ,  $p<.001$ ,  $\eta_p^2=.564$ . Under the attractive faces condition, happiness ( $M=4.337$ ,  $SD=.164$ ) were  
 206 rated with higher score than disgust ( $M=3.421$ ,  $SD=.135$ ,  $t(36)=7.508$ ,  $p<.001$ ,  $d=2.503$ , 95% CI [.668,  
 207 1.164]), and neutral ( $M=3.582$ ,  $SD=.123$ ,  $t(36)=7.704$ ,  $p<.001$ ,  $d=2.568$ , 95% CI [.556, .954]), disgust  
 208 were rated with lower score than neutral ( $t(36)=2.439$ ,  $p=.020$ ,  $d=0.813$ , 95% CI [-.294, -.027]). Under  
 209 the unattractive faces condition, happiness ( $M=3.361$ ,  $SD=.163$ ) were rated with higher score than disgust  
 210 ( $M=2.837$ ,  $SD=.143$ ,  $t(36)=6.39$ ,  $p<.001$ ,  $d=2.13$ , 95% CI [.358, .690]) and neutral ( $M=2.953$ ,  $SD=.163$ ,  
 211  $t(36)=5.826$ ,  $p<.001$ ,  $d=1.942$ , 95% CI [.266, .550]), no significant differences between disgust and neutral  
 212 ( $t(36)=1.634$ ,  $p=.112$ ,  $d=0.545$ , 95% CI [-.260, .029]).

213

214 In this study, we examine how facial attractiveness influences the processing of ME recognition in static  
215 conditions. Analysis of accuracy indicated that the recognition of ME is influenced by attractiveness.  
216 Participants categorized attractive faces more accurately than unattractive faces. Specifically, participants  
217 showed the happiness superiority effect for the faces with higher attractiveness levels but not for the  
218 unattractive ones, the expression of happiness on the attractive faces was the easiest to recognize, followed  
219 by neutral, and then disgust.

220

### 3 EXPERIMENT 2

221 In Experiment 2 we presented dynamic stimuli to investigate the effects of facial attractiveness on the  
222 processing of MEs. We hypothesized that participants could judge attractive faces faster overall in a dynamic  
223 context; participants showed the happiness superiority effect for the faces with higher attractiveness levels  
224 but not for the unattractive ones.

225

#### 3.1 Methods

227 The Experiment 2 employed a 2 (ME: happy, disgust)  $\times$  2 (Attractiveness: attractive, unattractive) within-  
228 subject factors design. The dependent variables were the participants' mean accuracy score (%) and the  
229 mean reaction times (ms) for participants to accurately detect MEs. Participants and procedure were the  
230 same as in Experiment 1. Based on a post hoc power analysis by using G\*Power 3.1 (Faul et al., 2007)  
231 and calculating power analysis for the main effect of attractiveness (a partial  $\eta^2$  equal to 0.436, an alpha  
232 of 0.05, and a total sample size of 38), we observed that this sample size generated a high power of  $1-\beta$   
233 equal to 0.999. To exclude practice effects, we balanced the order of Experiment 1 and Experiment 2  
234 between participants. Thirty-eight participants were randomly divided into two groups (Group A and B),  
235 each comprised of nineteen participants. Group A completed Experiment 1 follow by Experiment 2, and  
236 Group B did the opposite. Also, we used the materials from Experiment 1 to create short video clips. Shen  
237 et al. (2012) found a significant difference in recognition accuracy with durations of 40 ms and 120 ms  
238 under the METT paradigm condition; however, when the duration was greater than 120 ms, there was no  
239 difference in accuracy rate. Thus, we employ the intermediate values with duration of 80 ms as the target  
240 stimulus. Based on the neutral-emotional-neutral paradigm (Zhang et al., 2014), we used neutral as the  
241 context expression in this experiment. Zhang et al. (2014) indicated that MEs are contained in the flow of  
242 expressions including both neutral and other emotional MEs, considering that a ME is occurred very fast  
243 and is always submerged in other MEs, the neutral faces before and after the target ME were presented for  
244 60ms in order to simulate the real situation in which the ME happened, with happiness or disgust flashed  
245 briefly for 80 ms, resulting in a total of 200 ms. Thus, the dynamic stimuli consisted of 20 clips (each clip  
246 lasting for 200 ms and shows the same model), comprised of two levels of Attractiveness (attractive and  
247 unattractive) and presented as two stimulus types (neutral-happiness-neutral and neutral-disgust-neutral)  
248 for each of the 10 models, each clip shown twice in random order. E-Prime (version 3.0) was used to show  
249 the stimuli and collect the data.

