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Multicultural Face Recognition Memory And Own-Race-Bias Among Adults With Acquired Brain Injury

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MULTICULTURAL FACE RECOGNITION MEMORY AND OWN-RACE-BIAS AMONG ADULTS WITH ACQUIRED BRAIN INJURY

by

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DEDICATION

I dedicate my dissertation to my parents, Phyllis Billings-Griffith and Jerone Griffith who have championed my educational pursuits as well as instilled the values of independence, benevolence, and purpose in all that I do. Your love lifts me up when the world weighs me down. I am so fortunate to have you as parents. To Dr. Debra Furr-Holden, for being one of my first inspirations. You are a trailblazer both in our family and in the communities that you serve. Thank you for showering me with your loving mentorship on the days when I couldn't see the light at the end of the tunnel. I am proud to forever be your "baby cousin." And finally, to Kortni Myers for being a constant a ray of sunshine on innumerable, gloomy Michigan days. Even in your absence, your light lives on in those that love you. Thank you for your friendship and happy memories I will always cherish. I miss you so very much.

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CHAPTER 1: INTRODUCTION

Acquired brain injury (ABI) is one of the leading causes of death and disability in the United States (Centers for Disease Control & Prevention, 2006; Jager, Weiss, Coben, & Pepe, 2000; Ma, Chan, & Carruthers, 2014) as it often leads to residual deficits requiring rehabilitation for activities of daily living (Demaerschalk, Hwang, & Leung, 2010; McGarry et al., 2002). Those with moderate to severe injuries may face long-term disabilities (Selassie et al., 2008), which often include impairments in cognitive processes such as memory, attention, processing speed, facial recognition and emotion processing. Additionally, sensory and motor disabilities (Thurman, Alverson, Dunn, Guerrero, & Sniezek, 1999), as well as an increased likelihood for psychopathology including mood and anxiety disorders, substance use disorders, and higher rates of suicide attempts (Corrigan, Selassie, & Orman, 2010; Pompili et al., 2012; Robinson, 2003) are common.

Facial Processing in ABI

Persons with ABI often have impaired understanding of facial information (Babbage et al., 2011; Biszak & Babbage, 2014; Bornhofen & Mcdonald, 2008; R. E. Green, Turner, & Thompson, 2004; Jackson & Moffat, 1987; Knox & Douglas, 2009; Milders, Fuchs, & Crawford, 2003). Although some specific deficits vary by the location and severity of the injury, various areas of the brain are associated with facial memory and emotion processing, such that heterogeneous injuries may have similar patterns of functional deficits. Right hemispheric injuries are most often associated with deficits in visual memory processing. Such regions include areas in the hippocampus (Ariza, Serra-Grabulosa, et al., 2006; Baxendale, 1997; Beauchamp et al., 2011; Bigler et al., 1996; Wilde et al., 2007) and right temporal lobes (Ariza, Pueyo, et al., 2006). Longitudinal studies of patients with ABI indicate that various brain structures may atrophy, including the hippocampus, amygdala, and globus pallidus, but that the hippocampus typically sustains the disproportionate damage relative to other brain structures. Despite these patterns, many brain injuries are diffuse and leave patients with both verbal and visual memory impairments. Thus, even if a primary injury was not to the hippocampal or other specified regions, ABI patients are likely to still suffer from memory deficits.

Due to their injuries, people with ABI perform below healthy adults on recognizing facial expressions (McMurray, 2001; Neumann, McDonald, West, Keiski, & Wang, 2016). Functional MRI studies of indicate that emotion perception involves a diffuse neural network that may be impaired following ABI, including structures in the limbic system, prefrontal cortex, parietal and occipital lobes, putamen, posterior cingulate, middle temporal gyri and the fusiform gyrus, and insula (Fusar-Poli, Placentino, Carletti, Landi, & Abbamonte, 2009; Neumann, Keiski, McDonald, & Wang, 2014; Neumann et al., 2016; Sabatinelli et al., 2011). As such, accuracy of identifying facial emotions is often compromised. Some facial expressions, however, are more recognizable than others. Negative emotional expressions such as angry, sad, and frightened faces are most often misidentified in ABI populations (Callahan, Ueda, Sakata, Plamondon, & Murai, 2011; Dethier, Blairy, Rosenberg, & McDonald, 2013; McDonald et al., 2011; McMurray, 2001; Rosenberg, McDonald, Dethier, Kessels, & Westbrook, 2014). People with ABI also have poorer recognition of neutral faces (Zupan & Neumann, 2014), whereas happy facial expressions are most accurately recognized by both healthy adults and persons with ABI (Zupan, Babbage, Neumann, & Willer, 2014).

These deficits in face processing could underlie miscommunication in a variety of settings for ABI patients (Bird & Parente, 2014; Milders et al., 2003) including in social interactions and with healthcare professionals. For family and other persons in the social network, communication deficits are among the most debilitating and burdensome consequences of ABI (Bornhofen & Mcdonald, 2008; Milders et al., 2003). ABI patients who have poor psychosocial interactions report more social isolation, lower life satisfaction (Stålnacke, 2007) and quality of life (Dan Hoofien, 2001), as well as poorer coping skills strategies (Tomberg, Toomela, Pulver, & Tikk, 2005). As such, risk for anxiety and depressive disorders is increased after ABI, and the prevalence of these disorders after ABI is high (Bombardier et al., 2010; E. Kim et al., 2007; Ponsford et al., 2016).

Social support is a known protective factor for a variety of physical and psychological disorders, including multiple sclerosis, spinal cord injury, muscular dystrophy, and type II diabetes (Frasure-Smith et al., 2000; Jensen et al., 2014; Wu et al., 2013). In these groups, social support decreases symptoms of depression and mortality rates (Frasure-Smith et al., 2000; Jensen et al., 2014; Wu et al., 2013). Therefore, individuals with ABI may have an increased likelihood of depressive symptoms due in part to deficiencies in face processing, which undermine their social support.

Racial Disparities in ABI Populations

Minority racial groups are at an even greater disadvantage in terms of post-ABI outcomes, as racial disparities are well documented in multiple domains. Generally speaking, minorities receive less information regarding the rationale for their treatments (Lin & Kressin, 2015), are less likely to be adequately treated for pain (C. R. Green et al., 2003), and are less likely to be referred to a specialist for treatment compared to whites (Manfredi, Kaiser, Matthews, & Johnson, 2010), even after accounting for relevant background factors. Minorities incur ABIs at higher rates (Benjamin et al., 2017; Bruns & Hauser, 2003), and they have higher mortality rates (Adekoya & White, 2002; Egede, Dismuke, & Echols, 2012; Yang et al., 2017) than whites. As such, minorities are more likely to have poorer outcomes during treatment, at discharge (Haider et al., 2007), and at long-term follow ups (Gary, Arango-Lasprilla, & Stevens, 2009; Sorani, Lee, Kim, Meeker, & Manley, 2009; Staudenmayer, Diaz-Arrastia, de Oliveira, Gentilello, & Shafi, 2007) compared to equivalently-injured whites. Minority patients are also more likely to experience negative interactions and discrepant care from their providers due to explicit and implicit biases. Common themes reported by marginalized patients include an overall lack of respect from their providers, improper diagnoses and treatment, and discrimination based on ethnicity, racial stereotypes, assumed socioeconomic status or educational attainment, and fluency in English (Nelson, 2002).

Black patients have uniquely negative outcomes following an ABI. For instance, compared to white and other minority groups, Black patients tend to have longer hospital stays (Sorani et al., 2009). Also, even after controlling for injury severity, Black patients continue to have worse clinical and functional outcomes at long-term follow up compared to equivalently-injured whites (Staudenmayer et al., 2007). Factors such as community integration, engagement in leisure activities, employment status and overall standards of living are lower in Black ABI patients, all of which are related to poor psychosocial outcomes (Arango-Lasprilla et al., 2012; Arango-Lasprilla, Ketchum, Gary, Kreutzer, et al., 2009; Arango et al., 2006; Gary et al., 2008; Perrin et al., 2014; Rosenthal et al., 1996; Sander, Pappadis, Davis, Clark, & Evans, 2009; Sherer et al., 2003; Staudenmayer et al., 2007). Likewise, Black ABI patients report greater symptoms of depression and report lower life satisfaction following their injury than other racial groups, independent of injury severity (Arango-Lasprilla, Ketchum, Gary, Hart, et al., 2009; Arango-Lasprilla et al., 2007; Perrin et al., 2014), and yet research indicates that Black and other minority patients are less likely to be treated for depression (Lagomasino, 2011; Simpson, 2007).

The reasons for these disparities are likely complex and multidimensional; however, a possible contributing factor may be related to differences in face processing which could underlie important psychosocial outcomes after ABI. It is especially important to understand these deficits in Black patients with ABI, because they are disproportionately vulnerable to adverse psychosocial outcomes. Research indicates that there is an *own-race-bias* (ORB) for facial information, such as recognition memory and emotion perception (Beaupré & Hess, 2006; Bell, 2008; Kilbride & Yarczower, 1983; Meissner & Brigham, 2001; Talley, 2001). Own-race bias (ORB) is an unconscious phenomenon in which individuals are better at recognizing and distinguishing face information from their own race than they are of other-race faces (Bothwell, Brigham, & Malpass, 1989; Malpass & Kravitz, 1969; Meissner & Brigham, 2001). ORB is a robust finding in a variety of fields, including various domains of psychology, sports (Schroffel & Magee, 2012) and the justice system (Brigham & Ready, 1985; Wylie, Bergt, Haby, Brank, & Bornstein, 2015). Implicit racial biases are well documented in the medical field (FitzGerald & Hurst, 2017). As such, the own-race-bias effect may be a double-edged sword in rehabilitation and hospital settings for Black and other minority patients. In most medical settings, Black patients are more likely to have health care providers from people outside of their race (Deville et al., 2015; Guglielmi, 2018; US Department of Health Human Services, 2017); in these dynamics the own-race bias effect may increase the likelihood of nonverbal doctor-patient miscommunication. For example, due to the combined effect of diminished face processing and own-race bias, Black ABI patients may misperceive feedback from their providers regarding their illness which may result in lower motivation and poorer adherence to medical intervention. ORB could also lead to non-Black providers to fail to recognize Black ABI patient’s individuality or mistake them for a different patient. Non-Black physicians may also misinterpret Black ABI patients’ expressive affect, which is likely already diminished due to their injury. Physicians' misperceptions of their Black ABI patients affect may subsequently lead to increased misdiagnoses and inadequate care for psychological or physiological problems in this vulnerable group. For the patient, these slights and misunderstandings are likely to be experienced as microaggressions (Cruz, Rodriguez, & Mastropaolo, 2019), which can have additional deleterious impacts on Black patients' overall health and quality of life (Hall & Fields, 2015). This dynamic may create a cyclical negative process, as negative emotional states increase ORB effects (Johnson, 2006). Taken together, Black patients with ABIs may be more likely to have poor rehabilitative outcomes due to the combined effect of their minority status, emotional experiences and own-race bias from both themselves and their predominately-white medical team. These underlying subconscious processes may account for health disparities between Black and non-Black patients across countless conditions.

Theories of Own-Race-Bias

Brigham and Malpass (1985) described four theories regarding the underlying mechanisms of ORB. First is the *differential distinctiveness hypothesis,* which states that unique facial features enhance recognizability (Brigham & Malpass, 1985; Malpass & Kravitz, 1969). Although it is common for individuals to perceive other race groups to be homogenous (Mullen & Hu, 1989), there are no empirical studies that characterized any racial group as more or less physically homogenous or easily recognizable than others (Goldstein & Chance, 1976; Shepherd & Deregowski, 1981).

Racial prejudices have also been considered as the underlying drive of ORB. This *differential attitudes hypothesis* suggests that racial prejudice may lead to poorer recognition of other races than same-race faces (Brigham & Malpass, 1985). It is hypothesized that prejudices may lead to poor effort in discriminating between faces of other racial groups (Secord, Bevan, &

Katz, 1956). However, research that directly measures racial attitudes, via self-report or implicit measures have not supported this hypothesis (Brigham & Barkowitz, 1978; Ferguson, Rhodes, Lee, & Sriram, 2001; Lavrakas, Buri, & Mayzner, 1976).

The *differential social orientation hypothesis* suggests that other-race faces are encoded more superficially than same-race faces, which may lead to poorer other-race recognition (Brigham & Malpass, 1985; Goldstein & Chance, 1981). However, this theory has mixed support. Devine and Malpass (1985) found that ORB exists in both superficial and inferential coding contrary to this hypothesis. However, later studies offer support that in-group faces are processed differently than out-group members. Sporer's (2001) study found when a face is perceived, it is automatically identified as either an in-group or out-group member. Those perceived as in-group members are processed more carefully as they are perceived as individuals, whereas outgroup members are processed as a member of a general social category (Sporer, 2001). Other recent studies have also found that in-group faces are processed holistically, whereas other-race faces are processed more by their physiognomic parts (Michel, Rossion, Han, Chung, & Caldara, 2006). Studies using a recognition task in which faces are misaligned, found that participants performed better on same-race trials than on other-race trials, providing additional evidence of the ORB. Hills and Lewis (2006) found that Black and white participants focused on facial structures that have the most variability within in their own race, that typically do not exist in other races. This strategy compromises facial recognition of other-race faces because the most distinguishing features in one group are not as unique in other groups (e.g., eye or hair color in whites vs. Blacks). Other social theories suggest that ORB for facial recognition is driven by a need for belongingness to an in-group (Van Bavel, Swencionis, O'Connor, & Cunningham, 2012).

An extension of the social orientation theory is the *differential experience* or *contact hypothesis*, which has garnered the most consistent support (Bar-Haim, Ziv, Lamy, & Hodes, 2006; Chiroro & Valentine, 1995; Hancock & Rhodes, 2008; Meissner & Brigham, 2001). According to this theory, ORB develops due to increased familiarity with one's own race. Because individuals presumably have more contact and interactions within their race, they are more adept at distinguishing more subtle features in their in-group. Further, the more contact an individual has with a particular group (same or other) the better they are at facial memory for those high-contact groups (Chiroro & Valentine, 1995). The contact hypothesis of ORB is supported across cultures (Goodman et al., 2007) and throughout the lifespan (Meissner & Brigham, 2001; Pezdek, Blandon-Gitlin, & Moore, 2003). Children as young as 3 to 6 months exhibit ORB responses (Sangrigoli & De Schonen, 2004). Developmentally, infants prefer to look at faces rather than other objects (Spangler, Freitag, Jaeger, & Schwarzer, 2011), and by 3 months their facial preferences are of their own race (Kelly, Liu, et al., 2007; Kelly, Quinn, et al., 2007; Kelly et al., 2005). Visual exposure to their own racial group, via their family and community members is thought to drive this preference, which eventually develops into ORB as they become more adept at distinguishing and recognizing faces in their in-group (Bernstein, Young, & Hugenberg, 2007). This finding lends support to the contact hypothesis and is empirically based (Meissner & Brigham, 2001), as infants who have exposure to their own and another race, do not exhibit a preference between the two groups (Bar-Haim et al., 2006).

A contemporary theory suggests that ORB is instead a product of inconsistent response styles to other-race faces, rather than any systematic differences in same- and other-race facial recognition (Busche, 2012). In Busche's (2012) study, participants observed target faces, then performed two subsequent recognition trials (block 1 and 2). Results indicated that white participants had higher recognition accuracy for faces, and that their responses were more consistent across the two recognition trials when identifying faces from their own race, confirming ORB. However, when their inconsistent processing of other-race faces was accounted for, other-race faces were as or more recognizable than own-race faces, thereby eliminating the ORB effect. This effect however, was only observed in white participants and has yet to be replicated.

Advanced technologies lend their support to varying hypotheses. For example, fMRI studies of ORB have found that same-race faces elicited activation in the left fusiform and right hippocampal areas in the brain (Golby, Gabrieli, Chiao, & Eberhardt, 2001). This structural difference in processing could potentially support components of all four hypotheses. Likewise, in eye tracking studies ORB is thought to occur due to inappropriate attention to certain facial features (Hills, Cooper, & Pake, 2013; Hills & Pake, 2013) in support of the social orientation and contact hypotheses. In the studies by Hills et al. (2013), when a fixation cross was presented to draw participants attention to the most diagnostic visual features, ORB could be reduced depending on where the fixation cross was located (Hills et al., 2013; Hills & Lewis, 2005, 2006, 2011; Hills & Pake, 2013).

Regardless of the mechanism that drives ORB, there are documented perceptual differences by race. As ORB relates to ABI, there are limitations in the assessment measures used to evaluate post-injury deficits, which in turn may influence treatment planning and follow-up care. Most standardized measures used to evaluate facial memory and emotion processing include exclusively white actors (Benton, 1978; Ekman & Friesen, 1976; Warrington, 1984). Therefore, it is unknown whether there are differences in facial processing that are unique to Blacks with ABI that may indirectly contribute to racial disparities.

