Examining the Effect of Exposure to Nature on Attention During Racial Categorization

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Person perception denotes a cognitive process during which individuals organize and interpret information characteristic of other people. Human faces are a key factor in identifying and collecting information from an individual. Social categorization is the first step in the person perception process. It represents a quick and effortless process that quickly obtains information based on perceptual features, and it helps to reduce the complexity of information taken (Zarate, Smith, 1990; Fiske, 1999). Consequently, even though this process is advantageous in increasing the speed of information processing, it has the negative consequences of activating stereotypes, such as those based on age, race, or gender (Butler, Ward, Downing, Ramsey; 2018), which in turn can cause prejudice (Blumer 1958a). Therefore, perceivers are susceptible to seeing others not as individuals, but as representatives of the social categories that were derived during categorization. (Bodenhausen, Macrae, Sherman, 1999; Fiske, 1998; Wheeler, Petty, 1983).

The stereotype content model (Fiske, 2002) suggests what are some common cultural stereotypes for Black and White males and females. Stereotypes create expectations of how members of a social category ought to behave. Black males, for example, are viewed as more dangerous than White males due to the stereotype that Black males are hostile and aggressive. This behavior would include being vulgar in language and rude. In contrast, social perceivers would find White males to be more trustworthy than Black males since they are being perceived as less dangerous. They would be expected to act formal, and more polite than Black males. With regards to gender, men are perceived to be more qualified for jobs than females. According to the model, women are seen as more valuable as a stay at home wife than as a worker. Perceivers also see women as shyer and meeker than men (Fiske, 2002).

Research in the area demonstrates that more prejudiced people are more likely to activate social stereotypes when perceiving others (Devine,1989). Even though the activation of stereotypes is automatic, individuals can inhibit the degree to which activated stereotypes shape behavior towards members of social outgroups. Devine and colleagues (1989) have demonstrated that high prejudice subjects are less likely to inhibit stereotypical thinking. On the other hand, low prejudice subjects are more likely to effortfully inhibit the automatically activated stereotype, and are therefore able to respond behaviorally without prejudice. The research shows that prejudice does not need to be a consequence of social categorization. It is feasible to inhibit stereotyping by controlling how one responds to stereotype activation. Prejudice is the byproduct of stereotype activation, and it can become a precursor to discrimination, unless stereotypical thinking is actively inhibited (Devine 1989).

Role of Attention in Social Cognition

An important facet of social categorization is attention. Attention denotes the extent to which one is vigilant of his or her surrounding environment. Paying attention allows one to stay vigilant in different environments. It allows one to keep caution of the environment and others (Fan, McCandliss, Fossella, Flombaum, Posner, 2002; Jonides, 1981). In addition, it allows one to quickly obtain information automatically from salient features of objects, people, or situations. Attention can be both involuntary and voluntary. Involuntary attention is an automatic response where attention is captured by interesting objects. Voluntary attention, on the other hand, is a cognitive control process that is directed willfully, often to suppress the influence of distracting information. Research shows that attention can be influenced by the type of environment one is in. For example, nature and urban environments have been shown to impact attention differently. Urban environments include dirty scenery and loud noises. These stimuli forcibly grab one’s attention, making involuntary attentional processes more dominant. Inversely, Nature environments softly evoke attention, which includes the sounds of bird chirping or the swaying of trees, and therefore are not as taxing on one’s voluntary attention. This is vital as voluntary attention is a limited resource, and can cause fatigue due to overuse. An example is trying to pay attention to a lecture. One may try to pay attention, yet if voluntary attention is depleted, focus on the lecture will greatly decrease (Kaplan, 1995). According to Attention Restoration Theory (ART) (Kaplan, 1995, 2009), exposure to nature and nature-like stimuli restores voluntary attention and reduces the impact of fatigue on attention.

