ABSTRACT

Title of Thesis:	INVESTIGATING THE INFLUENCE OF SOCIAL EXCLUSION ON FACE PROCESSING
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Because social exclusion leads to adverse effects, excluded individuals exhibit altered social information processing. In particular, these individuals process social information from faces differently than their included counterparts. However, the cognitive mechanisms leading to this difference are unknown. The goal of the present study was to investigate whether or not a decrease in holistic processing, and consequent increase in attention to individual facial features, might characterize some of the observed effects of exclusion on how people process facial information. Adult participants were either excluded or included during a game of Cyberball and then completed the Vanderbilt Holistic Face Processing Task (VHFPT). Excluded and included individuals did not differ in performance on the VHFPT, suggesting that excluded individuals do not attend to facial features differently than included individuals. Results are discussed in conjunction with previous research and future directions.

INVESTIGATING THE INFLUENCE OF SOCIAL EXCLUSION ON FACE PROCESSING

by

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VHFPT- Vanderbilt Holistic Face Processing Test

NPC – Non-Player Characters

Chapter 1: Introduction

The need to belong is a fundamental aspect of the human experience (Baumeister & Leary, 1995). From an early age, people invest time and energy in forming and maintaining relationships through social interactions. When this goes well, people feel a sense of belonging, and this leads to more positive overall well-being (Leary & Cottrell, 2013). However, not all social interactions go well. Social exclusion, a social event in which an individual wants to participate but is intentionally left out by at least one other individual, produces negative consequences across several aspects of everyday life, including biological, social, and cognitive functioning (Williams, 2007; see Appendix A for a review). In particular, socially excluded individuals demonstrate altered social information processing. However, the precise mechanisms underlying these changes are largely unknown.

Evidence of Altered Mechanisms

Biased Processing.

While the mechanisms are not known, there is evidence that excluded individuals demonstrate altered social information processing compared to included individuals. For instance, excluded individuals exhibit a positive bias when presented with neutral social information. When given a neutral description of an unknown individual, excluded individuals evaluate the person as more positive than may be warranted given the presented evidence. Additionally, these excluded individuals endorse strangers as friendlier than included individuals do (Maner, DeWall, Baumeister, & Schaller, 2007). A similar bias occurs when socially excluded individuals are asked to rate emotional faces. When individuals are presented with a single face depicting a neutral expression, excluded individuals label a neutral face "happy," while included individuals do not (DeWall, Maner, & Rouby, 2009). If the face conveys subtle positive emotions, excluded versus included individuals identify the face as possessing stronger positive emotions (Maner et al., 2007).

It is important to note that excluded individuals are not incorrectly labeling emotions. In other words, excluded individuals do not label a negative expression as a positive emotion or vice versa. Rather, excluded individuals interpret ambiguous information more positively. When asked to match emotional faces with labels, excluded individuals are quicker and more accurate than included individuals for both positive and negative emotions (Gardner, Pickett, Jefferis, & Knowles, 2005; Pickett, Gardner, & Knowles, 2004).

Attention to Faces.

This altered social information processing also influences attention to faces. Socially excluded individuals attend to social information gained from details in faces with less difficulty than included individuals. After social exclusion, participants were quicker than included individuals to find a smiling face among a crowd of other faces in a visual search paradigm (DeWall et al., 2009).

Exclusion also influences individuals' preferences for what types of faces to view. When excluded individuals were shown an arrangement of four faces, they fixated longer on the happy, smiling face than on sad, angry, or neutral faces. In fact, excluded individuals avoided fixation on sad faces (DeWall et al., 2009; Xu, Li, Zhan, Sun, Fan, Zeng, & Yang, 2015). Excluded individuals show a similar pattern when presented with a pair of faces. When shown a face with a positive expression and another with a neutral expression, excluded individuals will look at the positive face longer than the neutral face. Excluded individuals will also look at the positive expression face longer when the other face could signal threat, such as when the other face has an angry expression. However, this preference for a positive face over an angry face does not reflect avoidance of the angry face, because excluded individuals attend to the angry face more than a simultaneously presented neutral face (DeWall et al., 2009; Xu, et al., 2015).

The above changes may occur because excluded individuals demonstrate enhanced discrimination of social stimuli when compared to included individuals. For instance, excluded individuals discriminate between positive and negative vocal tones as well as facial emotions more accurately than included individuals (Pickett et al., 2004; Sacco, Wirth, Hugenberg, Chen & Williams, 2011). In particular, excluded individuals are quicker and more accurate at distinguishing real, genuine smiles, called Duchenne smiles, from fake, or non-Duchenne smiles (Bernstein, Sacco, Brown, Young, & Claypool, 2010; Bernstein, Young, Brown, Sacco, & Claypool, 2008; Ekman, Davidson, & Frieson, 1990).

The deviations of socially excluded individuals' behavioral patterns from those of included individuals provide evidence of altered social information processing. Excluded individuals process emotion information from faces more accurately and quickly than included individuals. In other instances, they show biased interpretations that give ambiguous information more meaning. These changes are thought to occur because they support excluded individuals' attempts to recover from the negative event by making it easier to identify potential social partners.

Motivation for Altered Mechanisms

After experiencing social exclusion, individuals experience increased levels of self-distress and decreased feelings of belonging (DeWall et al., 2009; Williams, 2007). This distress causes them to monitor their environments for exclusion and respond immediately to its occurrence (Gardner, Pickett, & Brewer, 2000; Pickett et al., 2004; Wesselman & Williams, 2013). A quick response allows excluded individuals to evade the negative consequences of exclusion and replenish their need to belong.