Measures of Facial Memory

One of the most widely used tests in neuropsychology is the Warrington Recognition Memory Test (RMT; Warrington, 1984). The RMT is composed of two subtests, one for words and one for faces. The Warrington Recognition Memory Test for Faces (RMT-F) is designed to assess memory for visual information. Fifty grayscale images of unfamiliar men are presented one at a time for 3 seconds each. Participants orally rate each face as pleasant or not pleasant by stating "yes" or "no" for each presentation. Immediately following these trials are 50 forced-choice trails in which one of the initial stimulus photos is paired with a foil; participants indicate which image they were previously shown. The RMT-F was initially developed to help clinicians distinguish between right and left hemisphere brain damage in persons with brain injuries (Warrington, 1984), and has been supported as a reliable measure in neurologically impaired groups (Soukup, Bimbela, & Schiess, 1999). Norms are available for adults ages 18-70 years old (Warrington, 1984). The RMT-F takes less than 15 minutes to administer and is easily scored.

Despite its strengths, there are many criticisms of the RMT-F. Although the RMT-F is a memory test for faces, the targets featured in the test are wearing distinctive clothing (i.e., scarves or ties) and dated hairstyles. Additionally, the facial orientation, body postures, and lighting conditions are not consistent across images (See Figure 1). This additional visual information increases the likelihood of recognition by non-facial stimuli, such that even when all facial features have been removed from the RMT-F, respondents continue to score in the normal range (Duchaine & Weidenfeld, See Figure 2).

(Figure 1.Warrington, 1984)

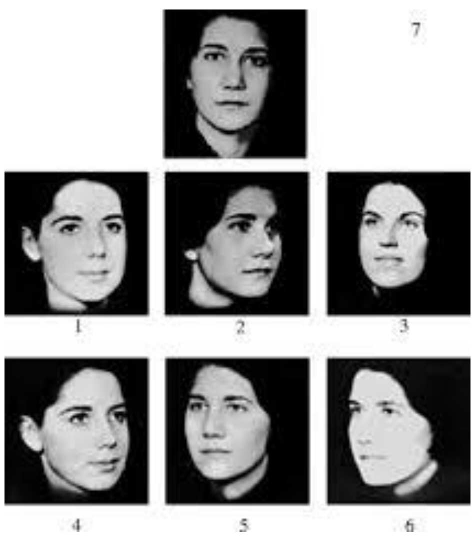
(Figure 2. Duchaine & Weidenfeld, 2003)

Faces on the RMT-F are not based on Ekman and Frisen's (1978) anatomically standardized Facial Action Coding System (FACS), and thus have variable facial expressions (Ekman & Friesen, 1978). Although the faces in the RMT-F are purported to be emotionally neutral, many faces on the measure appear emotionally expressive. As noted previously, accuracy of face memory varies by emotional expression, so some faces on the RMT-F may be differentially memorable. Additionally, some of the men pictured on the RMT-F have atypical facial defects, such as drooping features that may be uncharacteristic of average faces and may change the likelihood of image recognition. Taken together, the lack of standardization of faces on the RMT-F challenge its validity as an accurate estimator of memory for faces.

Further, the images on the RMT-F are exclusively of white men, many of which are older in age. As such, there may also be gender and age biases in facial recognition, such that older people, and especially older white men, may perform better on the RMT-F than younger people and women. Regarding gender differences in face memory, women typically perform better on recognition tasks than men (Loftus, Banaji, Schooler, & Foster, 1987). Own gender-biases also tend to be stronger in women, more so than in men indicating that women are more likely remember female faces rather than male faces (Cross, Cross, & Daly, 1971; Herlitz & Loven, 2013; Lewin & Herlitz, 2002; Loven, Herlitz, & Rehnman, 2011; Loven et al., 2012; Slone, Brigham, & Meissner, 2000). Own-gender biases are present in men; however, the research is mixed as men's own-gender biases appears to be less consistent on tasks of face recognition compared to women (Herlitz & Loven, 2013; Loven et al., 2011; Wright & Sladden, 2003). Previous evaluations the RMT-F have not found gender differences in performance of the RMT-F (Diesfeldt & Vink, 1989; Millis, 1992; Soukup et al., 1999). Evidence of own-age biases is robust in the research literature (Bortolon, Louche, Gely-Nargeot, & Raffard, 2015; Rhodes & Anastasi, 2012; Wright & Stroud, 2002). Regarding the RMT-F specifically, O'Bryant, Hilsabeck, McCaffrey, and Gouvier (2003) found that nearly half of cognitively intact young adults scored in the 10^{th} percentile or less on the RMT-F based on age norms in the manual. Likewise, the test-retest reliability for young adults was below acceptable correlations for a clinical test (O'Bryant et al., 2003). This suggests that the RMT-F may be differently valid for younger people.

The Benton Facial Recognition Test (BFRT; Benton et al., 1994) is another test designed to measure face memory in brain-injured patients. There is a 13-item short form and a 22-item long form of the test. In each version, a target photo is presented simultaneously with six face options (See Figure 3). The target face always faces forward. Respondents must identify the matching target photo in three conditions: 1) respondents select an identical face to the target face; 2) respondents select three images that are of the same person as the target face from different angles; and 3) respondents select the three images of the target face under different lighting conditions. All images are black-and-white photos of unfamiliar faces; all hair and clothing are shaded out, so that only facial information is presented during each trial. There is no time limit to complete the task.

One major advantage the BFRT has over the RMT-F is that includes both male and female faces and that all other non-facial content is omitted (i.e. clothing, hair), so that recognition is only based on facial content, rather than on clothing or other accessories. However, because the target image is displayed simultaneously with the response options, the BFRT is not a *memory test* per se; instead it is a matching task, which relies less on the memory system. Also, similar patterns of own-gender bias have been found on the BFRT where women perform better on the task overall, and specifically for female faces (Gur et al., 2001).



(Figure 3. Benton et al., 1994)

Rationale/Purpose for Present Study

The combined influences of acquired brain injury, own-race bias and potential for measurement error may exacerbate racial disparities among minority patients with ABI. To begin to address the interaction of these factors, equitable assessment tools must be used. To date, most research investigating face processing lack standardized stimuli and/or racial diversity (Anderson, 1996; de Gelder, Huis in ‘t Veld, & Van den Stock, 2015; O'Bryant & McCaffrey, 2006); thus, these measures may be biased against Black and other non-white groups. The inclusion of multicultural faces in the assessment process may attenuate potential racial biases and may help maximize patient engagement and minimize feelings of alienation that can lead to negative interactions between different-race patients and providers. Negative emotional states compromise face processing, so it is critical to measure both the patients' subjective mood states as well as the emotional valence of the facial stimuli on an updated measure.

Further, the phenomenon of own-race-bias has not been researched in people with acquired brain injuries. Previous studies of ORB have primarily used undergraduate populations or utilized small sample sizes which compromise the generalizability of their findings to special populations (Chiroro, Tredoux, Radaelli, & Meissner, 2008; Lindsay, Jack, & Christian, 1991; Loven et al., 2012; Marsh, Pezdek, & Ozery, 2016; Tanaka, Kiefer, & Bukach, 2004; Wright, Boyd, & Tredoux, 2003). Based on what is known about own-race bias and face processing, current research is incomplete and may be differentially valid across Black and white samples with ABIs. The implicit process of ORB may also contribute towards health disparities between Black and non-Black patients across countless conditions. As such, it is critical to evaluate potential racial differences in face processing, as the available literature may lead to inaccurate diagnoses and treatment in minority groups. Therefore, the current study will evaluate facial memory using monocultural and multicultural stimuli among Black and white adults with ABI. The current study aims to evaluate ORB in ABI patients via facial processing of racially similar and dissimilar faces, as well as to examine the effects of target and subject emotion to enhance understanding of racial/ethnic differences in face processing.

Study Aims and Hypotheses

Aim 1: Explore evidence of validity of newly created multicultural task of face memory.

- Hypothesis: The Multicultural Facial Recognition Memory Test for Faces (MCFR) will show convergent validity with the Warrington Recognition Memory Test – Faces (RMT-F) and will be more strongly related to measures of visual memory than to other domains of cognitive functioning. Potential demographic covariates will be explored, including age, education, and time since injury.

Aim 2: Explore the equivalence of facial recognition memory processing on monocultural and multicultural tasks and own race bias effects.

- Hypothesis 2a: Face recognition memory will be related to emotion valence (i.e., the extent to which participants experience the faces as pleasant/unpleasant) in multicultural and monocultural target stimuli.
- Hypothesis 2b: Face recognition memory will be affected by the participants' experience of trait affect intensity. Analyses will test for linear and nonlinear relationships. The relationship may be nonlinear, such that facilitation effects of arousal on performance reach an asymptote, after which it undermines performance. For example, consistent with the Yerkes-Dodson arousal curve, experienced affect intensity can facilitate performance at moderate levels but can disrupt performance at high levels.
- Hypothesis 2c: White participants will have higher accuracy on the traditional, monocultural RMT-F than on a newly-created, MCFR, supporting ORB.
- Hypothesis 2d: Black participants will have equivalent accuracy on the RMT-F and MCFR based on the contact hypothesis, which posits that ORB develops due to increased familiarity with one's own race (Bar-Haim et al., 2006).

Aim 3: Examine the role of target variables on face processing and explore evidence of own-race bias on the MCFR.

- Hypothesis 3a: Accuracy of facial recognition memory will be greater for happy faces than for neutral faces, regardless of actor race.
- Hypothesis 3b: Response time for facial recognition memory will be quicker for happy faces than for neutral faces, regardless of actor race.
- Hypothesis 3c: Accuracy of facial recognition memory will be higher for same-race actors than for than for different-race actors.
- Hypothesis 3d: Response time for facial recognition memory will be faster for same-race actors than for than for different-race actors.
- Hypothesis 3e: Accuracy of facial memory will be greatest for same-race faces (main effect of group) and for happy versus neutral faces (main effect of emotion), with an additive interaction of the main effects.

Aim 4: Explore the consumer acceptability of the MCFR.

- Hypothesis: The MCFR will be acceptable to Black and White examinees. Black participants will rate the Multicultural Facial Recognition Memory Test for Faces (MCFR) with better consumer response and engagement (e.g., likability, ease, etc.) as compared to the standard Warrington RMT-F.

CHAPTER 2: METHOD

Participants

The study included 115 adults (63 Black, 52 White) with self-reported moderate acquired brain injury (ABI). Participants were recruited from multiple locations including the Rehabilitation Institute of Michigan as part of the Southeastern Michigan Traumatic Brain Injury Model System (SEMTBIS), 11 local brain injury and stroke support groups, and via community postings in the greater Metropolitan Detroit area.

All participants were between ages 18 and 79 and had a self-reported neurological injury of moderate to severe severity that resulted in hospitalization. All participants were at least 6 months post their most recent ABI. Exclusionary criteria included participants who did not identify as either Black or White, non-English speakers, those with sensory or motor impairments that would preclude valid cognitive, visual, or auditory testing, and individuals with progressive neurological diseases (i.e., dementias), psychotic disorders, or other medical conditions that are likely to affect cognition or vision (e.g., unmanaged diabetes, uncontrolled pain).

Measures

Measures of Facial Memory Recognition

<u>Warrington Recognition Memory Test for Faces (RMT-F; Warrington, 1984)</u>: The Warrington Recognition Memory Test (RMT) was initially developed to help clinicians distinguish between right and left hemisphere brain damage in persons with brain injuries (Warrington, 1984), and has been supported as a reliable measure in neurologically impaired groups (Soukup et al., 1999).

The RMT-F is one of two subtests on the Warrington. The RMT-F is designed to assess memory for visual information. A computerized version of the RMT-F was used for this study.

The original stimuli were scanned as high definition images and presented on a computer screen via E-Prime 2.0 Professional software. The RMT-F stimuli is composed of 50 grayscale images of white male faces. The computerized task maintained the standardized administration, with the addition of task instructions being printed on the computer screen while the examiner read them aloud. Each face was presented individually in the center of a blank screen for 3 seconds. During each 3-second trial, the participant orally rated the face as pleasant or not pleasant by saying "yes" or "no". Immediately following the stimulus presentation trials were 50 forced-choice trials in which each face was paired with its standardized foil. Participants indicated which face they were previously shown by selecting right or left keys on a computer response box (i.e., left key to select the face presented on the left side of the screen and right key to select the face presented on the right side of the screen). Participants had unlimited time to respond to each trial. Accuracy and reaction time were recorded via Eprime for each recognition trial.

The RMT has demonstrated adequate reliability and validity in several populations including assessing memory impairment in moderate to severe ABI (Millis & Dijker, 1993; Strauss, Sherman, & Spreen, 2006). Further, the RMT has been found to measure response bias and effortful performance (i.e., symptom validity) in neuropsychological testing (Iverson & Franzen, 1998; M. S. Kim et al., 2009; Millis, 2003). Regarding the RMT-F subtest, internal consistency reliability in ABI populations (Cronbach's alpha = .77) as well as test-retest reliability ($r = .81$) and validity via moderate correlations with other measures of visuospatial functioning is well supported in neurological samples (Malina, Bowers, Millis, & Uekert, 1998; Soukup et al., 1999). In the present study, internal consistency reliability was adequate (Kuder-Richardson 20, $r = .73$) for the total sample (Lord & Novick, 1968).

<u>Multicultural Facial Recognition Memory Test for Faces (MCFR)</u>: The design of the MCFR was modeled after the computer administration of the RMT-F. Facial images used in the MCFR were obtained from the Montreal Set of Facial Displays of Emotion (MSFDE) with permission from the authors (Beaupré, Cheung, & Hess, 2000; Beaupré & Hess, 2005). The MSFDE is a collection of black-and-white photos of actors from four ethnicities (Asian, Hispanic, White, and African). There are eight actors in each ethnic group (four men, four women), with images of each actor performing seven facial expressions: neutral, happy, sad, fear, anger, disgust, and shame (Beaupré et al., 2000; Beaupré & Hess, 2005). Images on the MSFDE were created using a directed facial action task, and all expressions were FACS coded to assure identical expressions across actors. Each image includes only the actor's face and neck region and there are no variations of actor attire. Each actor is wearing a buttoned shirt, with only the collar visible in each image. These images have been used in previous studies to evaluate cross-cultural differences in the visual processing of faces (Beaupré et al., 2000).

For the MCFR, happy and neutral faces from both genders of four racial groups were utilized, for a total of 32 trials. Instructions were presented on the computer screen and also read aloud to participants. For the stimulus presentation trials each image was presented on a computer screen via E-Prime 2.0 Professional software individually for 3 seconds. During each of the presentation trials, the participant orally rated the face as pleasant or not pleasant by saying "yes" or "no". Following the presentation trials there were 32 forced-choice trials in which participants indicated which exact face they were previously shown using the right and left keys of a computer response box. Participants had unlimited time to respond on each trail. Order of presentation of the forced-choice trials was counterbalanced for race and gender. Each forced-choice pair was also matched for facial expression (happy or neutral), and pairs were counterbalanced for race (i.e., an equal number of matched-race pairs and unmatched-race pairs). Accuracy and reaction time were recorded for each recognition trial. Internal consistency for accuracy was low in the current sample, (Kuder-Richardson-20, r = .34) for the total sample (Lord & Novick, 1968); however, response time had high internal consistency (α = .92).

Measures of Learning, Memory, and Recognition

Brief Visuospatial Memory Test-Revised (BVMT-R; Benedict, 1997): The BVMT-R measures encoding, short- and long-term recall, and recognition memory of visual stimuli. There are three trials to learn a collection of geometric shapes. Target shapes are presented for 10 seconds, following an immediate recall trial in which participants must draw each shape in its correct location. A delayed recall trial is administered after a 25-minute delay, which is followed by a recognition task.

The BVMT-R has demonstrated stronger correlations with other tests of visual memory than with tests of verbal memory (Benedict, 1997). Construct and criterion validity of the BVMT-R have been demonstrated in clinical as well as healthy samples (Benedict, Schretlen, Groninger, Dobraski, & Shpritz, 1996).

Hopkins Verbal Learning Test-Revised (HVLT-R; Benedict, Schretlen, Groninger, & Brandt, 1998): The HVLT-R measures encoding, learning, short- and long-term recall, and recognition memory. It is a verbal list-learning task in which participants are asked to recall 12 words over three learning trials. The target words belong to three semantic categories. Following the three immediate-recall trials, there is a 25-minute delay. After the delay is another recall trial and a recognition task in which participants must identify target words from semantically-related and unrelated distractors. The HVLT-R has six alternate forms; however, this study only used Form 1.

The HVLT-R is widely used in research and clinical settings, and it has demonstrated validity as test of verbal learning and memory (Benedict et al., 1998) as well as in ABI populations (O'Neil-Pirozzi, Goldstein, Strangman, & Glenn, 2012).

Other Neuropsychological Measures

Wechsler Adult Intelligence Scale – 4th Edition (WAIS-IV; Wechsler, 2008) Digit Span: The Digit Span subtest measures encoding and auditory processing. Further, its subtests provide measures of attention and short-term auditory memory, (digits forward), working memory (digits backward) and cognitive flexibility (digits backward and sequencing). Participants were read a sequence of numbers and were required to recall the series in one of three ways: in the exact order, in reverse order, and in ascending order.