In a test of ART Berman and colleagues (2008) used the Attention Network Task (ANT), also called the Eriksen Flanker Task, to examine the effects of nature and urban environments on information processing. The ANT assesses executive control (Posner, Petersen; 1990). Executive control involves several complex processes that assist in goal-directed behavior and cognitive abilities like impulse inhibition. The researchers wanted to observe whether nature stimuli can positively affect focus and complete multiple tasks efficiently. They exposed participants to nature stimuli via a predetermined hike around a park and tracked participants with GPS. Within the ANT, participants were tasked to indicate what direction a centrally presented arrow is pointing to (left or right). The central stimulus was flanked by distracting stimuli, which were also arrows. Participants were instructed to ignore these stimuli. Incongruent trials are those during which the flankers point in the opposite direction, relative to the central stimulus. Congruent trials are those where the flankers point in the same direction as the central stimulus.

Berman and colleagues (2008) discovered that participants were slower to respond and less accurate if the flanking stimuli were incongruent with the central stimulus, and they were faster and more likely to be correct when the central and flanking arrows are congruent with each other. After being immersed in nature, participants were more accurate and had a shorter latency on trials with incongruent arrow stimuli. In contrast, urban walks caused participants to have decreased directed-attention abilities. This was indicated by decreased accuracy and higher latency on incongruent arrow stimuli trials. Overall, Berman and colleagues found that after a nature walk, participants had a faster latency and were more accurate on incongruent trials. This revealed that nature had a significant impact on directed-attention abilities.

The Eriksen Flanker Task has also been successfully used in the study of social cognition. Dickter and Bartholow (2007) were interested in investigating differences in directed attention after the activation of both race and gender stereotypes. They adapted the ANT, and used faces rather than arrows. Therefore, the participants' task was to identify the gender of the centrally presented face, while it was flanked by other faces. Dickter and Bartholow manipulated both the race and gender of the targets and the flankers. The design of the experiment prioritized the identification of gender with race as an irrelevant dimension. The flanking stimuli yielded four conditions: Compatible Race Compatible Gender, Incompatible Race Compatible Gender, Compatible Race Incompatible Gender, Incompatible Race Incompatible Gender. They measured participants' accuracy and latency. The results revealed that participants were fastest and most accurate on Compatible Race Compatible Gender trials.

The current study tested whether directed attention following exposure to nature-like stimuli was improved during social categorization. Specifically, we manipulated whether participants were exposed to nature or urban stimuli. Subsequently they completed an Eriksen Flanker task where they categorized faces along a gender dimension (Male vs. Female). The target and flanker faces varied along a race dimension (Black vs. White) and a gender dimension (Male vs. Female). Participants were instructed to categorize the gender of the target stimulus while ignoring race. Our aim was to test whether improvements in directed attention following exposure to nature will improve participants' ability to suppress the attention to the task-irrelevant categorization dimension (i.e. Race). For the purpose, we recorded response accuracy and reaction time data. We expected that, following exposure to nature, participants would be faster and more accurate on Compatible Gender Compatible Race, and Compatible Gender Incompatible Race trials, relative to Incompatible Gender Compatible Race and Incompatible Gender Incompatible Race trials.

Methods

Participants

Data was collected from N= 201 participants. All participants were 18 or older. Participants were compensated with $3 for their time and data. In addition, this study was conducted in accordance with ethical principles that have been established by the

Human Research Committee at Hampden-Sydney College.

Materials

The Flanker categorization task consisted of three blocks with 40 trials each. During each trial participants categorized a centrally presented target face along a gender dimension (Male vs. Female). Target faces were flanked by other faces that varied along a race dimension (Black vs. White) and a gender dimension (Male vs. Female). We only used emotionally neutral faces, all of which were obtained from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015) and have been chosen to have the same or similar age and attractiveness ratings. Four kinds of faces were selected from the Database; White Male and Female, and Black Male and Female. Each block was interspersed with 12 images of either nature or urban stimuli. The type of environment (Nature vs. Urban) was manipulated between subjects, where half of the subjects were in each of the two conditions. These images were the same ones used in the Berman and colleagues' study (2008). Participants were instructed to focus on the task relevant gender dimension and ignore the task irrelevant race dimension. In both the Nature and Urban conditions, participants were instructed to look at each picture (Nature vs. Urban) for 7 seconds. Afterwards, they are instructed to answer how much they liked the image on a scale ranging from 1 (Don't Like At All) to 5 (Like Very Much). After these 12 trials, the participants continued to the next block of 40 trials of the face categorization task.

