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Attention and Mimicry in Minimal Groups

Abstract

There is a group effect on matching behavior; ingroups tend to be matched more than outgroups. Differences in attention to ingroup and outgroup members may correspond with group differences in matching. Determining how both attention and matching are influenced by minimal groups can help distinguish between potential mechanisms used to explain group effects in social behavior. Furthermore, it would be beneficial to know if attention biases can be trained to social groups. Study 1 replicated attention training to neutral faces, but study 2 failed to replicate attention training to emotional faces. Study 3 used the same attention training method, but failed to train attention to minimal groups. Study 4 measured attention and mimicry to minimal groups and concluded that they follow the same pattern. Mimicry of ingroup happiness expressions was observed, but incongruent frowning reactions to outgroup happiness expressions were observed. No clear overall attention bias to minimal groups was observed, but individuals with an ingroup attention bias smile to ingroup happy expressions, while individuals with an outgroup attention bias frown to outgroup happy expressions. Future studies should determine if attention might play a causal role in the group effect on mimicry. Future research should also search for other methods of overcoming the potentially deleterious effects of being in the outgroup.

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by

Heidi S. Blocker

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Advisor: Kateri McRae

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Introduction

People tend to match the behaviors of others; including movements, posture, speech mannerisms, and facial expressions (Chartrand & Bargh, 1999; Dimberg, 1982; Hess, Blairy, & Philippot, 1999). Previous research suggests that matching serves a number of social purposes, including emotion contagion, creating rapport, facilitating social interactions, and increasing prosocial behavior (Hatfield, Cacioppo & Rapson, 1992; Lakin, Jefferis, Cheng & Chartrand, 2003, van Baaren, Holland, Kawakami, & Knippenberg, 2004). Matching behavior occurs even when there is no explicit affiliation goal – people match as a default (Chartrand & Bargh, 1999). However, there is a *group effect* on this matching; in general, ingroup members are matched more than outgroup members (Bourgeois & Hess, 2008; Likowski, Mühlberger, Seibt, Pauli, & Weyers, 2008; Seibt et al., 2013). Despite this evidence that group membership matters for matching, little work has identified processes that might correspond with this group effect on matching. Since matching behavior is related to important social processes, it is important to identify processes for future research to investigate as candidate mechanisms for the group effect on matching.

A leading theory identifies general affiliation goals as one possible mechanism for the group effect on matching (Chartrand & Lakin, 2013; Hess & Fischer, 2013). According to this *affiliation model*, people typically have a higher desire to affiliate with positive others (presumably, the ingroup) versus negative others (presumably, the

outgroup). However, another explanation is that differences in attention to ingroup and outgroup members may correspond to group differences in matching. In support of this, there is also a group effect on attention, such that ingroup and outgroup members are attended to differentially (e.g. Bean et al., 2012; Ito & Urland, 2003, 2005; Richeson & Trawalter, 2008). While some studies have examined how attention and matching behavior might be associated with one another, few studies have measured attention and mimicry at the same time. Furthermore, no studies have examined if both matching and attention to in- and out-group members follows the same pattern within the same study. Determining if attention and matching follow the same pattern is the first step to determining if attention is a mechanism that contributes to the group effect on matching.

Studies of matching and attention in different groups have tended to focus on more complex groups where a number of different factors could contribute to the group effect. In these studies, group membership has been confounded with stereotypes, negative attitudes, competition for resources, familiarity, threat-value, and similarity. One way to reduce the number of candidate processes that might drive these differences is to study minimal groups, which conservatively manipulate mere identification with one group over another. In minimal group paradigms, people are assigned to minimal groups under the cover of arbitrary group differences, such as a preference for abstract art or dot estimation abilities; however they are in fact randomly assigned (Tajfel, 1970; Tajfel, Billing, Bundy, & Flament, 1971). Categorizing individuals into minimal groups has a significant influence on intergroup perception, evaluation, and other behaviors (e.g.

Ashburn-Nardo, Voils, & Monteith, 2001; Otten & Wentura, 1999; Van Bavel & Cunningham, 2009, 2011).

However, little is known about how attention and matching function in these minimal groups, and especially whether attention and matching will follow the same pattern to minimal groups. There are three possible models of how differences in attention and matching to minimal groups may manifest. Identifying which model is consistent with the results will allow me to distinguish between mechanisms used to explain both attention and mimicry results.

Mechanisms used to explain the group effect on mimicry include two tenets of the affiliation model: pre-existing rapport and a goal to affiliate. The pre-existing rapport mechanism maintains that people have a motivation to affiliate with individuals with whom they already have a positive relationship, such as friends or ingroup members (Hess & Fischer, 2013). The goal to affiliate mechanism maintains that people are motivated to affiliate with individuals with whom they currently do not have a relationship, such as strangers or some outgroup members (Chartrand & Lakin, 2013). A final possibility is that attentional differences between groups capture different mechanisms used to explain group attention effects, such as the threat-value of the outgroup, the novelty of the outgroup, and the motivational relevance of the ingroup.

Measures of both attention and matching are necessary to distinguish between three possible models governing intergroup behavior. First, the pre-existing rapport model predicts that both attention and mimicry will be increased to the ingroup. Second, the goal to affiliate model predicts that both attention and mimicry will be increased to

the outgroup. Third, the threat model predicts that attention will be increased to the outgroup, but mimicry will be increased to the ingroup. There is strong evidence for early attention to the outgroup that is usually explained by the greater threat-value of the outgroup. If the pattern of results follows the goal to affiliate model of increased attention and mimicry to the outgroup, then this calls into question the threat mechanism explanation of group attention biases. Instead, greater attention to the outgroup could be due to motivations to affiliate. However, if the pattern of results follows the threat model (increased attention to the outgroup that is NOT associated with increased mimicry), then it seems unlikely that attention could play a role in group differences in matching behavior.

In addition, the present studies tested whether attention to minimal groups could be manipulated with a computerized training. If attention and matching show similar patterns, and attention can be manipulated to minimal groups, future studies might test the causal role attention may have on matching by attempting to manipulate attention to minimal groups and then measure matching.

Finally, in reviewing the literature on matching of groups, I will cover behavioral matching (copying non-emotional motor movements, such as face touching) and synchrony (moving together at the same rate) in addition to facial emotional mimicry. While these behaviors are likely not the same (see Hess & Fischer, 2013), the group effect is remarkably consistent across them. I use matching as a broader term to cover behavioral matching, synchrony, and facial emotional mimicry. I use mimicry to specifically cover facial emotional mimicry.

The Role of Affiliation in Matching

Researchers reviewing the recent matching literature propose that a general affiliation desire is a key mechanism of mimicry behavior; matching increases as affiliation desires increase (Chartrand & Lakin, 2013; Hess & Fischer, 2013). Consistent with this model, there is evidence that pre-existing rapport is influential in matching. Pre-existing rapport is often operationalized as an attitude toward a target, such as when participants are manipulated to like or dislike targets. Participants show increased movement synchrony (Miles, Griffiths, Richardson, & Macrae, 2010) and behavioral matching (Stel et al., 2010) with a liked compared to a disliked target. Participants also demonstrate greater emotional mimicry to a liked confederate (McIntosh, 2006), liked avatar (Likowski et al., 2008) or liked politician (McHugo, Lanzetta, & Bush, 1991) compared to disliked others. For emotional mimicry, there seems to be an elevation of mimicked smiles for liked individuals, a reduction of mimicked sad expressions to disliked individuals, while anger expressions are not mimicked differentially. These studies demonstrate that when participants like an individual they will match that individual more than a neutral or disliked individual, while neutral and disliked individuals are mimicked to the same extent (except for sad expressions) (Miles et al., 2010; Stel et al., 2010, study 1). However, none of these studies addresses whether attention and matching behavior follow the same pattern to liked or disliked individuals. It is possible that individuals simply pay more attention to liked individuals, with a corresponding increase in matching behavior.

There is also evidence that a goal to affiliate is influential in matching. Giving participants either a conscious or unconscious affiliation goal increases behavioral matching (Lakin & Chartrand, 2003, study 1). When participants are unable to fulfill an affiliation goal due to the unfriendliness of a confederate, they show increased levels of behavioral matching with a subsequent interaction partner (Lakin & Chartrand, 2003, study 2). Those who have recently experienced social exclusion or are primed with social exclusion are especially motivated to affiliate through increased behavioral matching of a later interaction partner (Lakin, Chartrand, & Arkin 2008; Over & Carpenter, 2009). These studies demonstrate that having a goal to affiliate with others increases matching behavior. However, none of these studies addresses whether attention and matching follow the same pattern, especially to those from different groups. It may be that a goal to affiliate may simultaneously increase attention and matching to the affiliation target.

Mechanisms of Attention Bias to Groups

It is important to better understand the mechanisms responsible for attention biases to social groups, as attention biases to groups have important real-world outcomes (e.g. shooter bias – decision to shoot a potentially hostile target; Correll, Park, Judd, & Wittenbrink, 2002). Research on attention biases to groups has generally found greater early attention to outgroups, and greater later attention to ingroups.

The threat mechanism hypothesizes that attention may be biased because the outgroup is perceived as more threatening. Emotional stimuli grab attention; emotion is detected faster and is more distracting than neutral information (Vuilleumier & Brosch, 2009). Angry faces, in particular, seem especially likely to capture attention (Calvo,

Avero & Lundqvist, 2006). Therefore, social identities that are considered threatening should capture attention. Specifically, outgroup members may be considered threatening, especially those with threat-related stereotypes (Riek, Mania, & Gaertner, 2006). The threat mechanism explains the attention bias to outgroup faces as resulting from the threat-value of these outgroup faces. Therefore, this mechanism would predict greater attention to outgroup members, but only if they are perceived as threatening.

Alternatively, outgroup attention biases may result from the relative novelty of outgroup faces. Novel stimuli tend to capture attention (Bradley, 2009). Outgroup, especially racial outgroup, faces are generally more novel and less familiar than ingroup faces and therefore may tend to capture attention irrespective of the threat value of the faces. However, because minimal groups themselves are novel, it is unlikely that novelty would drive attention biases to minimal groups. Therefore, this mechanism would predict greater attention to any faces that are relatively more novel, usually outgroup faces.

Finally, ingroup attention biases may be driven by the greater motivational relevance of the ingroup. Ingroup members are an important social resource with greater psychological significance (Correll & Park, 2005). Ingroup members are more likely to have an important impact on an ingroup member's life, by allocating rewards and/or punishments. Therefore, this mechanism would predict greater attention to ingroup faces because of their greater motivational relevance. The research reviewed below reveals evidence for each of these potential mechanisms used to explain group attention biases.

Patterns of Attention and Matching

Behavioral matching, including facial mimicry, is proposed to occur through a perception-action link, where the mere perception of an action by another increases the likelihood that another person will perform the same action (Chartrand & Bargh, 1999). The perception-action understanding of matching suggests that attention should follow the same pattern as matching. As I review below, there is evidence that attention allocation is different to ingroups versus outgroups; therefore, it is reasonable to expect that attention could follow the same pattern as group differences in matching behavior. However, there is limited research on how attention and matching are associated in general; some research suggests that attention and matching behavior follow different patterns, while other research suggests that attention and matching do follow the same pattern.

Research that suggests no association between attention and matching comes from the studies employing measures of memory and eye gaze fixation time. One study tested memory for interaction partners as a measure of attention (Cheng & Chartrand, 2003). The researchers found that participants' memory for details of their interaction partners was independent of their matching behavior. Additionally, two studies found that eye gaze fixation time, as measured by eye tracking, does not predict the degree of facial mimicry (Mojzisch et al., 2006; Schrammel, Pannasch, Graupner, Mojzisch, & Velichkovsky, 2009). These studies provide some evidence that attention and matching behavior may not follow the same pattern, however it is possible that memory and fixation time are not the most direct and therefore not the best measures of attention.

In contrast, research utilizing event-related potential (ERP) components and task instructions to direct attention suggest that attention and matching do follow the same pattern. One study simultaneously recorded ERP components and facial mimicry and found that the amplitude of an early visual evoked potential related to attentional processes (right P1) and the degree of facial mimicry moved in the same direction (Achaibou, Pourtois, Schwartz, & Vuilleumier, 2008). This indicates that when an ERP component related to attention increases, mimicry also increases. Another study demonstrates that instructed selective attention for non-emotional information suppresses mimicry behavior (Cannon, Hayes, & Tipper, 2009). Researchers had participants identify either the emotional expression or the color of a series of happy and angry faces that were either blue or yellow. Facial mimicry was suppressed when focusing attention on the color of the face as compared to the emotional expression. This suggests that directing attention away from facial expression attributes suppresses mimicry behavior.

Overall, evidence on attention and matching is largely inconclusive. Behavioral matching may not be related to memory of the interaction partner and facial mimicry may not be related to face fixation time. However, there is evidence that facial mimicry may be related to ERP components that index attention and that facial mimicry is influenced by task instructions that change the focus of attention. Finally, none of these studies measured whether attention and mimicry follow the same pattern to groups, specifically minimal groups. As reviewed below, there is a plethora of research on the group effect on both matching and attention, but most of it does not consider that how groups are formed might matter.