The WAIS-IV test manual describes substantial evidence for test retest reliability, convergent validity, and discriminant validity for WAIS-IV subtests across age groups, and clinical and non-clinical samples (Wechsler, 2008)

Trail Making Test (TMT; Reitan & Wolfson, 1985). The TMT is a two-part paper and pencil test that measures visual attention and task switching. In Part A (TMT-A), participants were asked to draw a line that connects numbered circles in ascending order from 1 to 25 as quickly and accurately as possible. In Part B (TMT-B), participants were instructed to connect circled numbers and letters in ascending order, alternating between numbers and letters (e.g., 1, A, 2, B, etc.). The TMT has demonstrated adequate reliability, validity and sensitivity to a variety of organic and psychiatric disorders across multiple cultures (Heaton, Miller, Taylor, & Grant, 2004; Perianez et al., 2007; Reitan, 1958; Sánchez-Cubillo et al., 2009; Strauss et al., 2006).

Measures of Affect Experiences

Toronto Alexithymia Scale-20 (TAS-20; Bagby, Parker, & Taylor, 1994). The 20-item Toronto Alexithymia Scale measures deficiencies in understanding, processing, and describing emotions. It is composed of three scales: Difficulty Describing Feelings, Difficulty Identifying Feelings, and Externally-Oriented Thinking. The total alexithymia score, the sum of responses of all 20 items, was used in this study; higher scores indicate higher symptomology of alexithymia. The TAS-20 uses cutoff scoring in which total scores less than 51 indicate "no alexithymia" and total scores greater than or equal to 61 indicate "alexithymia." Participants rate their typical emotional response on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The TAS-20 has good internal consistency (Cronbach's alpha = .80 to.83) reliability. The scale also has demonstrated adequate external validity, as evidenced by significant correlations with clinician ratings of alexithymia in patients at a behavioral medicine clinic and patient somatic complaints (Bagby et al., 1994). Internal consistency reliability was adequate in the current sample ($\alpha = .79$).

Affect Intensity Measure (AIM; Larsen & Diener, 1987): The AIM is a 40-item self-report that assesses individual differences in affect intensity to everyday events. Participants rate their typical emotional reactions to positive and negative experiences on a 6-point Likert scale, ranging from 1 (never) to 6 (always). The authors designed the AIM as a unidimensional construct of affect intensity, where higher total scores indicated greater affect intensity (Larsen, Diener, & Emmons, 1986). As such, total scores were used in this study. Other researchers have found that that AIM may be a three (Bryant, Yarnold, & Grimm, 1996) or four-factor model (Rubin, Hoyle, & Leary, 2012; Weinfurt, Bryant, & Yarnold, 1994), including scales such as: Negative Intensity, Positive Intensity, Negative Affectivity, and Positive Affectivity. Psychometric properties of the AIM have been established in clinical and nonclinical samples (Flett & Hewitt, 1995; Goldsmith & Walters, 1989; Rapport, Friedman, Tzelepis, & Van Voorhis, 2002). The AIM total score demonstrated good internal consistency reliability in the current sample (α = .92).

Positive Affective and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988): The PANAS is a 20-item self-report measure of positive and negative mood. Respondents rate the extent to which they have experienced positive and negative affective words, on a 5-point Likert scale from 1 (very slightly) to 5 (extremely). Affect scores range from 10 to 50, with higher scores indicating greater affect. The PANAS has been supported as a reliable and valid measure in a variety of clinical and in non-clinical (Crawford & Henry, 2004; Watson et al., 1988) populations. The alpha reliabilities range from .86 to .90 for Positive Affect and from .84 to .87 for Negative Affect. In the present sample, internal consistency reliabilities were adequate for both Positive Affect (α = .83) and Negative Affect (α = .87).

Post-test Consumer Survey:

Post-test Consumer Survey: The post-test consumer survey was developed by the author and asked participants which measure of facial memory (RMT-F or MCFR) they liked the most, which test they liked the least, and on which test they think they performed best. The results from this survey were used to analyze the acceptability of the MCFR.

Procedures

Recruitment. Participants were recruited from the pool of registered participants in Southeastern Michigan Traumatic Brain Injury System (SEMTBIS) who volunteered to be contacted for research, local brain injury and stroke groups, and through community postings. SEMTBIS participants had medically documented moderate to severe TBI via loss of consciousness (LOC) > 30 minutes at the time of injury, posttraumatic amnesia (PTA) > 24 hours, Glasgow Coma Scale (GCS) < 12 at the time of admission to the emergency department, or positive neuroimaging. Participants from area support groups were recruited in person by the author or other members of the research team at their support group meetings. Community participants contacted the research team via telephone or email to in response to local advertisements or referral. All potential participants were screened for interest and basic inclusion criteria. If initial screening criteria were met, individuals were scheduled for an in-person appointment.

Participants were tested at multiple locations, including, the Rehabilitation Institute of Michigan Outpatient Centers in Detroit, Sterling Heights, and Novi, in a laboratory on the campus of Wayne State University, or in a private room at their local support group location. Some participants were also assessed in a private room at the Henry Ford Retirement Village.

Participants completed informed consent procedures per Institutional Review Board and hospital policy guidelines where applicable. Once eligibility was confirmed during a brief in-session interview, enrolled participants completed a battery of paper-and-pencil and computerized neuropsychological measures and questionnaires. Participants were paid $25 in cash for their time at the end of the session.

Statistical Analyses

The total scores for the MCFR and RMT tests were converted to percentages so that each test could be reported on a common metric. Response times were measured in milliseconds (ms). The data were screened for violations of assumptions for the statistical models employed as recommended by Tabachnick and Fidell (2007). This included winsorizing outliers > 3z and evaluating for skewness. Consistent with traditional protocol in data screening procedures for timed data, response time (RT) data points less than 250ms were excluded because that is understood to be faster than what can be cognitively processed.

Descriptive statistics for demographic information, accuracy, response times, and performance on neuropsychological and affectivity measures were conducted for the overall sample and the Black and White groups separately. Groups were examined for the extent to which performance differed on accuracy and response times on memory measures, as well as demographic variables of age, education, and time since injury using independent samples t tests. Chi square analyses were used to evaluate group differences in gender proportions and injury type.

Scatterplots were visually examined and formal tests for nonlinear trends and correlations were completed. Pearson correlations were conducted to examine the relationships between facial memory accuracy with affectivity measures (AIM, PANAS, TAS-20) as well as tests of curvilinear estimates to evaluate nonlinear relationships among these variables. Mixed-model ANOVAs were used to examine participant pleasantness ratings on the MCFR and RMT. Post hoc independent t-tests assessed between-group differences and dependent (paired) t-tests assessed within-group profile.

A three-way mixed-model repeated-measures ANOVA was used to analyze accuracy and response times on the MCFR, with participant group (Black, White) as a between-subjects factor and target race (similar, dissimilar) and target emotion (happy, neutral) as within-subject factors. Post hoc independent t-tests were used to assess between-group differences and dependent (paired) t-tests assessed within-group (within race, by emotion) profiles. Multivariate F statistics were used to address violations of sphericity. Effect sizes for all analyses were interpreted according to guidelines presented by J. Cohen (1998), in which $d = 0.20$ reflects a small effect, $d \geq 0.50$ reflects a medium effect, and $d \geq 0.80$ is large.

CHAPTER 3: RESULTS

Characteristics of Study Sample

Descriptive statistics for demographic characteristics variables are presented in Table 1, along with injury characteristics for the total sample and for both racial groups separately. Age was not significantly different between the groups, $t(113) = -1.05$, $p = .294$, nor was education $t(113) = -1.04$, $p = .212$ or time since injury $t(113) = 0.59$, $p = .555$. The ratio of men to women did not significantly differ between groups, $X^2(1, N = 115) = 0.76$, $p = .383$. Likewise, the groups were equivalent in proportion for type of injury; the ratio of traumatic brain injury to stroke did not significantly differ between groups $X^2(1, N = 115) = 0.21$, $p = .646$.

Descriptive statistics and group comparisons for the RMT-F, MCFR, and neuropsychological measures are presented in Table 2. ANOVAs revealed that the White group outperformed the Black group on measures of memory discrimination, immediate and delayed visual recall, auditory processing and processing speed. Specifically, small effect size differences were found on HVLT Discrimination, $t(113) = -2.33$, $p = .002$, Cohen's $d = 0.44$; Digit Span Total, $t(112) = -2.17$, $p = .032$, Cohen's $d = 0.41$; and Trails B, $t(112) = 2.07$, $p = .041$, Cohen's $d = 0.39$. Medium effect size differences were found on BVMT Total Recall, $t(113) = -3.86$, $p < .001$, Cohen's $d = 0.72$ and BVMT Discrimination, $t(111) = -3.33$, $p < .001$, Cohen's $d = 0.69$. A large effect size was found on BVMT Delayed Recall, $t(113) = -4.82$, $p < .001$, Cohen's $d = 0.90$.

Descriptive statistics and group comparisons for measures of participant affect are presented in Table 3. ANOVAs indicated that there were no significant group differences in scores on the TAS-20, AIM, or Negative Affect ratings on the PANAS. However, medium effect size group differences were observed on Positive Affect ratings on the PANAS with the Black group reporting higher ratings of positive affect ($M = 37.8$, $SD = 7.1$) than the White group ($M = 33.4$, *SD* = 7.7), *t*(111) = 3.16, *p* = .002, Cohen's *d* = 0.60.

Aim 1: Explore evidence of validity of newly created multicultural task of face recognition memory.

Reliability of the MCFR. Table 4 presents reliability statistics for the two tests of facial recognition memory for the Black, White, and total group sample. Internal consistency reliability for the MCFR was low (α = .34). In examining item-total statistics, it was found that exclusion of 10 items could increase the level of internal consistency; however, none of possible exclusions would bring internal reliability near an acceptable rate. The MCFR total score distribution appeared relatively normal (see Figure 1), and MCFR accuracy scores were not significantly skewed (Skewness / SE Skewness = 1.41). Participants' scores ranged from 34.4% correct (11/32) to 87.5% correct (28/32 correct), with 11.3% of the total sample scored at or below chance (50%). No participants scored 100% correct. The 25th quartile was 53.1% (16 items correct), the 50th quartile was 62.5% (20 items correct) and the 75th quartile was 68.8% (22 items correct). For the total sample, there were 16 items with item difficulties in the ideal range for dichotomous items with P = .60 - .80. Two items were answered correctly by 80% or more of the participants. There were 14 items that were answered correctly by fewer than 60% of the participants.

MCFR Accuracy correlations. Pearson correlation analyses were performed to examine the relationship of the MCFR with the RMT, measures of visual memory, and other cognitive domains. Correlations among the cognitive tests and demographic variables for the total sample are presented in Table 5a. For the total sample, there was a moderate relationship between percent accuracy on MCFR and percent accuracy on RMT (*r* = .44). MCFR accuracy also showed small to moderate relationships to the indices of visual memory that were statistically significant at $p < .01$, including BVMT Immediate Recall, (*r* = .32), BVMT Delayed Recall (*r* = .26) and BVMT

Recognition Discrimination (r = .25). Accuracy scores on the MCFR also demonstrated a small to moderate inverse relationship with measures of visual attention (Trails A, r = -.28, Trails B, r = -.30); however, this association may be influenced by processing speed as there were commensurate correlations between these variables and response time on the MCFR. All HVLT-R memory scores (Immediate Recall, Delayed Free Recall and Recognition Discrimination) had small, but statistically significant correlations with MCFR accuracy (r .17 to .24). Overall, the MCFR showed no meaningful relationship with age, education, or time since injury.

To show convergent and discriminant validity, the MCFR should be most strongly correlated with the RMT and more strongly correlated to the RMT than to tests tapping cognitive domains theoretically unrelated (or less related) to face recognition memory. The correlation between the MCFR and the RMT was strongest among the set of correlations. Fisher's r-to-z transformation (Fisher, 1915) and comparison of the correlation between the MCFR and RMT (r = .44) and the correlation between the MCFR and Digit Span (r = .12) was significant, Steiger's z = 2.96, p = .001. This result indicates that the MCFR is significantly more strongly correlated with the RMT than it is to Digit Span. Similar tests showed that the correlation of the MCFR to RMT was also significantly stronger than its correlation to Trails A, z = 1.69; p = .046; and HVLT-R Delayed Recall, z = 1.88; p = .030; with a notable trend for Trails B, z = 1.58; p = .056. Lastly, the correlations of the MCFR to BVMT visual memory indices should be stronger than the correlations of MCFR to other domains. The correlation between the MCFR and BVMT Total recall score was the second strongest among the set of correlations. Fischer's r-to-z transformation and comparison of the correlations between the MCFR and BVMT total (r = .32) and the correlation between the MCFR and Digit Span (.12) was significant, Steiger's z = 2.19, p = .015. This result indicates that the MCFR is significantly more strongly correlated with the BMVT total score than it is to Digit Span. However, r-to-z transformations indicated that for the correlation between MCFR and BVMT Total Recall (*r* = .32) showed nonsignificant trends toward being stronger than the correlations between MCFR and HVLT indices, (*p*s .059 to .303); Trails A (*p* = .325) and Trails B (*p* = .398).

By comparison, the RMT showed a pattern of generally stronger but diffuse relation to most of the cognitive tests. RMT accuracy showed medium correlation to BVMT indices (*r* .42 to .47), HVLT-R verbal indices (*r* .40 to .45), as well as time to complete Trails A and B (*r* -.39 to -.47). Additionally, RMT accuracy showed small but significant correlation with education (*r* = .22) and time since injury (*r* = -.20). For the RMT, Fisher's r-to-z comparisons between MCFR-RMT and the correlations of RMT to Digit Span, HVLT-R Delayed Recall, Trails A, and Trails B were not significant ($p > .05$). However, RMT showed stronger correlation to BVMT-Delayed Recall (*r* = .47) than did MCFR (*r* = .26), z = 2.31; *p* = .010.

Separate group analyses – accuracy. When examining the groups separately, there are striking differences in correlations between accuracy and memory measures, with the Black group primarily accounting for the total sample correlations. Table 5b presents the correlations among the cognitive tests and demographic variables for the Black participants. Among Black participants, MCFR accuracy had strong correlation with RMT-F accuracy (*r* = .55), as well as small to moderate significant correlations with all other measures of visual (*r* .30 to .43) and verbal (*r* .31 to .45) memory. MCFR accuracy was also correlated to measures of auditory attention (Digit span Total, *r* = .24; Backward, *r* = .30), as well as processing speed (Trails A, *r* = -.30) and executive function (Trails B, *r* = -.32). Lastly, there was a moderate, negative correlation between MCFR accuracy and time since injury (*r* = -.32). Fisher's r-to-z transformation (Fisher, 1915) and comparison of the correlation between the MCFR and RMT (*r* = .51) and the MCFR and Digit

Span (*r* = .24) was significant, Steiger's z = 1.89, *p* = .029. This result indicates that the MCFR is significantly more strongly correlated with the RMT than it is to Digit Span. Similar tests showed strong trends that the MCFR-RMT correlation was stronger than the MCFR correlation to HVLT Total Recall, z = 1.63, *p* = .051 Trails A, z = 1.59; *p* = .056; and Trails B, z = 1.61; *p* = .054. R-to-z transformations indicated that for the correlation between MCFR and BVMT Total Recall (*r* = .43) showed nonsignificant trend toward being stronger than the correlations between MCFR and Digit Span, z = 1.43; *p* = .076; HVLT indices (*p*s .176 to .526); Trails A (*p* = .142) and Trails B (*p* = .159).

Table 5c presents the correlations among the cognitive tests and demographic variables for the White participants. In the White group, MCFR accuracy was significantly correlated with RMT-F accuracy (*r* = .35); however, this relationship was weaker than correlations in the Black group, although not significantly so, z = 1.03, *p* = .153. Also, among the visual memory indices of the BVMT, MCFR accuracy scores were significantly correlated only to the total recall score (*r* = .26); it was not significantly correlated with BVMT delayed recall or the discrimination index. No significant correlations were found between MCFR accuracy and verbal memory scores (HVLT-R) or auditory attention (Digit Span). Correlations of MCFR accuracy and visual attention scores were small (Trails A, *r* = -.25, Trail B, *r* = -.28), but in a similar direction observed for the Black group. The correlation between the MCFR and RMT-F was strongest among the set of correlations. Fisher's r-to-z transformation between the MCFR and RMT (*r* = .35) and the correlation between the MCFR and Digit Span (r = -.004) was significant, Steiger's z = 1.99, p = .023. This result indicates that the MCFR is significantly more strongly correlated with the RMT than it is to Digit Span. Similar tests showed that the correlation of the MCFR to RMT was also significantly stronger than its correlation to HVLT indices (*p*s = 0.23 to .046). The correlation between the

MCFR and BVMT Total was the second strongest among the set of correlations of memory measures. Fisher's r-to-z transformation and comparison of the correlations between the MCFR and BVMT total scores (*r* = .26) and the correlation between the MCFR and Digit Span (r = -.004) was significant, Steiger's z = 1.89, p = .030. This result indicates that the MCFR is more strongly correlated with the BVMT total score than it is to Digit Span. Fisher's r-to-z transformation indicated that for the correlation between MCFR and BVMT total score, showed nonsignificant trends toward being stronger than the correlations between the MCFR and HVLT indices (*p*s = .068 to .146); Trails A (*p* = .468 and Trails B (*p* = .568). Regarding demographic variables, the White group had a small correlation with time since injury (*r* = .26); removal of a single outlier reduced the correlation to near zero (*r* = .15).

