THE FUNCTIONAL CONSEQUNCES OF FACIAL MIMICRY:

EFFECTS OF ACTION ON IMAGE PERCEPTION

by

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Abstract

The present study asks whether social exclusion causes negative emotion, lower self-esteem, and loneliness. Unconsciously mimicking other people's facial expressions after social exclusion reduces these negative effects. The current study explored whether interfering with unconscious mimicry of faces following social exclusion would reduce the protective effects of mimicking others. Participants played a computerized game in which they were either excluded by other participants or not, and then they viewed a series of smiling faces. Half of participants viewed the faces with a pen in their teeth (no mimicry interference) or in their lips (mimicry interference). Then they completed questionnaires measuring empathy, mood, self-esteem, and loneliness. This experiment revealed that people excluded reported having more positive emotion compared to those included. There were no other effects of social exclusion or mimicry interference, nor were there any interactions. More work is needed to better understand the role of unconscious mimicry in social exclusion.

The functional consequences of facial mimicry: Effects of action on image perception

Imagine viewing an image of family members or loved ones. We often experience emotion when we view two-dimensional images of people. How is it that viewing a two-dimensional image get translated into an emotional response? One possibility is that we mimic the faces that we see in pictures. Facial expressions from the subject in the photograph causes people to automatically express the same facial expression. What emotional consequences could occur during the mimicry of an image?

Factors that affect the emotionality of photographs

Previous research has attempted to identify the features of a photograph that contribute to its emotionality. Previous research has found that certain low-level features of photographs are associated with emotionality. For example, bright colors and smooth lines create positive emotions, whereas dark colors and chaotic textures induce negative emotions. The reason is that humans have this natural ability to perceive and induce emotional signals of their visual surroundings unconsciously. This reason is essential for humans to comprehend the interaction of the features between the image and the viewer and the physical, social, and historical information the viewer may experience (Yanulevskaya et al., 2012). Adding colors, lines, and the inclusion of the subject into the frame leads to a more robust dynamic that is essential to the features of a photograph. The human figure creates certain emotions in photographs that can also elicit positive or negative implications. Images of people smiling gives us a positive reaction to happiness, and the same can be said when viewing images of people frowning (Aragon & Clark, 2017). In a study by Walters and Walk (1988), they revealed that people are capable of using light cues to make inferences of the movement in the subject of the photograph. Because with their use of the streaks of light, people can identify a happy woman by the bounce in her step,

and anger may be observable because of its violent movements. Pico, Espert, and Gadea (2020) presented an idea of how salient emotional cues, like tears, capture attention and intensify emotional processing. For example, tears running down a cheek change our bioelectric brain activity and can also alter the typical visual inspection pattern so that tears act as magnets of attention (Pico and Gadea, 2020).

To what extent do people mimic the action represented in a static image

If photographs contain information that occurs in the subject's movement, to what extent do people mimic the action represented in an image? *Mimicry* is an act of replicating another person's mannerisms, facial expressions, postures, and even linguistic accents. Many things in our environment can trigger unconscious mimicry, only our reactiveness to the environment eventually influences how we perceive and interact with the environment (Baaren, 2006). Faces capture attention, promote top-down processing, and may lead to mimicry or embodied simulation (Massaro et al., 2012). Embodied simulation refers to the sub-threshold activation of motor mechanisms and emotional states that do not necessarily lead to actual, visible mimicry. However, it activates some of the same motor areas. These activations are where the brain activates mirror neurons and other mirroring mechanisms in our brain to mimic the same emotions or sensations from other people (Massaro et al., 2012).

We have reviewed further that a static image represents functions and emotionality, and several ideas further explain to what extent people mimic the action of a static image. Dimberg (1982) explained further in his previous report that when people are exposed to pictures of emotional facial expressions, they react spontaneously with distinct facial electromyographic (EMG) reactions in muscle areas relevant to positive and negative images (Dimberg, 1982, 1990). He explains that pictures of spontaneously evoked positive imagery, including happiness

and the physiological movement of the lips and cheeks upward, result from an activated *zygomatic major* muscle. Negative images, which include fear and disgust, these physiological movements of the circumorbital and a palpebral group of upper muscles located on the end of the inner eyebrows activates the *corrugator* muscle. A study by Sonnby-Borgstom, Peter Jonsson, and Ove Svensson (2003) demonstrated facial mimicry reactions using an electromyographic (EMG) measure. The two major muscle groups were detected by presenting each subject with pictures of happy and angry faces. Their results show that people activate the corrugator muscle more when viewing angry faces than happy faces. In addition, they activate the zygomaticus muscle more when viewing happy faces than angry faces. It is important to note that people were not necessarily visibly smiling or frowning when viewing these images. However, instead, they were micro-activating the corresponding muscles at sub-threshold levels.