Group Differences in Matching and Attention

Much of the research on matching and attention largely ignores the fact that ingroups and outgroups can refer to several different types of groups. Below, I separated research on matching and attention by the nature of the group distinction, into socially consequential groups, interdependent groups, incidental groups, and minimal groups, and covered attention and matching effects for each type of group. Specifically, there is evidence that once group types are separated into these different categories, distinct patterns of matching for specific emotional expressions (angry, happy, sad, and fear) emerge.

Socially consequential groups. These are groups with histories of clear differences in opportunities and social power (e.g., people of a different race, religion, or political affiliation). Groups that are socially consequential are the most complex type of group; they involve negative attitudes, stereotypes, differences in social power and often competition with outgroups (Fiske, Cuddy, Glick, & Xu, 2002).

Matching of socially consequential groups. So far, the matching literature has examined socially consequential groups that can be divided into differences by race, ideology, and social power and found that generally ingroup members are matched more than outgroup members (Bourgeois & Hess, 2008; Carr, Winkielman, & Oveis, 2014; van der Schalk et al., 2011; Yabar, Johnston, Miles, & Peace, 2006). Race influences facial mimicry; Caucasian participants show greater emotional mimicry of anger expressions of Caucasian individuals compared to non-Caucasian individuals, but no differential mimicry of smiles (van der Schalk et al., 2011, study 2).

Ideological differences, such as religion and political party affiliation, also influence matching behavior. In New Zealand, where religious individuals are a relatively disliked minority, individuals tend to show greater behavioral matching of non-religious compared to religious individuals (Yabar et al., 2006). People also show greater emotional mimicry of anger expressions to ingroup politicians compared to outgroup politicians, but no differential mimicry of smiles (Bourgeois & Hess, 2008, study 1).

Finally, social power also influences emotional facial mimicry (Carr et al., 2014). Participant power interacts with target power to influence the amount of mimicry to angry or happy facial expressions. Participants mimic the anger expressions of the high power target (e.g., senior executive) and not the low power target (e.g., fast food worker). Importantly, low power participants smile to all targets (low and high power) and expressions (happy and angry faces). Generally, mimicry in socially consequential groups is enhanced to the ingroup – especially for the emotion of anger – while there seems to be no differential mimicry of smiles. However, none of the studies have measured attention in these group-driven matching differences. Consistent with the idea that matching and attention may follow the same pattern, there is also evidence that attention allocation differs between ingroup and outgroup for socially consequential groups.

Attention to socially consequential groups. The literature on attention to socially consequential groups has largely focused on the differences in attention allocated to Black versus White individuals (by White individuals). Findings from this research distinguish between early and late attentional biases. Research using event-related

potentials (ERP) finds that Black faces evoke larger early attentional components (N100 and P200) than White faces, indicating that greater early attention is directed to outgroup faces (Ito & Urland, 2003, 2005). Conversely, later in the attentional stream (N200 or P300), Whites' attention appears to shift toward White targets and away from Black targets.

Research using the dot-probe detection paradigm also finds that White participants have biased attention toward Black faces (Trawalter, Todd, Baird, Richeson, 2008, study 1). White participants are faster to detect a dot presented behind faces of Black compared to White men when the face is only presented for 30ms, indicating that individuals direct early attention to Black men. Importantly, this attention bias disappears when faces are presented with averted eye-gaze (Trawalter et al., 2008, study 2). Averted eye-gaze may attenuate the threat signal communicated by Black faces and therefore eliminate the attention bias to threat. Another study has shown that when White participants are induced to think about crime, Black faces are much more likely to capture attention (faces presented for 450ms) than individuals not induced to think about crime (Eberhardt, Goff, Purdie, & Davies, 2004). Endorsement of danger stereotypes of Black individuals predicts an increase in attention to Black (compared to White) faces (presented for 40ms) for White participants (Donders, Correll, & Wittenbrink, 2008). All of these studies provide considerable support that this early attentional bias toward Black targets for White individuals may indicate specific attention to threatening cues as Black individuals are commonly associated with a threat stereotype.

Furthermore, attentional bias toward outgroup members is also moderated the motivation to respond without prejudice to Black individuals (Bean et al., 2012; Richeson & Trawalter, 2008). Individuals with high external motivation (EM) to respond without prejudice show a greater attention bias to Black faces (compared to White faces) at brief presentation times (35ms), but at longer presentations (450ms) this bias reverses to favor White rather than Black faces. However, individuals with low EM to respond without prejudice do not show either of these attentional biases. This study, which used the dot-probe to measure attention, is corroborated by eye-tracking research demonstrating that high-EM participants exhibit the same early-late, vigilance-avoidance pattern of attention (Bean et al., 2012). In this study participants with high EM may hold stronger threat stereotypes about Black individuals than participants with low EM.

The studies above largely consider early attention to outgroups as reflecting the outgroup's threat value. In contrast, other studies provide evidence that an attentional bias to racial outgroup members may not be that simple. Similar to the ERP studies above, researchers found that Black targets elicit enhanced P200 amplitudes (reflecting early attention) and White targets elicit enhanced N200 (reflecting late attention) for White participants (Dickter & Bartholow, 2007). In contrast, the opposite pattern is observed for Black participants. This suggests that attentional differences may not be due merely to the threat stereotype of Black males, but could reflect the novelty of outgroup faces and/or the motivational relevance of the ingroup. It is also possible that Black individuals find White faces threatening and so it is not merely a threat stereotype that motivates early

attention, but rather that outgroup faces may often be considered more threatening than ingroup faces.

Other research supports the conclusion that attention biases result from novelty instead of threat-value of the faces. White participants with fewer close other-race friends (Blacks or Asians), demonstrate greater attentional bias toward outgroup faces (early, at 100ms). Conversely, the more racial outgroup friendships participants' report, the less attentional bias to outgroup faces they display (Dickter, Gagnon, Gyurovski & Brewington, 2015). In this case, outgroup members may capture attention because of their relative novelty and unfamiliarity to perceivers. Furthermore, another study found that East Asian female faces selectively capture attention compared to White female faces for White participants at presentation times of 100ms and 500ms (Al-Janabi, MacLeod, & Rhodes, 2012). Greater attention to outgroup faces may not be simply be due to threat detection, as East Asian female faces were not rated as more threatening than White female faces. Again, attention to non-threatening outgroups may reflect the relative novelty of outgroup faces compared to ingroup faces.

In conclusion, research on natural attention allocation to racial groups generally suggests that early attention is directed toward racial outgroup members and later attention is directed toward racial ingroup members. There is considerable evidence that threat detection may play a role in this initial attention bias to Black targets. However, there is also evidence that novelty of the outgroup may play a role. Finally, there is some evidence that motivational relevance could be responsible for a late ingroup attention bias. Research examining group effects must carefully control for, or eliminate, the

effects of novelty and/or threat-value and determine if group attention biases still exist. To most clearly test for group effects, in- and out- groups should be perceived as equally threatening and novel. For example, using minimal groups that lack threat stereotypes and where the outgroup is not any less familiar than the ingroup, is one way to clarify these group attention biases. If an attention bias exists within minimal groups, then it cannot be due to novelty and is unlikely due to threat and therefore may suggest that a different mechanism is operating, such as motivational relevance.

Overall, mimicry research finds ingroup members are mimicked more than outgroup members, while attention research finds that early attention is directed toward outgroup members and later attention is directed toward ingroup members. Overall, mimicry findings could be consistent either with the affiliation model or late attention allocation, but they are not consistent with the observed patterns of early attention allocation. In general, mimicry research on socially consequential groups measures mimicry over several seconds, so it seems consistent that mimicry effects match findings for later attention. Also, as mimicry usually occurs after 500ms (Dimberg & Thunberg, 1998), it is logical that mimicry may always track with later attentional processes.

Interdependent groups. Interdependent groups are groups that are cooperating or competing to obtain resources. Therefore, there are ramifications to the relationship; an ingroup emotion has signal value for the outgroup in terms of a gain or a loss (Sherif, Harvey, White, Hood, & Sherif, 1961; Deutsch, 1949; Fiske & Ruscher, 1993). By creating groups in the laboratory, the influence of stereotypes, familiarity, or a history of social conflict should not impact reactions to interdependent groups.

Matching of interdependent groups. A number of studies have examined the influence of competition on emotional mimicry. Specific patterns are hard to discern because different comparisons have been made across studies (e.g. many studies include only two of the three groups of competitor, neutral and cooperative other). A consistent observation is that findings appear affected by the expression being studied. People show greater mimicry of happy and sad expressions of cooperative others compared to competitive others (Likowski, Mühlberger, Seibt, Pauli, & Weyers, 2011; Seibt et al., 2013; Weyers, Mühlberger, Kund, Hess, & Pauli, 2009). Reactions to competitive others show evidence for reduced mimicry compared to neutral others in response to happy and sad expressions (Likowski et al., 2011). However, people also tend not to mimic the angry expressions of neutral or cooperative others either (Likowski et al., 2011; Seibt et al., 2013; Weyers et al., 2009), and suppress the corrugator muscle in response to angry expressions of competitive others (Likowski et al., 2011; Seibt et al., 2013). Suppression of the corrugator in response to angry faces is an incongruent emotional reaction that could indicate a Schadenfreude reaction (i.e. mild positive affect in response to angry responses of the competitive other).

Across studies, two common findings emerge. First, mimicry of competitive others is suppressed compared to neutral or cooperative others. Second, mimicry differs by expression – happy and sad expressions are enhanced for cooperative others and suppressed for competitors, while angry faces are not mimicked at all. This effect of expressions is different from that found in socially consequential groups, where happy expressions are not differentially mimicked. To my knowledge, there are no studies

examining attention allocation to interdependent groups. Therefore, it is unknown whether attention allocation would parallel the findings of mimicry behavior.

Incidental groups. These groups are conceptualized as minimal groups, but they are based on actual pre-existing social identities, such as hobbies, activities, or academic interests. Incidental groups do not have clear and consistent histories of unequal opportunities in the social structure, as in socially-consequential groups. However, because these identities often have social consequences and sometimes a degree of familiarity, there is likely more meaningful identification with group characteristics than occurs when minimal groups are created entirely arbitrarily in the laboratory.

Matching of incidental groups. A number of studies have examined the influence of incidental groups on matching behavior. High self-monitoring undergraduate students match ingroup undergraduate students more than outgroup high school or graduate students (Cheng & Chartrand, 2003). Individuals also match others who share the same name more than those who do not share the same name (Gueguen & Martin, 2009, study 1). Additionally, individuals show significantly more behavioral matching (Gueguen & Martin, 2009, study 2) and emotional mimicry of fear and anger expressions (but not happy expressions) for same college major versus different college major (van der Schalk et al., 2011, study 1). Finally, people who like basketball mimic the sad expressions of basketball players more than individuals who do not like basketball (Bourgeois & Hess, 2008, study 2). However, happy expressions are not mimicked differentially between groups, and anger expressions are not mimicked at all.

Overall, incidental ingroup members are matched more than incidental outgroup members. For incidental groups there are different effects for sad, angry and happy expressions. Smiles seem to be positive enough stimuli that they are able to overpower incidental group differences and therefore ingroup and outgroup smiles are matched to the same extent (see Hess & Fischer, 2013). In contrast, fear, sadness, and sometimes anger do not seem to have this effect, so ingroup members are matched more than outgroup members. These findings are consistent with socially consequential groups, where smiles are not differentially mimicked, but anger is. However, these findings contrast with interdependent groups, where mimicry of happy and sad expressions is enhanced for cooperative others and the emotional expressions of competitive others are not mimicked at all.

Attention to incidental groups. To my knowledge, there is only one study examining attention allocation to incidental groups (Brosch & Van Bavel, 2012). In this study, participants were told they were looking at either students belonging to their own university (ingroup) or to a different university (outgroup). Using the dot probe paradigm, researchers found faster reaction times to outgroup faces when the faces were presented for 100ms. This attention allocation finding is consistent with the early attention bias toward outgroups observed in socially consequential groups. However, at a longer presentation time, 500ms, researchers also found greater attention to unfamiliar outgroup faces. This fits with the novelty mechanism, but is in contrast to the majority of findings for a later attention bias to racial ingroup members (however these studies did not introduce novel faces). Because these findings for attention to incidental groups are

somewhat preliminary, using minimal groups should simplify and clarify the effect of mere group categorization on attention processes.

Minimal groups. Minimal groups are created to study the social and psychological effects of arbitrary categorization into different social groups (Billig & Tajfel, 1973; Tajfel & Billig, 1974; Tajfel et al., 1971). This mere categorization creates a sense of group membership without any accompanying knowledge about any one particular group member. These ingroup-outgroup distinctions do not involve even mild competition or conflict over scarce resources (Brewer, 1999). However, people still tend to be more favorable, in terms of resource allocation, to members of their own group even if there is no outgroup animosity (Brewer, 1979, 1993; Hewstone, 2002). Therefore, the creation of minimal groups should result in ingroup favoritism, but no stereotypes, negative attitudes, competition or familiarity with outgroup members.