MCFR Response time correlations. Response times were measured in milliseconds. Regarding the total sample, overall response times on the MCFR and RMT were strongly correlated (*r* = .75, *p* < .01). However, no significant relationships were observed between accuracy and response time on either face recognition memory measure. As noted above, small correlations were found between response times on the MCFR and Trails A (*r* = .24) and Trails B (*r* = .20), as they are also measures of processing speed. Finally, MCFR response time was significantly correlated with age (*r* = .17); however, this relationship was very small.

Separate group analyses – response time. There were some distinct differences in response time correlations between memory measures by race. In the Black group, the only significant correlations with MCFR response time were MCFR accuracy (*r* = .22), which is consistent with a small effect of the speed-accuracy tradeoff (i.e., an increase in errors with rapid responding), and RMT-F response time (*r* = .76), which indicates stability of RT across tasks. MCFR response times were not significantly correlated to performance any other cognitive measure or any demographic variables (*r*s .00 to .18). The same pattern was observed for RMT RT (i.e., no significant correlations; *r*s .00 to .17). It is noteworthy that time to complete Trails A, an index of processing speed, was correlated in the expected direction (inversely) with performance accuracies on the MCFR, RMT and the rest of the cognitive tests (i.e., worse performance with slowed processing speed).

The White group also had a strong correlation between response times on the MCFR and RMT-F (*r* = .75) commensurate with the Black group. However, MCFR response times were *inversely* related to MCFR accuracy (*r* = -.27), indicating that accuracy decreased with increasing (slower) response time (and conversely accuracy increased with speeding of response time), which is *opposite* of the speed-accuracy tradeoff. Given the difference in the directions of the correlations observed for the Black group (.22) and the White group, the difference is significant, z = 2.60, *p* = .005. BVMT Discrimination (*r* = -.29) and HVLT Total (*r* = -.27) were also inversely correlated with MCFR RT (i.e., indicating worse performance with long response time on the MCFR). MCFR response times were positively correlated with time to complete to Trails A (*r* = .35), Trails B (*r* = .41), and age (*r* = .29). It is noteworthy that time to complete Trails A was correlated in the expected direction (inversely) with performance accuracies on the MCFR, RMT and the rest of the cognitive tests (i.e., worse performance with slowed processing speed). The pattern of correlations for RMT RT among the White group was largely similar to that observed for the MCFR (i.e., moderate correlations to RMT accuracy, BVMT Discrimination, Trails A and B, and age). An additional significant correlation was observe for RMT RT with education (*r* = .32). Please see Table 5b and Table 5c for the correlations of RT variables for the Black and White groups, respectively.

Aim 2: Explore equivalence of facial recognition memory processing on unicultural and multicultural tasks and own race bias effects.

Pleasantness ratings and performance on the MCFR and RMT-F. Average pleasantness ratings were converted to percentages for the MCFR and RMT so that the tests could be reported on a common metric. Descriptive statistics for pleasantness ratings are presented in Table 6. Pearson correlations examining the relationship between pleasantness ratings and the accuracy and response times on the MCFR and RMT are presented in Tables 7a - c for the total sample and Black and White groups separately. For the total sample, pleasantness ratings on the MCFR were significantly related to pleasantness ratings on the RMT (r = .33). However, no significant correlations were found for pleasantness ratings and recognition accuracy, nor were there any significant correlations between pleasantness ratings and response times (rs .04 to .12). This pattern was observed in both the Black and White groups, in that pleasantness ratings on both the MCFR and RMT-F were moderately correlated with each other (r = .35 and r = .31, respectively), but not with accuracy or response time on either of the tasks (rs .02 to .18).

A mixed-model ANOVA was conducted to evaluate participant pleasantness ratings of faces on the MCFR and RMT. Participant group was the between-subjects factor and average pleasantness ratings of stimuli on the MCFR and RMT were the within-subject factor. The main effect of participant race was not significant, $F(1, 113) = 0.74$, $p = .391$, $\eta^2 < .01$, indicating that there were no group differences in overall pleasantness ratings across the MCFR and RMT. Tests of within-subjects contrasts indicated that there was a significant main effect for pleasantness ratings, Wilks λ= .671, $F(1, 113) = 55.32$, $p < .001$, $\eta^2 = .33$. Examination of the marginal means using simple contrasts indicated that across groups, target faces on the RMT (M = 70.63; SD = 15.03) were rated as pleasant more frequently than target faces on the MCFR (M = 59.57; SD =

11.73). No significant interactions were found between participant race and pleasantness ratings, Wilks λ= .999, $F(1, 113) = 0.08$, p =.777, $\eta^2 < .01$.

Participant emotion and performance on the MCFR and RMT-F. Pearson Correlations examining the relationship between the face recognition memory and participants reported emotional states are presented in Tables 8a-c.

Accuracy and emotion ratings. In the overall sample, participant emotional state was weakly correlated with accuracy on both face recognition memory tasks. TAS-20 scores showed small but significant ($p < .05$) inverse relation with accuracy on the MCFR (r = -.16) and on the RMT (r = -.22). Negative Affect was also inversely related to accuracy scores (MCFR, r = -.21; RMT, r = -.19). However, no significant relationships were found between the AIM or positive affectivity and accuracy (MCFR, r = .14; RMT, r = .03) for the total sample. In the Black group, there were no significant relationships between accuracy and emotion ratings on either the MCFR or RMT-F (*r*s -.01 to -.20). For White participants, scores on the TAS-20 were inversely related to accuracy on both the MCFR (r = -.23) and RMT-F (r = -.26). Negative affectivity was also inversely related to response times on the RMT-F (r = -.28), but not for the MCFR. No significant relationships were found between accuracy scores for AIM scores or positive affect (*r*s -.09 to .21).

Response times and emotion ratings**.** On measures of response time in the overall group, positive affect was significantly inversely related to response time on both measures (MCFR, r = -.18; RMT, r = -.20). There was no relationship between response time and TAS, AIM or negative affect on either face recognition task (*r*s .01 to .10). Again, in the Black group no significant correlations were found between emotion ratings and response times on either the MCFR or RMT-F (*r*s -.00 to .18). However, for the White group, there were moderate significant correlations between negative affect and response times for the MCFR (r = .27) and RMT-F (r = .32).

A series of curvilinear regression analyses were used to determine if non-linear relationships exist between participant emotional state and face memory accuracy. No statistically significant curvilinear relationships were found between scores on the TAS-20, PANAS, or AIM and accuracy scores on the MCFR or RMT-F. Curvilinear analyses were also performed on response time scores. Reaction time on both the MCFR (quadratic $R^2 = .06$, $p = .042$) and RMT (quadratic $R^2 = .06$, $p = .035$) had a significant nonlinear relationship with scores of positive affect. However, no other curvilinear relationships were found for reaction time.

Participant race and performance on the MCFR and RMT-F.

Accuracy. A mixed-model ANOVA was conducted to investigate the roles of participant race and test type on accuracy scores. Participant race group (Black, White) was the between-subjects factor and test type (MCFR or RMT) was the within-subject factor. The main effect of participant race was not significant, $F(1, 112) = .14$, $p = .705$, $\eta^2 <. 00$, indicating that the groups demonstrated equivalent accuracy on the MCFR and RMT tasks, respectively. Tests of within-subjects contrasts indicated that there was a significant main effect for accuracy by test type, Wilks $\lambda = .647$, $F(1, 112) = 61.23$, $p < .001$, $\eta^2 = .35$. Examination of the marginal means using deviation contrasts indicated that overall accuracy was higher on the RMT ($M = 70.1$, $SD = .1.01$) compared to the MCFR ($M = 61.6$, $SD = 0.9$). There was not a significant interaction between participant group and test type on accuracy Wilks $\lambda = .999$, $F(1, 112) = 0.41$, $p = .708$, $\eta^2 < .01$.

Response Times**.** A second mixed-model ANOVA was conducted to investigate response times by participant race and test type. There was a significant main effect of participant race, $F(1, 112) = 4.19$, $p = .043$, $\eta^2 = .04$. Examination of the marginal means indicated that across tests, Black participants responded faster ($M = 3037$ms, $SD = 127$ms) on average than White participants ($M = 3425$ms, $SD = 139$ms). Tests of within-subjects contrasts indicated that there was a significant main effect of test type for response time, Wilks λ= .859, F(1, 112) = 18.33, p < .001, η^2 = .14. Examination of the marginal means using deviation contrasts indicated that overall response time was faster on the RMT (M = 3071ms, SD = 90ms) compared to the MCFR (M = 3391ms, SD = 111ms). There was not a significant interaction between participant group and test type on response times Wilks λ= .987, F(1, 112) = 1.52, p = .220 η^2 = .01.

Aim 3: Examine the role of target variables on face processing and explore evidence of own-race bias on the Multicultural Facial Recognition Memory Test for Faces (MCFR).

To examine Aim 3, a three-way, mixed-model, repeated-measures ANOVA was conducted to determine the effects of participant race (Black, White), target race (Asian, Black, Hispanic, White) and target emotion (Happy, Neutral) on accuracy and response times. Participant race was the between-subjects factor, and within-subject factors were target race and target emotion. Descriptive statistics of target race accuracy and response times are presented in Tables 9 and 10 for the total sample and Black and White groups separately.

Accuracy. For the three-way interaction effect, Mauchly's test of sphericity indicated that the assumption of sphericity was met, χ2(5) 8.805, p = .117. There was homogeneity of variances, as assessed by Levene's test for equality of variances (p > .05), except for Black Neutral faces, p = .003. There was also equality of covariances, as assessed by Box's test, p = .145. There was a statistically significant three-way interaction between participant race, target race, and target emotion, Wilks λ= .932, F (3, 111) = 2.70, p = .049, partial η^2 = .07. The assumption of sphericity was met for both simple two-way interactions effects, as assessed by Mauchly's test of sphericity (p > .05). There was a statistically significant two-way interaction between target race and target emotion for Black participants, Wilks λ= .745, F (3, 60) = 6.86, p < .001, partial η^2 = .26; however, the two-way interaction was not significant for White participants, Wilks λ= .875, F (3, 49) = 2.34,

p = .085, partial η^2 = .13. There was a statistically significant simple-simple main effect of target race for Black participants when viewing neutral targets, Wilks λ= .595, F (3, 60) = 13.60, p < .001, partial η^2 = .41, but not for happy targets Wilks λ= .908, F (3, 60) = 2.02, p = .120, partial η^2 = .09. All simple-simple pairwise comparisons were run for accuracy in the Black group for neutral targets for each target race. Within the Black group, the mean accuracy score for neutral Asian targets was 2.3 (*SD* = 0.9), neutral Black targets was 2.9 (*SD* = 0.7), neutral Hispanic targets was 2.4 (*SD* = 0.8), and neutral White targets was 2.1 (*SD* = 1.0). There was a statistically significant mean difference between accuracy of neutral Black targets, and natural targets for all other target races. Specifically, accuracy was higher for Black neutral targets than Asian neutral targets (p < .001), Hispanic targets (p = .001) and for White neutral targets (p < .001).

To further evaluate the nature of the interactions, paired-samples t tests were used to make post hoc comparisons between all possible conditions for Black and White groups separately. In the Black group, face recognition memory was greatest for Black Neutral targets (M = 3.0, SD = 0.7) and lowest for White Neutral targets (M = 2.1, SD = 1.0). More specifically, accuracy for Black neutral targets were significantly greater than Black Happy targets, t(62) = -3.01, p = .004; Asian Happy targets , t(62) = -4.52, p < .001; Asian Neutral targets, t(62) = -4.48, p < .001; White Happy targets, t(62) = 3.15, p = .003; White neutral targets, t(62) = 6.05, p < .001; and Hispanic neutral targets, t(62) = 3.92, p < .001. Accuracy for Black Happy targets were significantly greater White neutral targets, t(62) = 2.72, p = .008. Among other race targets, accuracy for Hispanic happy targets were significantly higher than Asian happy targets, t(62) = -2.40, p = .019; Asian neutral targets, t(62) = -2.41, p = .019; and White neutral targets, t(62) = 3.58, p = .001. Accuracy for Hispanic neutral targets were significantly greater than White neutral targets t(62) = 2.32, p = .024. Lastly, White happy faces were significantly greater than White neutral faces, t(62) = 2.83,

p = .006. In contrast, in the White group, no significant differences were found among any combination of target race or target emotion. Instead, White participants had equivalent accuracy on all targets. Figure 2 illustrates the three-way interaction on MCFR accuracy between participant race, target race and target emotion. Overall, for Black participants there is hierarchy of accuracy, favoring identification of Black target faces, especially neutral ones. Identification of White neutral faces followed by Asian faces were relatively the most difficult for the Black group. For White participants, no significant differences were found across target race for either happy or neutral expressions.

Response Times. For the three-way interaction effect, Mauchly's test of sphericity indicated that the assumption of sphericity was violated, $\chi2(2) = 33.244$, $p < .05$, therefore multivariate F statistics were used. There was homogeneity of variances, as assessed by Levene's test for equality of variances ($p > .05$). There was not a significant three-way interaction between participant race, target race, and target emotion, Wilks λ= .975, F (3, 111) = 0.95, p = .418, partial η^2 = .03, additionally no group interactions were observed. However, there was a statistically significant two-way interaction between target race and target emotion, Wilks λ= .785, F (3, 111) = 10.11, $p < .001$, partial η^2 = .22.

Therefore, simple main effects were run. Mean response times were significantly different among happy targets, Wilks λ= .736, F (3, 112) = 13.364, $p < .001$, partial η^2 = .26, and neutral targets, Wilks λ= .894, F (3, 112) = 4.438, p = .004, partial η^2 = .11. Pairwise comparisons of happy targets revealed that mean response times were significantly slower for White targets than for Black (p = .020) or Hispanic (p = .003) targets. Among neutral targets, response times were significantly slower for Asian targets than for Black ($p < .001$), Hispanic (p = .007), or White targets ($p < .001$). Pairwise comparisons within each target race revealed that mean response times were significantly different for happy and neutral targets among Asian targets, Wilks λ= .917, *F* (1, 114) = 10.39, *p* =.002, partial η^2 = .08; Black targets, Wilks λ= .937, *F* (1, 114) = 7.61, *p* =.007, partial η^2 = .06; and White targets, Wilks λ= .884, *F* (1, 114) = 15.01, *p* < .001, partial η^2 = .12; but not for Hispanic targets, Wilks λ= .987, *F* (1, 114) = 1.48, *p* =.226, partial η^2 = .01. Specifically, among Asian targets, response times were slower to neutral targets, *M* = 3873 (*SD* = 1818) compared to happy faces, *M* = 3346 (SD = 1496). However, an opposite effect was observed for Black and White targets. Among Black and White targets, response times were significantly slower to happy targets (Black *M* = 3243, SD = 1313; White *M* = 3556, *SD* = 1440) compared to neutral targets (Black *M* = 2976, *SD* = 1170; White *M* = 3154, *SD* = 1136).

To further evaluate the nature of the interactions, paired-samples t tests were used to make post hoc comparisons between all possible conditions. Response times for Asian Neutral targets (M = 3873, SD = 1818) were significantly slower than all other combinations of target race and target emotion. More specifically, response times for Asian Neutral targets were significantly slower than Asian Happy targets, *t*(114) = 3.22, *p* = .002; Black Happy targets, *t*(114) = 4.22, *p* < .001; Black Neutral targets, *t*(114) = 6.04, *p* < .001; Hispanic Happy targets, *t*(114) = 4.53, *p* < .001; Hispanic Neutral targets, *t*(114) = 3.33, *p* = .001; White Happy targets, *t*(114) = 2.07, *p* = .041; and White Neutral targets, *t*(114) = 4.53, *p* < .001. Asian Happy targets were significantly slower than Black Neutral Targets, *t*(114) = 3.46, *p* = .001, and White Neutral Targets, *t*(114) = 2.01, *p* = 047. Black Happy targets were significantly slower than Black Neutral targets, *t*(114) = 2.76, *p* = .007. Hispanic Happy targets were significantly slower than Black Neutral targets, *t*(114) = 2.30, *p* = .023. Hispanic Neutral targets were significantly slower than Black Neutral targets, *t*(114) = 3.06, *p* = .003. White Happy targets were significantly slower than all targets except for Asian neutral targets, including Asian Happy targets *t*(114) = 2.24, *p* = .027; Black Happy targets,

$t(114) = 3.00$, $p = .003$; Black Neutral targets $t(114) = 5.13$, $p < .001$; Hispanic Happy targets, $t(114) = 3.60$, $p < .001$; Hispanic Neutral targets, $t(114) = 2.31$, $p = .023$; and White Neutral targets $t(114) = 3.86$, $p < .001$. Lastly, White Neutral targets were significantly slower than Black Neutral targets $t(114) = 2.10$, $p = .038$. Figure 3 illustrates the interaction of MCFR response times between target race and target emotion.