Another study by Jun-Wen Tan and Holger Hoffman (2011) presented a similar concept to the previous study, in response to various images that don't represent faces but have an emotional element to them. Tan & Hoffman (2011) included pictures of theme parks, food, helicopters, and nature, and they used EMG scans to record stimulation of the facial muscles. Their results showed that corrugator muscles activate higher when participants view negative pictures, and zygomaticus muscles activate when viewing positive emotional states accordingly (Tan & Hoffman, 2011). Activation for the corrugator is more active for negative images than for neutral images, and for positive images is suppressed relative to neutral images. Conversely, the zygomaticus is activated more for positive than neutral or negative images.

These findings demonstrate that our facial muscles can correspond with our sense of reacting toward an image, whether positive or negative. However, some findings suggest that facial mimicry may not often occur. Regarding the research made from both studies, limitations

were done based on how judgment tasks were done. There was no statistical evidence to prove that facial EMG responses are differentiable in the dimension of arousal since high arousal emotions cannot be easily elicited by pictures in laboratory situations (Tan & Hoffman, 2011). Furthermore, in another study, the instructions to mimic the emotional facial expressions could have led to empathetic processes (Bairly, Herrera, Hess, 1999). As in this research, they created a similar scenario of mimicking imagery. However, they did not find that mimicry acutally lead to the experience or contagion of that emotion.

Functional consequences of unconscious mimicry

Previous work has shown that when people view pictures of faces, they spontaneously mimic the emotional expressions in the photographs. Rymarczyk et al. (2016) describe how some studies have reported more robust emotion-specific responses to dynamic expressions, mainly the zygomaticus muscle and the corrugator muscle for happiness and anger. Why do people mimic the faces they see? What role does facial mimicry play?

Ostracism is an extreme act of social rejection in which one is excluded and ignored by other individuals. People frequently use this act to exclude someone from many activities and institutions both in modern times and historical (Williams et al., 2000). Social exclusion is an act that uses peoples fear to become excluded, rejected, or just being ignored. Researchers have found that socially excluded people become more psychologically challenged, as depressed moods, loneliness, anxiety, frustration, and helplessness (Williams et al., 2000).

Furthermore, excluded people will find ways to come back to their senses and get back to remain included in their social groups. For example, a study done by De Clerk et al. (2020) demonstrated that toddlers could use facial mimicry to enhance social affiliation after being

ostracized. Their experiment was used with a third-party ostracism measure, where they would view one shape being ostracized by other shapes. Afterward, participants viewed videos of faces from women to detect facial mimicry. And they found that toddlers who were ostracized showed greater facial mimicry at posttest than the toddlers who didn't see the social exclusion. Another study by Jessica Lakin, Valerie Jefferis, Clara Cheng, and Tanya Chartrand (2003) researched the importance of mimicry, including the idea of mimicry being an adaptive value. They pointed out the relationship between exclusion and ostracism and unconscious mimicry. This correlational study demonstrated that the degree of unconscious mimicry predicted the degree to which viewing faces reduced negative emotions from being excluded. However, it is unclear from this study whether mimicry caused the reduction in negative emotions, or whether people who were less affected by social exclusion happened to mimic the faces they saw more.

Even with social exclusion becoming a solid factor that would increasingly activate a person to mimic the behaviors of another person (Lakin et al., 2003), to what extent does facial mimicry become an automatic step for emotional recognition. Many things in our environment can trigger unconscious mimicry (Baaren, 2006), particularly facial imagery (Massaro et al., 2012). Activations of mirror neurons and other mirroring mechanisms in our brain lead people to mimic the same emotions or sensations from other people. However, the nature of these muscle responses does not clear up the meaning as to why it happens to us. On one side, mimicry is a nonfunctional relevance to emotional recognition (Borgomaneri et al., 2020). Moreover, mimicry could be contributed to emotion recognition as it is when they observe facial emotional expressions (Borgomaneri et al., 2020). In a study done by Sara Borgomaneri, Corinna Bolloni, Paola Sessa, and Alessio Avenanti (2020), they investigated how facial mimicry plays a role in facial recognition of emotional facial expressions and how it recognizes the expressions of