Matching of minimal groups. Only one study has examined the impact of minimal groups on matching behavior – specifically synchrony behavior. Participants demonstrate more synchrony with a target that belongs to the minimal outgroup compared to the minimal ingroup (Miles, Lumsden, Richardson, & Macrae, 2011). While this is inconsistent with the pre-existing rapport mechanism, it is consistent with the desire to affiliate mechanism. The authors argue that in this case synchrony may be used as a means to reduce social distance with an outgroup member. In other words, individuals use synchrony to diminish the minor interpersonal differences rather than enhance the preexisting self-other similarities with the ingroup. In the absence of stereotypes, negative attitudes, competition, or familiarity with outgroup members,

people exhibit more synchrony with outgroup members, not less. However, it is unknown if these findings replicate when examining emotional facial mimicry. This study suggests that there might be greater emotional mimicry of outgroup than ingroup members, in contrast to the previous research summarized on the group effect on mimicry.

Attention to minimal groups. In contrast to research on attention biases in other groups, research on attention allocation to minimal groups generally suggests that minimal ingroup members are attended to more than minimal outgroup members. For example, members of minimal ingroups benefit from greater face memory (Bernstein, Young, & Hugenberg, 2007), facial emotional expression identification (Young & Hugenberg, 2010), face processing (Hugenberg & Corneille, 2009; Van Bavel, Packer, & Cunningham, 2008), fusiform face area activation (Van Bavel, Packer & Cunningham, 2011), and mental representations of faces (Ratner, Dotsch, Wigboldus, van Knippenberg & Amodio, 2014). All of these studies conclude that these processes are more favorable for minimal ingroup members compared to minimal outgroup members.

Eye tracking and ERP studies provide further evidence that minimal ingroups receive greater attention than minimal outgroups. When participants are presented with both a minimal ingroup and outgroup face on a screen, eye-tracking measures indicate that participants spend more time looking at ingroup than outgroup faces, and specifically the eye region in comparison to the nose or mouth regions (Kawakami et al., 2014). An ERP study found that minimal ingroup faces elicit larger ERP components reflecting face processing (N170) than outgroup faces (Ratner & Amodio, 2013). Finally, one exception to the above attentional findings identified appraisals of danger as a moderating factor.

More specifically, participants who rate minimal outgroup members as dangerous are more likely to attend to outgroup males than ingroup males as measured by the dot probe paradigm with presentation times of 500ms (Maner & Miller, 2013). This finding is consistent with the threat mechanism of attention, while the other research for an ingroup advantage is consistent with the motivational relevance of the ingroup.

Generally these studies indicate that minimal ingroup members seem to capture greater attention than minimal outgroup members, with the one exception of minimal outgroup members who are perceived as dangerous. It is unknown whether minimal ingroups will be mimicked more than minimal outgroups. If mimicry follows that pattern, it will be consistent with attention effects. While it seems plausible that attention and matching may move in the same direction, it would be beneficial to examine the influence of minimal groups on both attention and matching behavior within the same study. Future studies could then determine if attention is a mechanism that could directly influence mimicry. If so, then it opens up the possibility that attention could be changed instead of changing someone's affiliation motivation. Therefore, as another first step, it is important to test if directly manipulating attention to social groups can actually change group attention biases. In order to test for and train attention to minimal groups, an experimental paradigm to measure and manipulate attention is needed.

Measuring and Manipulating Attention

To my knowledge, no studies to date have attempted to directly manipulate attention to social groups. A single experimental paradigm – the dot-probe – has been used to both measure and manipulate attention in anxiety and other contexts (Bar-Haim,

Lamy, Pergamin, Bakermans-Kranenburg, & Van IJzendoorn, 2007; Bar-Haim, 2010; MacLeod, Mathews & Tata, 1986; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). Studies measuring attention frequently assess attention to threatening compared to neutral stimuli and report an attention bias towards threat that is associated with anxiety (Bar-Haim et al., 2007; MacLeod et al., 1986). To measure the attention bias, these studies briefly present a pair of words or faces, one threat-related and one neutral. The removal of the word or face pair is followed by a small target probe that appears in the location just occupied by one of the two stimuli. In the classic dot-probe paradigm designed to measure attention, targets appear with equal probability behind threat and neutral stimuli (MacLeod et al., 1986). Participants are required to respond to the probe as quickly as possible. An attention bias is measured by determining response latencies to the probes; faster responses are indicative of greater attention. Attention bias toward threat is revealed when participants are faster to respond to probes that replace threat-related stimuli compared to neutral stimuli (MacLeod et al., 1986). Eye tracking studies also confirm that these response latencies are associated with differential gaze toward threatening and non-threatening stimuli. Individuals with generalized anxiety disorder are more likely to look first toward threat faces compared to neutral faces (Mogg, Millar, & Bradley, 2000) and individuals with social anxiety are quicker to look at emotional compared to neutral faces (Garner, Mogg, & Bradley, 2006).

Attention-training dot-probe studies manipulate probe location to systematically appear behind the location of the stimulus type that attention is to be trained to. For example, if the goal of the study is to train attention away from threat stimuli and toward

neutral stimuli, the probe will appear more frequently behind the neutral stimulus, therefore directing the individual's attention to the neutral stimuli. A learned bias away from threat is gradually induced over many trials. Therefore, the attentional focus of the participant is changed and directed toward the neutral stimulus. Furthermore, participants who have successfully undergone this attention training to avoid threat have reported significant reductions in general anxiety (Amir, Beard, Burns, & Bomyea, 2009a; Hazen, Vasey, & Schmidt, 2009) and social anxiety (Amir et al., 2009b; Amir, Weber, Beard, Bomyea, & Taylor, 2008; Schmidt, Richey, Buckner, & Timpano, 2009). In other words, dot-probe attention-training does effectively change attention. Specifically, one study demonstrated that attention training modulates ERP components associated with relatively late top-down cognitive processes of attention (reduces P2 and P3 and enhances N2) for anxious individuals (Eldar & Bar-Haim, 2010). Eye tracking data also demonstrates that participants trained to selectively attend to affectively positive (rather than neutral) stimuli spend less time looking at negative images in a later task (Wadlinger & Isaacowitz, 2008). This attention-training paradigm seems to be an effective method for manipulating attention toward affective stimuli; however, it is unknown whether this training can manipulate attention toward social aspects of stimuli, such as group membership.

The Present Project

The overarching goal of this project was to study the influences of minimal group membership on attention and mimicry. My first goal was to replicate attention training to emotional faces and then determine if attention to minimal groups could be manipulated.

Second, I wanted to determine if there is an attention bias to minimal groups. Third, I wanted to determine if minimal ingroup members are mimicked more than minimal outgroup members. Finally, I wanted to see if attention and mimicry effects on minimal groups follow the same pattern. Studies 1 replicated previous work, demonstrating that attention can be manipulated to neutral faces, while study 2 failed to replicate previous work demonstrating that attention can be trained to emotional faces. Study 3 determined if attention can be manipulated to minimal group members. Study 4 examined attention and mimicry to minimal group members and determined if their effects on minimal groups follow the same pattern.

Study 1

Method

Participants. Twenty-two undergraduate students at the University of Denver were recruited to participate in this study for extra credit in psychology classes. With an N of 22 and given the power of .80, a power analysis informs that I could detect an effect size as big as Cohen's $f = .31$. Data was visually inspected for bivariate outliers and one participant was removed. One participant was excluded for less than 93% accuracy on the dot-probe trials during pre and post training (18.7% inaccurate trials). This cutoff is similar to another attention training study (Krebs, Hirsch, & Mathews, 2010).

Stimuli. Photos were selected from the NimStim face set (Tottenham et al., 2009). A total of 12 individuals (six male, six female) were used, each displayed neutral and angry expressions. Gender of face stimuli was matched to participant's gender so that each participant only saw six individuals total.

Procedure. Participants completed the entire procedure in a private room. The experimenter helped to clarify instructions, but otherwise was not in the room with participants. Participants completed the attention-training task (pre-training dot-probe, attention training dot-probe, post-training dot-probe). Then they completed individual difference measures on Qualtrics, an online survey tool. Before beginning the experiment, participants consented to participate; all procedures were IRB approved.

Attention training. To manipulate attention, participants completed a directed dot-probe task. First, participants completed a pre-training dot-probe task to assess natural, un-manipulated attention allocation to neutral and angry faces. Next, they completed the attention-training dot-probe task to manipulate attention allocation toward neutral faces. Finally, they completed the post-training dot-probe to assess that attention was successfully manipulated.

Pre-training dot-probe. In this pre-training task, each attention trial began with a crosshair fixation cue centered on the computer screen for 500ms followed by a pair of pictures (a neutral face and an angry face) presented for 500ms, one picture appeared right above the crosshair and one right below (following MacLeod et al., 2002). The position of the neutral versus angry faces was randomized. Next, a small target (. or ..) appeared with equal probability in either the upper or lower location of one of the faces previously presented on the screen. The small target appeared roughly behind where the eyes of the target face were. The participant's task was to discriminate the target's identity (. or ..) as accurately and quickly as possible by pressing either the "1" or "2" key. As soon as the computer detected a response, the target was cleared and the next trial resumed in 500ms. There were 96 trials total. There was always one neutral face and one angry face on the screen.

Dot-probe attention training. Next, participants completed the attention-training dot-probe task. Participants completed the dot-probe task described above with one change: 94.44% of the targets appeared behind the pictures of neutral faces (Wadlinger &

Isaacowitz, 2008). There were a total 324 trials with 306 critical trials that trained attention to neutral faces.

Post-training dot-probe. Next, participants completed a post-training dot-probe task to ensure attention training was successful. This was exactly the same as the pre-training task, with targets appearing with equal likelihood (50%) behind neutral or angry faces.

Analysis plan. For each study, first I investigated natural, pre-training attention biases with paired samples *t*-tests. Second, for studies 1-3, I investigated effects of the attention training manipulation with repeated measures analysis of variance (ANOVA). Third, I examined whether pre-training attention bias influenced effects of training. To determine whether pre-training bias scores influenced training effects on post-training attentional biases, I first constructed pre- and post-training attention bias scores by subtracting the RT to emotion (outgroup) faces from the RT to neutral (ingroup) faces. Thus, a positive attentional bias score reflects faster RTs to emotion (outgroup) versus neutral (ingroup) faces and a negative score reflects faster RTs to neutral (ingroup) versus emotion (outgroup) faces.

I used hierarchical regression analyses to examine continuous effects of pre-training attention biases on post-training attention bias. Post-training attention bias always served as the dependent variable. For studies 2 and 3, to examine whether training condition, pre-training attention biases, or the interaction between training condition and pre-training attention bias moderated the effects of attention training on post-training attention biases, a hierarchical multiple regression analysis was conducted. Training

condition was dummy coded and entered in step one, pre-training attention bias was entered in step two, and the training condition by pre-training bias interaction term was entered in step three.

In studies 3 and 4, I explored the effectiveness of the minimal groups manipulation. Participants' ratings for the individuals were collapsed within the ingroup or outgroup for each manipulation check question separately for each time point. Paired samples *t*-tests were conducted to compare ratings on the subjective impression composite, threat, and inclusion variables of individuals belonging to the ingroup versus outgroup. When the subjective impression composite overall was not significant, any effects of interest were provided in a footnote. Across all analyses, whenever higher order 2 or 3-way interactions were significant, analyses were broken down into appropriate 2-way ANOVAs or *t*-tests. Whenever effects violated assumptions of sphericity, greenhouse--geisser corrected values were reported.

Results

Reaction Time Data Reduction. Trials with incorrect responses were removed (2.08%). Participant accuracy ranged from 93.25% to 100%. Trials with reaction times (RTs) greater than 2000ms were also excluded from analyses (0.10% of trials with correct responses). Trials with RTs 3 standard deviations (calculated separately for each condition) above each participant's mean were also excluded from analyses (1.57% of remaining trials). Previous literature has used similar criteria to eliminate individual RT trials (Brosch & van Bavel, 2012; Klumpp & Amir, 2010). RTs for the remaining trials within each condition were averaged across trials.

Pre-training (Untrained) Attention Bias. To test for an untrained attentional bias to neutral versus angry faces pre-training, I conducted a two-tailed paired samples t -test comparing mean RT to neutral versus angry faces. This t -test revealed a significant difference such that participants were faster to angry versus neutral faces, $t(19) = -5.121$ $p < .001$. See Figure 1 for means. Therefore, before training participants demonstrated an untrained attentional bias to angry faces.

Post-training Attention Bias. To test my central hypothesis that training attention to neutral faces would decrease reaction times to neutral versus angry faces I conducted a time (pre, post) by emotion (angry, neutral) analysis of variance (ANOVA). There were no significant main effects (p 's $> .665$). There was a significant time by emotion interaction, $F(1, 19) = 29.695$, $p < .001$. To break apart this interaction, follow up t -tests indicated that after training to neutral faces, participants were faster to neutral as compared to angry faces, $t(19) = 5.319$, $p < .001$. Figure 1 demonstrates that attention training was successful because participants became faster to neutral faces at post-training, reversing the angry attention bias observed at pre-training.