Responding to Social Exclusion.

To eliminate the negative effects of social exclusion, individuals need to resolve the consequent distress. In some instances, excluded individuals act aggressively to accomplish this goal. However, this only occurs if excluded individuals feel as if they do not have control over their circumstances, have experienced long-term exclusion, or believe that reinclusion is not a possibility (Twenge, Baumeister, Tice, & Stucke, 2001; Warburton, Williams, & Cairns, 2006; Williams, 2007).

A majority of excluded individuals seek reinclusion as a means to diminish the negative effect and restore their sense of belonging (Richman, 2013). To do this, excluded individuals must identify potential social partners quickly. Individuals look for signs that another person is approachable so they can avoid future exclusion events (Molden, Lucas, Gardner, Dean, & Knowles, 2009).

While evidence suggests that excluded individuals process information from faces efficiently to find a new social partner, the precise mechanisms are unknown. There are several possibilities, but I will consider two in detail. One possibility is that an excluded individual's attention is directed by a mechanism to relevant social information. Thus, the individual attends to relevant social information from the face. However, it is also possible that an excluded individual experiences a more general shift in attention that leads them to focus more on details of the face. These options, directing attention to social information or a general shift in attention to faces, lead to the same behavioral outcomes, but require different mechanisms.

Directed Attention to Social Information

If excluded individuals direct more attention to specific social information, then we should see differences in the ways that included and excluded individuals process information from faces. In particular, excluded individuals should attend more to signals of approachability, such as smiles and positive expressions, than do included individuals (Molden et al., 2009; Xu et al., 2015). A specific direction of attention to social information would explain how excluded individuals quickly and accurately identify emotions (DeWall et al., 2009). It would also explain why excluded individuals prefer to look at and fixate on faces with positive expressions. By efficiently attending to only relevant information, excluded individuals can determine the necessary next steps toward reinclusion.

General Shift in Attention to Faces

However, it is also possible that a more general shift of attention underlies the tendency for excluded individuals to attend more to social information. In this case, the focus of attention would narrow, and individuals would attend more to details than the full picture of the face. Thus, excluded individuals should still perform better than included individuals when asked to identify social information that depends on isolated analysis of these details. Excluded individuals should attend more to smiles and positive expressions (Molden et al., 2009; Xu et al., 2015). However, there should also be changes in the ways excluded and included individuals attend to less relevant information from faces or information unrelated to approachability and acceptance. For instance, socially excluded individuals should detect differences in eye shape more accurately than included individuals.

Face Processing.

To understand how a general shift of attention to face information could influence social information processing, it is important to understand the levels of face processing. The highest level is holistic processing, or taking in information from the whole face. In holistic processing, the individual parts, like the mouth or eyes are not attended to in isolation. Rather, holistic processing allows the whole face to be seen as a single unit (Richler, Palmeri, & Gauthier, 2012). Configural processing is similar to holistic processing because it also does not involve processing information about the specific pieces of a face. In configural processing, the relationships between individual parts are taken into account. For instance, configural processing is involved when determining the amount of space between the eyes or between the eyes and the nose (Mondloch, Le Grand, Maurer, 2002). The final level of face processing is featural processing, which is the only level that allows the individual to gain information about specific parts of the face in isolation. In featural processing, the individual is able to attend to single parts of the face and can gain information about what the parts look like (Freire & Lee, 2001). For instance, featural processing is used to detect the size, color, and shape of the eye. The interactions between these processing levels and their uses are complex and under debate (McKone, Crookes, Jeffery, & Dilks, 2012; Richler & Gauthier, 2014).

Face Processing and Emotions.

Both configural and featural processing are necessary to identify facial expressions. Information from facial features, particularly the mouth and eyes, is indicative of positive emotions like happiness (Calvo & Nummenmaa, 2008; Leppanen & Hietanen, 2007). Although identification of many emotions relies more on configural processing, some emotions rely more on featural processing. In particular, identifying happiness requires featural processing, and individuals can accurately identify the emotion based on the shape of the mouth (Beaudry, Roy-Charland, Perron, Cormier, & Tapp, 2014; Calvo & Nummenmaa, 2016).

To identify a happy face, an individual relies on several featural cues from the mouth and eyes (Leppanen & Hietanen, 2007). Some indicators of genuine happiness, such as the Duchenne smile, are associated with featural changes. For instance, Duchenne smiles cause changes in the shape of the eyes and the mouth (Ekman, 2003). When exhibiting a genuine smile, an individual's eyes become more narrowed or squinted, wrinkles ("crow's feet") appear at the external corners of the eyes, and upturned corners of the mouth appear (Leppanen & Hietanen, 2007; Manera, Giudice, Grandi, & Colle, 2011). These featural changes allow individuals to accurately discriminate between happy expressions and other emotional expressions (Leppanen & Hietanen, 2007).

Narrowed Attention and Social Exclusion.

A more general shift in attention that causes the individual to focus on details does not explain all of the effects of social exclusion. For instance, focusing on details in the face may not lead to positive interpretations of ambiguous information, but it could explain how excluded individuals differentiate faces quickly and more accurately than included individuals. As discussed above, Duchenne smiles, an indicator of happiness and approachability, cause featural changes in the face (Manera et al., 2011). Socially excluded individuals quickly identify Duchenne smiles and are more accurate at differentiating between Duchenne and non-Duchenne smiles (Bernstein et al., 2008; Bernstein et al., 2010). These changes can be subtle, and excluded individuals may pick up on these more subtle changes in facial features, allowing them to make more accurate interpretations.