emotions. Participants viewed a series of emotional faces (happy, neutral, fearful). They performed a mimicry interference manipulation, where participants either held a pen in their lips or in their teeth. Their goal for having the pen in their lips was to prevent participants from moving their mouths to mimic the pictures. Mimicry interference using the bite condition impaired emotion recognition of happy expressions. Lindsay M. Oberman, Piotr Winkielman, and Vilayanur S. Ramachandran (2007) similarly tested how interfering with facial muscles involved in facial mimicry could impair the recognition of emotions that engage those muscles. Furthermore, their results found that interfering facial muscles of happiness and sadness impaired the participant's ability to detect the transition between happy and sad facial expressions.

Previous studies that tested empathy showed an increase of activation in specific brain areas associated with empathic behavior (Rymarczyk, Zurawskil, Jankowiak-Siuda, Szatkowska1, 2016). High empathetic individuals produced greater facial mimicry than lower empathetic individuals.

However, it is unclear from this broad literature whether mimicry caused the reduction in negative emotions or cause people to be more empathetic. Alternatively, people who were affected by social exclusion happened to mimic the faces they saw more. The present study will test whether interfering with unconscious mimicry reduces its protective effects following social exclusion. Participants in this study were first either excluded or they were included in a game of cyberball. Then they saw a series of images, while either prevented or not prevented from mimicking the images. Then participants reported on their mood, empathy, loneliness, and self-esteem. Based on previous research and measurements, the following key factors are shown for the present study of this experiment. Social exclusion leads to a significant increase in negative

emotion, low self-esteem, and feelings of loneliness compared to social inclusion. People who are allowed to engage in facial mimicry of happy faces will experience a reduction in these negative consequences of social exclusion compared to people who are prevented from mimicking the faces. Therefore, the predictions for the study will be that the negative consequences of social exclusion should be greater in the pencil in lips condition (mimicry interference) than in the pencil in teeth condition (no interference).

Methods

Participants

Eighty participants (41.25% male, 56.25% female, and 2.50% non-binary or preferred not to say) were recruited using the Mechanical Turk participant pool. All participants had an age range between 20 to 70 years old (M = 40.06, SD = 12.78). Every participant had normal or corrected-to-normal vision, and all participants were provided informed consent prior to beginning the study. The study was conducted in accordance with ethical guidelines and approved by the head of the IRB at the State University of New York at Purchase College.

Materials

Face stimuli. Participants were seeing static images of happy faces. Half the faces being female faces and half male faces. In total there were 80 static images (40 static happy, 40 moving happy). For our questionnaire, the following dependent variables be used to determine our results for out study: Each questionnaire was used as key sources of mimicry and its protective effects.

Empathy: Measured using The Questionnaire Measure of Emotional Empathy (QMEE) developed by Mehrabian and Epstein (1972). It contains items such as: A 33 item nine-point ratings Scale rating from -4 (being very strong disagreement) to +4 (very Strong agreement)

Mood: Measured using the Positive and Negative Affect Schedule Scale (PANAS), developed by Watson, Clark and Tellegen (1988). An example item includes: an 11 item five-point Likert scale ranging from *'Very slightly or not at all'; 'A little'; 'Moderately'; 'Quite a bit'; to 'Extremely'*.

Loneliness: Measured using the Revised UCLA Loneliness Scale, developed by Russel et al. (1980). An example item includes: a 20 item 4 points Likert scale, indicating loneliness and emotional state. Ranging from never too often.

Self-esteem: Measured using Rosenberg Self-Esteem Scale (RSE) developed by Rosenberg (1976). An example item includes A ten item 4-point Likert scale from strongly agree to strongly disagree, with higher scores indicating high self-esteem.

Procedure

Each participant completed the study individually online via Qualtrics. To begin the study, they played a virtual game of Cyberball, where each participant began to play a ball passing game with three other participants, whom the participant was told were other participants playing virtually. All the other "players," however, are computerized. In addition, each participant will be randomly assigned to one of two game versions, exclusion or non-exclusion. Participants in the exclusion condition will receive a few balls passes once at the beginning of the game and then will not receive the ball again. As for the non-exclusion, participants will receive the ball regularly with the other players throughout the game. This manipulation has been used to induce feelings of low self-esteem and loneliness in previous studies (Williams et al., 2000).