Post-training effects considering pre-training bias. A linear regression analysis was conducted with pre-training attention bias serving as the predictor. A significant regression equation was found, $R^2 = .692$, $F(1, 18) = 40.357$, $p < .001$. Figure 2 demonstrates that the stronger the pre-training attention bias to angry faces, the more effective training was, such that participants showed a stronger attention bias to neutral faces at post-training. This indicates that the training is most effective on participants with a strong pre-training bias in the opposite direction.

Discussion

This study replicated previous research by successfully training attention to neutral faces (e.g. Amir et al., 2008; Amir et al., 2009b; Eldar & Bar-Haim, 2010; Schmidt et al., 2009). The attention manipulation transformed the natural, pre-training angry attention bias into a neutral attention bias post-training, which indicates that our dot-probe training paradigm successfully manipulated attention. Considering pre-training attention biases revealed that attention training to neutral faces was related to the degree of pre-training anger attention bias. The individuals with the greatest pre-training attention bias to angry faces, showed the greatest reversal of the attention bias through training by demonstrating a greater neutral attention bias at post-training. Because emotional faces differ from neutral faces in that they capture more attention and carry more meaning (Vuilleumier & Brosch, 2009), I next wanted to determine if attention to emotional faces could be trained successfully.

Study 2

Method

Participants. Forty-one undergraduate students at the University of Denver were recruited to participate in this study for extra credit in psychology classes. One participant was excluded for less than 93% accuracy on the dot-probe trials during pre and post training (33.85% inaccurate trials). Participants were either in the train to angry condition ($N = 21$) or the train to happy condition ($N = 19$).

Stimuli. Photos were the same as study one, except that happy expressions were used in addition to neutral and angry expressions.

Procedure. Participants completed the attention-training task (pre-training dot-probe, attention training dot-probe, post-training dot-probe). Then they completed individual difference measures on Qualtrics.

Attention training. To manipulate attention, participants completed a directed dot-probe task. First, participants completed a pre-training dot-probe task to assess un-manipulated attention allocation to neutral and angry faces or neutral and happy faces. Next, they completed the attention-training dot-probe task to manipulate attention allocation toward angry or happy faces. Finally, they completed the post-training dot-probe to assess if attention was successfully manipulated.

Pre-training dot-probe. This was exactly the same as study 1, except that individuals in the train to happy condition always saw one happy and one neutral face on the screen and attention bias to happy versus neutral faces was measured.

Dot-probe attention training. This was exactly the same as study 1, except half of the participants were trained to attend to angry faces and half were trained to attend to happy faces.

Post-training dot-probe. This was exactly the same as the pre-training dot-probe trials.

Results

Reaction Time Data Reduction. As in study 1, trials with incorrect responses were removed (1.76%). Participant accuracy ranged from 94.8% to 100%. Trials with RTs greater than 2000ms were also excluded from analyses (.066% of trials with correct responses). Trials with RTs 3 standard deviations (calculated separately for each condition) above each participant's mean were also excluded from analyses (1.23% of remaining trials). RTs for the remaining trials within each condition were averaged across trials.

Pre-training (Untrained) Attention Bias. To test for an untrained attentional bias to neutral versus emotional (angry/happy) faces pre-training, I conducted two-tailed paired samples *t*-test comparing RT to neutral faces versus RT to angry or happy faces. These *t*-tests revealed no significant effect; participants were on average not faster to any particular type of face (p 's > .248). In contrast to study 1, participants did not hold an untrained attention bias to neutral or angry or happy faces.

Post-training Attention Bias. To test my central hypothesis that training attention to emotional (angry/happy) faces would decrease reaction times to emotional (angry/happy) versus neutral faces I conducted a time (pre, post) by emotion (neutral, angry/happy) ANOVA. There was a main effect of time, indicating participants were faster at detecting the probe during post-training as compared to pre-training, $F(1, 40) = 30.036$, $p < .001$. No other main effects or interactions were significant (p 's $> .184$). There were no effects of training condition (train to angry/happy), so these analyses are not reported. In contrast to study 1, attention training does not appear to be successful.

Post-training effects considering pre-training bias. A hierarchical multiple regression analysis was conducted as outlined in the analysis plan. The step one model, training condition, was not significant, $R^2 = .020$, $F(1, 38) = .786$, $p = .381$. The addition of the pre-training attention bias variable at step two also did not account for a significant proportion of variance, $\Delta R^2 = .022$, $\Delta F(1, 37) = .055$, $p = .815$, nor did the interaction term of condition by pre-train attention bias at step three, $\Delta R^2 = .038$, $\Delta F(1, 36) = .627$, $p = .434$. Training attention to emotional faces was not successful and considering pre-training bias did not reveal training effects on post-training attention bias scores.

Discussion

This study did not replicate previous research that has successfully trained attention to angry (Eldar, Rincon, & Bar-Haim, 2008) or happy faces (Browning, Holmes, Charles, Cowen, & Harmer, 2012; Li, Tan, Qian, & Liu, 2008; Heeren, Reese, McNally, & Philippot, 2012). Training attention to emotional faces was not successful and unlike study 1, considering pre-training attention biases did not show that training

attention was only successful for those individuals who held the opposite attention bias at pre-training (e.g. a neutral attention bias). It is unclear why training attention to emotional faces did not successfully replicate previous findings. It may be that it is more difficult to train attention to emotional than neutral faces. Next, I wanted to determine if it is possible to manipulate attention to minimal group members.

Study 3

Method

Participants. Forty-two undergraduate students at the University of Denver were recruited to participate in this study for extra credit in psychology classes. Data from nine participants were excluded; one participant incorrectly reported their own group membership, an additional five participants incorrectly reported the group membership of other individuals, and another three participants had less than 93% accuracy on the dot-probe trials across pre and post-training. Participants were either in the train to ingroup condition ($N = 19$) or the train to outgroup condition ($N = 14$).

Design. The design consisted of one between-subjects factor and two within-subject factors. Attention training toward group-type (ingroup or outgroup) occurred between groups. The within subject factors were time (pre, post) and group membership (ingroup vs. outgroup faces).

Stimuli. The face stimuli were the same as in study 2.

Procedure. Participants first completed the minimal groups manipulation to be assigned to a minimal group. Next, they learned about the group membership of the individuals they viewed throughout the study. Then they completed the first round of manipulation check questions on Qualtrics. Next, they completed the attention-training task (pre-training dot-probe, attention training dot-probe, post-training dot-probe). Finally, they completed the second round of manipulation check questions, other

individual difference measures, and rated the believability of the manipulation on Qualtrics.

Minimal groups manipulation. To manipulate minimal groups, an established “numerical estimation style” minimal group procedure was used to assign participants to arbitrary, but believable groups (Tajfel, 1970; Tajfel et al., 1971, Ratner & Amodio, 2013; Ratner et al., 2014). Participants were led to believe that people vary in numerical estimation style, defined as the tendency to overestimate or underestimate the number of objects they encounter. Participants were told that half the population are overestimators and half are underestimators.

Participants were shown a series of ten dot patterns presented sequentially on a computer screen for five seconds each. Each pattern of dots included 98-200 black dots arranged randomly on a white background (see Ratner & Amodio, 2013). Following each image, participants were prompted to estimate the number of dots presented. Upon completion, the computer ostensibly analyzed their responses and presented pre-determined feedback regarding their numerical estimation style. Feedback was randomized across participants.

Group membership learning paradigm. Participants were then presented with the six gender-matched neutral faces one at a time and asked to guess whether the individual was an underestimator or overestimator. Three faces were labeled as underestimators and three were labeled as overestimators; these estimation styles correspond to ingroup or outgroup membership depending on the participant’s own estimation style. The six faces were presented for three trials followed by five test trials until the participant correctly

identified group membership of the individuals 80% of the time. Then the participants were required to achieve 100% accuracy in identifying the group membership of the individuals before they could move on with the experiment. This learning paradigm was used to ensure that participants learned the group memberships of the individuals (Potts & Shanks, 2014). Faces were randomly assigned numerical estimation style and assignment was fully counterbalanced so no perceptual cues allowed participants to visually sort the faces into groups. This design ensured that participants were equally likely to see each face as an ingroup or outgroup member.

Attention training. To manipulate attention, participants completed a directed dot-probe task. First, participants completed a pre-training dot-probe task to assess un-manipulated attention allocation to ingroup and outgroup members. Next, they completed the attention-training dot-probe task to manipulate attention allocation. Finally, they completed the post-training dot-probe to assess if attention was successfully manipulated.

Pre-training dot-probe. The overall dot-probe is the same as in Study 1. However, instead of presenting a neutral and angry face simultaneously, one ingroup face and one outgroup face were presented on the screen. The position of the ingroup versus outgroup member's faces was randomized. Dot-probe trials occurred with all emotional expressions (angry, happy, neutral). Importantly, emotional expression was always matched for the ingroup/outgroup pair displayed on each trial. There were 108 trials total.

Dot-probe attention training. Next, participants were split into two groups (train ingroup or train outgroup) to complete the attention-training dot-probe task. The train-ingroup group was exposed to the training condition designed to induce selective

attention toward ingroup members. They completed the dot-probe task described above with one change: 94.44% of the targets appeared behind pictures of ingroup members. The train-outgroup was exposed to the training condition designed to induce selective attention toward outgroup members, with 94.44% of the targets behind pictures of outgroup members. There were a total 324 trials with 306 critical trials that trained attention to the respective group members.

Post-training dot-probe. Next, participants completed a post-training dot probe task to ensure attention training was successful. This was exactly the same as the pre-training task, with targets appearing with equal likelihood (50%) behind ingroup or outgroup members.

Measures

Minimal group rating questions. Participants were asked to rate the likeability, friendliness, desire to spend time with, trustworthiness, threat, and similarity to the individuals presented in the study. Questions were answered on a seven-point scale from one (not at all) to seven (very much). Questions to assess the subjective impression of the individuals included: “How much do you like this person?,” “How friendly do you think this person is?,” “How much time would you want to spend time with this person in the future?”, and “How trustworthy do you think this person is?”. Threat was assessed with the question: “How threatening do you think this person is?”. Finally, similarity was assessed using the Inclusion-of Other-in-Self scale (IOS) (Aron, Aron, & Smollan, 1992). These questions were administered after learning about the group membership of the different individuals in the study and after the attention training trials.

Results

Minimal Groups Manipulation Check. A subjective impression composite variable was created combining the liking, friendliness, desire to spend time with and trust ratings for time 1 (ingroup $\alpha = .855$, outgroup $\alpha = .868$) and time 2 (ingroup $\alpha = .952$, outgroup $\alpha = .943$). To explore the influence of the minimal groups manipulation, *t*-tests were conducted to compare ratings of individuals belonging to the ingroup versus outgroup. At time 1 (immediately after learning about the groups, before attention training), participants rated the outgroup as more threatening than the ingroup, $t(32) = 2.779$, $p = .009$ and reported feeling closer (on the IOS scale) to the ingroup compared to the outgroup, $t(32) = 2.080$, $p = .046$. There was not a significant effect of the subjective impression composite¹. At time 2 (after attention training) there were no significant effects for any of the ratings (p 's $> .121$).

Reaction Time Data Reduction. Trials with incorrect responses were removed (1.85%). Participant accuracy ranged from 93.55% to 100%. Trials with RTs greater than 2000ms were also excluded from analyses (0.23% of trials with correct responses). Trials with RTs 3 standard deviations (calculated separately for each condition) above each participant's mean were also excluded from analyses (1.33% of remaining trials).

Pre-training (Untrained) Attention Bias. To test for an untrained attentional bias to minimal ingroup versus outgroup members for the different emotional expressions

¹ Because the composite variable was not significant, I investigated the individual variables. There was a marginal effect of participants reporting the ingroup to be friendlier than the outgroup, $t(32) = -1.773$, $p = .086$. There were no significant differences between ingroup and outgroup individuals for ratings of liking, desire to spend time with or trust (p 's $> .357$).

of angry, happy or neutral, I conducted a group (ingroup, outgroup) by emotion (angry, happy, neutral) ANOVA. There was a main effect of emotion, $F(1.431, 45.797) = 3.808$, $p = .043$. To break down this main effect, follow-up t -tests indicate that participants were faster to anger compared to happy faces, $t(32) = -2.675$, $p = .012$. No other differences between emotions were significant (p 's $> .155$). No other main effects or interactions were significant (p 's $> .128$). In the interest of fully exploring the data, this analysis was followed up by separating the trials by emotion expression. See Figure 3 for means.

For angry expressions, a two-tailed paired samples t -test compared RT to angry ingroup versus angry outgroup faces. This t -test was not significant, $t(32) = -1.426$, $p = .164$.

For happy expressions, a two-tailed paired samples t -test compared RT to happy ingroup versus happy outgroup faces. This t -test was also not significant, $t(32) = 1.019$, $p = .316$.