Attending to details could also explain how excluded individuals find happy faces and fixate on them in a crowd. Finding a face in the crowd requires looking at the details in the face and requires featural processing (Calvo & Marrero, 2009). Excluded individuals find happy faces in visual arrays of faces faster than included individuals (DeWall et al., 2009).

Testing Mechanisms

While the above evidence fits with a general shift to narrow processing, it could also occur if an excluded individual directed more attention to social information. In order to investigate the mechanisms underlying an excluded individual's altered processing of social information, a task that deemphasizes social information from faces should be used. For instance, some tasks use faces conveying neutral expressions, and others require participants to solely attend to portions of the face that convey neutral information. In both types of tasks, the faces do not contain information signaling reinclusion, as reinclusion relies on the identification of approachable social partners who often display positive emotional cues. Therefore, excluded individuals should only perform better at these tasks if there is a general shift of attention to details of the face. If excluded individuals experience a specific shift to focus on social information, then excluded individuals should perform similarly to included individuals.

Composite Face Task.

The composite face task requires attention to specific features rather than whole faces (Rossion, 2013). The composite face task measures a phenomenon called the composite face effect. The composite face effect occurs when individuals are shown a composite face, or a face made of two halves of different faces. Rather than seeing the composite as two separate halves, individuals view the composite as a new complete face (Hole, 1994; Murphy, Gray, & Cook, 2016). This effect occurs because holistic processing causes the two aligned halves to be processed together. This gives the illusion of a new face, and it is very difficult to identify the separate halves (McKone, Kanwisher, & Duchenne, 2007).

The composite face task is helpful to explore whether or not excluded individuals experience a general narrowing of attention. In this task, participants are shown a study face and asked to remember a highlighted half. Then, participants see two composite faces and are asked to identify which one has the previously studied face half (Rossion, 2013).

The Current Study

The goal of the present study was to explore potential mechanisms underlying the changes in excluded individuals' altered processing of social information. More specifically, this project aimed to determine if excluded individuals attend to facial features more than included individuals do. If excluded individuals direct attention only to specific social information related to reinclusion, there should be no differences between the performance of included and excluded individuals on a composite face task. If excluded individuals' attention shifts more to features, then excluded individuals should outperform included individuals on a composite face task. By exploring how excluded individuals process facial information, we can better understand the cognitive processes underlying the behavioral effects of social exclusion. In order to test the influence of social exclusion on face processing, undergraduates were randomly assigned to an inclusion or exclusion condition, and all participants completed the same version of the composite face task.

Chapter 2: Methods

Participants

Two hundred twenty-six participants were recruited from the University of Maryland paid participant research pool. Eight participants were excluded from subsequent data analyses for the following reasons: 2 for experimental error, 4 for technology errors, and 2 for correctly identifying the purpose of the study. Thus, 218 (68 males, 149 females, 1 did not disclose) participants aged 18 to 56 years (M = 21.19, SD = 3.36) were retained in this sample. This is slightly above the 216 participants determined by a power analysis for a two-group independent sample t-test conducted in G*power (Faul, Erdfelder, Buchner, & Lang, 2009). This test assumed 90% chance to detect an effect and a Cohen's d effect size of .41 for the exclusion manipulation (Newman & Smith, 2016). There were 109 participants in each group of the final sample, and this number is consistent with the number of participants recruited for experiments using the composite face task (Richler, Floyd, & Gauthier, 2014).

To ensure that undergraduate participants understood the instructions and completed the full study, participants were required to have normal or corrected-to-normal vision and hearing. Participants also must have spoken at least 70% English. Participants provided informed consent prior to the start of the study, and all participants received five dollars as compensation for their participation.

Manipulation

In order to manipulate feelings of social inclusion and exclusion, participants played Cyberball. Cyberball is a virtual ball toss game that has been widely used to create an in-lab social exclusion experience (Hartgerink, van Beest, Wicherts, & Williams, 2016). In this game, participants are told that they are playing with other participants (identified by different avatars) and to mentally imagine the game and their interactions with other participants (Williams, Yeager, Cheung, & Choi, 2012). However, the other players are not really people; they are non-player characters (NPC) controlled by the computer to carry out preprogrammed actions. The game has two conditions, inclusion and exclusion. In the inclusion condition, participants play a game consisting of 35 throws, and each player receives the ball an equal number of times. In the exclusion condition, participants receive the ball twice in the first five throws, and then the NPCs throw the ball amongst themselves for the remainder of the game (Williams & Jarvis, 2006).

This manipulation has been shown to strongly increase feelings of social exclusion. Individuals excluded in Cyberball report increased threat to their sense of belonging and higher levels of self-distress (Godwin et al., 2013; Williams et al., 2000). These negative responses still occur if the participant knows the game is programmed and knows that they will be excluded (Godwin et al., 2013).

Measures

Manipulation Check.

In order to determine if the Cyberball manipulation was successful, participants filled out a brief 12-question survey to assess whether their need to belong was threatened (Newman & Smith, 2016; Zadro, Williams, & Richardson, 2005). Each question was rated on a scale of 1 (*Strongly Disagree*) to 9 (*Strongly Agree*). Lower scores signified more threatened needs and higher scores signified more fulfilled needs to belong. This short scale is derived from The Need Threat Questionnaire, a survey used predominantly to determine if the Cyberball manipulation was effective (Williams & Nida, 2011). The scale measures changes in self-distress after playing the game (Williams, 2007). Rather than completing the full 20-question scale, participants completed 12 questions representing dimensions of self-distress. Using a shorter scale as a manipulation scale allowed participants to complete all measures in about ten minutes. This is important because the effects of ostracism are less severe ten minutes after game completion (Hartgerink et al., 2016).