250

#### 3.2 Results and Discussion

252 We launched a 2 $\times$ 2 repeated measures ANOVA with ME (happy, disgust) and Attractiveness (attractive,  
253 unattractive) as within-subject factors, and with mean accuracy as dependent variables. The mean accuracy  
254 of the two MEs is shown in Fig. 3. The results revealed a significant main effect of attractiveness,  
255  $F(1,37)=28.560, p<.001, \eta_p^2=.436$ . The main effect of ME was not significant,  $F(1,37)=.062, p=.805$ .  
256 The interactions between ME and attractiveness were significant,  $F(1,37)=14.637, p<.001, \eta_p^2=.283$ . A

**Table 2.** Mean accuracy of recognition of each Micro-expression in Experience 2

Micro-expression	Accuracy of recognition (%)	
	Attractive M±SD	Unattractive M±SD
Happy	0.942±0.136	0.731±0.221
Disgust	0.731±0.221	0.857±0.127

257 simple main effect of ME was analyzed to examine the interaction between attractiveness and ME. The  
 258 results revealed a significant simple main effect of ME under the attractive faces condition,  $F(1,37) = 5.512$ ,  
 259  $p=.024$ ,  $\eta_p^2 = .130$ , and a significant simple main effect of ME under the unattractive faces condition,  $F(1,37)$   
 260  $=9.294$ ,  $p = .004$ ,  $\eta_p^2 = .201$ . Furthermore, happiness ( $M=.942$ ,  $SD=.022$ ) identified higher recognition  
 261 accuracy than disgust ( $M=.732$ ,  $SD=.036$ ,  $t(37)=2.362$ ,  $p=.024$ ,  $d=.777$ , 95% *CI* [.015, .206]) under the  
 262 attractive faces condition, happiness ( $M=.832$ ,  $SD=.040$ ) identified lower recognition accuracy than disgust  
 263 ( $M=.858$ ,  $SD=.021$ ,  $t(37)=3.073$ ,  $p = .004$ ,  $d=1.010$ , 95% *CI* [-.210, -.042]) under the unattractive faces  
 264 condition (see Table 2).

265

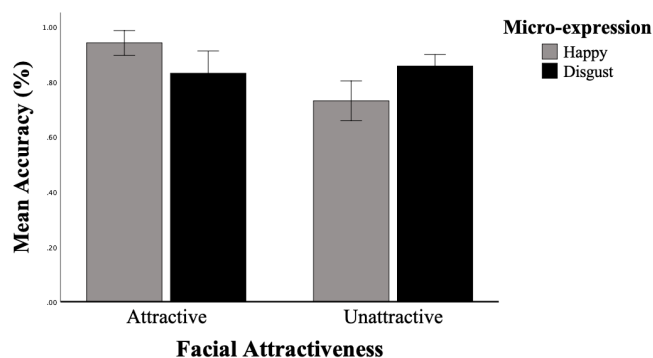
266 Mean reaction times were submitted to a second repeated measures ANOVA with the same factors  
 267 described above, outliers (reaction times exceeding the mean of each participant by 1.5 SD) were not  
 268 included in the analysis. There was no significant main effect of ME,  $F(1,35) = .218$ ,  $p=.644$ , or a significant  
 269 main effect of attractiveness,  $F(1,35) = 2.492$ ,  $p = .123$ . Remarkably, the interaction of ME × Attractiveness  
 270 was significant,  $F(1,35)=21.245$ ,  $p<.001$ ,  $\eta_p^2 = .378$ . A follow-up simple effect analyses were employed  
 271 to investigate the effect of ME within each level of attractiveness. The results revealed a significant  
 272 simple main effect of ME under the attractive faces condition,  $F(1,37) = 9.267$ ,  $p= .004$ ,  $\eta_p^2 = .200$ , and a  
 273 significant simple main effect of ME under the unattractive faces condition,  $F(1,37) = 21.773$ ,  $p<.001$ ,  
 274  $\eta_p^2 = .370$ . Happiness ( $M=758.280$ ,  $SD=55.873$ ) identified faster than disgust ( $M=919.013$ ,  $SD=79.390$ )  
 275 under the attractive faces condition ( $t(37)=3.044$ ,  $p= .004$ ,  $d=1.001$ , 95% *CI* [-267.715, -53.752]), disgust  
 276 ( $M=821.605$ ,  $SD=66.602$ ) identified faster than happiness ( $M=982.400$ ,  $SD=76.192$ ) under the unattractive  
 277 faces condition ( $t(37)=4.666$ ,  $p<.001$ ,  $d=1.534$ , 95% *CI* [-230.616, -90.973]).