For neutral expressions, a two-tailed paired samples t -test compared RT to neutral ingroup versus neutral outgroup faces. This t -test revealed a marginally significant effect such that participants were faster to neutral ingroup compared to outgroup faces, $t(32) = -2.130$, $p = .053$. There is no evidence for attention biases to ingroup versus outgroup faces for angry or happy expressions; however there is evidence for an ingroup attention bias for neutral expressions.

Post-training Attention Bias. To test my central hypothesis that attention training would decrease reaction times to the trained group, I ran a time (pre, post) by group membership (ingroup faces vs. outgroup faces) by training condition (train

ingroup, train outgroup) ANOVA. There was a marginal time by group by training condition 3-way interaction, $F(1, 31) = 3.179, p = .084$. No other main effects or interactions were significant (p 's $> .108$). In the interest of fully exploring the data, I conducted time by group ANOVAS separately for each training condition to assess if training to the ingroup reduced RTs to ingroup faces and if training to the outgroup reduced RTs to outgroup faces. See Figure 4 for effects of each training condition.

For the train to ingroup condition there was a marginal main effect of time, $F(1, 18) = 4.244, p = .054$, indicating that participants were marginally faster at post versus pre-training. There was also a marginal time by group interaction, $F(1, 18) = 2.947, p = .103$. Follow-up t -tests show that participants became marginally faster to outgroup faces from pre to post-training, $t(18) = 2.224, p = .039$. No other follow-up comparisons were significant. No other main effects or interactions were significant (p 's $> .706$). Participants trained to the ingroup actually became marginally faster to the outgroup at post-training.

For the train to outgroup condition there was a marginal main effect of group, $F(1, 18) = 3.514, p = .084$, revealing that participants were marginally faster to the ingroup compared to outgroup. No other main effects or interactions were significant (p 's $> .403$). Neither training attention to the ingroup nor outgroup reduced RT to the appropriate group.

Post-training effects considering pre-training bias. A hierarchical multiple regression analysis was conducted as outlined in the analysis plan. The step one model was significant, $R^2 = .135, F(1, 31) = 4.836, p = .035$, indicating training condition was

related to post-training bias. However, this was in the opposite direction as predicted, such that individuals in the train to ingroup condition held an attention bias to outgroup faces post training. Furthermore, the addition of the pre-training attention bias variable at step two did not account for a significant proportion of variance, $\Delta R^2 = .000$, $\Delta F(1, 30) = .013$, $p = .911$, nor did the interaction term of condition by pre-train attention bias at step three, $\Delta R^2 = .003$, $\Delta F(1, 29) = .113$, $p = .739$. Unlike the results we report for Study 1, effects of training did not depend on the degree of pre-training attention bias to either the ingroup or the outgroup.

Discussion

This study failed to successfully train attention to minimal ingroup or outgroup members. Participants' RTs did not decrease from pre- to post-training for their trained group. In fact, in the train to ingroup condition, participants became marginally faster to outgroup faces from pre- to post-training. Training actually decreased RT to the opposite faces than intended. It is unclear why training attention would have the opposite effect than intended. It is possible that this is due to the change in task contingencies between training and post-training trials. During training, the dot appeared 94.44% of the time behind ingroup faces; however in post-training trials, this reverted to 50% of the time behind ingroup or outgroup faces. Therefore, it is possible that participants become faster to outgroup faces in the train ingroup condition, because these outgroup faces are relatively more predictive of where the dot will appear during post-training compared to the training trials. However, future studies should seek to replicate this finding. Additionally, considering pre-training bias did not reveal a more comprehensible pattern.

Overall, it is clear that training attention to group members was not successful. It may not be possible to train attention to group members, because group membership is a different type of stimulus than emotional expressions.

In addition, this study provides some evidence that neutral expressions of ingroup members are attended to more than outgroup members. This is consistent with numerous studies demonstrating minimal ingroups are attended to more than minimal outgroups with methodologies ranging from face processing to eye-tracking and ERP studies (Young & Hugenberg, 2007; van Bavel et al., 2008; Kawakami et al., 2014; Ratner & Amodio, 2013). However, this finding is in contrast to the one other study examining attention to minimal groups using the dot-probe methodology (Maner & Miller, 2013). That study found greater attention to outgroup members who were rated as more threatening. However, in this study, while outgroup faces were generally rated as more threatening than ingroup faces, there was no relationship between attention biases and threat ratings. Because training attention to minimal groups was not successful, the next study examines whether attention and mimicry to minimal groups follows the same pattern.

Study 4

Method

Participants. One hundred and forty one undergraduate students at the University of Denver were recruited to participate for credit in psychology classes. With an N of 141 and given the power of .80, a power analysis informs that I could detect an effect size as big as Cohen's $f = .118$. Data from 15 participants were excluded; 5 participants incorrectly reported the group membership of other individuals and 10 participants had less than 93% accuracy on the dot-probe trials across pre and post-training (7.4% to 22.2% inaccurate trials).

Stimuli. All stimuli are the same as the previous studies.

Design. For attention, the design consisted of three within-subject factors. The within-subject factors were group membership (ingroup, outgroup), stimulus expression (angry, happy, neutral), and presentation time (100ms, 500ms). For mimicry, the design consisted of three within-subject factors. The within-subject factors were group membership (ingroup, outgroup), stimulus expression (angry, happy, neutral), and muscle (corrugator, zygomaticus).

Procedure. Participants completed the minimal groups manipulation and group membership learning paradigms described in study 3. Next, participants completed the subjective rating questions on Qualtrics. Then participants completed a dot-probe task to assess untrained attention allocation to minimal ingroup and outgroup members. Next,

participants observed the photos of the minimal ingroup and outgroup members while electromyography (EMG) was recorded to measure mimicry behavior. Finally, participants completed the subjective rating questions a second time.

Minimal group manipulation / learning paradigm. This is the same as study 3.

Untrained attention allocation. The structure of the dot-probe trials is the same as study 3. However, in addition to trials where faces were presented for 500ms, there were trials where faces were presented for 100ms. There were four blocks of 54 trials each. Emotion expression and presentation times of 500ms or 100ms were randomized within each block. There were 108 trials for each presentation time (same as study 3).

Mimicry session. Participants were asked to report their numerical estimation style at the start of the mimicry session. Then participants were asked to report the numerical estimation style of the six individuals they learned about earlier. Participants were required to repeat this until they achieved 100% accuracy reporting on the individuals' estimation style. Participants then viewed each individual (three ingroup, three outgroup) displaying happy, angry and neutral expressions. First a fixation cross was presented for 500ms. Then, faces were presented for three seconds with an inter-trial interval of either 5000ms or 7000ms, randomly chosen for each trial. Each face was repeated six times in a randomized order. There were a total of 108 trials. Participants were told to closely watch the faces and to remember whether each individual was an overestimator or underestimator. Participants were asked to report the numerical estimation style of each individual once after viewing that individual in this session. These reporting screens appeared after the faces disappeared from the screen and

appeared randomly interspersed throughout the viewing session, so participants did not know when to expect to report on numerical estimation style.

Measures

All other measures were the same as study 3.

EMG recording and processing. EMG recorded muscle activity over the *corrugator supercilii* (knits brow) and *zygomaticus major* (raises corners of mouth). Standard EMG site preparation and electrode placement procedures were followed (Dimberg, Thunberg, & Elmehed, 2000; Moody & McIntosh, 2011). Before electrode placement, skin was cleansed with rubbing alcohol and gently abraded with NuPrep Gel®. Electrodes were 4 mm Ag-AgCl, cup style electrodes and were placed approximately 1.25 cm apart center-to-center, roughly parallel to the length of the muscle. Activity over each muscle was continuously recorded using BioPac MP150 at a sampling rate of 2000 Hz with a 10 Hz to 500 Hz band pass filter and a 60 Hz notch filter.

To analyze EMG, each continuous file was visually inspected for noise and artifacts. EMG data was then used to calculate responses to the stimuli. The pre-stimulus baseline window was the 500ms before stimulus onset. The response analyzed was the activity from stimulus onset to 3000ms after stimulus onset. These data were smoothed and rectified, and the integral under the curve was calculated. The integral values were standardized within participant and muscle so meaningful comparisons could be made across muscles and participants. Next the pre-stimulus activity was subtracted from the stimulus activity to measure the change in activity caused by viewing each facial stimulus

(i.e., to calculate the change from baseline). Each participant's mean level of activity for each muscle (corrugator and zygomaticus) was calculated.

Results

Minimal Groups Manipulation Check. A subjective impression composite variable was created as in study 3 for time 1 (ingroup $\alpha = .824$, outgroup $\alpha = .813$) and time 2 (ingroup $\alpha = .898$, outgroup $\alpha = .883$). To explore the influence of the minimal groups manipulation, *t*-tests were conducted to compare ratings of individuals belonging to the ingroup versus the outgroup. At time 1 (immediately after learning about the groups), participants rated the ingroup more favorably than the outgroup on the subjective impression composite variable, $t(125) = -2.660$, $p = .009$, and reported feeling closer (on the IOS scale) to the ingroup compared to the outgroup, $t(125) = 3.324$, $p = .001$. At time 2 (immediately after completing the mimicry session), participants rated the ingroup more favorably than the outgroup on the subjective impression composite variable, $t(125) = -2.440$, $p = .016$ and, reported feeling closer to the ingroup compared to the outgroup, $t(125) = 3.381$, $p = .001$. There were no effects for threat at either time point (p 's $> .104$).

Reaction Time Data Reduction. As in all previous studies, trials with incorrect responses were removed (2.26%). Participant accuracy ranged from 93.5% to 100%. Trials with RTs greater than 2000ms were also excluded from analyses (0.24% of trials with correct responses). Trials with RTs 3 standard deviations (calculated separately for each condition) above each participant's mean were also excluded from analyses (0.39% of remaining trials).

Untrained Attention Bias to Minimal Groups. To test for an untrained attentional bias to minimal ingroup versus outgroup members for the different emotional expressions of angry, happy, or neutral faces at different presentation times, I conducted a group (ingroup, outgroup) by emotion (angry, happy, neutral) by presentation time (100ms, 500ms) ANOVA. There was a main effect of emotion, $F(2, 246) = 6.219, p = .002$, such that participants were faster to neutral versus angry, $t(123) = 3.241, p = .002$, and neutral versus happy faces, $t(123) = 2.408, p = .018$. There was also a main effect of presentation time, $F(1, 123) = 31.764, p < .001$, such that participants were faster to respond to probes that appeared behind faces that were presented for 500ms versus 100ms. There was also a marginal emotion by presentation time interaction, $F(2, 246) = 2.481, p = .086$. To break apart this interaction, follow-up *t*-tests indicated that for presentation times of 500ms, participants were significantly faster to neutral versus angry, $t(123) = 3.843, p < .001$, and neutral versus happy, $t(123) = 2.594, p = .011$, faces. There were no other differences between emotions at 500ms ($p > .344$) and no comparisons at 100ms reached significance ($p > .474$). There were no main effects or interactions with group (p 's $> .366$). Therefore, in contrast to study 3, there was no evidence of an attention bias to ingroup or outgroup faces in study 4.

Mimicry. I define mimicry as a significant difference between corrugator and zygomaticus activity that matches the observed expression. Or in the case of group differences in muscle activity, greater muscle activity to one group versus the other group that matches the observed expression. I will also report incongruent emotional reactions (i.e. a significant difference between corrugator and zygomaticus activity that does not

match the observed expression. I conducted a group membership (ingroup, outgroup) by emotion (happy, angry, neutral) by muscle (corrugator, zygomaticus) repeated measures ANOVA. There was a main effect of muscle, $F(1, 126) = 7.185, p = .008$, with overall more corrugator than zygomaticus activation. A significant emotion by muscle interaction, $F(2, 252) = 3.626, p = .028$, demonstrated that muscles responded distinctly to different stimuli. Consistent with facial mimicry, follow-up t -tests show that there was marginally more corrugator activation to angry versus happy faces, $t(129) = 1.962, p = .052$. However, there was not greater zygomaticus activation to happy versus angry faces $t(128) = -.728, p = .468$.

There was a marginal group by emotion by muscle 3-way interaction, $F(2, 252) = 2.342, p = .098$. As planned, I examined responses to expressions separately in order to examine the effect of each expression on the appropriate muscle. See Figure 5 for means.

Responses to angry expressions. I conducted a group membership (ingroup, outgroup) by muscle (corrugator, zygomaticus) repeated measures ANOVA on responses to angry expressions. There was a main effect of muscle, $F(1, 126) = 8.182, p = .005$, indicating greater corrugator than zygomaticus activation. There was no main effect or interactions with group (p 's $> .769$). This indicates mimicry of angry expressions that does not differ by group membership.

Responses to happy expressions. I conducted a group membership (ingroup, outgroup) by muscle (corrugator, zygomaticus) repeated measures ANOVA on responses to happy expressions. There was group by muscle interaction, $F(1, 126) = 7.696, p = .006$. This interaction was characterized by more zygomaticus activation to ingroup

versus outgroup expressions, $t(128) = 2.705, p = .008$, with no difference in corrugator activation between groups, $t(129) = -.266, p = .791$. This is indicative of relatively greater happy mimicry to the ingroup, but not the outgroup. Another way of reporting this interaction reveals more corrugator than zygomaticus activation in response to the outgroup face, $t(127) = 2.471, p = .015$, but no significant difference between the muscles in response to the ingroup face, $t(126) = -.707, p = .481$. This is indicative of an incongruent response to outgroup happy expressions.