Procedure

After obtaining informed consent from the participants, they completed the Flanker Task

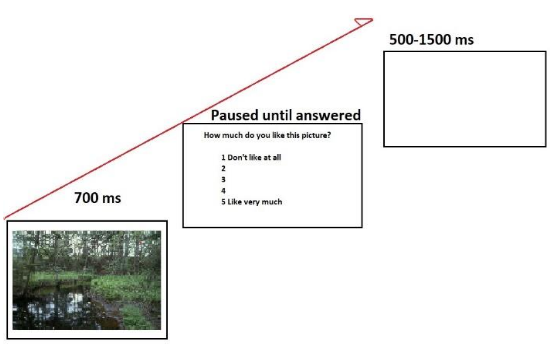

Figure 1. *Schematic representation of the nature exposure trials*

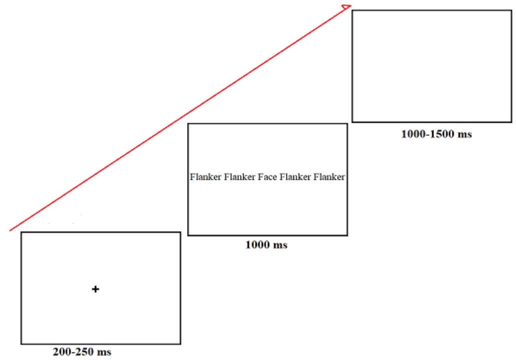

Figure 2. *Schematic representation of the categorization task trials*

individually. Finally, they were briefly debriefed with an ending slide and thanked for their participation.

Results

Analytic Approach

Both reaction time and accuracy data were subjected to a 4 (Flanker Compatibility: CGCR, CGIR, IGCR, IGIR) x 2(Target gender: Male and Female) x 2(Target Race: Black and White) repeated measures ANOVA with type of environment (Nature vs. Urban) as a between subjects factor.

Reaction Time Data Analysis

The data produced a significant main effect for target race, $F_{(1,\ 202)}$=737.80, p=0.00, η^2 = .79, such that participants were significantly faster when responding

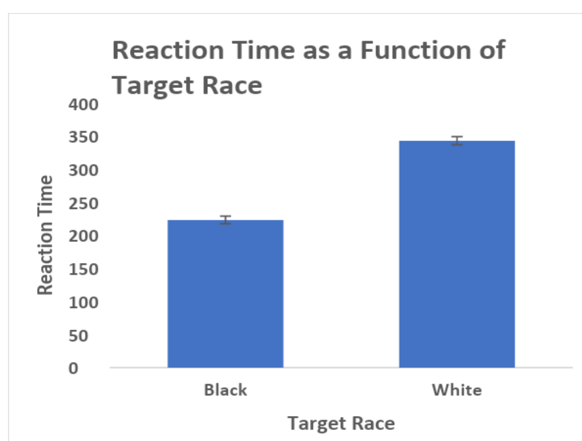

Figure 3. *Participants were significantly faster on trials where the centrally presented target was Black, relative to trials with White targets.*

to Black target faces (M=238.34. SE=5.71) than White target faces (M=343.2, SE=6.11). The data however produced no significant main effect for compatibility with reaction time data. Refer to Figure 3 for graphic representation of these results.

The data also produced a significant main effect for Target Gender, $F_{(1,202)}$=647.245, p=0.00, η^2 = .762, such that participants were significantly faster when responding to Female target faces (M=217.307, SE=6.2) than Male target faces (M=349.22, SE= 5.95). Refer to Figure 4 for graphic representation of these results.