Next, participants viewed a sequence of 80 happy faces in succession. Participants indicated whether the gender of the person pictured is male or female for each face before beginning the facial imagery section. Participants were randomly assigned to one of two between-subjects conditions: mimicry interference or no mimicry interference. The no-mimicry group will place a pen/pencil in their mouth horizontally, biting it with their teeth for the duration of the face task. For the mimicry interference group, each participant instead would place the pen/pencil on their lips for the duration of the experiment. This manipulation has been shown to interfere with unconscious mimicry toward the faces in previous work (Borgomaneri et al., 2020). One limitation of this experiment is that since the experiment is being held online, we cannot be sure that all participants will have done the experiment correctly and followed all the instructions asked of them.

After the experiment was finished, participants removed their pens/pencils from their mouths and completed four different questionnaires measuring self-esteem, loneliness, mood, and empathy. The order of these questionnaires was randomized across all participants. Finally, each participant was instructed to report whether they followed our instructions and placed a pen or pencil in their mouth. Followed by if they had previously played the cyberball game and report how many passes they received when the ball was passed to them. Then they will complete a demographic questionnaire based on age and gender and present an overview of the study.

Results

Each participant's response to each questionnaire was averaged together, with reverse coding being needed in certain questions from each questionnaire. 2 participants were excluded from the exclusion condition due to reporting that they received more than two passes in the cyberball game. We also had to exclude 5 more participants from the study since they reported that they played the cyberball game prior to doing our study. Additionally, 7 participants reported in our follow-up questions that they did not place a pen or pencil in their mouths as instructed and were excluded from analyses. Thus, our analyses are based on 73 participants.

Loneliness. I conducted a factorial ANOVA on Loneliness scores with two between-subjects factors: social exclusion and mimicry interference. The analysis from the revealed that there was no significant difference for individuals who were in the included condition (M = 2.38, SD = 0.55) compared to the excluded condition, (M = 2.37, SD = 0.61); $F(1,69) = 0.01$, p = .925. For the mimicry factor, there was no significant difference in loneliness between people who were prevented from smiling (M = 2.35, SD = 0.55) and people who were not prevented from smiling (M = 2.40, SD = 0.61), $F(1,69) = 0.15$, p = .696. There was no significant interaction between social exclusion and mimicry, $F(1,69) = 0.06$, p = .809. Meaning that individuals who performed whether in the included condition, (pen in lips, M = 2.44, SD = 0.13, pen in teeth, M = 2.30, SD = 0.58) or in the excluded condition, (pen in lips, M = 2.50, SD = 0.50, pen in teeth, M = 2.20, SD = 0.78) have had similar average loneliness scores. The means from this analysis are plotted in Figure 1.

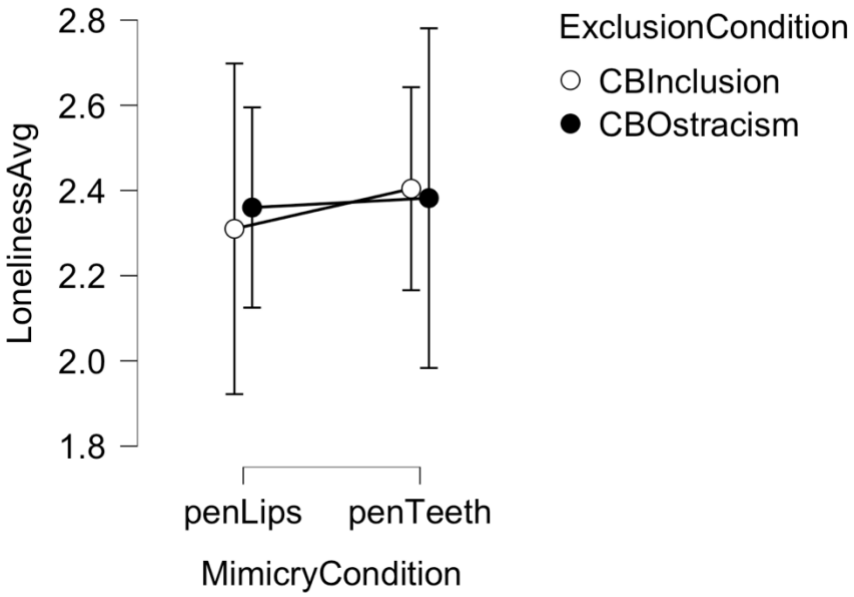

Figure 1: A descriptive graph of the average scores of Loneliness measure broken down by the mimicry condition and the inclusion condition. Error bars represent confidence in the polls.