Responses to neutral expressions. I conducted a group membership (ingroup, outgroup) by muscle (corrugator, zygomaticus) repeated measures ANOVA on responses to neutral faces. There was a main effect of muscle, $F(1, 126) = 8.182, p = .002$, indicating greater corrugator than zygomaticus activation. There was no main effect or interactions with group (p 's $> .110$).

Mimicry to happy expressions considering attention biases. Because responses to happy expressions were different for the ingroup versus outgroup, and because of an a priori prediction that holding different attention biases might influence mimicry behavior, I explored how an ingroup versus outgroup attention bias might be associated with different patterns of happy mimicry. First, I present how attention biases at 100ms were associated with different patterns of happy mimicry, then I present attention biases at 500ms.

Attention Bias at 100ms. For presentation time of 100ms, there were 65 participants with an ingroup attention bias and 74 participants with an outgroup attention bias. I selected individuals with an attention bias to ingroup faces at 100ms and

conducted a group (ingroup, outgroup) by muscle (corrugator, zygomaticus) ANOVA on responses to happy expressions. None of the main effects were significant (p 's > .168). As in the group overall, there was a group by muscle interaction, $F(1, 59) = 4.069, p = .048$. To break apart this interaction, follow up t -tests indicate that there was greater zygomaticus activation to ingroup versus outgroup faces, $t(59) = 2.089, p = .041$, but no difference in corrugator activation. This is indicative of greater happy mimicry to ingroup happy expressions. None of the other differences were significant (p 's > .077). See Figure 6 for means.

Then I selected individuals with an attention bias to outgroup faces at 100ms and conducted a group (ingroup, outgroup) by muscle (corrugator, zygomaticus) ANOVA on responses to happy expressions. None of the main effects were significant (p 's > .300). Again, there was also a group by muscle interaction, $F(1, 64) = 4.683, p = .034$. In contrast to the above findings, follow-up t -tests indicate neither zygomaticus nor corrugator activation differed in response to ingroup or outgroup faces (p 's > .157). However, there was greater corrugator versus zygomaticus activation to the outgroup happy expressions, $t(65) = 2.157, p = .035$, but not to ingroup happy expressions ($p = .888$). This demonstrates an incongruent emotional reaction to outgroup happy expressions. Notably, there is only happy mimicry of the ingroup for those individuals who have an ingroup attention bias, but a lack of happy mimicry and incongruent emotional responses for those individuals who have an outgroup attention bias.

Attention Bias at 500ms. For presentation time of 500ms, there were 67 participants with an ingroup attention bias and 72 participants with an outgroup attention

bias. I selected individuals with an attention bias to ingroup faces at 500ms and conducted a group (ingroup, outgroup) by muscle (corrugator, zygomaticus) ANOVA on responses to happy expressions. None of the main effects were significant (p 's > .285). As in the group overall, there was a group by muscle interaction, $F(1, 61) = 4.069$, $p = .048$. To break apart this interaction, follow up t -tests indicate that there was marginally greater zygomaticus activation to ingroup versus outgroup faces, $t(61) = 1.954$, $p = .055$, and marginally greater corrugator versus zygomaticus activity to outgroup faces, $t(62) = 1.884$, $p = .064$. This is indicative of greater happy mimicry to ingroup happy expressions and a marginal incongruent reaction to outgroup happiness. None of the other differences were significant (p 's > .447).

Then I selected individuals with an attention bias to outgroup faces at 500ms and conducted a group (ingroup, outgroup) by muscle (corrugator, zygomaticus) ANOVA on responses to happy expressions. None of the main effects were significant (p 's > .280). Again, there was also a group by muscle interaction, $F(1, 62) = 5.118$, $p = .027$. In contrast to the above findings, follow-up t -tests indicate neither zygomaticus nor corrugator activation differed in response to ingroup or outgroup faces (p 's > .120). However, there was greater corrugator versus zygomaticus activation to the outgroup happy expressions, $t(62) = 2.082$, $p = .041$, but not to ingroup happy expressions ($p = .980$). This demonstrates an incongruent emotional reaction to outgroup happy expressions. Notably, there is only happy mimicry of the ingroup for those individuals who have an ingroup attention bias and some incongruent reactions to outgroup

happiness, but a lack of happy mimicry and incongruent emotional responses for those individuals who have an outgroup attention bias.

Discussion

This study found no attention biases to the angry, happy or neutral expressions of minimal ingroups or outgroups at either 100ms or 500ms. Participants did mimic the angry expressions of both the ingroup and outgroup, but this mimicry did not differ between groups. Participants demonstrated corrugator activity in response to neutral expressions of both the ingroup and outgroup. This may indicate negative affect during the experiment, or this could reflect the fact that neutral faces may be interpreted as negative expressions (Yoon & Zinbarg, 2008) and therefore elicit corrugator activation. Finally, participants mimicked ingroup happy expressions, but frowned at outgroup happy expressions. Importantly, individuals who showed an ingroup attention bias demonstrated mimicry of ingroup happy expressions, whereas individuals who showed an outgroup attention bias demonstrated the incongruent reaction of frowning to outgroup happy expressions. This suggests that there may be individual differences in how minimal groups are interpreted and this influences attention and mimicry behavior.

General Discussion

The overarching goal of this project was to study the influence of minimal groups on attention and mimicry behavior. In addition, this project also successfully replicated some previous attention training studies and extended previous findings by showing that attention was successfully manipulated to neutral faces depending on the degree of attention bias pre-training. In contrast, attention training to minimal groups was not successful and there was no reliable evidence of an attentional bias to minimal groups. Minimal group membership influenced happy, but not angry mimicry; ingroup happy expressions were mimicked, while outgroup happy expressions elicited a significant frowning response. However, this mimicry response to ingroup happy expressions was strongest in those participants who showed an ingroup attention bias. While an incongruent frowning response to outgroup happiness was strongest in those participants who showed an outgroup attention bias. Attention and mimicry follow the same pattern to the ingroup. This pattern of results is most consistent with the pre-existing rapport model.

Training Attention to Emotional Faces

Study 1 replicated previous research by successfully training attention to neutral faces. In contrast, in study 2, training attention to emotional (angry or happy) faces was not successful even when the pre-training attention biases were taken into consideration. The results from study 1 suggests that successful attention training is likely influenced by the pre-existing, untrained attention bias held by participants. In study 1 post-training

attention bias scores was dependent on the degree of bias at pre-training. Attention was only trained away from a pre-existing bias (change the attention bias from anger to neutral). However, in study 2, I was unable to train attention to angry or happy faces, even when considering the attention biases held pre-training. Future research should seek to determine whether it is more difficult to train attention to emotional faces and whether the degree that pre-training biases influence success of attention training is only influential for training attention to neutral faces or whether it can be influential when attention is successfully trained to emotion faces.

Other research has suggested that a pre-existing attention bias is important; one study successfully trained attention toward neutral faces by only enrolling children with an attention bias toward threat (Eldar et al., 2012). Additionally, a recent meta-analysis found that pre-training attention bias was a significant factor for attention training studies (Mogoase, David, & Koster, 2014). However, this meta-analysis only estimated preexistent attention biases by contrasting an experimental group with a control group. Many attention training studies do not measure pre-training attention biases. Researchers may assume that enrolling individuals with a clinical diagnosis of anxiety or an elevated anxiety level is sufficient indication that these individuals hold a threat attention bias. However, while a threat-related attention bias is reliably observed in anxious individuals as a group-mean effect, approximately one-half of clinically anxious individuals do not show an attention bias toward threat (Bar-Haim et al., 2007). In addition, some research suggests that attention biases do not correlate with anxiety (Kappenman, Farrens, Luck, Hajcak, & Proudfit, 2014). Future research should strongly consider the impact of

preexisting attention biases on the success of attention training paradigms. Perhaps the requirement of a pre-existing attention bias can explain some unsuccessful attempts at attention training (Julian, Beard, Schmidt, Powers & Smits, 2012; Boettcher, Berger, & Renneberg, 2012) and the existence of a publication bias (see Mogoase et al., 2014).

Additionally, the fact that attention training was successful to neutral faces, but not emotional faces supports the idea that it may be easier to train attention to neutral versus emotional faces, especially threatening faces. This could be because clinical individuals are more likely to hold an attention bias to threat (MacLeod et al., 1986) and therefore it is easier to train away from this bias. Or it could be that emotional stimuli, especially emotional faces, are more likely to capture attention than neutral stimuli, even for non-clinical individuals (Vuilleumier & Brosch, 2009). Angry faces, in particular, seem especially likely to capture attention (Calvo, Avero & Lundqvist, 2006). Therefore, it may be especially difficult to enhance an attention bias to angry faces. In fact, I only know of one study that has successfully trained attention to angry faces (Eldar et al., 2008), whereas other studies have been able to train attention to non-facial threat stimuli such as threatening words (e.g. Browning, Holmes, Murphy, Goodwin, & Harmer, 2009; Harris & Menzies, 1998; MacLeod et al., 2002). Future studies should investigate how the emotional properties of the stimulus influence the effectiveness of attention training.

Training Attention to Minimal Groups

Training attention to minimal groups was not successful. In fact, individuals in the train to ingroup condition actually became marginally faster to outgroup faces from pre to post training; but most importantly they did not become faster to ingroup faces. In the

train to outgroup condition, individuals were marginally faster to the ingroup throughout pre and post-training. In contrast to training to neutral faces where considering stronger pre-existing angry biases made training effects stronger, pre-existing ingroup or outgroup attention biases did not influence results. It is unclear why training attention to minimal groups might have had the opposite effect than intended. Future work should determine if this effect will replicate. It is also unclear why training to social groups failed. It is possible that attention to social groups is less flexible than attention to neutral faces. Or that there are stronger pre-existing biases to neutral compared to emotional and social faces and it is therefore easier to manipulate emotional biases in the opposite direction.

There could be something in how individuals attend differentially to neutral faces that makes it possible to train attention to neutral faces and not possible to train to emotional faces or social groups. To clarify whether it is something special about neutral faces, future research could attempt to train attention to other non-emotional stimuli, such as shapes of different colors or train to neutral faces with specific identities, but without group membership. These studies would clarify if attention training is possible without emotion or if attention training for some reason requires emotional stimuli. Future research should also investigate other methods of attempting to manipulate attention, such as a visual search training, which is another methodology that has been used to manipulate attention to emotional stimuli (e.g. Dandeneau & Baldwin, 2004, 2009).

Untrained Attention to Minimal Groups

There was no reliable evidence for an attention bias to minimal ingroups or outgroups. In study 3, participants demonstrated a marginal attention bias to neutral

ingroup faces, but no attention bias to happy or angry faces. However, in study 4 there was no evidence for any attention bias to ingroup or outgroup faces at 100ms or 500ms for angry, happy, or neutral expressions, despite being well-powered to detect these effects.

In studies 3 and 4 there were no overall attentional biases to minimal ingroups or outgroups; therefore the mechanisms of threat or novelty cannot be ruled out as driving mechanisms for attentional biases to groups. If there were an overall attention bias to minimal groups, then this would rule out the novelty mechanism, because minimal groups are newly created and participants never see ingroup faces more frequently than outgroup faces (i.e. both ingroup and outgroup faces are equally novel). In neither study 3 nor 4 were threat ratings of minimal outgroup members related to attention biases. This is in contrast to the one other dot-probe study on attention biases to minimal groups (Maner & Miller, 2013). There were two primary differences between that study and this one. First, the other study created minimal groups based on ostensible personality type. This may be a stronger type of minimal group manipulation as personality type is probably more meaningful than numerical estimation style. Second, the nature of ratings differed; that study had participants rate how characteristic the personality trait of dangerous was for the minimal in- and outgroup. Whereas, we had participants rate how threatening they thought each individual was in the minimal in- and outgroup. It could be that the difference in questions, type of minimal group, or even rating individuals versus traits characteristic of the group changed the relationship between explicit threat ratings and attention biases.

While explicit ratings of threat were not related to attention biases, it is still possible that participants' implicit threat-associations with the outgroup could be related to an outgroup attention bias. In fact, the mimicry findings for participants with an outgroup attention bias provide support for this interpretation. Participants with an outgroup attention bias expressed facial reactions consistent with a threat interpretation of outgroup faces; they frowned to outgroup happy expressions. These findings will be discussed in more detail below, but they provide some evidence that when participants behave in a way consistent with a threat interpretation they show an outgroup attention bias. This provides some support that threat may be an important mechanism driving group attention biases.