Vanderbilt Holistic Face Processing Test.

The Vanderbilt Holistic Face Processing Test (VHFPT) is a derivative of the composite face task, and has been validated in several individual difference studies (Richler et al., 2014; Wang, Ross, Gauthier, & Richler, 2016). The task was designed to increase reliability for measuring differences in holistic face processing, and to resolve some issues that occur with the traditional composite face task. Unlike other measures of holistic face processing, the VHFPT has three test faces rather than two. By including more choices, the VHFPT is less susceptible to response bias than the traditional, incomplete design composite tasks (Richler & Guathier, 2013). By including a third test face, the VHFPT also reduces the role of chance and the influence of guessing (Richler et al., 2014).

In this task, participants studied a composite face on each trial for about two seconds. This composite face was comprised of two different faces from different identities, with a highlighted section indicating the portion of the face to consider when making judgments during the test phase. Non-face cues that could help an individual identify a face, such as hair, were removed from the face during the study phase. Study faces were also different sexes, sizes, and contained different facial expressions. After two seconds, the study face disappeared, there was a 500 ms pause, and three new composite test faces appeared. Participants were asked to identify which test face featured the same identity within the highlighted target area as the target area in the studied face. This means that the studied area and the test target were not identical, but were drawn from different images of the same person. These test faces also may have included the previously removed non-face cues. Therefore, a correct test face may have hair that was not present during the study phase (Richler et al., 2014).

Like other composite face paradigms, the VHFPT included two types of test trials, labeled "congruent" and "incongruent." Congruent trials and incongruent trials were defined consistently between the VHFPT and other composite face paradigms. A congruent trial was a trial in which the correct test choice was comprised of the same identity in the studied target area and the same distractor from the study face. This meant that the participant should select the correct face regardless of the test area they attended to. In incongruent trials, the target identity was associated with a new distractor face, and the distractor from the study phase was paired with another new identity. This meant that the participant would only select the correct face if they attended to the highlighted study portion. Looking at the non-target portion from the study face would result in an incorrect choice. Therefore, it was easier to accurately identify target areas in congruent trials than in incongruent trials (Richler et al., 2014; Richler & Gauthier, 2013; Wang et al., 2016).

Including both congruent and incongruent trials in the VHFPT was important because accuracy on both trial types was used to calculate the congruency effect. The congruency effect was defined as the difference between accuracy on congruent ("C") trials and accuracy on incongruent ("IC") trials, i.e., ((C correct trials) ⁄ (Total C trials)) – ((IC correct trials) ⁄ (Total IC trials)). The calculation was necessary because the outcomes on congruent trials are confounded by definition. For instance, a participant could respond to a congruent trial accurately, even if they failed to attend solely to the target portion of the face. However, incongruent trials can only be responded to correctly if the participant selectively attended to the target portion. By taking the difference of the two scores, a more accurate holistic processing score can be calculated (Richler et al., 2014). The congruency effect can be analyzed using the difference between accuracy on congruent trials and accuracy on incongruent trials, or accuracy can be compared as two levels of a within-subject factor. In a repeated-measures ANOVA with accuracy as the outcome and congruency as a factor, a main effect of congruency is indicative of holistic processing.

Additionally, the portion of the face in the target area varies across nine trial blocks to allow for more variability in scores. Different blocks highlight the nose, mouth, eyes, top half of the face, bottom half of the face, top third of the face, bottom third of the face, top two-thirds of the face, and bottom two-thirds of the face. Varying the amount of the face in the target area increases sensitivity for detecting individual differences in participants' overall bias toward holistic versus non-holistic (i.e., featural) processing. Blocks with small target areas, like the eyes, are most likely to be processed holistically because it is harder to selectively attend to the small region. Thus, participants who accurately identify the smallest target regions are relying more on featural processing and those who get these trials wrong rely more on holistic processing. Blocks with large target areas (e.g., top two-thirds of the face) are least likely to be processed holistically because it is easy to selectively attend to this region. In blocks with larger targets, participants who accurately identify the target portion are employing some degree of featural processing, while those who inaccurately identify the target are employing more holistic processing (Wang et al., 2016).

Procedure

This study occurred in a single session that lasted approximately 35 minutes. Experimenters were trained to interact with participants in a neutral way in order to not influence the participant's sense of belonging. While obtaining informed consent, the experimenter explained that the study was actually two different studies and they were being tested together so that the participant could complete their session more quickly (see Appendix B). The purpose of this deception was to make it less apparent that the face processing task and the Cyberball task were related. Before beginning the experiment, the experimenter went through the instructions for both tasks. The experimenter described how to play Cyberball and how to complete the face processing task while providing visual instructions via Powerpoint. During the Powerpoint, the participant completed three practice trials of the VHFPT consisting of Muppets characters. All participants accurately completed the practice trials. Giving all of the instructions at once eliminated the interactions between the experimenter and participant in the interval between the manipulation and the measures.

After completing the instructions, the experimenter opened the game program for the participant. Participants were randomly assigned to play in the inclusion or exclusion condition. When the game ended, the shortened Need Threat Questionnaire appeared. After participants completed the survey, the face-processing task began. Participants received a brief set of instructions to ensure they remembered how to complete the task. Then the VHFPT trials began, and blocks of trials were presented in a randomized order. After participants completed the VHFPT, they were asked to notify the experimenter. The experimenter then debriefed the participants and answered any questions. During this debriefing period, the experimenter explained that the other players were not real individuals, but programmed computer players. The experimenter then provided information about the specific hypotheses and reasons for the tasks. The University Institutional Review Board approved the deception and methods used in this procedure (Appendix C).