Overall, participants were fastest to respond to Black targets and slowest to respond to Asian targets. However, different trends emerged when considering target emotional expression. Response time was faster for happy faces than neutral faces if the targets were either Asian or Hispanic. However, the opposite pattern was observed for Black and White targets, in which response times were faster for neutral faces than happy faces. Notably, although Black participants were faster to respond to White neutral faces than all other-race faces, their accuracy for White neutral faces was lower than all other targets. Whereas White participants showed equivalent accuracy for all the targets regardless of their response time to the stimuli.

Aim 4: Explore the consumer acceptability of the MCFR

Difficulty. Participants completed a post-test survey to gain insight into their expereinces with the computerized measures. Participants rated the difficulty of the RMT-F and MCFR using 5-point scales, with response alternatives ranging from *very easy* to *very hard*. Mann-Whitney test indicated that the Black and White participant groups did not differ in the difficulty ratings for RMT-F (Black group, mean rank = 60.23, White group mean rank = 55.30, $Z = -0.84$, $p = .403$). Similarly, the groups did not differ significantly for rated difficulty of the MCFR (Black group, mean rank = 62.00, White group mean rank = 53.15, $Z = -1.50$, $p = .133$). Notably, no participants in the Black group rated the MCFR as “very hard.”

Likeability. When asked to identify which test they liked the most, 21 particiapnts reported liking the RMT-F the most, 50 participants reported liking the MCFR the most, and the remaining participants chose a different test in the battery (*n* = 27), or said that all tests were equal in preference (*n* = 16). When asked to identify which test they liked the least, 31 participants reported the RMT-F, 10 reported the MCFR, 66 reported a different test in the battery, and 7 reported that all tests were disliked equally. This information was then combined into a single likeablity variable, in that participants were identified as as liking the MCFR over the RMT-F if they rated the MCFR as the test they liked the most, or the RMT-F as the test they liked the least. Similarly, participants who stated they liked the RMT-F the most, or the MCFR the least were identified as liking the RMT-F over the MCFR. Based on this reclassification, of 96 participants who expressed a preference for one of the two tests, the number of participants who preferred the MCFR (*n* = 67) and RMT (*n* = 29) did not significantly differ between the Black and White participant groups, $X^2(1, N = 96) = 0.75$, $p = .338$. However, there was a significant difference in which test was liked most, with the majority of participants in both groups preferring the MCFR (69.8%) over the RMT-F (30.2%), $X^2(1, N = 96) = 96.00$, $p < .001$.

Subjective Performance. Participants were also asked to identify the measures on which they believed they performed best and worst. When asked to select the test on which they performed the best, 46 participants stated the RMT-F, 42 stated the MCFR, 21 reported another test, and 4 reported they thought they performed equally on all measures. When asked to describe which test they believed they performed the worst on, 23 reported the RMT-F, 10 reported the MCFR, 76 reported another test, and 3 reported performing equally poorly on all measures. This information was then combined into a single subjective performance variable, in that participants were classified as subjectively performing better on the RMT-F relative to the MCFR, if they rated the RMT-F as their best performance or if they rated some other measure as their best while also rating the MCFR as their worst performance. Likewise, participants were classified as subjectively performing better on the MCFR relative to the RMT-F, if they rated the MCFR as their best performance, or if they rated some other measure as their best while also rating the RMT-F as their worst performance. Based on this reclassification the ratio of participants who rated their best performance on MCFR and RMT did not significantly differ between the Black and White participant groups, $X^2(1, n= 109) = 0.392$, $p = .531$. Black participants reported that they thought they performed better on the MCFR (55.0%) than the RMT-F (45.0%), but this difference was not significant. There was, however, a significant relationship between which test participants reported liking the most and ratings of their subjective performance, in that participants were more likely to like the test on which they thought they performed best, $X^2(1, N = 95) = 23.42$, $p < .001$.

Objective Performance. In examining accuracy scores on the RMT-F and MCFR, 75.7% ($n = 87$) of participants performed objectively better on the RMT-F than on the MCFR. Compared to their subjective ratings, only 45.2% ($n = 52$) of participants believed they performed better on the RMT-F than the MCFR, and 49.6% believed they performed better on the MCFR than RMT-F. The concordance between objective and subjective performance was poor: 36.1% of participants correctly identified themselves as having performed relatively better on the RMT-F than the MCFR, and 13.0% correctly identified themselves as having performed relatively better on the MCFR than RMT-F. Objective performance was not related to likeability $X^2(1, N = 95) = .736$, $p = .391$.

CHAPTER 4: DISCUSSION

The present findings indicate that there are nuanced differences in face processing by racial group membership that are influenced by racial similarity-dissimilarity, as well as the by the emotional expression of the face observed. These findings support prior research observing own-race bias (ORB) in other populations (Hilliar, Kemp, & Denson, 2010; Marsh et al., 2016; Teitelbaum & Geiselman, 1997); the findings also extend prior research by demonstrating these effects in a neurological sample with cognitive impairment. Notably, in the current study there were different own-race bias effects between groups, such that ORB – superior recognition of own versus other race targets – was only observed within the Black group, and specifically for neutral expressions. Although the White group showed equivalent accuracy for racial group targets, they did show a unique pattern of processing that was contrary to the typically robust phenomenon of the speed-accuracy tradeoff, which was observed as expected among the Black participant group. Moreover, the current findings are also consistent with prior research that indicates that emotional awareness and negative mood states influence face memory (Johnson & Fredrickson, 2005; Leppänen, Milders, Bell, Terriere, & Hietanen, 2004; Pine et al., 2004); however, this pattern too was observed only in the White group. Contrary to expectation, the experienced pleasantness of the faces presented were not related to face memory in either group. Reliability of the Multicultural Face Recognition Test (MCFR) was low, yet it demonstrated evidence of construct validity as predicted by theory and was most related to the standard measure of face recognition, the Warrington Memory Recognition Test for Faces (RMT-F), and other visual memory measures. Despite these mixed outcomes, ratings of consumer feedback indicated that both groups rated the MCFR more favorably than the traditional, unicultural RMT-F.

Psychometric Properties of MCFR

The reliability of the MCFR in the present sample is below expectation and is currently not satisfactory for research or clinical use. The reason for low reliability of this measure is unclear. No floor or ceiling effects were observed, and accuracy was equivalent between groups; however, it is notable that no one in the sample obtained 100% accuracy, and the average score was only 62%. This average score was substantially lower than the criterion measure in the battery, the RMT-F, with a large effect. Additionally, the average score on the MCFR is lower than observed in many experimental paradigms testing face recognition and emotion perception (Derntl, Seidel, Kryspin-Exner, Hasmann, & Dobmeier, 2009), and considerably lower than the average scores of popular forced-choice recognition tests used to assess performance validity, such as the Test of Memory Malingering and the Medical Symptom Validity Test (P. Green, 2008; Tombaugh & Tombaugh, 1996), which typically show very high scores and ceiling effects for accuracy even among persons with cognitive impairments. These comparisons indicate that the MCFR was more challenging than expected for this sample.

On the MCFR, each of the target actors appear as both a stimulus to be recalled showing a happy or neutral expression and also as a foil, with the alternate facial expression (happy or neutral). Participants therefore had to remember the target and the target's facial expression, which is a more challenging task than traditional face recognition memory measures. Prior research indicates that individuals with acquired brain injuries (ABI) have difficulty distinguishing emotional expressions (Babbage et al., 2011; Biszak & Babbage, 2014; Braun, Traue, Frisch, Deighton, & Kessler, 2005; Harciarek, Heilman, & Jodzio, 2006; Knox & Douglas, 2009; Yuvaraj, Murugappan, Norlinah, Sundaraj, & Khairiyah, 2013). As such, the participants in the study may have underperformed or inconsistently performed on the MCFR, as they are more likely to struggle with detecting expressive differences between the target and foils than adults without ABI. Despite the MCFR's low reliability, it is notable the task demonstrated evidence of convergent and discriminant validity as expected by theory. For example, the MCFR was more strongly associated with other measures of visual memory than with verbal memory or other cognitive tasks. Compared to the RMT-F, the MCFR appears to have stronger associations with the expected visual memory domains. In this study, the RMT-F had associations with a wide variety of domains, suggesting that it is a nonspecific memory measure compared to the MCFR. Thus, in some regards, the MCFR appeared to show superior validity to the RMT-F as a measure of face recognition memory. This set of results regarding validity is a very odd companion to the very low reliability, because it is not possible for validity to exceed to reliability (i.e., theoretically and psychometrically, reliability places an upper bound on validity; Anastasi, 1997). Taken together, the findings suggest that an internal consistency calculated for the MCFR via classical test theory is not capturing the measure's true reliability. Reasons for this phenomenon are beyond the scope of this dissertation, but they may be resolved via sophisticated examinations of the scale's reliability, such as Item Response Theory approaches (R. J. Cohen & Swerdlik, 2018).

There were no group differences in performance on the MCFR or RMT-F. However, it is worth noting that average performance on the RMT-F in the current sample was somewhat lower than performance found in other samples of patients with neurological impairments (Malina et al., 1998). Despite this observation, both groups in the current study had higher accuracy and faster response times on the RMT-F compared to the MCFR. Although it is not fully aligned with predictions, this finding is consistent with the literature suggesting that the additional visual cues provided by the non-standard photographs used in the RMT-F (e.g., differences in clothing, angle, lighting, etc.) inflate accuracy and speed response time via recognition of non-facial stimuli

(Duchaine & Weidenfeld, 2003). In case studies of patients with developmental prosopagnosia, patients scored within the normal range (84-88% accuracy) on the RMT-F due to this additional content despite impairments on tests of familiar and unfamiliar face recognition (Duchaine, 2000; Nunn, Postma, & Pearson, 2001). Further, Nunn et al. (2001) found that when the surrounding non-facial information was removed from the RMT-F images, the patient's score dropped by over 20%. Interestingly, the accuracy rate of the RMT-F without non-facial information in the Nunn et al., study is comparable to the accuracy rate of the MCFR found in the current study (62% vs. 61.6%, respectively).

Emotional influences on Face Processing

Both groups rated images on the unicultural measure as pleasant more frequently than images on the MCFR. This finding is contrary to expectation; moreover, contrary to prediction, pleasantness ratings were not associated with performance on either measure. This finding may be related to subjective differences of how pleasantness was conceptualized by study participants. Pleasantness may be synonymous for a variety of positively-valenced characteristics, including agreeableness, pleasurableness, or attractiveness. Prior research indicates that these subjective ratings may lead to different outcomes in facial recognition. Studies involving children's performance on the RMT-F found similar outcomes to the present study, such that their ratings of "niceness" did not influence their performance on face memory (Lawrence et al., 2008). However, studies of attractiveness and face memory yield different results. Shepherd and Ellis (1973) found that average-looking faces had higher recognition than faces rated as having high or low attractiveness. Subsequent studies have observed similar patterns, in that although attractive faces are rated more favorably than unattractive faces, unattractive faces tend to have greater recognition (Light, Hollander, & Kayra-Stuart, 1981; Wiese, Altmann, & Schweinberger, 2014). Although the all-white/all-male RMT-F is less diverse than the MCFR in terms of race and gender, subjectively, attractiveness of the faces varies more on the RMT-F than the MCFR, especially because the hairstyles and outfits are dated and would likely be experienced as unusual. Perceived attractiveness, rather than pleasantness ratings, may have contributed to higher accuracy scores on the RMT-F as compared to the MCFR. Feedback provided by the study participants frequently described images on the RMT-F as unappealing compared to their ratings of images on the MCFR, which may have led to higher accuracy on the RMT-F due to the targets' unattractiveness.

In the current study, face recognition showed small, but reliable, inverse associations with alexithymia (low awareness of emotions) and experience of negative emotion. These findings are consistent with prior research which indicates that poor emotional awareness (i.e., alexithymia) inhibits accuracy of facial information. For example, Takahashi, Hirano, and Gyoba (2015) studied Japanese adults and found that participants high on alexithymia demonstrated impairments in recalling happy faces compared to angry faces. Others have reported that alexithymia suppresses memory for both verbal and nonverbal information (DiStefano & Koven, 2012), including emotionally-valenced information (Apgáua & Jaeger, 2019; Meltzer & Nielson, 2010). Prior research also indicates that negative dispositions may alter face memory. Specifically, individuals with disorders characterized by negative affect, such as depression, have enhanced face memory for negatively-valenced expressions (Ridout, Astell, Reid, Glen, & O'Carroll, 2003).

Surprisingly, in the present sample, these patterns were found exclusively in the White group. Among White participants, there was a small but reliable inverse association between low emotional awareness (alexithymia) and performance on both face recognition measures. Likewise, for White participants, negative emotionality was inversely associated with response times on both measures, and accuracy scores on the unicultural measure. This pattern was not observed in the

Black group and may reflect cultural differences in emotional experiences and expression. Additionally, most common psychological measures are developed by and for members of the majority culture, and therefore, they may not capture minority experiences well.

Racial Differences in Face Processing

Other racially distinct patterns of performance emerged in this study as well. On the MCFR, White participants' accuracy was equivalent overall among the combinations of target races and expressions (neutral and happy). However, trends emerged, as White participants performed best on White targets with neutral expressions, which lends support to the presence of own-race bias. Their performance on other-race faces was also slightly better for those with neutral expressions, which is contrary to prediction for general ORB effects, but in the expected direction given the White group's relatively higher levels of negative affectivity. This trend may suggest that White members specifically perceived neutral faces of Whites, Blacks and Asians as negatively valenced (Ridout et al., 2003), therefore making them more memorable targets in this group. Alternatively, the White group's performance could also indicate that they misperceived neutral expressions of Black and Asian targets as happy. Zebrowitz, Kikuchi, and Fellous (2010) found that Black and Asian faces with neutral expressions are often perceived by white raters as more positively valenced. Their research indicates that Black and Asian faces have more structural similarity to positive expressions such as happiness and surprise (Zebrowitz et al., 2010). As such, the White participants in the current study may have experienced the targets on the MCFR as equivalently happy, despite differences in target expression, which would support this author's prediction.

Disparate findings for accuracy on the MCFR emerged within the Black group. Among Black participants, the highest accuracy was for same-race faces; however, they also performed substantially better for Black neutral targets than on Black happy targets. Additionally, their performance on Black neutral targets was remarkably better than all other-race targets. Outside of their own racial group, Black participants tended to perform better on other-race faces with happy expressions, which is in the predicted direction, but contrasts with the pattern observed in the White group. Members of the Black group performed most poorly on White neutral targets, followed by Asian targets with either happy or neutral expressions. The Black group's relatively poor performance with White neutral targets as compared to Black targets is not directly contrary to prior research that indicates that Black Americans are as or more adept at other-race identification of White targets compared to White Americans' identification of Black targets (Anderson, 1996; Cross et al., 1971; Lindsay et al., 1991; Talley, 2001). The pattern of strengths and weaknesses for Black participants was stronger as a within-group profile than between groups: Black participants exceeded Whites in accurately identifying Black targets, and although the trend was toward worse performance than Whites on White targets, it was a small (albeit not trivial) effect.

It is notable that the Black group was only relatively poor at recognizing neutral faces of White targets. Their performance on White happy targets was commensurate with their performance of Black happy targets, which is the predicted pattern and was has been established by prior studies. Thus, there is potentially some unique quality of White neutral faces that inhibited performance of Black participants. Prior research has found that neutral expressions on White faces show greater resemblance to angry expressions than Black or Asian faces with neutral expressions (Zebrowitz et al., 2010). Although angry expressions generally result in superior face recognition (Ackerman et al., 2006; Fox et al., 2000), in ABI populations, both angry and neutral faces are often misidentified or misremembered (Callahan et al., 2011; Dethier et al., 2013;

McDonald et al., 2011; McMurray, 2001; Rosenberg et al., 2014; Zupan & Neumann, 2014). As such, the combination of own-race bias effects, poor emotion recognition, general memory deficits from ABI, and structural differences among different-race faces (Zebrowitz et al., 2010) may have compromised the Black group's accuracy of White neutral targets, specifically.

Regarding response times, there were group differences on response patterns by face memory task. Black participants tended to respond faster to all faces on both measures compared to White participants. Quicker response times in the Black group may be a manifestation of race-related hypervigilance developed from the chronic stressors of interpersonal and institutional racism and discrimination (Brooks Holliday et al., 2018; Carter & Forsyth, 2010; Helms, Nicolas, & Green, 2012). Further, the group difference in response time speed favoring the Black participants was substantial (medium effect size) and substantially larger for the all-white RMT-F as compared to the MCFR. Response speeds on the MCFR also appeared to favor the Black group consistently across each of the target race groups; however, the effect sizes were small and relatively much smaller than that observed on the RMT-F. This difference may reflect less hypervigilance among the Black participants in completing the multicultural measure as compared to the all-white unicultural scale.