Self-Esteem. A factorial ANOVA on Self-Esteem scores with two between-subjects factors: social exclusion and mimicry interference was done. The analysis from the revealed that there was no significant difference for individuals who were in the included condition (M = 27.53, SD = 6.18) compared to the excluded condition, (M = 30.03, SD = 5.92); F (1,69) = 2.08, p = .154. For the mimicry factor, there was no significant difference in self-esteem between people who were prevented from smiling (M = 29.63, SD = 5.66) and people who were not prevented from smiling (M = 28.16, SD = 6.53), F (1,69) = 0.23, p = .635. There was no significant interaction between social exclusion and mimicry, F (1,69) = 0.05, p = .816. Meaning that individuals who performed whether in the included condition, (pen in lips, M = 28.30, SD = 6.83, pen in teeth, M = 27.21, SD = 6.01) or in the excluded condition, (pen in lips, M = 30.16, SD = 5.18, pen in teeth, M = 29.79, SD = 7.28) have had similar average self-esteem scores. The means from this analysis are plotted in Figure 2.

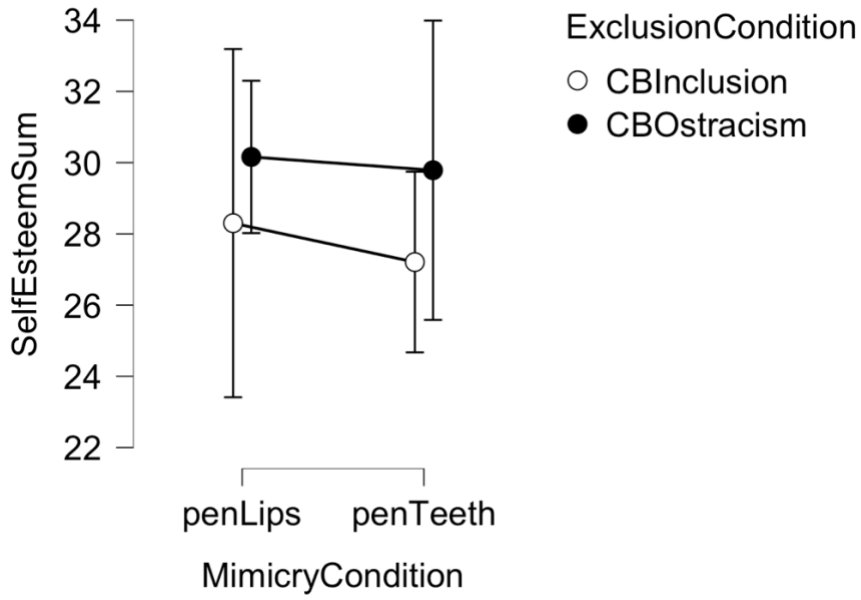

Figure 2: A descriptive graph of the average scores of Self-Esteem measure broken down by the mimicry condition and the inclusion condition. Error bars represent confidence in the polls

Mood. A factorial ANOVA on Mood scores with two between-subjects factors: social exclusion and mimicry interference have been done. The analysis from the revealed that there was now a partial difference for individuals who were in the included condition (M = 3.51, SD = 0.44) compared to the excluded condition, M = 3.76, SD = 0.49; F (1,69) = 5.53, p = .022. For the mimicry factor, there was no significant difference in loneliness between people who were prevented from smiling (M = 3.65, SD = 0.45) and people who were not prevented from smiling (M = 3.63, SD = 0.51), F (1,69) = 0.39, p = .535. There was no significant interaction between social exclusion and mimicry, F (1,69) = 0.16, p = .693. Meaning that individuals who performed whether in the included condition, (pen in lips, M = 3.42, SD = 0.27, pen in teeth, M = 3.54, SD = 0.50) or in the excluded condition, (pen in lips, M = 3.75, SD = 0.48, pen in teeth, M = 3.78, SD = 0.53) have had similar average mood scores. The means from this analysis are plotted in Figure 3.