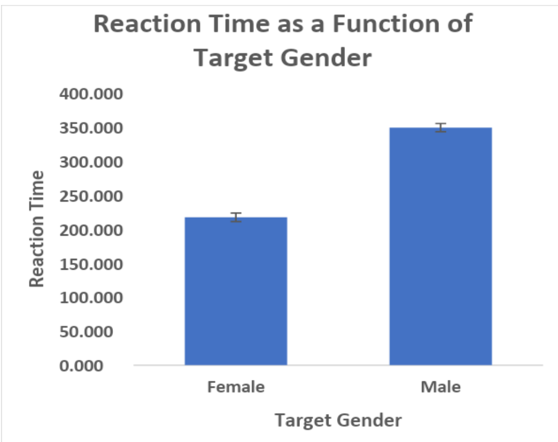

***Figure 4**. Participants were significantly faster on trials where the centrally presented target was Female trials relative to Male trials.*

The data produced a significant interaction between Target Gender and Target Race, $F_{(1,\ 202)}$= 607.5, p=.000, η^2 = .750. Participants were fastest when responding to Black Female (M=95.6, SE=8.22) target faces, relative to the remaining conditions: Black Male (M=351.123, SE=6.34), White Female (M=339.1, SE=6.93), White Male (M=347.325, SE=6.024). Refer to Figure 53for graphic representation of these results.

The data did not reveal any significant interactions between the type of environment (Nature vs. urban) and the other independent variables in the experiment. Below you can see a summary of the significance testing:

Target race and type of environment- $F_{(1,\ 202)}$=.581, p=.447, η^2 = .003.
Target Gender and type of environment - $F_{(1,\ 202)}$= .094, p=.759, η^2 =.000.
Compatibility, $F_{(3,\ 606)}$= 2.7, p=0.154, η^2 = .013.
Compatibility and type of environment- $F_{(3,\ 606)}$= 1.2, p=.1212, η^2 = .006.
Target Race and Target Gender with type of environment- $F_{(1,\ 202)}$= .073, p=.788, η^2 = .000.

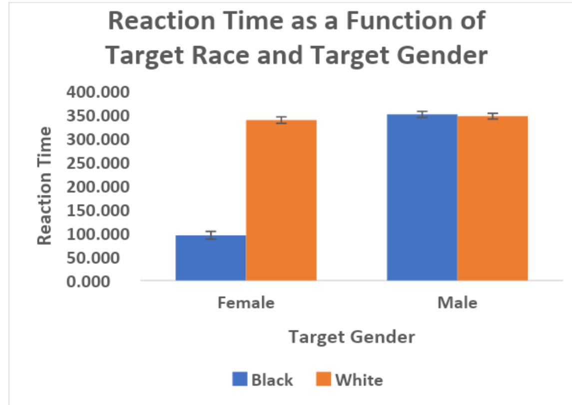

***Figure 5**. Participants were significantly faster when the centrally presented target was Black Female faces relative to Black Male, White Male, and White Female target faces.

Target Gender and Compatibility- $F_{(3,\ 606)}$= 3.120, p=.16, η^2 = .015.
Target Race and Compatibility- $F_{(3,\ 606)}$= 2.07, p=.463, η^2 = .01.
Target Race and Compatibility with type of environment- $F_{(3,\ 606)}$= .957, p=.16, η^2 = .005.
Target Gender and Compatibility with type of environment- $F_{(3,\ 606)}$= .349, p=2.91, η^2 = .002.
Target Gender, Target Race, and Compatibility- $F_{(3,\ 606)}$= 3.261, p=.14, η^2 = .016.
Target Gender, Target Race, and Compatibility with type of environment, $F_{(3,\ 606)}$= .033, p=3.83, η^2 = .000.

Accuracy Data Analysis

The data produced a significant main effect for Target Race, $F_{(1,\ 203)}$=116.63, p=0.00, η^2 = .365, such that participants were significantly more accurate on Black target face (M=3.885, SE=.035) relative to White targets (M=3.443, SE=.039). Refer to Figure 6 for a graphic representation of these results.