On the MCFR, both groups were slower to neutral than happy faces of Asian and Hispanic targets, and faster to neutral than happy faces of Black and White targets. Both groups also showed expected patterns of relation among measures of other cognitive domains. For example, slowed processing speed was associated with worse performance on face recognition and other tasks. However, other response time patterns were distinct between groups. The Black group showed a pattern consistent with the well-established speed-accuracy tradeoff on the MCFR: Accuracy increased as response time slowed. In contrast, among the White group, accuracy increased as response time speeded. Thus, the White group's unusual pattern of response times when viewing multicultural faces (MCFR) dissociated uniquely from the rest of the battery. Although own-race bias may be conceptualized as a phenomenon linked to relatively lower accuracy for other races (which was not observed for the White group), this combination of findings supports the notion that Black and White participants experienced the task substantially differently. The importance of this departure from the expected speed-accuracy tradeoff pattern is unclear, given that the White group showed equivalent accuracy for the different race targets; however, they were less accurate for Black targets than were Black participants, and the overall pattern suggests a subtle processing difference in experience that occurs prior to behavioral action.

For the Black participants with ABI, the combination of findings might raise the potential for concern regarding interpersonal functioning in a cross-cultural setting. As noted, both Black and White participants responded most quickly to neutral Black and White targets. This finding may be due to perceptual threats related to eye-gaze in the MCFR stimuli that were absent on the RMT-F. Targets on the RMT-F have varying gaze, facial orientation, and body postures; however, all stimuli on the MCFR face forward. Eye-tracking research indicates that direct-eye gaze is more negatively arousing and perceived as more threatening than averted gaze (Richeson, Todd, Trawalter, & Baird, 2008); this effect has been found in studies of other-race gaze with both Black and White targets (Richeson et al., 2008; Trawalter, Todd, Baird, & Richeson, 2008). These implicit threats may explain why Black and White neutral targets had the quickest response times in both groups. Additionally, it is possible that the White neutral faces on the MCFR were perceived by participants as more threatening than the White targets on the RMT-F related to differences in eye-gaze.

For Black participants there was also a hierarchy of accuracy on the MCFR, favoring identification of Black target faces, especially neutral ones, whereas White neutral faces were relatively the most difficult. Thus, for Black participants, responding fastest to neutral Black targets is benign, because they are also most accurate for them; however, responding fastest to neutral White targets is ***not*** necessarily benign, because they are significantly less accurate for them. The Black participants' fast-but-inaccurate response style to White neutral faces is likely due to the combined effects of overall poor emotion recognition, perceiving White neutral faces with direct-gaze as more hostile, and race-related hypervigilance. Race-related hypervigilance is considered a coping strategy for minority populations who must quickly detect potential racial threats, as they are more likely to be exposed to multicultural settings or circumstances where they are the overwhelming minority, and vulnerable to racial slights (Brooks Holliday et al., 2018; Carter & Forsyth, 2010; Helms et al., 2012). Prior research indicates that recognition accuracy for faces decreases during circumstances of high negative arousal and that this diminishing effect is greatest during brief viewing times (MacLin, MacLin, & Malpass, 2001). As such, the Black participants increased negative perceptual experiences to White neutral faces likely impaired their accuracy. Although White participants may have negatively perceived neutral targets as aggressive, they would not be affected by race-related vigilance, as they are the dominant racial group. Thus, the White group's accuracy for same- and other-race faces would be less influenced by response times which was observed in the current study. Research indicates that race-related vigilance is associated with a variety of health concerns and contributes to some of the health disparities between Black and white groups on a variety of disorders related to vascular health commonly associated with ABI, including hypertension, obesity, and sleep quality (Hicken, Lee, Ailshire, Burgard, & Williams, 2013; Hicken, Lee, & Hing, 2018; Hines, Pollack, LaVeist, & Thorpe, 2017).

Together, these findings are partly consistent with to the *contact hypothesis* (Chiroro & Valentine, 1995; Hancock & Rhodes, 2008; Meissner & Brigham, 2001; Wright et al., 2003). Metro Detroit, a tri-county region including Detroit city, is often considered "diverse" as it has a substantial non-white population. However, the demographics of each county and Detroit city separately, are quite distinct, with most of the Black and Hispanic population concentrated in Detroit City (Metzger & Booza, 2002a; U.S. Census Bureau, 2018). Likewise, the Asian population does not exceed 4% in any of these regions (Metzger & Booza, 2002b; U.S. Census Bureau, 2018). As such, most of Metro Detroit reflects the nation's majority white population with minority groups primarily clustered together in major cities and in specific suburbs (Logan & Stults, 2011). Neighborhoods in Metro Detroit remain largely segregated, especially within predominately white communities outside of Detroit City (New Detroit, 2014).

As such, participants in the current study have more opportunities for interactions with Black and white community members, as they represent most of the population in the Metro Detroit area (Metzger & Booza, 2002a; New Detroit, 2014; U.S. Census Bureau, 2018). Likewise, both groups will have fewer opportunities for interactions with Asians, as there are fewer of this population local to this region. Therefore, Black participants would be doubly primed to excel relatively in identifying Black targets, influenced by both own-race effects as well as demographic effects of contact primarily with Black people. Black participants were also more adept at recalling facial information of Hispanic targets presumably because they have relatively more contact with Hispanic people than Asian people, who represent only 4% of the Metro Detroit population and are not concentrated in the urban city center. Based on the contact hypothesis, Black participants should be proficient at identifying White faces; however, in the current study their skillfulness depended on the emotional expression of White targets. Most Black participants in the study were recruited within Detroit city; however, only 10% of Detroit city residents are white (U.S. Census Bureau, 2018). Thus, Black participants would most likely have superficial encounters with most white people they encounter in Detroit, via exchanges of goods and services in which positive facial expressions would be the norm.

The contact hypothesis, however, does not hold up as well in the White group. Own-race bias trends were observed in the study participants, though to a lesser extent than among Black participants. Examining group differences, White participants were inferior to Black participants in identifying Black targets and showed a small edge for identifying White targets; however, the within-group profile of differences across race targets showed a subtler pattern. Presumably, White participants in Metro Detroit are likely to have more interactions with Black people than do most white people in America, and fewer encounters with Asian and Hispanic people based on regional demographics. However, the White participants' pattern of responses may indicate that the enhancing effects of own-race bias are offset by the benefits of contact with non-white people in the metro region, despite high rates of residentially segregated neighborhoods.

Consumer Response to MCFR

As predicted, the MCFR was rated favorably by both groups compared to the RMT-F. Both groups believed they performed better on the MCFR, despite the fact that the majority of participants objectively performed better on the RMT-F. Participants experienced the MCFR as equivalent in difficulty to the RMT-F. There were no meaningful differences in experience of difficulty or subjective performance on the MCFR or RMT-F, indicating that the MCFR demonstrated comparable face validity to the RMT-F in those regards. Although no remarkable differences emerged between the groups, Black participants reported more favorable consumer responses to the MCFR in the predicted direction. Nearly three of four Black participants reported preferring the MCFR compared to the RMT- F, and Black participants had fewer instances of reporting the MCFR as "difficult" or "very difficult." Black participants also subjectively experienced their performance as better on the MCFR, whereas White participants' subjective experiences of their performance was equivalent for the two measures. Regardless of their subjective ratings, objectively, both groups performed better on the RMT-F.

Importantly, open-ended feedback from the participants varied greatly by test. Consistent with the literature, participants noted that the RMT-F was "easier" due to differences in apparel as well as distinctive facial features (Duchaine & Weidenfeld, 2003). However, an unexpected finding was that both groups provided negative feedback about the RMT-F targets, describing the faces as "ugly," "unattractive," "untrustworthy," "angry," "disturbing" and looking like "mugshots." Also, although questions about race were asked regarding either face memory task, unprompted racial themes emerged, specifically for the RMT-F. Participants commented on the lack of racial diversity in the task; for example, stating "They're all white people," and "Why are there no Black people?" Some participants had more visceral reactions, stating that the RMT-F targets looked like "racists," and "old slave owners." Racial themes were mostly absent in feedback on the MCFR; one participant noted that they enjoyed having "different cultures" featured on the task and another commented that "all the sistas [Black women] looked pleasant." Most of the other feedback on the MCFR was regarding differences in target emotion and anticipated memory differences for male and female targets.

The differences in feedback observed in this study strongly suggest that the RMT-F targets were not perceived as neutral by the sample. The negative evaluations of the RMT-F targets may have contributed to increased recognition compared to the MCFR, as perceived social traits can influence face memory. Specifically, memory for targets that are perceived as untrustworthy or unlikeable are greater than other positive or neutral social traits (Rule, Slepian, & Ambady, 2012). Although these negative social traits represent social projections by the participants, given that both Black and White participants found the RMT-F targets aversive and that there are recognition advantages for negative and distinctive stimuli, neuropsychology is long overdue to update or replace the RMT-F with another measure that elicits less of a negative response and is more representative of current cultural, racial, and gender diversity. The MCFR has demonstrated that it is perceived more neutrally, rated more favorably, and addresses many of the RMT-F's shortcomings. Therefore, with further psychometric development, the MCFR has the potential to become the more culturally competent assessment.

Limitations and Future Research

The primary limitation of the current study is that details regarding the location and severity of the participants' brain injuries were not reported. Although all participants reported a history of hospitalization for their injuries, medical records confirming their injuries, such as Glasgow Coma Scale scores or neuroimaging, were not available for all group members. Further, some participants reported a history of multiple ABIs, which may have had complicated the deleterious effects on their overall performance. As such, participants in the current study represent a heterogeneous collection of injury types, which may have dampened the findings. Right- and left-hemispheric injuries typically are associated with visual and verbal memory processing, respectively (Ariza, Pueyo, et al., 2006); but it is unknown whether right and left hemispheric injuries were equally represented in both groups. Likewise, traumatic and non-traumatic brain injuries may represent distinctly different populations in terms of performance on the MCFR, as traumatic injuries are commonly accompanied by other physical and psychological injuries compared to non-traumatic injuries such as stroke. Lastly, rehabilitative history was also unknown in the present sample. Given what is already known about racial disparities in rehabilitative care, it is possible that these groups received unequal care that may have influenced their performance. Future research therefore should also include this critical background medical information regarding the participants' injury and course of care.

Further evaluation of the psychometric properties of the MCFR is needed. The MCFR demonstrated limited reliability in the sample though there was evidence of convergent validity with the RMT-F. Including foils that are more distinct from targets may lower the difficulty level and help to improve reliability of this measure, as well as make the design of the MCFR more commensurate with the RMT-F. Alternatively, updating the MCFR instructions to inform participants at the beginning of the task that targets will also be foils may help improve reliability.

Normative information regarding using computerized versions of MCFR and RMT-F should also be explored, as people with ABI often have motor impairments and slowed processing speeds that may independently diminish their performance on computerized measures. Future research could also evaluate own-age and own-gender biases in a variety of populations. The targets on the MCFR appear substantially younger than targets on the RMT-F, which may create an advantage for younger participants, although this was not observed in the current sample. Own-gender biases have been found in other research, so it is also worth investigating this phenomenon with multicultural images (Gur et al., 2001).

Given the group differences, replication of this study is warranted. Participants with acquired brain injuries from other racial backgrounds should also be evaluated to investigate whether these findings replicate in Asian, Hispanic or multiracial persons. This endeavor may require broadening recruitment beyond the Metro Detroit region, as neighborhoods in southeastern Michigan remain racially and ethnically separated (New Detroit, 2014). Additional information regarding the participants' exposure to other cultural groups should also be pursued to further evaluate the contact hypothesis of ORB. This kind of information would provide a direct test of the contact hypothesis, as compared to assuming the nature of contact experienced by examinees solely from their own race and where they were recruited.

Conclusions

This is the first study to evaluate own-race bias (ORB) in a neurologically impaired sample. The Multicultural Facial Recognition Test (MCFR) was modeled after a commonly used recognition paradigm, akin to the Warrington Recognition Memory Test for Faces (RMT-F). However, unlike the Warrington and other measures of face recognition memory, the MCFR incorporated faces from four different ethnicities, and it used well-vetted and validated stimuli presenting two distinct facial expressions. As such, the MCFR addresses common criticisms of the RMT-F and similar measures, by including gender and racial diversity as well as standardized materials in terms of facial expressions and apparel.

Evidence of ORB was demonstrated in this neurologically impaired sample but was more nuanced that predicted. Although the traditional concept of own-race bias as evidenced in superior recall for own- versus other-race targets was observed only among Black participants, White participants showed evidence that they experienced the MCFR differently than did the Black participants. White participants generally responded with equivalent accuracy to targets regardless of target race or expression, but they appeared process the images more slowly and uniquely before responding as compared to Black participants. Black participants demonstrated superior recognition memory for Black targets, in direct support of ORB. In general these findings lend support to the contact hypothesis, as Black participants were most accurate for faces of individuals from races with whom they are most likely to have contact with given the racial demographics of Metro Detroit (i.e., Black and Hispanic), and they struggled most in recognizing and recalling faces of individuals from races underrepresented in their region, specifically Asian adults showing neutral expressions. Of particular importance is the finding that Black participants struggled most in accurately identifying and recalling faces of White people providing neutral expressions. This response pattern could indicate that Black participants perceived neutral White faces as threatening, in part, due to race-related hypervigilance which could quicken responses, but compromise accuracy. Race-related hypervigilance is associated with a variety of health disparities between Black and white groups (Hicken et al., 2013; Hicken et al., 2018; Hines et al., 2017), which may further disenfranchise Black patients. Most general practitioners are White or Asian (76% and 8% respectively; Xierali & Nivet, 2018); these demographics hold true with increases of Asian providers for a variety of specialty physicians that individuals with neurological injury are likely to encounter, including psychiatrists, neurologists, cardiologists, and surgeons from multiple disciplines (Peckham, 2017a, 2017b, 2017c; US Census Bureau). Although there have been substantial increases in minorities in the overall field of psychology, Black, Asian, and Hispanic professionals are still grossly underrepresented (American Psychological Association, 2015). The specialty field of Neuropsychology has not substantially increased in diversity, maintaining marginal rates of Black, Asian, and Hispanic neuropsychologists (Elbulok-Charcape, Rabin, Spadaccini, & Barr, 2014; Hill-Briggs, Evans, & Norman, 2004; Sweet, Benson, Nelson, & Moberg, 2015). Practicing neuropsychologists of all backgrounds cite challenges in appropriately assessing multicultural patients, many citing lack of appropriate measures, norms, and ecological validity of assessments (Elbulok-Charcape et al., 2014).

Taken together, both Black and white patients with ABI are likely to encounter medical providers different from their own racial background; however, Black patients are more likely to have other-race providers in every domain of physical and mental healthcare. The implications of the current study's findings suggest that Black patients may be more likely to experience neutrally expressive white providers as negative or hostile, which may inhibit their access or adherence to medical care. In turn, this phenomenon may contribute to widening health disparities between Black and white patients. Further, Black patients with ABI who do seek appropriate neuropsychological assessment and interventions are likely to be evaluated with measures that include constructs that may only be valid to members of the dominant culture (Helms, 1992; Manly, 2008; Manly & Echemendia, 2007; Pontón & Ardila, 1999). Although race-adjusted norms are a step in the right direction, they are not available for all tests, and depending on how they are applied can lead to misdiagnoses, including disparately over-or under-pathologizing different cultural groups (Manly & Echemendia, 2007).

Tests designed from a multicultural framework, such as the MCFR, have the potential to address some of the systemic racial disparities found in traditional neuropsychological measures. The MCFR demonstrated some evidence of equivalence to the RMT-F as an appropriate face recognition memory task and importantly, and it was preferred over the RMT-F by both Black and White examinees with ABI. This new measure showed sensitivity to detect subtle differences in processing of multicultural faces among both Black and White examinees, which is evidence in support of its validity and potential usefulness. However, despite the fact that the test design parallels the most popular and well-established measures of face recognition memory, and it employed extremely well-vetted stimulus materials, it showed critical limitations. These limitations and mysteries regarding its psychometric properties (i.e., low reliability in the presence of evidence for validity) prevent it from being acceptable as an applied clinical measure in its current form. Nonetheless, the present study highlights the necessity for the development of multicultural measures of face and emotion recognition and memory, as the multicultural task was experienced distinctively by two racial groups. This disparity emphasizes the need for the inclusion of multicultural participants in clinical research, as findings from the dominant culture may not generalize to minority populations. Despite differences in face processing, both groups preferred the multicultural task as the more up to date and representative measure, which may reflect a societal shift in a desire for more integrated assessment tools. As such, further evaluation of the psychometric properties of the MCFR should be pursued.

APPENDIX A (TABLES)

Table 1.

Demographic Information for Black (n = 63), White (n = 52), and Total (N = 115) Sample

	Black (*n* = 63)		White (*n* = 52)		Total (*N = 115)*		
Variable	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*Range*
Age (years)	55.5	(12 .3)	58.1	(14.6)	56.7	(13.4)	23 – 79
Education (years)	13.9	(2.5)	14.5	(2.7)	14.1	(2.6)	7 – 20
Time Since Injury (years)	12.8	(10.4)	11.6	(10.8)	12.3	(10.5)	0.4 – 40
Sex (Percent)							
Men	61.9		53.8		58.3		
Women	38.1		46.2		41.7		
Injury Type (Percent)							
TBI	52.4		48.1		50.4		
Stroke	47.6		50.9		49.6		

Note. TBI = traumatic brain injury.

