INDIVIDUAL DIFFERENCES IN PERSONALITY

AND FACE RECOGNITION ABILITY

by

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ABSTRACT

Differences in face recognition between extraverts and introverts as well as emotionally negative and emotionally positive individuals were investigated. Personality was measured through the administration of the Big Five Inventory-2 (BFI-2), and face recognition was measured through the administration of the Cambridge Face Memory Test (CFMT). A non-significant correlation between extraversion and face recognition suggests the two variables are unrelated. A marginally significant correlation between negative emotionality and face recognition was negative, which suggests increased negative emotionality is related to decreased face recognition.

Experimental manipulations were used to differentially impact the performance of extraverts and introverts in Experiment 1 and emotionally negative and emotionally positive individuals in Experiment 2. In Experiment 1, participants listened to music that was either neutral or exciting (non-neutral), and in Experiment 2, participants watched a video that was either neutral or tense. While neither extraverts and introverts nor emotionally negative and emotionally positive individuals were differentially impacted by the experimental manipulations, the results indicated the experimental manipulations had an overall effect on face recognition for all subjects. Specifically, subjects placed in the non-neutral conditions demonstrated worse face recognition than subjects placed in the neutral conditions. Further testing is warranted to better understand the relationship between negative emotionality and face recognition as well as the impact of the experimental manipulations used in the present study on face recognition.

DEDICATION

This dissertation is dedicated to my husband, my family, and my close friends who patiently encouraged me throughout the completion of this project. This manuscript would not exist were it not for their steady and continuous support.

LIST OF ABBREVIATIONS AND SYMBOLS

=	Equal to
M	Mean
SD	Standard deviation
BFI-2	Big Five Inventory-2
CFMT	Cambridge Face Memory Test
CCMT	Cambridge Car Memory Test
d’	Sensitivity index
zHit	Inverse of the cumulative standardized normal distribution for the percentage of hits
zFalse Alarm	Inverse of the cumulative standardized normal distribution for the percentage of false alarms
n	Number of participants
t	Computed value of *t* test
p	Probability associated with the occurrence under the null hypothesis of a value as extreme as or more extreme than the observed value
ANOVA	Analysis of Variance
F	Fisher’s *F* ratio: A ration of two variances
r	Pearson product-moment correlation
<	Less than

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1. INTRODUCTION

Wang, Li, Fang, Tian, and Liu (2012) asked the question, "Why do some people recognize faces easily and others frequently make mistakes in recognizing faces?" Faces communicate things to others such as mood, age, and friendliness, but they also serve to distinguish one person from another. Without the ability to recognize another human face, it would be difficult to function in a society. Because of a condition that results in an agnosia for faces, that is the reality some live every day. Until we as scientists better understand the face recognition system, we cannot hope to offer relief to those suffering from debilitating face recognition disorders. Further, once we learn more about the reasons some people excel at face recognition, we can develop strategies for helping others improve their face recognition abilities.

The purpose of the present study was to advance the goal set by Wang et al. (2012), to more completely understand why some people are better than others at recognizing faces. To accomplish this purpose, I selected a topic for which the literature is surprisingly thin; I chose to study the relationships that exist between personality, specifically the personality characteristics of extraversion and negative emotionality, and face recognition.

Normal Face Recognition

Within a normal population, there are a number of factors that can affect a person's ability to recognize faces. Some of these factors include age, gender, experience, and brain injury. For example, Carey, Diamond, and Woods (1980) found evidence of maturational changes in face processing throughout development. These researchers tested 160 participants between the ages of six and 16 on a face recognition test and found the greatest improvement in

ability between the ages of six and 10. For the next several years, performance either remained the same or declined. However, by age of 16 face processing ability had improved again and either met or exceeded the performance of participants between the ages of six and 10 (Carey et al., 1980). In another study, Rehnman and Herlitz (2007) found evidence to suggest that women are better than men at recognizing faces. In this study, women performed exceptionally well when asked to recognize female faces, but they also performed better than men when asked to recognize male faces. Because women outperformed men on both male and female faces, the researchers concluded that women have possibly developed an enhanced interest in faces over time which results in an enhanced ability to recognize faces (Rehnman & Herlitz, 2007).