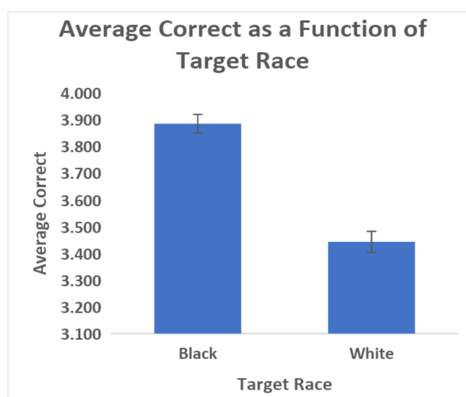

***Figure 6**. Participants were significantly more accurate when the centrally presented target was Black relative to White target trials.

The data produced a significant main effect for Target Gender, $F_{(1,\ 203)}$=3652.5, *p*=0.00, η^2 = .947, such that participants were significantly more accurate on Male target faces (*M*=5.2, *SE*=.044) than Female target faces (*M*=2.14, *SE*= .036). Refer to Figure 7 for graphic representation of these results.

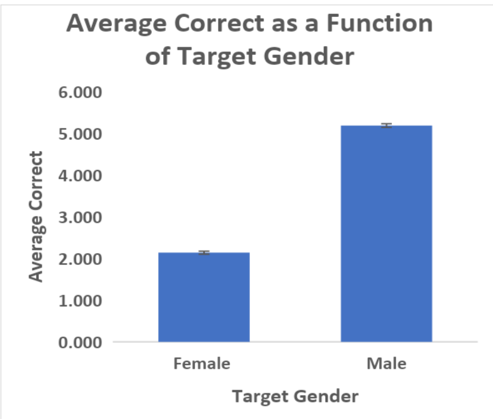

Figure 7. *Participants were significantly more accurate when the centrally presented stimulus was Male relative to Female trials.*

The data produced a significant main effect for Compatibility, $F_{(3,\ 609)}$=490.8, *p*=0.00, η^2 = .707, such that participants were significantly more accurate on Compatible Race Incompatible Gender trials(*M*=4.6, *SE*= .040) than Compatible Race Compatible Gender (*M*=3.9, *SE*=.074), Incompatible Race Compatible Gender (*M*=3.8, *SE*=.040) and Incompatible Race Incompatible Gender trials (*M*=2.332, *SE*=.027). Refer to Figure 8 for graphic representation of these results.

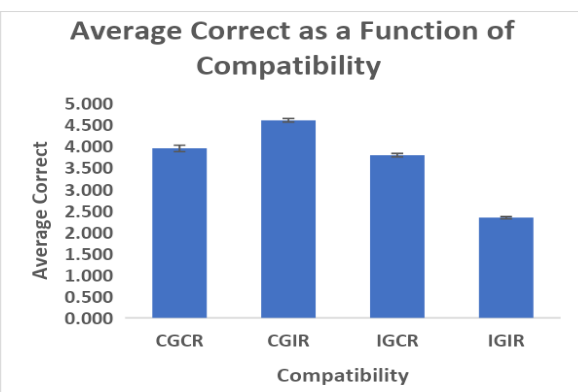

Figure 8. *Participants were significantly more accurate when the centrally presented stimulus was Compatible Race Incompatible Gender relative to other compatibility trials.*

The data produced a significant interaction between Target Gender and Target Race, $F_{(1,\ 203)}$= 6054.4, *p*=.000, η^2 = .968. Participants were significantly more accurate on Black Male target faces (*M*=7.4, *SE*=.07) relative to Black Female (*M*=.384, *SE*=.040), White Female (*M*=4, *SE*=.055), and White Male target faces (*M*=2, *SE*=.034). Refer to Figure 9 for graphic representation of these results.