278

279 Attractiveness ratings were submitted to a third repeated measures ANOVA with the same factors  
 280 described above. The results revealed a significant main effect of ME,  $F(1, 37)=62.947$ ,  $p<.001$ ,  $\eta_p^2=.630$ ,  
 281 a significant main effect of attractiveness,  $F(1,37)=101.369$ ,  $p<.001$ ,  $\eta_p^2=.733$ . The interactions between  
 282 ME and attractiveness were significant,  $F(1, 37) = 20.428$ ,  $p<.001$ ,  $\eta_p^2=.356$ , indicating that the attractive  
 283 manipulation of the stimuli used in the current study is effective. Further analysis revealed a significant  
 284 simple main effect of ME under the attractive faces condition,  $F(1,37) = 143.607$ ,  $p<.001$ ,  $\eta_p^2=.795$ , and a  
 285 significant simple main effect of ME under the unattractive faces condition,  $F(1,37) = 29.711$ ,  $p<.001$ ,  
 286  $\eta_p^2=.445$ . Under the attractive faces condition, happiness ( $M=4.471$ ,  $SD=.173$ ) were rated with higher score  
 287 than disgust ( $M=3.195$ ,  $SD=.167$ ,  $t(37)=11.925$ ,  $p<.001$ ,  $d=3.921$ , 95% *CI* [1.061, 1.492]). Under the  
 288 unattractive faces condition, happiness ( $M=3.374$ ,  $SD=.132$ ) were rated with higher score than disgust  
 289 ( $M=2.682$ ,  $SD=.146$ ,  $t(37)=5.449$ ,  $p<.001$ ,  $d=1.792$ , 95% *CI* [.435, .949]).

290

291 In this study, we examine how facial attractiveness influences the processing of ME recognition in dynamic  
 292 conditions. Analysis of accuracy indicated that attractiveness affects ME recognition. Participants could



**Figure 3.** Participants' mean accuracy of the dynamic micro-expression recognition task in two facial attractiveness levels (attractive, unattractive). Error bars reflect the 95% confidence intervals for the mean accuracy.

293 recognize attractive faces more accurately. Specifically, we observed a higher accuracy rate for happiness  
294 than disgust under the attractive faces condition, which supports the assumption that attractiveness could  
295 moderate the happiness superiority effect. For the response times, the interaction of Attractiveness  $\times$   
296 ME was significant, attractive faces were recognized faster than unattractive faces, and happiness was  
297 categorized faster than disgust under the attractive face condition whereas this happiness superiority effect  
298 did not apply to unattractive faces. According to the results of attractiveness ratings, the advantage of happy  
299 faces may be caused by its attractiveness. Overall, participants could identify the happy expression faster  
300 and more accurately in higher attractive faces, demonstrating that participants have a stronger ability to  
301 identify dynamic expressions that are very attractive.

302

#### 4 GENERAL DISCUSSION

303 Across two experiments, we showed participants static and dynamic faces to recognize MEs. We revealed  
304 evidence of the effect of attractiveness on the recognition of ME in either static condition or dynamically.  
305 The results suggest that these two attributes (Attractiveness  $\times$  ME) are strongly interconnected. Participants  
306 showed the happiness superiority effect for the faces with higher attractiveness levels but not for the  
307 unattractive ones in both experiments. These findings are in line with the attractiveness stereotype, which  
308 defines the phenomena in which individuals correlate physical appearance with a variety of beneficial  
309 qualities (Eagly et al. 1991). For instance, attractiveness could boost job interview chances (Watkins and  
310 Johnston, 2000). According to the attractiveness stereotype, attractive appearance and good qualities have a  
311 strong association with the thoughts of people. Therefore, the identification of attractive faces and positive  
312 emotions may be rewarded with an advantage, enhancing their speedy recognition (Golle et al., 2014).