McKone, Crookes, and Kanwisher (2009) discussed the different sides of the nature-nurture debate by presenting the evidence for both genetics and experience having influences on face processing. These researchers argued that developmental difficulties in recognizing faces suggests poor face recognition abilities can be hereditary and free from brain injury, which indicates aspects of face recognition may be established at birth. At the same time, McKone et al. (2009) described a situation in which an adult with such difficulties improved at face recognition with repeated training and exposure to faces. Therefore, the researchers concluded that genetics explain some of the variance in face recognition ability, but experience can continue to affect face recognition even into adulthood.

Additionally, Bruce and Young (1986) described two types of face recognition errors that people experience in differing degrees. The first error is knowing that a face is familiar without being able to recall any identifying information about the face. Identifying information includes such things as the location where the face was first encountered. The second error is called the tip-of-the-tongue state. In this state, we recognize a face's owner but cannot recall the owner's

name (Bruce & Young, 1986). Most of us are familiar with the uncomfortable feeling associated with these two face recognition errors; however, it seems some people experience them more often than others. Despite the evidence that differences in face processing ability exist even within the normal population, very little research has been conducted on why those differences exist. At the conclusion of this paper, I hope to provide some insight into this question.

Abnormal Face Recognition

For one group of people, face recognition is particularly difficult. What I previously referred to as a developmental difficulty in recognizing faces actually has a clinical name, which is prosopagnosia. Prosopagnosia refers to an impairment in a person's face recognition ability that may or may not be the result of brain damage (Bruce & Young, 1986; De Haan, 2001). People with prosopagnosia are commonly referred to as prosopagnosics, and the extent to which they suffer from prosopagnosia can vary (Temple, 1997). Most prosopagnosics can discriminate between faces and nonface objects but cannot assign identity to a viewed face. They often fail to recognize family members and close friends; therefore, even a spouse or parent would be perceived as a stranger (Behrmann & Avidan, 2005; Duchaine & Nakayama, 2006). Amongst prosopagnosics there are differing degrees to which a person's face recognition ability is impaired not to mention differing reasons for the impairment (De Renzi, Faglioni, Grossi, & Nichelli, 1991). Further, most research on prosopagnosia finds a dissociation between a person's ability to process such facial characteristics as age, gender, and expression and a person's ability to assign identification to a face (Tranel, Damasio, & Damasio, 1988; Mouchetant-Rostaing, Giard, Bentin, Aguera, & Pernier, 2000; Mouchetant-Rostaing & Giard, 2003).

Malone, Morris, Kay, and Levin (1982) found that a patient with prosopagnosia was unable to recognize a familiar face but could still pick out two identical unfamiliar faces within

an array of unfamiliar faces. This indicates that, for some patients, prosopagnosia affects face recognition but not the processing of facial characteristics. However, not all research on prosopagnosia has found the same result. In a separate study, Carlesimo and Caltagirone (1995) gave three face processing tasks to prosopagnosic patients, and the prosopagnosics performed below average on all three of them. One task required the patients to pick out identical unfamiliar faces within a set of unfamiliar faces. The second task required the patients to identify famous faces, and the third task required the patients to assign age to unfamiliar faces. The consistent poor performance by the prosopagnosic patients suggests some prosopagnosics have a deficit in several aspects of face processing.