Chapter 3: Results

Preliminary Analyses

Cyberball Manipulation Check.

To determine if the Cyberball manipulation was successful, an independent samples *t*-test compared mean scores on the shortened Need Threat Questionnaire between included and excluded individuals. Need Threat scores were computed by reverse scoring appropriate items and then summing responses for all responses. Included individuals ($M = 82.84$, $SD = 10.72$) scored significantly higher than excluded individuals ($M = 39.16$, $SD = 13.52$), $t(216) = 26.42$, $p < .01$. This suggests that the need to belong of included individuals was fulfilled more than that of excluded individuals, and the manipulation was successful.

VHFPT Scores.

Prior to comparing scores on the VHFPT between excluded and included participants, a paired samples *t*-test compared mean accuracy on the congruent trials and the incongruent trials in order to determine if a congruency effect existed across all participants. Consistent with Richler et al. (2014), the means for the congruent trials ($M = 0.74$, $SD = 0.08$) were significantly larger than for the incongruent trials ($M = 0.58$, $SD = 0.08$), $t(217) = 28.14$, $p < .01$. This showed that there were differences between participants' performance on congruent and incongruent trials. This suggests that, as a whole, participants were employing holistic processing during the task.

Additionally, a 2 (congruency) x 9 (block position) repeated measures ANOVA was conducted to determine if the block's position in the presentation sequence influenced participant's accuracy. There was a main effect of congruency, $F(1, 1736) = 792.12$, $p < .01$. However, there was not a main effect of block order, $F(8, 1736) = 1.12$, $p = .35$. The interaction between congruency and block order was also not significant, $F(8, 1736) = 1.12$, $p = .34$. These results suggest that block order did not influence participant's accuracy overall.

Sex Effects.

Potential differences between male and female participants were also assessed for both the shortened Need Threat Questionnaire and the congruency effect in two analyses. A 2 (game condition) x 2 (sex) ANOVA showed that the participant's sex did not significantly predict Need Threat scores, $F(2, 213) = 0.59$, $p = .55$. Participant's sex also did not significantly interact with game condition to predict Need Threat scores, $F(1, 213) = 0.02$, $p = .87$. Need Threat scores for males and females did not differ significantly across conditions.

An independent samples *t*-test compared mean congruency effect scores between males and females. There were no significant differences in congruency effect between males ($M = 0.15$, $SD = 0.08$) and females ($M = 0.16$, $SD = 0.08$), $t(215) = -0.79$, $p = .42$. Therefore, the main analyses did not include sex as a predictor.

Main Analyses

Differences in Overall Scores on the VHFPT.

To determine if there were differences based on game condition, an independent samples *t*-test compared mean congruency effect scores between the two groups. Congruency effect scores were calculated by subtracting participants' accuracy scores on incongruent trials from their accuracy scores on congruent trials. There were no significant differences between mean congruency effect scores for included (M = 0.16, SD = 0.08) and excluded (M = 0.15, SD = 0.08) individuals, $t(216) = -.77$, $p = .44$. Therefore, there was no evidence that being excluded influenced scores on the VHFPT or holistic processing.

Differences in Scores Based on Size of Target.

The VHFPT contains blocks that vary in difficulty based on the size of the target area. For instance, blocks in which the target is largest and that contain two-thirds of the face tend to be easiest, while blocks where the target contains only features tend to be hardest. This difference occurs because smaller regions are harder to disentangle from the distractor face, and larger areas are easier to represent by themselves (Richler et al., 2014). Based on the differences in difficulty, it is possible that being excluded could influence some blocks, but not others.

To examine this, blocks were grouped based on size of the target into four categories, two-thirds of the face, one-third of the face, half of the face, and specific features. A 2 (game condition) x 2 (congruency) x 4 (target size) repeated measures ANOVA compared mean differences between the groups. The complete results are listed in the table 1. There was no significant main effect of condition, $F(1, 216) <$

0.01, $p = .94$. There was no significant interaction between condition and congruency, $F(1, 216) = 0.30$, $p = .58$, between condition and size of target, $F(3, 648) = 0.11$, $p = .95$, or between the interaction of target size, congruency, and condition, $F(3, 648) = 1.06$, $p = .36$. These results suggest that being excluded did not significantly change accuracy scores for differently sized targets.

Differences in Scores Across Block Types.

Each of the nine blocks of the VHFPT contains a target with a specific portion of the face, and it is possible that performance differs based on the type of target in each block. For this reason, a 2 (condition) x 2 (congruency) x 9 (block type) repeated measures ANOVA was conducted (see Table 2). The main effect of game condition was not significant, $F(1, 216) < 0.01$ $p = .94$. Game condition did not interact significantly with congruency $F(1, 216) = 0.59$, $p = .44$, or with block type $F(1, 216) = 0.96$, $p = .45$. The 3-way interaction between condition, congruency, and block type was also not significant, $F(8, 1728) = 1.06$, $p = .38$. These results suggest that being excluded did not significantly change accuracy scores for the different targets in each type of block.

Controlling for Need Threat Scores.