A considerable amount of research suggests that there should be greater attention to minimal ingroup versus outgroup members. However, there was no overwhelming support for this attention bias in this project. The majority of this other research supporting an ingroup attention bias uses different measures of attention (e.g. eye-tracking, Kawakami et al., 2014, or facial processing, Young & Hugenberg, 2010; van Bavel & Cunningham, 2012) that focuses on aspects of face processing. While there is evidence that facial processing is related to attention (e.g. van Bavel & Cunningham, 2012), face processing and the dot-probe seem to measure different aspects of attention. Attention theorists have proposed that attentional processes are multi-componential and that these processes are independent, yet cooperate and work closely together (Posner & Boies, 1971). The dot-probe paradigm measures selective attention, or orienting, and also disengaging attention from one stimulus and shifting it to another stimulus (Posner &

Peterson, 1990), while these other measures of attention related to face processing may tap executive attention processes (Raz & Buhle, 2006). Future research could investigate how these different aspects of attention are related to one another and related to group differences in attention.

It is possible that we failed to find an attention bias to minimal groups, because there were not enough perceptual differences between minimal ingroup and outgroup faces for reliable attention biases to become apparent using the dot probe paradigm. Anecdotally, most participants were not aware that there was always one ingroup and one outgroup face on the screen during the group attention studies; whereas participants were more likely to report noticing that there were different emotions on the screen during the emotion training studies. Additionally, most of the research on group differences in attention biases have examined racial groups, which have much more distinct visual properties to distinguish between groups. The dot-probe studies measuring attention biases to minimal (Maner & Miller, 2013) and incidental groups (Brosch & van Bavel, 2012) used different colored backgrounds to distinguish between the two groups, therefore creating easily identifiable perceptual differences. However, the fact that differences in ingroup and outgroup attention biases strengthened the group differences in mimicry indicates that there are meaningful differences in the attention biases we measured without using different background colors to distinguish between minimal groups.

Mimicry of Minimal Groups

Study 4 provides evidence for differential mimicry of happy expressions of minimal ingroup and outgroup members; participants mimicked the happy expressions of minimal ingroup members, while they frowned at the happy expressions of minimal outgroup members. There were no differential mimicry effects for angry or neutral expressions; participants displayed corrugator activation to both angry and neutral expressions of both ingroup and outgroup members. The pattern of findings for minimal groups is most similar to mimicry patterns of the pre-existing rapport tenet of the affiliation model that finds enhanced mimicry of happy expressions, and equal mimicry of angry expressions. See Table 1 for an overview of facial mimicry findings for different types of groups and expressions.

Participants' mimicry of happy expressions signals a desire to affiliate with ingroup members and increase bonding and feelings of closeness. However, this affiliation signal to the ingroup seems to be most true for those individuals who also show an attention bias to the ingroup. Participants might signal a desire to disaffiliate with the outgroup by not matching the happy expression, but instead frown to outgroup happy expressions. By expressing incongruent emotional reactions like envy of outgroup member's happiness, participants express a desire for social distance. Previous research has not reported incongruent reactions to happy expressions. This may be because not all previous research has reported results in a way that captures incongruent reactions. However, incongruent emotional reactions have been reported in interdependent groups; there is evidence of slight happy expressions in response to outgroup's anger (Likowski

et al., 2011; Seibt et al., 2013). It is possible that incongruent reactions seen to outgroup happy expressions are due to a competitive-like response to the outgroup. This incongruent reaction, however, only exists for those individuals who demonstrate an attention bias to the outgroup.

There appear to be differences in attention biases that correspond with differences in mimicry behavior to minimal groups that might reveal differences in how individuals interpret minimal groups. Approximately half of participants both attend to and mimic the happy expressions of the ingroup; this might suggest that participants are focusing on the motivational relevance/affiliation aspect of the minimal ingroup. However, the other half of participants both attend to the outgroup and express incongruent reactions to happy outgroup faces; this might suggest that these participants are instead focusing on the threat value of the outgroup. These findings hint that threat may indeed be a mechanism that can drive attention to the outgroup, but that pre-existing rapport/motivational relevance may drive ingroup attention. In addition, threat or competition may drive incongruent reactions (e.g. happy expressions in response to competitor's angry expressions). Emotional facial responses may be driven by separate motivations; matching behavior may be driven by affiliation, while incongruent emotional facial reactions may be driven by a threat or competition interpretation.

There was mimicry of angry expressions; however this mimicry did not differ between in- and outgroups. One account of mimicry suggests that anger expressions should not be mimicked at all because anger signals antagonism and threat (Hess, Blairy & Kleck, 2000; Knutson, 1996) and people should only mimic emotional signals that are

interpreted to promote affiliation goals (Hess & Fischer, 2013). However, previous research has found greater mimicry of ingroup angry expressions for both incidental and socially consequential groups (Bourgeois & Hess, 2008; Carr et al., 2014; van der Schalk et al., 2011). Previous research may have found differential mimicry of angry expressions because the group distinctions for both incidental and socially consequential groups are more meaningful than minimal group distinctions and therefore these group distinctions influence mimicry of anger expressions. Perhaps because the signal value of minimal groups is relatively minor, but the signal value of an anger expression is relatively strong, participants react with a negative reaction to the anger expression and this overrides any potential minimal group differences in reactions that might exist.

It is possible that the corrugator activation seen in response to both ingroup and outgroup anger and neutral expressions is not mimicry, but rather a negative reaction evoked by an unpleasant stimulus (see Hess & Fischer, 2013), as corrugator activation has been used as a measure of negative affect (Lang, Greenwald, Bradley, & Hamm, 1993; Larsen, Norris, & Cacioppo, 2003). However, although the current research shows that the ingroup is rated higher on subjective impression measures and other research has shown more positive implicit attitudes to the ingroup (Ashburn-Nardo et al., 2001), these attitudes towards the minimal groups do not seem to drive mimicry to angry or neutral faces. If attitude specifically influenced facial reactions, there should have been greater corrugator to outgroup versus ingroup faces and greater zygomaticus to ingroup versus outgroup faces overall, particularly for neutral faces.

Facial reactions to neutral expressions are difficult to interpret. First of all, the concept of a neutral faces is a problematic one. There may be corrugator activation to neutral expressions because these expressions may have been interpreted negatively and therefore elicited corrugator activity (Yoon & Zinbarg, 2008). It is also possible that participants were in a negative mood state during the experiment and therefore expressed negative affect to angry or neutral expressions. However, although it is not possible to determine why exactly there is equal corrugator activation to minimal in- and outgroups, these findings underline that it is important to consider both how the type of expression and type of group influence mimicry behavior.

Patterns of Attention and Mimicry in Minimal Groups

In this study, attention and mimicry to minimal groups follows the same pattern. Participants with an attention bias to minimal ingroup faces mimic the happy expressions of minimal ingroup members, while participants with an attention bias to minimal outgroup faces did not match the ingroup, but displayed a frowning reaction to the happy expressions of the outgroup.

These findings rule out the threat model of potential results that predicted increased mimicry of the ingroup, but an outgroup attention bias. There is no evidence for this pattern of results – that attention and mimicry follow opposite patterns. There is also not convincing evidence in support of the goal to affiliate model that predicted mimicry and attention would follow the same pattern of enhancement to the outgroup. While some participants showed an outgroup attention bias, there is no evidence for enhanced mimicry to the outgroup, even in those who have an outgroup attention bias. Attention to

the outgroup, in this case, does not produce increased matching behavior, but rather incongruent emotional facial reactions.

In conclusion, overall these results are consistent with the pre-existing rapport model. Individuals mimic the ingroup more, specifically for happy expressions. It may be that the goal to affiliate mechanism (enhanced matching to strangers or outgroups) only drives behavior when there are no group boundaries or when, for example, the need to belong has been directly manipulated (e.g. Lakin, Chartrand, & Arkin 2008; Over & Carpenter, 2009). Overall, attention and mimicry do follow the same pattern. Therefore, it could be reasonable to expect that attention may play a mechanistic role for mimicry of ingroup members. Future work will need test for a causal role of attention in matching behavior by manipulating attention using different methods.

Implications for Studies of Intergroup Relations

To my knowledge, most studies on minimal groups have not asked participants to rate subjective impressions of individual group members. Studies typically measure whether a personality trait is characteristic of a group (e.g. Maner & Miller, 2013; Perdue, Dovidio, Gurtman, & Tyler, 1990; Cadinu & Rothbart, 1996) or have participants make spontaneous trait inferences (e.g. Otten & Moskowitz, 2000), rather than having participants report personal feelings towards and opinions of individual group members. In both studies 3 and 4, participants reported feeling closer to individual ingroup members compared to individual outgroup members using the inclusion-of-other-in-self scale. This is consistent with previous research that has suggested that a self-ingroup connection drives findings of ingroup favoritism in minimal groups (Smith & Henry,

1996). In addition, the differential patterns of mimicry findings for in- and outgroup attention biases suggests there may be individual differences in how minimal groups are perceived (see also Maner & Miller, 2012). Future research should explore what characteristics of individuals predicts whether they will focus on the affiliative-value of the ingroup or the threat-value of the outgroup.

Broader Implications for Society

Broadly, these findings provide evidence that even groups that differ from one another in inconsequential ways may suffer from an intergroup bias that influences matching behavior and subjective impressions of individual group members. In addition, individual differences in attention biases are related to different types of matching behavior. Matching behavior has real-world consequences, such as facilitating interpersonal interactions and increasing feelings of closeness and bonding (Hatfield et al., 1992; Lakin et al., 2003, van Baaren et al., 2004). Therefore, even trivial outgroups may suffer from reduced mimicry which could lead to poorer interpersonal interactions and reduced feelings of closeness with individual outgroup members. This could create a feedback loop that perpetuates and exacerbates differences between groups. In addition, those individuals who feel be threatened, even by trivial outgroups, seem especially likely to behave in a competitive manner toward outgroup individuals. Whereas, other individuals may be especially likely to favor the ingroup and therefore neglect the outgroup.

There are many times in everyday life that groups are created. Short-term, sometimes semi-competitive groups, can be formed in work-place trainings or as part of

classroom exercises. These seemingly meaningless groups may have more influence than expected. Forming these groups is likely to strengthen social bonds for individuals within the group, but could have deleterious effects between groups. Therefore, it is important to be aware of the implications when forming groups.

In addition, attention bias interventions to change attention biases to social groups seem to be ineffective. Other intergroup bias interventions should be considered such as the re-categorization of different groups into one common in-group; this may be a more effective way of reducing intergroup bias (e.g. Dovidio, Gaertner, Isen, & Lowrance, 1995; Gaertner, Dovidio, & Bachman). In such trainings, former outgroup members become fellow ingroup members within the created super-group and therefore receive benefits awarded to ingroup members. Forming superordinate groups may be a more effective way of changing behavior to outgroups, such as mimicry and subjective impressions, rather than attention training manipulations.

Limitations

As most of these studies were conducted exclusively with undergraduate students in psychology classes, the results may not generalize to the population as a whole. But as the processes under investigation (attention and mimicry) are assumed to be relatively basic psychological processes, theoretically they should operate in a similar way across the entire population.

The dot-probe paradigm was used across four studies to measure and train attention to emotional faces and social groups. Although the dot-probe paradigm is a widely used tool, it has been criticized for unreliability (Schmukle, 2005; Kappenman et

al., 2014). However, study 1 replicated and extended previous research on training attention to neutral faces. Because training attention to neutral faces was successful, our failure to train attention to emotional faces or minimal groups is not solely due to properties of the dot-probe paradigm. In addition, although there was no overall attention bias to minimal groups, ingroup and outgroup attention biases were corresponded with different patterns of mimicry behavior, so the attention biases measured in this study seem to be related to actual behavior.

Measuring emotional facial expressions with EMG allows for the recording of subtle muscle movements that cannot be perceived by the naked eye (Tassinari & Cacioppo, 1992). These emotional reactions are thought to be automatic (Dimberg et al., 2000) and cannot be suppressed (Dimberg, Thunberg & Grunedal, 2002). However, emotional facial reactions as measured by EMG can be influenced by a number of different processes such as mood (Moody, McIntosh, Mann, & Weisser, 2007) and mental effort (Waterink & Van Boxtel, 1994). While it is not possible to completely rule out the impact of these other processes, especially on responses to angry faces, responses to happy ingroup faces can be explained by an affiliative reaction to ingroup members' smiles and not purely by mood or a positive affective reaction to ingroup members overall. It is specifically ingroup membership plus smiling displays that elicit smiling responses in observers. Therefore, both group membership and expression type matter in producing mimicry behavior.

Conclusions

Pre-existing attention biases may be an important factor influencing successful training of attention to neutral faces. Attention training to social groups may not be possible. While there is no evidence for overall attention biases to minimal groups, ingroup and outgroup attention biases may reveal individual differences in how minimal groups are implicitly interpreted. These attentional biases may strengthen emotional facial reactions to minimal groups. Overall, attention and mimicry seem to follow the same pattern to the ingroup, which is largely consistent with the pre-existing rapport model. Future research should examine other ways to manipulate attention to social groups and whether attention can play a mechanistic role for mimicry to ingroups. Future research should also address other methods of increasing matching behavior to outgroups in order to extend the beneficial social purposes that matching behavior serves to outgroup members.