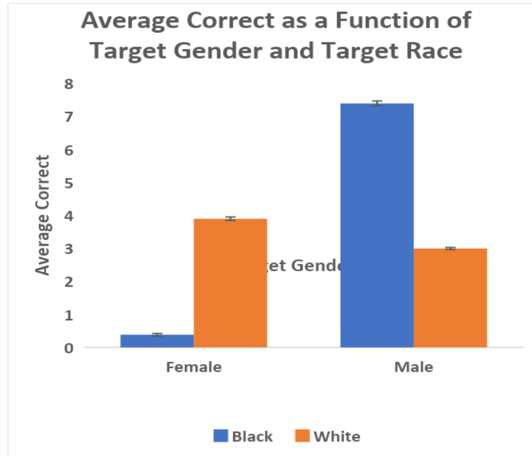

Figure 9. *Participants were significantly more accurate when the centrally presented stimulus was Black Male, relative to trials with White Male, Black Female, and White Female.*

The data produced a significant interaction between Target Gender and Compatibility, $F_{(3,\ 609)}$= 465, *p*=.000, η^2 = .7. Participants were more accurate on Male Compatible Race Compatible Gender trials (*M*=6.005, *SE*=.072) than Male Compatible Race Incompatible Gender (*M*=6.002, *SE*=.059), Male Incompatible Race Compatible Gender (M=5.76, SE=.071), Male Incompatible Race Incompatible Gender (*M*=3, *SE*=.040), Female Compatible Race Compatible Gender (*M*=2, *SE*=.100), Female Compatible Race Incompatible Gender (*M*=3.2,

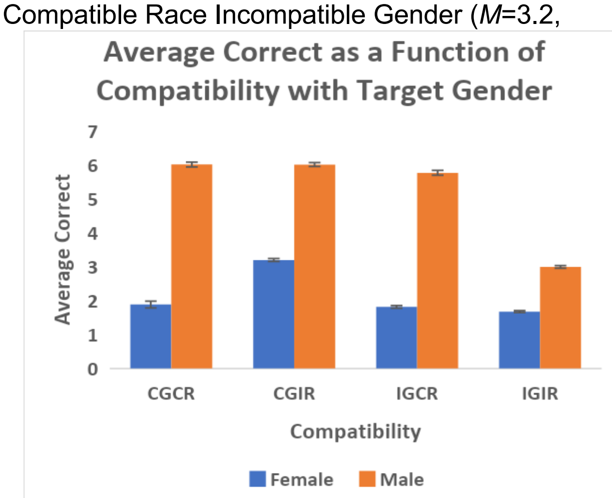

Figure 10. *Participants were significantly more accurate when the centrally presented stimulus was Male Compatible Race Compatible Gender, relative to other Male and Female compatible trials.*

SE=.043), Female Incompatible Race Compatible Gender (*M*=1.81, *SE*=.040), and Female Incompatible Race Incompatible Gender trials (*M*=1.7, *SE*=.031). Refer to Figure 10for graphic representation of these results.

The data produced significant interactions between Target Race and Compatibility, $F_{(3,\ 609)}$= 258.5, *p*=.000, η^2 = .560. Participants were significantly more accurate on Black Compatible Race Incompatible Gender trials (*M*=4.8, *SE*=.054) than Black Compatible Race Compatible Gender (*M*=4.62, *SE*=.06), Black Incompatible Race Compatible Gender (*M*=4.53, *SE*=.058), Black Incompatible Race Incompatible Gender (*M*=1.624, *SE*=.03), White Compatible Race Compatible Gender (*M*=3.3, *SE*=.13), White Compatible Race Incompatible Gender (*M*=4.424, *SE*=.05), White Incompatible Race Compatible Gender (*M*=3.044, *SE*=.04), and White Incompatible Race Incompatible Gender trials (*M*=3.04, *SE*=.041). Refer to Figure 11 for graphic representation of these results.