It is possible that participants respond differently to being excluded. For instance, some individuals may feel strong negative effects, while others do not feel the effects as strongly. A repeated measures ANOVA included participants' Need Threat scores as a covariate to determine if variations in participants' experiences produced changes in holistic processing (see Table 3). The interaction between congruency and Need Threat score was not significant, $F(1, 216) = 0.07$, $p = .79$. This suggests that there was no relationship between variations in responses to the shortened Need Threat scale and participants' accuracy on the VHFPT.

Exploratory Analyses

Individual Analyses of Block Types.

Being excluded may not influence overall performance on the VHFPT or across blocks of the tasks. However, it is possible that exclusion could influence performance on individual block types. For instance, excluded individuals may perform better on one or two specific block types, but this may not appear in the main analysis described earlier, which used an ANOVA to assess differences across all block types. To explore this, *t*-tests compared mean differences in the congruency effect between excluded and included individuals (see Table 3). There were no significant differences on congruency effect scores between conditions.

Differences in Scores Across Block Position.

Because the effects of being excluded from Cyberball dwindle over time, it was possible that a block's position in the presentation order could impact the influence of exclusion on holistic processing. A 2 (game condition) x 2 (congruency) x 9 (block position) repeated measures ANOVA compared mean differences in accuracy. There was no significant effect of condition, $F(1, 216) < 0.01$, $p = .94$. Additionally, condition did not significantly interact with congruency, $F(1, 216) = 0.59$, $p = .44$, or block $F(8, 1728) = 0.73$, $p = .67$. There was no significant 3-way interaction between condition, block, and congruency, $F(8, 1728) = 1.06$, $p = .38$.

These results indicate that being excluded did not influence participants' accuracy across the position a block occurred in the presentation sequence.

Image Size.

Trials in the VHFPT contain images that are 1.09 inches, 2.09 inches, or 3.09 inches. Larger images are easiest to identify accurately, and smaller images are hardest to identify accurately. A 2 (game condition) x 2 (congruency) x 3 (image size) repeated measures ANOVA explored differences in accuracy (see Table 5). There was no significant main effect of game condition, $F(1, 216) = 0.07$, $p = .94$. The interactions between image size and game condition, $F(2, 432) = 0.07$, $p = .79$, as well as between game condition and congruency, $F(1, 216) = 0.32$, $p = .73$, were not significant. There was no significant interaction between game condition, congruency, and image size, $F(1, 432) = 1.27$, $p = .28$. This suggests that being excluded did not affect accuracy across sizes of images.

Biological Sex of Faces.

Faces in the VHFPT can be male or female. It is possible that participants' accuracy can be influenced by the sex of face in the image, and that participants perform better on target faces of their sex. To explore this, a 2 (game condition) x 2 (trial face) x 2 (participants' sex) repeated measures ANOVA was conducted on congruency effect scores (see Table 6). There was no main effect of condition, $F(1, 213) < 0.01$, $p = .93$, and game condition did not interact with sex of the trial face or participant sex, $F(1, 213) = 0.34$, $p = .56$ and $F(1, 213) = 0.03$, $p = .12$, respectively. The 3-way interaction between condition, participant sex, and sex of the trial face was also not significant, $F(1, 213) = 0.52$, $p = .47$. This suggests that being excluded did not relate to participants' accuracy across trials with faces of the same or opposite sex.

Chapter 4: Discussion

The goal of the present study was to begin investigating the mechanisms underlying excluded individuals' altered social information processing. Specifically, this study examined whether or not excluded individuals were more accurate at identifying emotional information from faces because they could attend to feature information better than included individuals. It was hypothesized that excluded individuals would experience somewhat disrupted holistic processing, and thus rely on featural processing and information from specific features more than included individuals.

This hypothesis was not supported by the results. Overall, excluded and included individuals performed similarly on the VHFPT, meaning that individuals did not change their reliance on holistic processing as a result of being excluded. Excluded and included individuals' accuracy did not differ significantly based on the size of the face target or by the portion of the face they were asked to attend to. Finally, accounting for variations in participants' threatened need to belong did not reveal differences in holistic processing between excluded and included individuals.

Although there was no overall influence of exclusion on the balance of holistic and featural processing, these results provide some information about the mechanisms underlying altered social information processing. Based on these results, excluded individuals do not experience a shift from high holistic processing to more featural processing. However, this does not mean that excluded individuals are solely attending to social information. It is still possible that excluded individuals rely on a general shift of attention when processing faces. This study only investigated the effects of exclusion on holistic and featural processing, but did not examine the effects on configural processing. Although featural information is used to identify emotions, configural processing also plays an important role (Bombari, Schmid, Mast, Birri, Mast, & Lobmaier, 2013).

The main analyses revealed no overall relationships between social exclusion and increased featural processing, but it was possible that more specific differences between included and excluded individuals emerged. This led to three additional exploratory hypotheses. First, the effects of social exclusion dwindle after approximately ten minutes. This means that excluded individuals could exhibit heightened featural processing during the first blocks, but would return to their normal balance by the end of the experiment. However, our results indicate that this was not the case: Performance for included and excluders did not change over time.

A second possibility was that the processing of specific target portions of the face was impacted by exclusion. For instance, some areas, such as the mouth and the eyes, provide large amounts of social information, and attending to them provides information necessary for reinclusion. Alternatively, it was possible that individuals performed better on trials with faces of their sex than trials with faces of the opposite sex. However, results did not support either of these hypotheses: Included and excluded individuals performed similarly on these trials, indicating no differences in holistic processing.