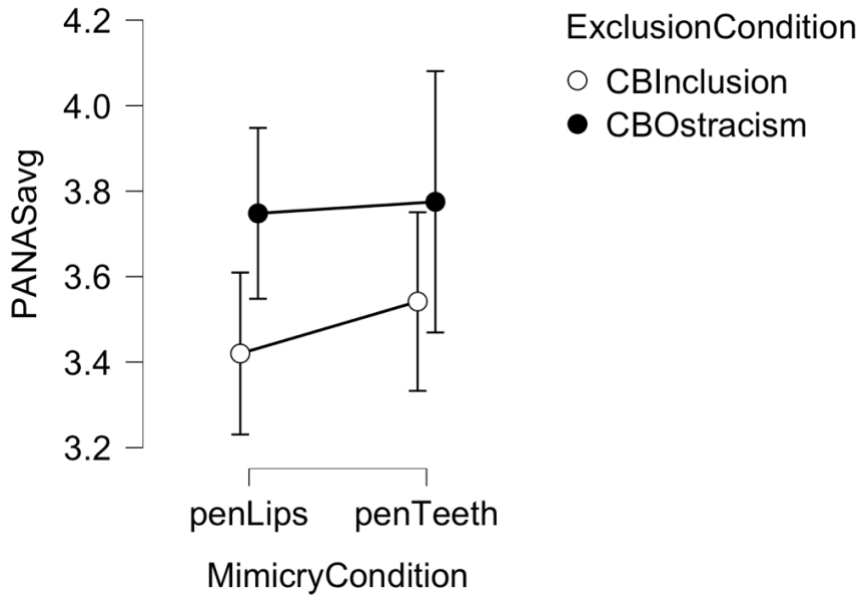

Figure 3: A descriptive graph of the average scores of Mood measure broken down by the mimicry condition and the inclusion condition. Error bars represent confidence in the poll.

Empathy. I conducted a factorial ANOVA on Empathy scores with two between-subjects factors: social exclusion and mimicry interference. The analysis from the revealed that there was no significant difference for individuals who were in the included condition (M = 0.82, SD = 0.79) compared to the excluded condition, M = 0.85, SD = 0.88; F (1,69) = 0.06, p = .803. For the mimicry factor, there was no significant difference in empathy between people who were prevented from smiling (M = 0.81, SD = 0.87) and people who were not prevented from smiling (M = 0.86, SD = 0.81), F (1,69) = 0.07, p = .796. There was no significant interaction between social exclusion and mimicry, F (1,69) = 0.13, p = .717. Meaning that individuals who performed whether in the included condition, (pen in lips, M = 0.83, SD = 0.92, pen in teeth, M = 0.81, SD = 0.75) or in the excluded condition, (pen in lips, M = 0.81, SD = 0.86, pen in teeth, M = 0.94, SD = 0.93) have had similar average empathy scores. The means from this analysis are plotted in Figure 4.

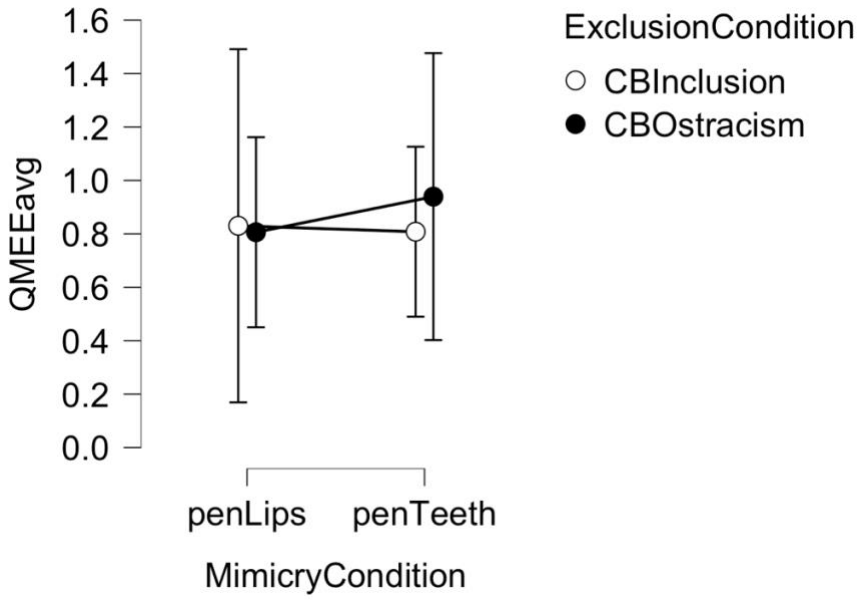

Figure 4: A descriptive graph of the average scores of Empathy measure broken down by the mimicry condition and the inclusion condition. Error bars represent confidence in the polls

Discussion

The main goal of this study was to observe whether the effects of interfering with unconscious mimicry of faces following social exclusion would reduce the protective effects of mimicking others. We implemented two between-subjects factors for our research: social exclusion and mimicry interference. In addition, four different questionnaires were used to measure the consequences of social exclusion: empathy, mood, loneliness, and self-esteem.