Just as the effects of prosopagnosia vary from person to person, the origin of the deficit also varies. Some research suggests that prosopagnosia is caused by lesions in the right hemisphere of the brain as a result of injury or seizures (Newcombe & Russell, 1969). Other research has found that the effects of prosopagnosia may not be due to brain lesions but could in fact be hereditary (Ariel & Sadeh, 1996; Behrmann & Avidan, 2005; De Haan, 1999). Still, a different strand of research suggests that prosopagnosia may not be the result of poor face recognition specifically. This research proposes that the poor face recognition abilities found in prosopagnosics is merely a symptom of a larger problem related to poor configural processing ability. Duchaine and Nakayama (2006) offered this theory after finding a face inversion effect in normal participants but not in prosopagnosics. The face inversion effect is the interrupted face processing that occurs when a face is inverted opposed to upright. When a face becomes inverted, it is no longer processed configurally, and face processing is impaired (Farah et al., 1995).

While a common cause of prosopagnosia remains undetermined, it is clear the presence

of the disorder is highly disruptive to the lives of those it affects. Young and Ellis (1989) described a child with prosopagnosia who lacked the ability to recognize familiar faces, including her own mother's. Instead of faces, she used voice cues to distinguish between one person and another. Therefore, recognition was only possible when the child was able to hear the voice of the person speaking (Young & Ellis, 1989). Temple (1997) also described a patient with severe face recognition problems. Dr. S, a prosopagnosic, was unable to remember a person's face no matter how many times she interacted with that person. Even after multiple meetings with the same person, Dr. S. was unable to distinguish that person from anyone else in the room. Dr. S maintained a positive outlook on life but expressed her frustration with not being able to recognize people she was supposed to know and interact with on a day-to-day basis (Temple, 1997).

Yardley, McDermott, Pisarski, Duchaine, and Nakayama (2008) discussed 25 prosopagnosic patients and the effects prosopagnosia had on those patients' social and professional lives. All 25 prosopagnosics reported difficulties with social interactions due to the inability to recognize people who should have been familiar. The prosopagnosics indicated that their inability to recognize familiar faces led to feelings of embarrassment, failure and guilt. Many of the patients expressed feelings of anxiety about being in social situations due to the fear of offending someone by not recognizing them. Oftentimes this fear led to the avoidance of social situations altogether, and some prosopagnosic patients missed important life events in order to escape the anxiety that came about as a result of being in social gatherings. Yardley et al. (2008) concluded that prosopagnosia has the potential to cause long-term effects in the lives of the people who suffer from it. Some of those long-term effects include job-loss, a reduced social network, and permanent dependence on others.

It is unclear whether there exists a way to reverse the negative effects of prosopagnosia. However, by more completely understanding what causes some people to perform better than others at face processing tasks, we will move one step closer toward developing strategies which will help people improve their face processing abilities. As a result, we will move one step closer toward offering relief to those suffering from deficits in face recognition.

While the effects of prosopagnosia are detrimental, it is estimated that only 2-2.5% of the population suffers from this disorder (Kennerknecht et al., 2006; Duchaine & Nakayama, 2006). While it is true that some prosopagnosics possess a "qualitatively different kind of face processing" (Russell, Duchaine, & Nakayama, 2009; pg. 256), it is also true that many cases of developmental prosopagnosia may merely represent the lower end of the face recognition spectrum (Russell et al., 2009).

A second group of people known as super-recognizers claim to have exceptional face recognition abilities. These people say they never forget a face regardless of the amount of time that passes between viewings (Davis, Jansari, and Lander, 2013). There is evidence to suggest that only 2% of the population can be classified as super-recognizers (Russell et al.,, 2009; Davis et al., 2013). However, in spite of the claim of exceptional face recognition abilities, there is no evidence to suggest that super-recognizers possess qualitatively different face processing abilities from the general population. Thus, in contrast to developmental prosopagnosia, it would appear that super-recognizers merely represent the upper end of the face recognition spectrum.