To probe further, a third hypothesis explored how other characteristics of stimuli in the VHFPT could influence participant performance. Image size could make it more difficult to identify target areas. Smaller images could make it more difficult to identify target areas, whereas larger images could make it easier to attend to the target area. The exploratory results did not provide evidence that included and excluded individuals performed differently.

Consistent with the main analyses, none of the exploratory analyses revealed significant differences in excluded and included individuals' use of holistic or featural processing. Although there were null results, the two manipulation checks showed significant differences. Consistent with previous literature, included individuals experienced a higher sense of belonging and more fulfilled need to belong than excluded individuals, indicating that the Cyberball manipulation was effective. Second, participants performed better on congruent trials than incongruent trials on the VHFPT, showing their reliance on holistic processing. This suggests that our results did not occur because participants could not successfully complete the tasks.

Overall, this study serves as a valuable first step in investigating the mechanisms underlying excluded individuals' altered social information processing. Although findings were not significant, it is still important to investigate these mechanisms because it will provide a better understanding of what happens after exclusion. Future research should examine how configural processing relates to this altered social information processing and alternative mechanisms, such as attention to cues signaling approach.

Appendices

Appendix A: Consequences of Social Exclusion

Social exclusion can occur throughout the lifespan, and negatively impacts young children as well as adults (Abrams, Weick, Thomas, Cobe, & Franklin, 2011; Berinstein & Claypool, 2012;Over & Carpenter, 2009). While the specific consequences of social exclusion change with age and length of exposure, the experience causes changes at the biological level, in subjective experience, in cognitive processing, and in social experiences.

Biological Level

After experiencing social exclusion, individuals experience changes at the biological level. Excluded individuals exhibit brain activity associated with experiencing physical pain after a single instance of exclusion (Eisenberger, Jarcho, Lieberman, & Nailboff, 2006; Eisenberger, Lieberman, & Williams, 2003). Individuals who have been excluded produce elevated levels of cortisol, a hormone associated with increased stress. If the individual continues to be excluded over a period of time, the chronic experience influences her typical cortisol patters may become unbalanced, making it harder to adapt to new situations (Blackhart, Eckel, & Tice, 2007; Dickerson & Zoccolo, 2013; Stroud, Tanofsky-Kraff, Wifley, & Salovey, 2000). Overall, continuously experiencing the biological effects of social exclusion is related to negative future health outcomes (Richman, 2013).

Subjective Experience

Not only does social exclusion influence individuals at the biological level, it also alters their subjective experiences. Excluded individuals describe their experiences of social exclusion with phrases typically used to report physical pain (Eisenberger et al., 2003; Eisenberger et al., 2006). After experiencing social exclusion, individuals report feeling more guilt, shame, and embarrassment than included individuals (Leary & Cottrell, 2013). Socially excluded individuals experience a larger overall negative affect and a more negative mood than included individuals immediately after the experience (Williams & Nida, 2011; Wolfer & Scheithauer, 2013). If exclusion persists over time, individuals may develop a blunted emotional response to future negative events, which make it harder to respond appropriately in social situations and can lead to further exclusion by others (Twenge, Catanese, & Baumeister, 2003).

Cognitive Processing

Social exclusion also leads to impairments in cognitive functioning (Wesselman & Williams, 2013; Wolfer & Scheithauer, 2013). Social exclusion reduces intellectual thought and reasoning abilities. Participants who were socially excluded performed worse on measures of IQ and GRE questions (Baumeister, Twenge, & Nuss, 2002). Excluded individuals experience reduced self-regulation abilities, and are less likely to make healthier decisions about food choices (Baumeister, DeWall, Ciarocco, & Twenge, 2005). Included individuals maintain intact inhibitory control, while excluded individuals experience decreased inhibitory control and perform worse on a Go/No-Go task (Otten & Jonas, 2013). Social exclusion also influences memory, and excluded individuals recall social events more accurately than other forms of information (Gardner, Pickett & Brewer, 2000). Perhaps more alarmingly, excluded individuals view themselves as less human, and expect others to view them in a more object-like way (Bastian & Haslam, 2010). Taken together, these findings suggest that social exclusion influences cognition in numerous ways.

Social Experiences

An excluded individual also faces detrimental changes in her social life. Active social exclusion, or explicitly being left out rather implicitly being ignored, is related to social withdrawal. After being excluded, individuals remove themselves from other social situations in order to prevent future instances of exclusion (Molden, Lucas, Gardner, Dean, & Knowles, 2009). Excluded individuals may also react in more aggressive ways, choosing to retaliate against their excluders more often than included individuals retaliate against their includers. For instance, excluded individuals pour large quantities of hot sauce for the person who threatened their need to belong to drink or to blast speakers louder in that person's testing room than included individuals are (Twenge, Baumeister Tice, & Stucke, 2001; Warburton, Williams, & Cairns, 2006). Over time, changes caused by social exclusion can become permanent and lead to antisocial tendencies.

As demonstrated above, social exclusion can lead to negative changes across various domains of an individual's life. Over time, these consequences worsen and become more permanent, creating a perpetual cycle that negatively impacts the individual for the rest of their lives.

Appendix B: Cover Story

E1: " Hi, are you _____ here for the psychology study? My name is _____. I will be running the study you are participating in today. Please put away your phone and leave your bag here. This room is locked, so your things will be safe. Please come with me into this room. First, I am going to go through the consent forms with you and tell you what you will be doing. You can take a seat in this chair." *Experimenter ensures front door is shut and goes into the testing room.*

The experimenter should bring the participant into the room and obtain informed consent.