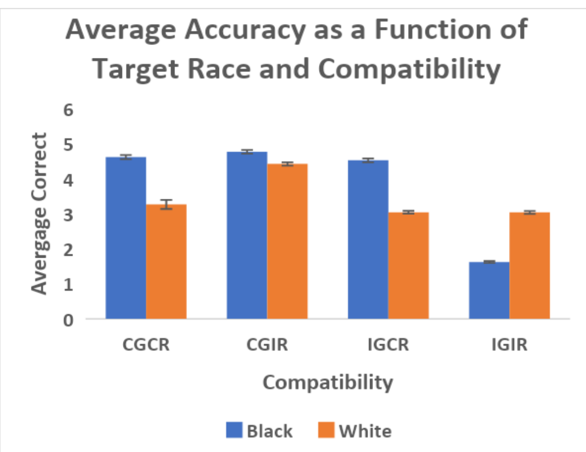

Figure 11. *Participants were significantly more accurate when the centrally presented stimulus was Black Compatible Race Incompatible Gender, relative to the other trials.*

The data produced significant interaction for target race, target gender, and compatibility, $F_{(3,\ 609)}$= 714.533, *p*= .000, η^2 = .779. Participants were more accurate on Black Male Incompatible Race Incompatible Gender targets (*M*= 353.5521, *SE*=8.5) relative to Black Male Compatible Race Compatible Gender (*M*=348.84, *SE*=7.6), Black Male Compatible Race Incompatible Gender (*M*=351.3, *SE*=7.8), Black Male Incompatible Race Compatible Gender (*M*=350.8, *SE*=7.53), Black Female Compatible Race Compatible Gender (*M*=94.45, *SE*=12.129), Black Female Compatible Race Incompatible Gender (M=110.202,SE=13.9), Black Female Incompatible Race Compatible Gender (*M*=114.14, *SE*=12.62), Black Female Incompatible Race Incompatible Gender (*M*=63.44, *SE*=11), White Female Compatible Race Compatible Gender (*M*=334.53, *SE*=8.318), White Female Compatible Race Incompatible Gender(*M*=39.65, *SE*=8.14), White Female Incompatible Race Compatible Gender (*M*=342.67, *SE*=8.1), White Female Incompatible Race Incompatible Gender (*M*=339.36, *SE*=7.853), White Male Compatible Race Compatible Gender (*M*=352.475, *SE*=7.85), White Male Compatible Race Incompatible Gender (*M*=343.642, *SE*=8.422), White Male Incompatible Race Compatible Gender (*M*=349.653, *SE*=7.853), and White Male Incompatible Race Incompatible Gender targets (*M*=343.53, *SE*=8.33). to Figure 12for graphic representation of these results.

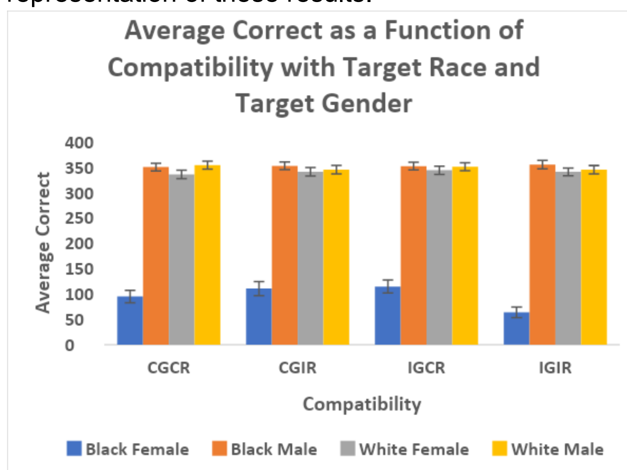

Figure 12. *Participants were significantly more accurate when the centrally presented stimulus was Black Male Incompatible Race Compatible Gender trials, relative to the other gender and condition trials.*

The data did not reveal any significant interactions between the type of environment (Nature vs. urban) and the other independent variables in the experiment. Below you can see a summary of the significance testing.

Target Race and type of environment- $F_{(1,\ 203)}$=.500, *p*=.480, η^2 = .002.

Target Gender and type of environment- $F_{(1,\ 203)}$= .416, *p*=.519, η^2 =.002.

Compatibility with type of environment- $F_{(3,\ 609)}$=.024, *p*=.381, η^2 = .000.

Target Gender and Target Race with compatibility- $F_{(3,\ 609)}$= .000, *p*=.987, η^2 = .000.