Table 2.

Descriptive Statistics and Group Comparisons for Cognitive Tests for Black and White Participants

	Black (n = 63)		*White* (n = 52)		*Total* (N = 115)					
Variable	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*Range*	*df*	*t*	*d*
RMT-F Percent Correct	69.6	(12.5)	70.7	(10.7)	70.1	(11.8)	38.0 – 98.0	112	0.24	0.09
MCFR Percent Correct	61.6	(9.9)	61.7	(10.4)	61.6	(10.1)	34.4 – 87.5	113	0.01	0.01
HVLT Total Recall	18.9	(5.3)	20.5	(6.4)	19.6	(5.8)	5 – 34	113	1.47	0.27
HVLT Delayed Recall	5.2	(3.4)	6.3	(3.6)	5.7	(3.5)	0 – 12	113	1.63	0.31
HVLT Discrimination	8.4	(2.9)	9.5	(2.2)	8.9	(2.7)	0 – 12	113	2.33^{*}	0.44
BVMT Total Recall	10.9	(7.3)	16.5	(8.4)	13.4	(8.2)	0 – 34	113	3.86^{**}	0.72
BVMT Delayed Recall	4.2	(3.0)	6.9	(3.0)	5.4	(3.3)	0 – 12	113	4.82^{**}	0.90
BVMT Discrimination	4.7	(1.6)	5.5	(0.8)	5.1	(1.4)	-1 – 6	111	3.33^{**}	0.63
Digit Span Total	21.2	(5.3)	23.4	(5.7)	22.2	(5.6)	9 – 34	112	2.17^{*}	0.41
Digit Span Forward	8.3	(2.1)	8.8	(2.1)	8.5	(2.1)	2 – 13	113	1.27	0.24
Digit Span Backward	6.8	(2.0)	7.2	(2.1)	7.0	(2.0)	2 – 12	112	0.88	0.16
Trails A	51.0	(20.7)	49.3	(25.0)	50.2	(22.7)	14 – 99	112	0.38	0.07
Trails B	172.2	(82.8)	137.8	(94.7)	156.8	(89.6)	37 – 300	112	2.07^{*}	0.39

Note. BVMT = Brief Visuospatial Memory Test-Revised; HVLT = Hopkins Verbal Learning Test- Revised; Digit Span variables are from the Wechsler Adult Intelligence Scale, 4th edition; Trails A and Trails B are from the Trail Making Test.
$^{*}p < .05$, $^{**}p < .01$.

Table 3**.**

Descriptive Statistics and Group Comparisons for Measures of Affect for Black and White Participants

	Black (n = 63)		*White* (n = 52)		*Total* (N = 115)					
Variable	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*Range*	*df*	*t*	*d*
TAS	50.4	(12.0)	50.1	(11.3)	50.3	(11.6)	26 – 74	112	0.11	0.02
AIM	150.9	(20.8)	144.6	(24.0)	148.1	(22.4)	102 – 200	107	1.45	0.28
PANAS – Positive Affect	37.8	(7.1)	33.4	(7.7)	35.8	(7.7)	18 – 50	111	3.16^{**}	0.60
PANAS – Negative Affect	14.5	(5.3)	13.7	(4.8)	14.1	(5.1)	10 – 28	111	0.92	0.17

Note. TAS = Toronto Alexithymia Scale -20; AIM = Affect Intensity Measure; PANAS = Positive and Negative Affect Schedule.
$^{*}p < .05$, $^{**}p < .01$.

Table 4.

Internal Consistency Reliability Group Comparisons for Black and White Participants

	Black (n = 63)	*White* (n = 52)	*Total* (N = 115)
Variable			
RMT-F Total (50 items)[1]	.76	.68	.73
MCFR Total (32 items)[1]	.31	.38	.34
Target Emotion (16 items each)			
MCFR Happy Target	.23	.26	.24
MCFR Neutral Target	.12	.28	.19
Target Race (8 items each)			
MCFR Asian Target	.09	-.45	-.10
MCFR Black Target	-.05	.06	.03
MCFR Hispanic Target	-.21	-.08	-.15
MCFR White Target	-.00	.33	.17
Target Emotion and Race (4 items each)			
Asian Happy	-.11	-.24	-.19
Asian Neutral	-.10	-.27	.08
Black Happy	-.09	-.07	-.07
Black Neutral	-.31	.12	-.05
Hispanic Happy	.15	.13	.12
Hispanic Neutral	-.59	-.26	-.42
White Happy	-.52	.27	-.10
White Neutral	.17	.09	.17

1. KR-20 = Kuder-Richardson Formula 20 coefficient (Lord & Novick, 1968).

Note. MCFR = Multicultural Test of Facial Recognition; RMT = Warrington Recognition Memory Test for Faces. $^{*}p < .05$, $^{**}p < .01$.

Table 5a.

Correlations Between Facial Recognition Tests Accuracy and Response Times for Total Sample (N = 115)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. MCFR Percent Correct	1.00																
2. MCFR Total RT	-.01	1.00															
3. RMT Percent Correct	.44**	-.05	1.00														
4. RMT Total RT	-.10	.75**	-.12	1.00													
5. HVLT Total Recall	.17*	-.06	.40**	-.02	1.00												
6. HVLT Delayed	.27**	.05	.45**	.02	.77**	1.00											
7. HVLT Discrimination	.24**	.05	.40**	.08	.66**	.67**	1.00										
8. BVMT Total Recall	.32**	-.04	.45**	-.02	.44**	.41**	.39**	1.00									
9. BVMT Delayed	.26**	.04	.47**	.04	.43**	.41**	.42**	.90**	1.00								
10. BVMT Discrimination	.25**	.01	.42**	.02	.36**	.31**	.36**	.46**	.48**	1.00							
11. Digit Span Total	.12	.02	.26**	.13	.53**	.28**	.15	.50**	.45**	.34**	1.00						
12. Digit Span Forward	.08	-.07	.09	.10	.40**	.17*	.06	.31**	.29**	.19*	.77**	1.00					
13. Digit Span Backward	.12	.10	.20*	.17*	.33**	.17*	.01	.37**	.33**	.27**	.82**	.54**	1.00				
14. Trails A	-.28**	.24**	-.39**	.24**	-.40*	-.24**	-.22**	-.51**	-.45**	-.31**	-.46**	-.37**	-.34**	1.00			
15. Trails B	-.30**	.20*	-.47**	.16	-.51**	-.38**	-.28**	-.62**	-.57**	-.35**	-.58**	-.45**	-.42**	.74**	1.00		
16. Age	-.01	.17*	-.06	.25**	-.19	-.09	.04	-.39**	-.27**	-.08	-.22**	-.11	-.16*	.35**	.36**	1.00	
17. Education	.08	.15	.22**	.21*	.16*	.23	.26**	.20*	-18*	-.27**	.13	-.00	.11	.07	-.05	.21*	1.00
18. Time Since Injury	-.04	.01	-.20*	.03	-.04	.15	-.07	.13	-.10	-.16	-.02	.09	.00	.03	.05	.03	-.01

Note. MCFR = Multicultural Test of Facial Recognition; RMT-F = Warrington Recognition Memory Test for Faces.
*$p < .05$, **$p < .01$.

Table 5b

Correlations Between Facial Recognition Tests Accuracy and Response Times for Black Participants (n = 63).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. MCFR Percent Correct	1.00																
2. MCFR Total RT	.22*	1.00															
3. RMT Percent Correct	.51*	.04	1.00														
4. RMT Total RT	.20	.76**	-.00	1.00													
5. HVLT Total Recall	.31**	.13	.42**	.12	1.00												
6. HVLT Delayed	.45**	.18	.45**	.17	.70**	1.00											
7. HVLT Discrimination	.35**	.16	.40**	.16	.69**	.67**	1.00										
8. BVMT Total Recall	.43**	-.03	.54**	-.00	.38**	.35**	.32**	1.00									
9. BVMT Delayed	.37**	.06	.51**	.04	.44**	.35**	.34**	.89**	1.00								
10. BVMT Discrimination	.30**	.06	.52**	.06	.43**	.28*	.36**	.39**	.41**	1.00							
11. Digit Span Total	.24*	.05	.23*	.16	.44**	.16	.06	.38**	.39**	.23*	1.00						
12. Digit Span Forward	.21	-.05	.19	.11	.37**	.13	.04	.28*	.32**	.08	.78**	1.00					
13. Digit Span Backward	.30**	.10	.16	.17	.21*	-.01	-.13	.25*	.25*	.18	.82**	.60**	1.00				
14. Trails A	-.30**	.15	-.32**	.09	.41**	-.15	-.14	-.47*	-.39**	-.33**	-.46**	-.49**	-.33**	1.00			
15. Trails B	-.32**	.07	-.46**	.05	-.50**	-.36**	-.19	-.56**	-.50**	-.34**	-.52**	-.48**	-.40**	.61**	1.00		
16. Age	-.02	.02	-.07	.08	-.16	-.12	.11	-.34**	-.29*	-.07	-.31	-.22*	-.26*	.27*	.40**	1.00	
17. Education	.10	.10	.27*	.03	.16	.18	.26*	.05	.06	.31**	.00	-.16	-.06	.15	-.07	.33**	1.00
18. Time Since Injury	-.32**	.08	-.29*	.13	-.03	-.17	-.08	-.13	.02	-.20	.04	.12	.03	-.05	.02	.05	-.10

Note. MCFR = Multicultural Test of Facial Recognition; RMT-F = Warrington Recognition Memory Test for Faces.
$^{*}p < .05$, $^{**}p < .01$.

Table 5c.

Correlations Between Facial Recognition Tests Accuracy and Response Times for White Participants (n = 52)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. MCFR Percent Correct	1.00																
2. MCFR Total RT	-.27*	1.00															
3. RMT Percent Correct	.35**	-.18	1.00														
4. RMT Total RT	-.35**	.75**	-.28*	1.00													
5. HVLT Total Recall	.04	-.27*	.38**	-.18	1.00												
6. HVLT Delayed	.09	-.13	.45**	-.17	.82**	1.00											
7. HVLT Discrimination	.10	.18	.42**	-.13	.63**	.66**	1.00										
8. BVMT Total Recall	.26*	-.15	.37**	-.19	.45**	.42**	.41**	1.00									
9. BVMT Delayed	.18	-.09	.49**	-.18	.39**	.42**	.43**	.88**	1.00								
10. BVMT Discrimination	.22	-.29*	.18	-.30**	.27*	.34**	.19	.54**	.49**	1.00							
11. Digit Span Total	-.00	-.08	.22	.04	.58**	.37**	.21	.54**	.44**	.54**	1.00						
12. Digit Span Forward	-.07	-.13	-.04	.05	.42**	.19	.02	.31*	.19	.40**	.76**	1.00					
13. Digit Span Backward	-.08	.08	.24*	.14	.44**	.35**	.20	.47**	.41**	.48**	.82**	.46**	1.00				
14. Trails A	-.25*	.35**	-.48**	.37**	-.39**	-.32**	-.33**	-.59**	-.57**	-.37**	-.48**	-.26*	-.35**	1.00			
15. Trails B	-.28*	.41**	-.49**	.33**	-.48**	-.36**	-.34**	-.63**	-.61**	-.32*	-.60**	-.39**	-.42**	.86**	1.00		
16. Age	-.20	.29*	-.05	.34**	-.25*	-.09	-.11	-.55**	-.41**	-.23	-.19	-.02	-.08	.43**	.39**	1.00	
17. Education	.06	.18	.14	.32*	.14	.25*	.23*	.29*	.25*	.17	.21	.14	.29*	.00	.03	.07	1.00
18. Time Since Injury	.26*	-.06	-.07	-.02	-.03	-.12	-.03	-.12	-.19	-.04	-.06	.08	-.01	.10	.05	.02	-.11

Note. MCFR = Multicultural Test of Facial Recognition; RMT-F = Warrington Recognition Memory Test for Faces.
$^{*}p < .05$, $^{**}p < .01$.

Table 6.

Descriptive Statistics and Group Comparisons MCFR and RMT Pleasantness Ratings

	Black (n = 63)		*White* (n = 52)		*Total* (N = 115)					
Variable	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*Range*	*df*	*t*	*d*
MCFR Pleasantness (%)	58.6	(10.7)	60.8	(12.8)	59.6	(11.7)	59.6 – 91.5	113	-1.00	0.19
RMT Pleasantness (%)	70.0	(14.5)	71.4	(15.8)	70.6	(15.0)	70.6 – 100	113	-0.48	0.09

Note. MCFR = Multicultural Test of Facial Recognition; RMT = Warrington Recognition Memory Test for Faces.
$^{*}p < .05$, $^{**}p < .01$.

Table 7a.

Correlations of Memory and Ratings of Pleasantness for Total Sample (N = 115)

	1	2	3	4	5	6
1. MCFR Percent Correct	1.00					
2. MCFR Total RT	-.01	1.00				
3. MCFR Pleasantness (Percent)	-.12	.07	1.00			
4. RMT-F Percent Correct	.44**	-.05	-.08	1.00		
5. RMT Total RT	-.10	.75**	.04	-.12	1.00	
6. RMT Pleasantness (Percent)	-.13	-.01	.33**	.06	.08	1.00

Note. MCFR = Multicultural Test of Facial Recognition; RMT-F = Warrington Recognition Memory Test for Faces. $^{*}p < .05$, $^{**}p < .01$.

Table 7b.

Correlations of Memory and Ratings of Pleasantness for Black Participants (n = 63)

	1	2	3	4	5	6
1. MCFR Percent Correct	1.00					
2. MCFR Total RT	.22*	1.00				
3. MCFR Pleasantness (%)	-.17	-.07	1.00			
4. RMT-F Percent Correct	.51**	.04	-.08	1.00		
5. RMT Total RT	.20	.76**	-.02	-.00	1.00	
6. RMT Pleasantness (%)	-.00	.07	.35**	.06	.06	1.00

Note. MCFR = Multicultural Test of Facial Recognition; RMT-F = Warrington Recognition Memory Test for Faces. $^{*}p < .05$, $^{**}p < .01$.

Table 7c.

Correlations of Memory and Ratings of Pleasantness for White Participants (n = 52)

	1	2	3	4	5	6
1. MCFR Percent Correct	1.00					
2. MCFR Total RT	-.27*	1.00				
3. MCFR Pleasantness (%)	.08	.18	1.00			
4. RMT-F Percent Correct	.35**	-.18	-.09	1.00		
5. RMT Total RT	-.35**	.75**	.04	-.28*	1.00	
6. RMT Pleasantness (%)	-.26*	-.10	.31*	.04	.07	1.00

Note. MCFR = Multicultural Test of Facial Recognition; RMT-F = Warrington Recognition Memory Test for Faces. $^{*}p < .05$, $^{**}p < .01$.

Table 8a.

Correlations Between Facial Recognition Test Accuracy and Participant Emotion for Total Sample (N = 115)

	1	2	3	4	5	6	7	8
1. MCFR Percent Correct	1.00							
2. MCFR Total RT	-.01	1.00						
3. RMT-F Percent Correct	.44**	-.05	1.00					
4. RMT Total RT	-.10	.75**	-.12	1.00				
5. TAS	-.16*	-.03	-.22*	-.05	1.00			
6. AIM	.13	-.02	-.03	-.10	.05	1.00		
7. PANAS – Positive Affectivity	.14	-.18*	.03	-.20*	-.18*	.32**	1.00	
8. PANAS – Negative Affectivity	-.21*	.01	-.19*	.04	.38**	.29**	-.02	1.00

Note. MCFR = Multicultural Test of Facial Recognition; RMT-F = Warrington Recognition Memory Test for Faces; TAS = Toronto Alexithymia Scale -20; AIM = Affect Intensity Measure; PANAS = Positive and Negative Affect Schedule.

$^{*}p < .05$, $^{**}p < .01$.

Table 8b.

Correlations Between Facial Recognition Test Accuracy and Participant emotion for Black Participants (n = 63)

	1	2	3	4	5	6	7	8
1. MCFR Percent Correct	1.00							
2. MCFR Total RT	.22*	1.00						
3. RMT-F Percent Correct	.51**	.04	1.00					
4. RMT Total RT	.20	.76**	-.00	1.00				
5. TAS	-.10	-.00	-.20	-.00	1.00			
6. AIM	.11	.18	.03	.00	.14	1.00		
7. PANAS – Positive Affectivity	.09	-.10	-.01	-.06	-.10	.19	1.00	
8. PANAS – Negative Affectivity	-.19	-.15	-.14	-.15	.52**	.22*	-.18	1.00

Note. MCFR = Multicultural Test of Facial Recognition; RMT-F = Warrington Recognition Memory Test for Faces; TAS = Toronto Alexithymia Scale -20; AIM = Affect Intensity Measure; PANAS = Positive and Negative Affect Schedule.
$^{*}p < .05$, $^{**}p < .01$.

Table 8c.