E1(*consenting script*): "Today's session is comprised of two separate tasks. We've placed them back to back in order to save some time. Completing both tasks should take approximately thirty minutes. Both studies that you're participating in today are behavioral assessments, which means that you may be asked questions about your thoughts or feelings, or you might be asked to describe things that you see during the experiment. Participating in this research has little risk, and is similar to everyday activities, such as sitting at a computer for thirty minutes. If you feel uncomfortable or want to discontinue your participation for any reason, you may stop at any time. And if you decide not to participate in this study or to stop participating, you will not be penalized. All of your personal information will be kept confidential. If we write an article about this study you will not be identified by name. Do you have any questions? (*Pause).* Please sign and date the release form, and initial the top of each page. " (*gives participant the forms to sign*)

E1: “Before we get started, I’m going to explain the instructions for both parts. *(opens instructions powerpoint)* That way, you can begin the second study right after the first study. I’ll start with the directions for the second study, and then we’ll go through the directions for the first study. You’ll receive reminder instructions before the second study.”

Appendix C: IRB Approval

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DATE:	July 25, 2017
TO:	Jonathan Beier, Ph.D.
FROM:	University of Maryland College Park (UMCP) IRB
PROJECT TITLE:	[357272-16] Cognitive and social processes in adults: Representation and evaluation of items, individuals, and events
REFERENCE #:	
SUBMISSION TYPE:	Continuing Review/Progress Report
ACTION:	APPROVED
APPROVAL DATE:	July 25, 2017
EXPIRATION DATE:	August 25, 2018
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category # *6 and 7*

Thank you for your submission of Continuing Review/Progress Report materials for this project. The University of Maryland College Park (UMCP) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

Prior to submission to the IRB Office, this project received scientific review from the departmental IRB Liaison.

This submission has received Expedited Review based on the applicable federal regulations.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of August 25, 2018.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Unless a consent waiver or alteration has been approved, Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

- 1 -

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Tables

Table 1

The Influence of Game Condition and Congruency on Accuracy Across Size of Target

	df	*F*	*p*	η^2_p
Condition	1	0.005	0.94	0
Residual	216			
Congruency	1	753.00	< 0.01**	0.78
Condition * Congruency	1	0.30	0.58	0.01
Target Size	3	19.38	< 0.01**	0.08
Target Size* Condition	3	0.11	0.95	< 0.01
Target Size* Congruency	3	36.76	<0.01**	0.14
Target Size* Congruency * Condition	3	1.06	0.36	0.005
Residual	648			

Note. * $p < 0.05$. ** $p < 0.01$.

Table 2

The Influence of Game Condition and Congruency on Accuracy Across Type of block

	df	*F*	*p*	η^2_p
Condition	1	0.007	0.94	0
Residual	216			
Congruency	1	790.65	< 0.01**	0.79
Condition * Congruency	1	0.59	0.44	< 0.01
BlockType	8	113.76	<0.01**	0.34
BlockType* Condition	8	0.96	0.46	< 0.01
BlockType * Congruency	8	21.34	<0.01**	0.09
BlockType * Congruency * Condition	8	1.06	0.38	< 0.01
Residual	1728			

Note. * $p < 0.05$. ** $p < 0.01$.

Table 3

T-tests Comparing Congruency Effect Scores in Each Block Between Game Conditions

	t	*df*	*p*
B_2third	0.18	216	0.85
B_half	-0.14	216	0.88
B_third	0.10	216	0.91
eyes	-1.94	216	0.052
mouth	0.33	216	0.73
Nose	-1.53	216	0.12
T_2third	-0.8	216	0.41
T_half	0.59	216	0.55
T_third	0.82	216	0.41

Notes. Positive t values indicate that the excluded group has a higher mean. * $p < 0.05$. ** $p < 0.01$.

Table 4

The Influence of Game Condition on Congruency on Accuracy Across Block Position

	df	*F*	*p*	η^2_p
Condition	1	0.007	0.94	0
Residual	216			
Congruency	1	24.94	< 0.01**	0.79
Condition * Congruency	1	0.59	0.44	< 0.01
Block	8	1.116	0.35	< 0.01
Block* Condition	8	0.73	0.67	< 0.01
Block * Congruency	8	1.13	0.34	< 0.01
Congruency * Block*Condition	8	1.06	0.38	< 0.01
Residual	1728			

Notes. * $p < 0.05$. ** $p < 0.01$.

Table 5

The Influence of Game Condition and Congruency on Accuracy Across Face Size

	df	*F*	*p*	η^2_p
Condition	1	0.007	0.94	0
Residual	216			
Congruency	1	790.65	< 0.01**	0.79
Condition * Congruency	1	0.59	0.44	< 0.01
Face Size	2	13.80	<0.01**	0.06
Face Size* Condition	2	0.32	0.73	< 0.01
Face Size * Congruency	2	8.06	<0.01**	0.04
Face Size * Congruency * Condition	2	1.27	0.28	< 0.01
Residual	432			

Notes. * $p < 0.05$. ** $p < 0.01$.

Table 6

The Influence of Game Condition and Congruency on Accuracy Across Sex of Trial Face

	df	*F*	*p*	η^2_p
Participant sex	1	0.68	0.41	<0.01
Condition	1	0.008	0.93	0
Residual	213			
Sex of Face	1	10.54	<0.01**	0.04
Sex of Face * Participant sex	1	0.169	0.68	< 0.01
Sex of Face* Condition	1	0.35	0.56	< 0.01
Sex of Face* Condition * Participant sex	1	0.52	0.47	< 0.01
Residual	213			

Notes. * $p < 0.05$. ** $p < 0.01$.

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