313 The happiness superiority effect was strengthened by neuroimaging evidence indicating that the medial  
314 frontal cortex plays an important role in happy face recognition (Kesler et al., 2001). Ihme et al. (2013)  
315 used functional magnetic resonance imaging (fMRI) for the first time to explore the brain mechanism of  
316 JACBART, and revealed increasing activation with higher performance in the basal ganglia for the negative  
317 faces and in orbitofrontal areas for happiness and anger. Furthermore, previous research implicated that  
318 basal ganglia and orbitofrontal cortex are both involved in the processing of emotional facial expressions.  
319 According to O'Doherty et al. (2003), the medial orbitofrontal cortex (OFC) is a region which is known  
320 involved in representing stimulus reward value, was shown to be more active when an attractive face was

321 associated with a happy expression, rather than a neutral one. Further studies should find out whether facial  
322 attractiveness that correlates with the detection performance of MEs predicts activation in basal ganglia  
323 and orbitofrontal cortex.

324 In general, this study aimed to explore the effects of facial attractiveness on the processing of MEs in  
325 static and dynamic experimental conditions. The findings of our study verified and represent an extension  
326 of previous research. On one hand, the results show that participants could identify the happy expression  
327 quicker in higher attractive faces, which supports the happiness superiority effect and strengthens this theory  
328 with more evidence. On the other hand, this research suggests that the moderation of ME recognition is not  
329 limited to invariant facial attributes (such as gender and race) but also applies to variable face features such  
330 as facial attractiveness. Furthermore, previous studies suggest that ME recognition training has significant  
331 effects on the recognition of MEs (Matsumoto and Hwang, 2011). However, the selection of stimulus  
332 material in prior research may not address the variations in the attractiveness of the faces representing the  
333 various groups. The current findings demonstrate that facial attractiveness is processed quickly enough to  
334 influence ME recognition; hence, facial attractiveness should be considered when selecting faces as stimuli  
335 for ME recognition training. Also, since individuals can be trained to recognize MEs more accurately and  
336 quickly in as little as a few hours, the effects of facial attractiveness on ME recognition may be reduced  
337 when individuals receive ME training.

338 The present experiments entailed several limitations. First, this research only used two basic expressions  
339 as experimental materials. It remains unclear whether facial attractiveness affects other MEs (such as a  
340 sadness expression) as much as in our research, a wider range of facial expressions should be examined  
341 in future research. Second, we used synthetic MEs in the experiences, while natural MEs may be shorter,  
342 asymmetrical, and weaker than synthetic MEs, future research could use natural MEs with more ecological  
343 validity as research materials. However, this would require a ME database with a rich sample. Third, we  
344 employed the Caucasian faces as experimental materials, which were outgroup members to the participants  
345 of the current study. However, evidence from cross-cultural studies suggests that the ME recognition  
346 process might differ between the ingroup members and outgroup members. For example, Elfenbein and  
347 Ambady (2002) suggested that individuals are more accurate at identifying ingroup emotions since they  
348 are more familiar with their own race expressions and faces. Therefore, it may be useful to use a wider  
349 variety of face types in future studies to evaluate the ingroup advantage in ME recognition-related facial  
350 attractiveness in a context of stimulus equivalence. Finally, since a ME is often embedded in the flow  
351 of other MEs, we employed 80 ms for target MEs, and the neutral MEs before and after the emotional  
352 MEs were only presented for 60ms to simulate the actual situation in which the ME occurred. This led  
353 to the neutral expressions and target ME being combined and the entire duration was examined. Future  
354 studies could employ an ERP experiment to investigate the modulation of early visual processing (e.g.,  
355 P1 and N170) by using natural MEs in order to investigate the neural mechanism for the effect of facial  
356 attractiveness on ME. Moreover, this research only examined the presentation time of MEs at 200 ms. Shen  
357 et al. (2012) showed that the accuracy of MEs recognition depends on how long they last and reaches a  
358 turning point at 200 ms or maybe even less than 200 ms before leveling off. This suggests that the critical  
359 time point that differentiates MEs may be 1/5 of a second. Does facial attractiveness have different effects  
360 on ME recognition with longer and shorter presentation times? These questions need to be further explored.  
361

## 5 CONCLUSION

362 In conclusion, the current research provides objective evidence that facial attractiveness influences the  
363 processing of MEs. Specifically, we observed that attractive happy faces can be recognized faster and

364 more accurately, emphasizing the happiness superiority effect whether in a static condition or dynamically.  
365 Moreover, these new results support the assumption that facial attractiveness could moderate emotion  
366 perception. Further studies should employ eye tracker technology to detect visual attention mechanisms in  
367 MEs processing that is influenced by facial attractiveness.

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