We hypothesized that people excluded from cyberball would have lower empathy, self-esteem, loneliness, and mood scores. The only measure that showed a significant difference in our experiment was the mood measure. Participants showed a higher average score for the excluded condition than the included condition. Average scores for each of the remaining questionnaires were similar between the excluded and included conditions. These measurements are opposite in comparison to another research. One study done by Lakin et al. (2008)

hypothesized that people in the exclusion condition would mimic facial behaviors more than in the inclusion condition. They measured their results using a different mood measure. They found that excluded participants reported liking the cyberball game less than included participants. Their results showed opposite mood patterns compared to our results.

Another hypothesis that we tested is that people who were prevented from mimicking the faces would experience a reduction in empathy, self-esteem, loneliness, and mood scores. Based on our findings from the experiment, every single measure used showed no significant difference between the mimicry interference and no mimicry interference conditions on reducing empathy, self-esteem, loneliness, and mood scores. This pattern is not consistent with previous research. In another study done by Rymarczyk et al. (2016), they hypothesized that mimicry interference would lower empathy scores and poorer emotional perception. A QMEE questionnaire showed a significant effect of mimicry on empathy. However, this study only used faces displaying fear and disgust. It could be that the functional role of mimicry is limited to faces displaying negative emotion. Research done by Arnold and Winkielman (2019) found that loneliness led to a reduced mimicry of smiling when viewing negative expressions. However, they saw that mimicking smiling images or any positive imagery did not affect loneliness.

Notably, the social exclusion did not interact with mimicry interference to affect people's feelings of empathy, mood, self-esteem, or loneliness. This suggests that facial mimicry may not functionally improve people's emotional experiences during social exclusion. Previous work that did find correlations between facial mimicry and reduced negative emotions may have captured spurious correlation.

Our study's limitations may explain why we had no significant interaction between social exclusion and mimicry interference. One of the most important limitations is the lack of

performing an in-person experiment. We are currently in the midst of the COVID-19 pandemic, and there have been limitations for having our participants be present on campus and putting objects in their mouths unmasked. Having an in-person experiment would have given us a more precise measure of each result from each questionnaire, and this would be essential for us to be sure that all our followed task instructions. Another limitation of our study had a somewhat low sample size. Compared to other research, some would have 40 participants (Lakin et al., 2008), 32 participants (Rymarczyk et al., 2016), and 70 participants (Sonnby-Borgström, Peter Jönsson, Owe Svensson, 2003). However, more is needed to test for the binding interaction effect in the present study. Finally, one useful measure to include in future research is the Facial Electromyography (EMG) measure. Many EMG studies have been used to support the concept of facial mimicry (Rymarczyk et al., 2016). The importance of this measure has the ability to detect facial reactions coming from facial muscle areas that include the zygomaticus major (smiling reaction) and the corrugator supercilii (frowning reaction) (Arnold and Winkielman, 2019). Having access to the EMG would have allowed us to know whether people in the no interference condition were smiling.

For the future of this experiment, some improvements should be made: If we could perform an in-person experiment, that would have addressed several limitations described above. Increasing our sample size would be essential to increase statistical power for detecting an interaction. Adding the EMG measure in our experiment can give us more precise information about how people spontaneously mimicked facial expressions in this study.

However, EMG measures are more informative in the no mimicry interference condition, relying on how frequently one mimics images. As for the mimicry interference condition, this could not work because we are preventing people from mimicking faces in the first place.

In conclusion, our present study was to test whether interfering with unconscious mimicry reduces its protective effects following social exclusion. However, being excluded and prevented from mimicking facial reactions did not lead to more negative emotion than being allowed to mimic. Future work in a more controlled experimental context is needed to understand better if and how facial mimicry causes people to feel better after being excluded.

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