Correlations Between Facial Recognition Test Accuracy and Participant emotion for White Participants (n = 52)

	1	2	3	4	5	6	7	8
1. MCFR Percent Correct	1.00							
2. MCFR Total RT	-.27*	1.00						
3. RMT-F Percent Correct	.35**	-.18	1.00					
4. RMT Total RT	-.35**	.75**	-.28*	1.00				
5. TAS	-.23*	-.05	-.26*	-.10	1.00			
6. AIM	.16	-.19	-.09	-.13	-.05	1.00		
7. PANAS – Positive Affectivity	.21	-.19	.11	-.20	-.30*	.41**	1.00	
8. PANAS – Negative Affectivity	-.23*	.27*	-.28*	.32*	.17	.38**	.11	1.00

Note. MCFR = Multicultural Test of Facial Recognition; RMT-F = Warrington Recognition Memory Test for Faces; TAS = Toronto Alexithymia Scale -20; AIM = Affect Intensity Measure; PANAS = Positive and Negative Affect Schedule.
*$p < .05$, **$p < .01$.

Table 9.

Descriptive Statistics of Facial Recognition Tests Accuracy and Response Times for Same and Different Race Targets

	Black (n = 63)		*White (n = 52)*		*Total*					
Variable	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*Range*	*df*	*t*	*d*
Accuracy										
RMT-F Percent Correct	69.6	(12.5)	70.7	(10.7)	70.1	(11.8)	38.0 – 98.0	112	-0.49	0.09
MCFR Percent Correct	61.6	(9.9)	61.7	(10.4)	61.6	(10.1)	34.4 – 87.5	113	-0.07	0.01
MCFR Asian Target	4.6	(1.4)	4.9	(1.1)	4.7	(1.3)	2 – 7	113	-1.22	0.23
MCFR Black Target	5.5	(1.2)	5.0	(1.4)	5.2	(1.3)	2 – 8	113	2.12^{*}	-0.40
MCFR Hispanic Target	5.1	(1.2)	4.9	(1.3)	5.0	(1.3)	2 – 7	113	0.81	-0.15
MCFR White Target	4.6	(1.3)	5.0	(1.5)	4.8	(1.4)	1 – 8	113	-1.72	0.32
Response Times (milliseconds)										
RMT Total RT	2831	(828)	3311	(1110)	3050	(992)	1226 – 5869	112	-2.64^{*}	0.49
MCFR Total RT	3251	(1158)	3539	(1206)	3381	(1184)	1174 – 6782	113	-1.30	0.24
MCFR Asian RT	3580	(1564)	3836	(1567)	3696	(1564)	1320 – 8086	113	-0.87	0.16
MCFR Black Target	2998	(1249)	3295	(1026)	3132	(1158)	1016 – 5890	113	-1.37	0.26
MCFR Hispanic Target	3147	(1089)	3340	(1068)	3234	(1079)	1146 – 5555	113	-0.56	0.18
MCFR White Target	3281	(1229)	3494	(1187)	3377	1210	1217 – 6372	113	-0.94	0.18

Note. MCFR = Multicultural Test of Facial Recognition; RMT-F = Warrington Recognition Memory Test for Faces

$^{*}p < .05$, $^{**}p < .01$.

Table 10.

Descriptive Statistics of Facial Recognition Tests Accuracy and Response Times for Same and Different Race Targets

	Black (n = 63)		*White* (n = 52)		*Total* (N = 115)		
Variable	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*Range*
Accuracy							
Asian Happy	2.3	(0.9)	2.4	(0.9)	2.3	(0.9)	0 – 4
Asian Neutral	2.3	(0.9)	2.5	(1.0)	2.4	(1.0)	0 – 4
Black Happy	2.5	(0.9)	2.3	(1.0)	2.4	(0.9)	0 – 4
Black Neutral	3.0	(0.7)	2.6	(1.0)	2.8	(0.9)	1 – 4
Hispanic Happy	2.7	(1.0)	2.6	(1.0)	2.6	(1.0)	0 – 4
Hispanic Neutral	2.4	(0.8)	2.3	(0.9)	2.4	(0.8)	1 – 4
White Happy	2.5	(0.8)	2.4	(1.0)	2.4	(0.9)	0 – 4
White Neutral	2.1	(1.0)	2.6	(0.9)	2.3	(1.0)	0 – 4
Response Times (milliseconds)							
Asian Happy	3134	(1336)	3603	(1646)	3346	(1496)	724 – 7502
Asian Neutral	3807	(1756)	3953	(1904)	3873	(1818)	1685 – 8572
Black Happy	3075	(1290)	3446	(1323)	3243	(1313)	1057 – 6524
Black Neutral	2762	(1073)	3235	(1238)	2979	(1170)	976 – 6330
Hispanic Happy	3063	(1202)	3344	(1331)	3190	(1264)	1155 – 6558
Hispanic Neutral	3254	(1301)	3378	(1116)	3310	(1217)	1137 – 6223
White Happy	3487	(1497)	3639	(1377)	3556	(1440)	1165 – 7483
White Neutral	2998	(1008)	3343	(1259)	3154	(1136)	1268 – 6610

APPENDIX B (FIGURES)

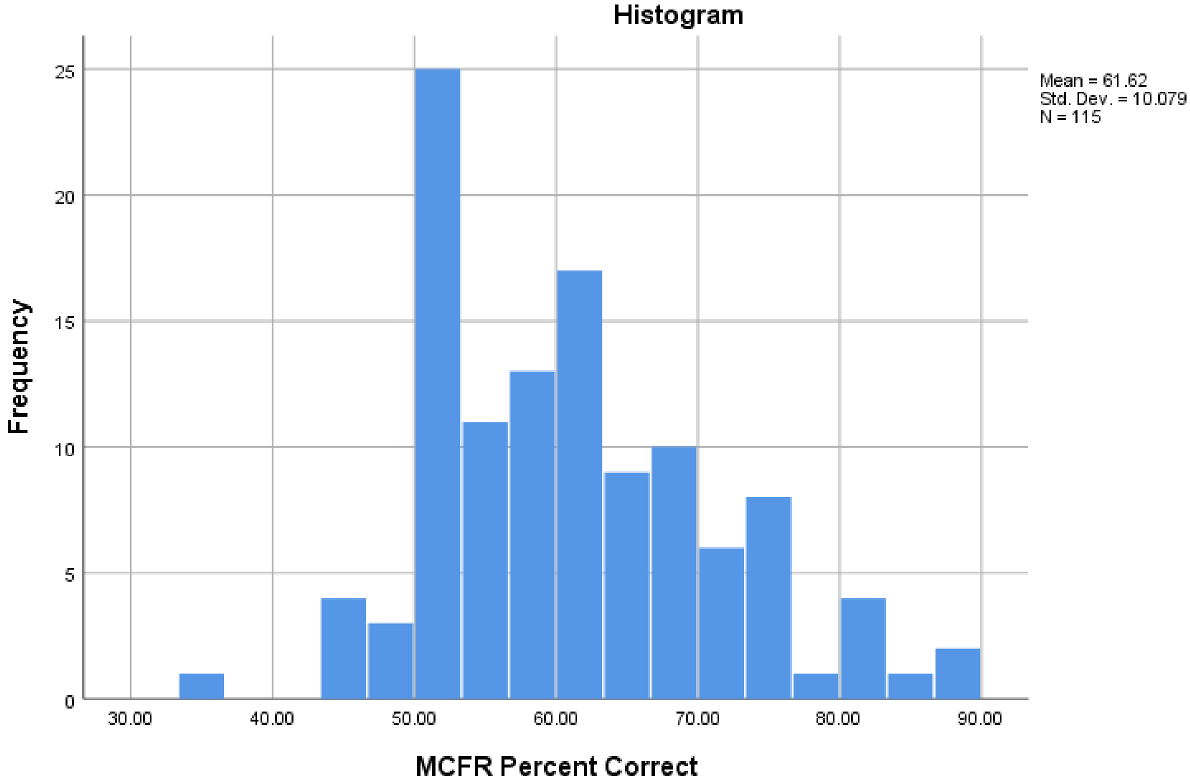


Figure 1. Frequency distribution of MCFR accuracy scores in percentages.

Note. MCFR = Multicultural Test of Facial Recognition

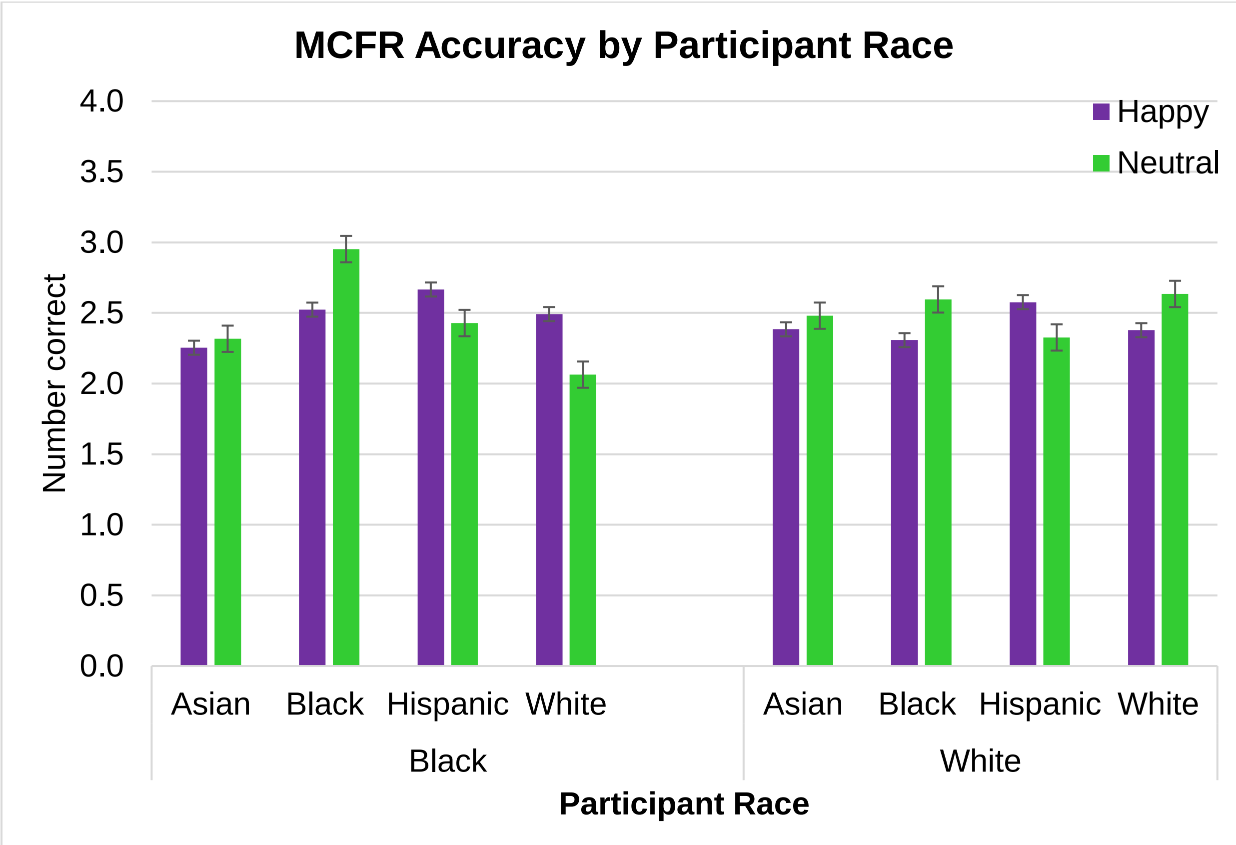


Figure 2. Mean number correct by Black and White participants for happy and neutral faces across four target races.

Note. Black participants: Black neutral > Asian happy, Asian neutral, White happy, White neutral, Hispanic neutral, Black happy; Black happy > White neutral; Hispanic happy > Asian happy, Asian neutral, White neutral; Hispanic neutral > White neutral; White happy > White neutral.

White participants, no significant differences across target race x emotion stimuli.

Group x target race x emotion interaction, F (3, 111) = 2.70, p = .049, partial η^2 = .07.

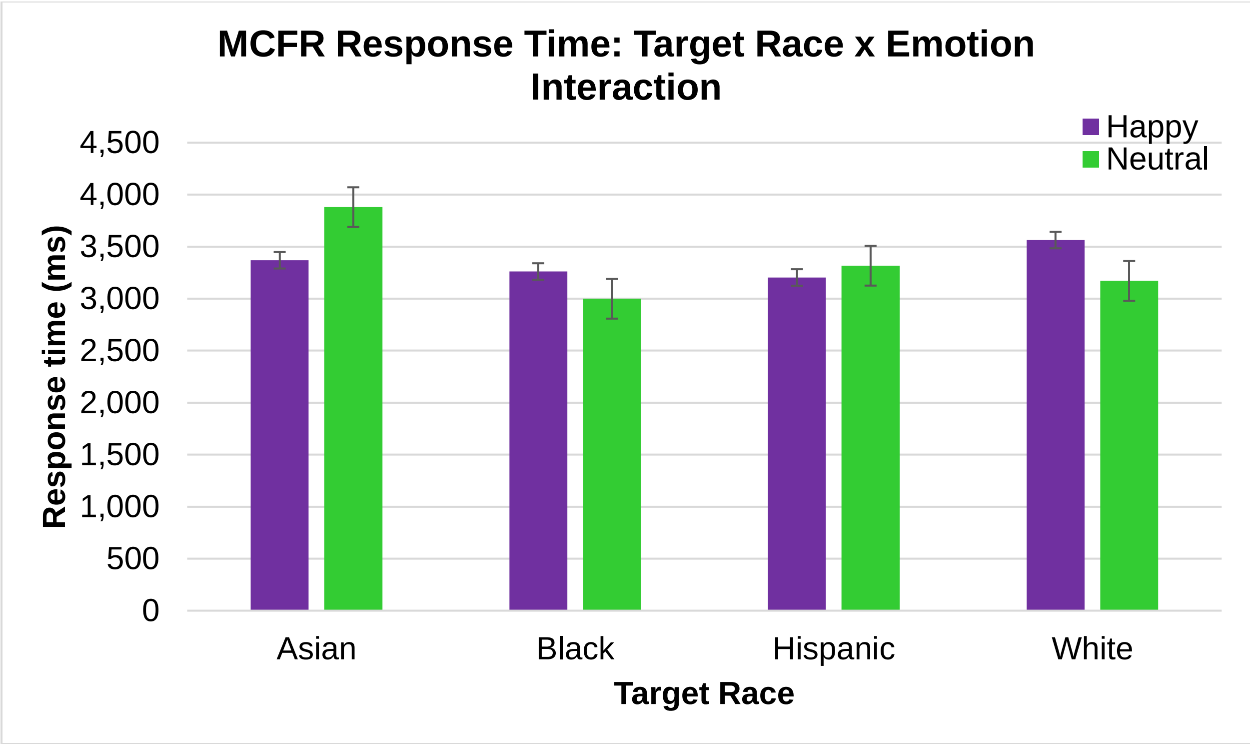


Figure 3. Mean response time of happy and neutral faces for the four target races.

Target Race x Emotion: F (3, 111) = 10.11, p < .001, partial η^2 = .22.
Asian targets, Happy < Neutral (p =.002), with a similar but trend for Hispanic targets (p = .226); Black (p = .007) and White (p < .002) targets, Happy > Neutral

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ABSTRACT

MULTICULTURAL FACE RECOGNITION MEMORY AND OWN-RACE-BIAS AMONG ADULTS WITH ACQUIRED BRAIN INJURY

by

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Own-race bias (ORB) is a well-documented phenomenon that may influence face memory, such that face memory is improved when the observed target matches the observer's racial background. However, the clinical measures widely used in neuropsychological evaluations lack racial diversity that may disenfranchise and disadvantage minority patients. Further, these existing measures have been criticized for having inconsistent visual contrast and facial content, as well as too much variability of non-facial information which may confound its acceptability as a measure of face memory specifically. To address these limitations, standardized, multicultural images with validated facial expressions (Beaupré et al., 2000) were used to create the Multicultural Facial Recognition Test (MCFR) to evaluate face recognition memory and ORB in a clinically relevant sample of persons with acquired brain injuries.

Method: One-hundred fifteen adults (63 Black, 52 White) with history of acquired brain injury participated. The participants ranged in age from 18 to 79 and were on average 12 years post injury. Participants completed a battery of cognitive tests, including the MCFR, the criterion Warrington Recognition Memory Test (RMT-F), and a post-test survey to provide consumer feedback on the MCFR.

Results: Internal consistency reliability of the MCFR was low, but the MCFR showed evidence of convergent validity as expected by theory. The MCFR correlated with the RMT-F and a measure of visual memory. However, the patterns of correlations among the MCFR and the cognitive measures differed significantly for Black and White participants. Additionally, evidence for ORB was present; however, this finding was only significant among Black participants. Although both racial groups performed best on the RMT-F, both groups also endorsed preferring the MCFR over the RMT-F.

Conclusions: The findings support evidence of ORB, but also suggest that ORB may be differently experienced by ABI patients of different racial groups. These findings highlight the need to include multicultural stimuli in the development of valid tests of face memory, as well as, the necessity to include multicultural participants in clinical research, as findings from the dominant culture may not generalized to minority populations. Further evaluation of the psychometric properties of the MCFR should be pursued.

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Education

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