Target Race and Compatibility with type of environment- $F_{(3, 609)}$= .189, p=.320, η^2 = .001.
Target Gender and Compatibility with type of environment- $F_{(3, 609)}$= 1.17, p= .1241, η^2 = .006.
Target Gender, Target Race, and Compatibility with type of environment- $F_{(3, 609)}$= .789, p= 1.85, η^2 = .004.

Discussion

The primary aim of the experiment was to observe whether exposure to nature would increase directed attention capabilities. The response latency data indicated that participants had a faster reaction time and increased accuracy towards Incompatible Race Compatible Gender trials in response to nature exposure, relative to Compatible Race Compatible Gender, Compatible Race Incompatible Gender, and Incompatible Race Incompatible Gender trials. In trials with the centrally presented stimulus being Female faces, participants were significantly faster to respond relative to Male faces. In response to trials with the centrally presented stimulus being Black Female, participants were significantly faster relative to Black Male, White Female, and White Male face trials. In response accuracy data, participants that completed trials with the centrally presented stimuli being Black Male faces were significantly more accurate relative to White Male, Black Female, and White Female face trials. In trials where the centrally presented stimulus included target gender, participants were significantly more accurate on Male trials relative to Female trials. Participants were significantly more accurate when the centrally presented stimulus were Black faces, relative to White faces. As a function of compatibility, participants were significantly more accurate when the centrally presented stimuli were Compatible Race Incompatible Gender trials, relative to Compatible Race Compatible Gender, Incompatible Race Compatible Gender, and Incompatible Race Incompatible Gender trials. In addition, participants were significantly more accurate when the centrally presented stimulus was Male Compatible Race Compatible Gender, relative to other target gender and race compatibility trials. Similarly, participants were also significantly more accurate when the centrally presented stimulus was Black Compatible Race Incompatible Gender, relative to target race compatibility trials. Participants were also significantly more accurate when the centrally presented stimulus was Black Male Incompatible Race Compatible Gender trials, relative to the other target race and target gender compatibility trials.

The data aligns with previous research, where both latency and accuracy are similar to research involving the flanker task. Participants were slower to respond and less accurate if the flanking stimuli were incongruent with the central stimulus, seen with Black Female Incompatible Race Incompatible Gender trials, relative to the other trials. In addition, there was a significant effect on the conditions for the centrally presented stimulus that varied along a race and gender dimension. However, nature exposure did not have an effect on how participants completed the task.

Unfortunately, the data did not support our hypothesis. We failed to find evidence that the type of environment influenced directed attention during the social categorization task. No significant interactions between the type of environment (Nature vs. Urban) and the other independent variables were observed.

It was likely that the stimuli were presented too briefly (7 seconds). We replicated Berman and colleagues experiment by using the same stimuli, the frequency of stimuli, and the duration of the presentation. However, this may be not enough time to bring up the restorative benefits of nature on attention (Kaplan, 1995, 2009)). Future efforts in the field need to consider how to manipulate the environment immersion more effectively. For instance, rather than merely looking at pictures, participants can actually be sent on a nature walk before taking part in the experiment.

Potential limitations involving the stimuli may have stemmed from the lack of the nature walks seen in previous studies. Participants went on a walk with their path guided by GPS. Actual nature stimuli instead of those in the pictures may have a higher response towards affecting the cognition of individuals. Another potential effect may have been that the stimuli was not strong of a stimulus to affect social cognition, or that it may not even affect social cognition due to the different processes.

We also experienced some technical difficulties, which may have compromised data quality on some of the trials. Specifically, participants were starkly less accurate on trials with Black Female targets, relative to all other conditions (Refer to Figure 12). It is unclear what may have accounted for the compromised data quality on these trials.

To conclude, the present study did not reveal differences in directed attention during social categorization as a result of manipulating the type of environment. Inversely, the study did work in providing data that followed Dickter and Bartholow's study. This contains the result that participants have focused on the task irrelevant gender dimension. It remains an open question what can reduce racial bias, but more research can be done in regards to increasing the impact of nature stimuli.

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