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Appendix

Table 1

Summary of Mimicry Findings of Different Expressions to Different Groups

	Happy	Anger	Sadness	Fear
Socially	in = out ^{1, 2, 3}	in > out ^{1, 2, 3}	-	-
Consequential				
Interdependent	in > out ^{4, 5, 6}	Ø ^{4, 5, 6} , * ^{4, 5}	in > out ^{4, 5, 6}	-
Incidental	in = out ^{7, 8}	in > out ⁸ , Ø ⁷	in > out ⁷	in > out ⁸
Minimal	in > out ⁹ , * ⁹	in = out ⁹	-	-

Note. The Ø represents that no mimicry to the expression was observed. The * represents there were incongruent emotional reactions to the expression. The – represents that there are no data for the cell. ¹Carr et al., 2014, ²Bourgeois & Hess, 2008, study 1, ³van der Schalk et al., 2011, study 2, ⁴Likowski et al., 2011, ⁵Seibt et al., 2013, ⁶Weyers et al., 2009, ⁷Bourgeois & Hess, 2008, study 2, ⁸van der Schalk et al., 2011, study 1, ⁹the present study



Figure 1. Reaction times to angry vs. neutral faces for training to neutral in Study 1. Error bars are ± 1 standard error of the mean

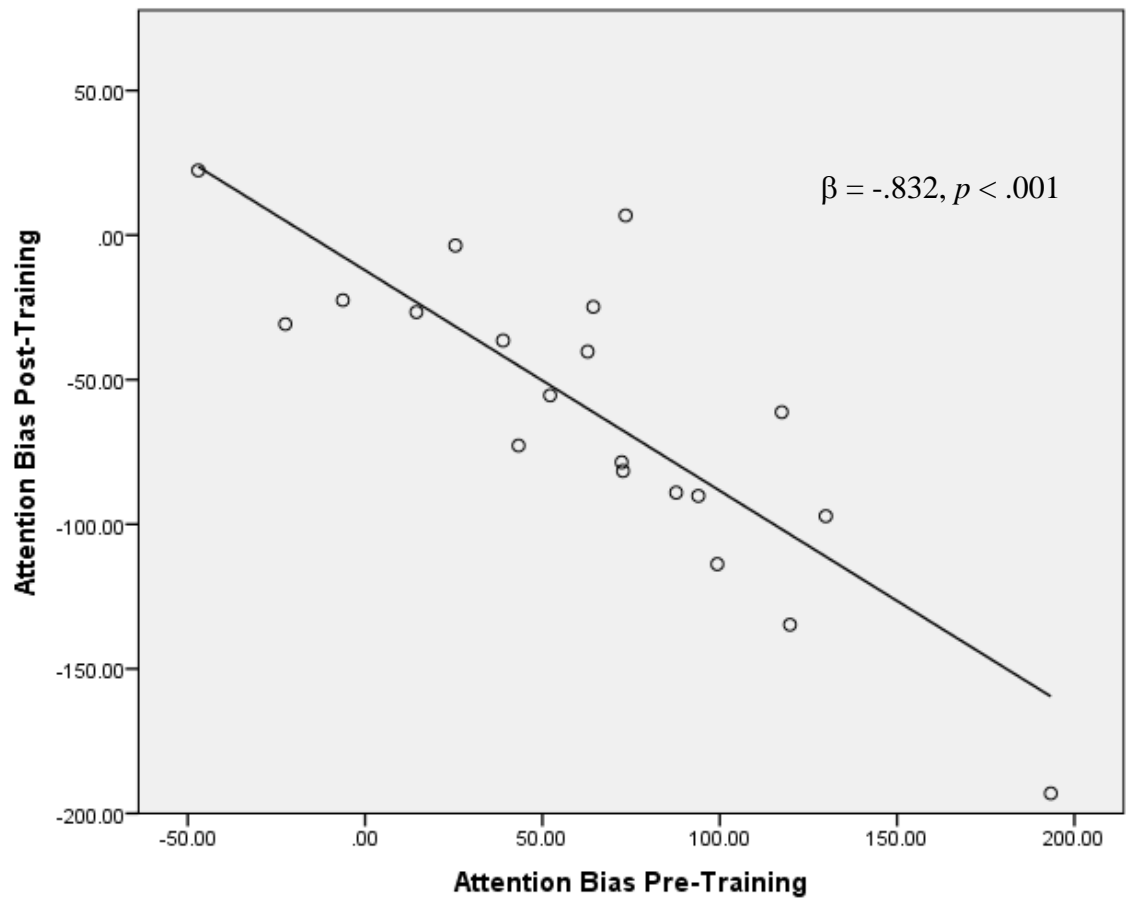


Figure 2. Relationship between pre-training attention bias and post-training attention bias in Study 1. The stronger the attention bias to angry faces at pre-training, the stronger the attention bias to neutral faces at post-training.

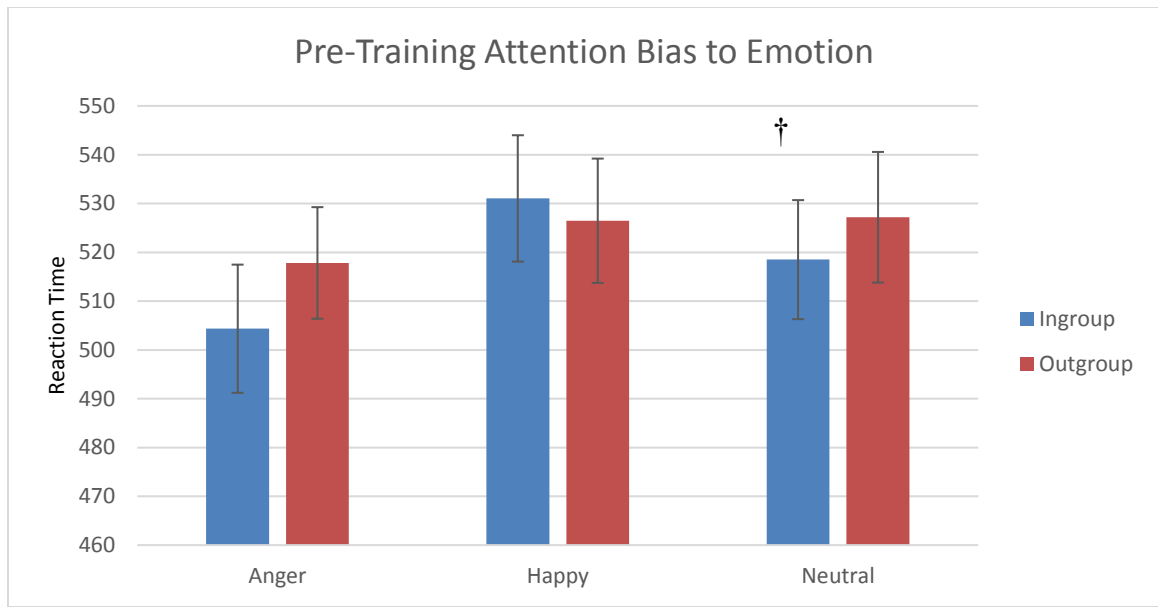


Figure 3. Pre-training attention bias to emotional faces of minimal group members for Study 3. Error bars are ± 1 standard error of the mean.

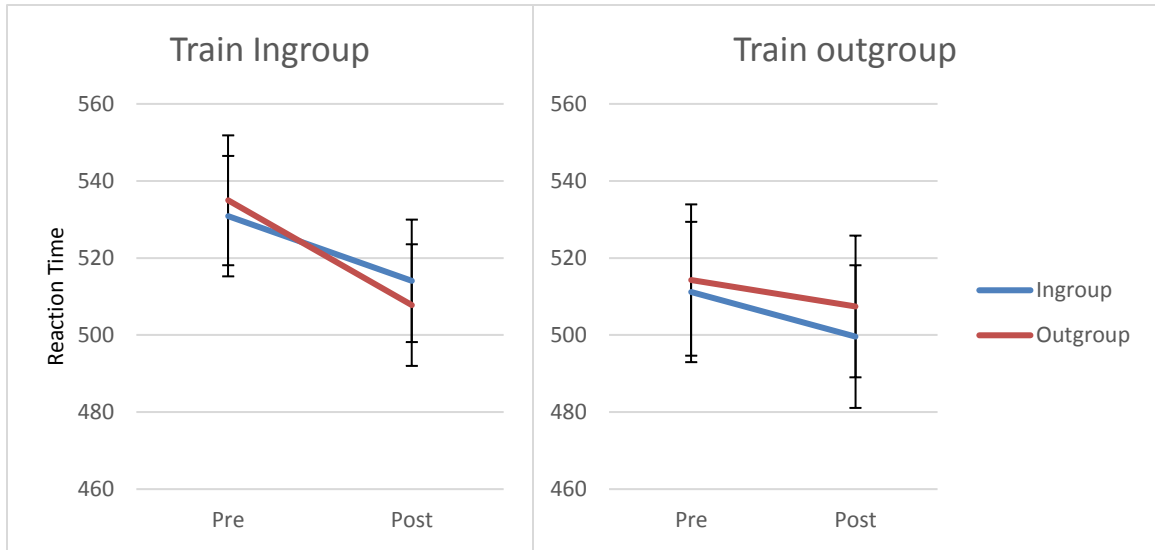


Figure 4. Reaction times to ingroup vs. outgroup faces by training condition in Study 3. Error bars are ± 1 standard error of the mean.

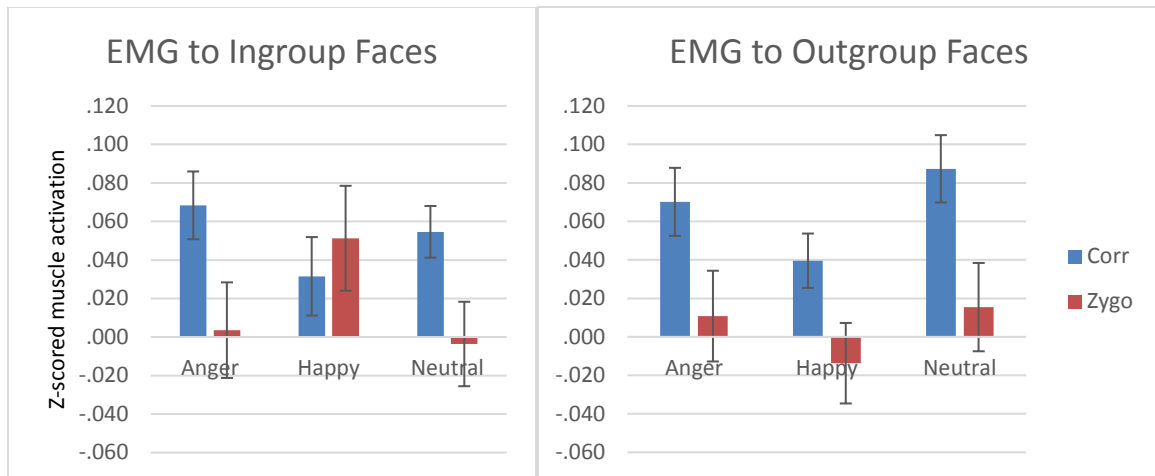


Figure 5. EMG activation to ingroup and outgroup emotional faces in Study 4. Error bars are ± 1 standard error of the mean.

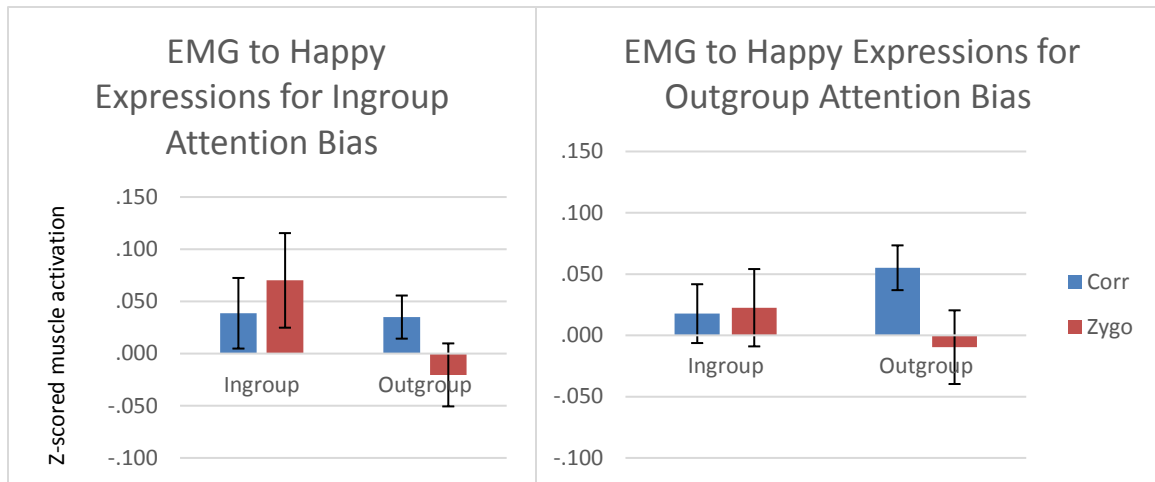


Figure 6. EMG activation to happy expressions for individuals with an ingroup or outgroup attention bias at 100ms in Study 4. Error bars are ± 1 standard error of the mean.