Therefore, if the lower 2-2.5% of the face recognition spectrum can be classified as prosopagnosics and the upper 2% of it can be classified as super-recognizers, the remaining 95.5-96% are people with normal face recognition abilities. As Davis et al. describes it, "...there appears to be a continuous spectrum of [face recognition] ability within the population, super-

recognition and developmental prosopagnosia are convenient labels for individuals represented in the two tails of this spectrum" (pg. 4). Because the majority of the population exhibits face processing abilities somewhere between the two tails, the focus of my present study was on this group of people.

Faces vs. Objects

Before proceeding, it is important to address a primary concern of all face research, which is the distinction between face processing and nonface object processing. There has been considerable debate as to the distinctiveness of face processing within the visual processing system, but the majority of researchers agree that people process faces in a way that is unique from the way people process nonface objects. For instance, Tsao, Moeller, and Freiwald (2008) identified entire neural networks devoted solely to the processing of facial information. These neural networks are almost completely contained in the fusiform gyrus, which is a region of cortex just underneath the surface of the brain where the temporal lobe and occipital lobe meet. The fusiform gyrus becomes active whenever a person is distinguishing between individual members of a large category (Gauthier et al., 2000; Breedlove, Watson, & Rosenzeweig, 2010). While the entire fusiform gyrus is not dedicated solely to the perception of facial stimuli, there is evidence to suggest that a subregion within the fusiform gyrus is specialized to respond to facial stimuli specifically (Haxby, 2006). This subregion specific to faces is known as the fusiform face area (FFA). While viewing faces activates the fusiform face area, viewing places and objects activates a similar area called the parahippocampal place area (PPA). This subregion is also located within the fusiform gyrus but is more medial than the fusiform face area (Kolb & Wishaw, 2009). This distinction between the neuroanatomical regions responsible for processing faces and objects offers support for a distinction between face processing and nonface

object processing.

Further, the existence of prosopagnosia itself suggests there is a distinction between face processing and nonface object processing. Using case studies involving prosopagnosic patients, De Haan (2001) clearly demonstrated that prosopagnosia is not a general perceptual disorder. The prosopagnosic patients he described, along with most prosopagnosics, were fully capable of perceiving faces and separating face stimuli from nonface stimuli. In fact, most of the prosopagnosic patients retained a fully intact ability to recognize nonface objects. Therefore, it appears the deficit brought about by prosopagnosia is specific to face processing and not generalizable to nonface object processing (De Haan, 2001).

Perhaps the strongest piece of evidence to support a unique face processing system is found by considering the face inversion effect. When faces are inverted, perception is disrupted, but when nonface objects are inverted, perception remains intact (Farah, Tanaka, & Drain, 1995). This suggests that faces and objects are processed differently and the ways in which they are processed are uniquely impacted by inverted stimuli. Taken together, the above results are highly suggestive of a face-specific recognition process that is distinct from the general, nonface object recognition process.

Configural Processing

As I just touched on, faces and objects are processed differently; it is often assumed that faces are processed configurally while objects are processed featurally (Farah et al., 1995; Maurer, Le Grand, & Mondloch, 2002; Jansari et al., 2015; Esins et al., 2016). Configural processing is the ability to process the individual parts of a stimulus in relation to one another so that the stimulus is processed as one whole unit. Featural processing on the other hand is the ability to process the individual parts of a viewed stimulus separately before piecing all of the

parts together (Maurer et al., 2002; Jansari et al., 2015). Despite the widely accepted view that faces are processed configurally, researchers have failed to find a consistent link between configural processing and face recognition (Konar et al., 2010; Le Grand et al., 2006; Susilo et al., 2010; Verhallen et al., 2017; Wang et al., 2012; DeGutis et al., 2013; Engfors et al., 2017; Esins et al., 2016; McGugin et al., 2012; Richler et al., 2011). Therefore, one aim of the present study is to offer clarity on this subject.

Prosopagnosic individuals have often been used in an attempt to better understand the processes involved in face recognition. Because prosopagnosics have significantly impaired face recognition abilities, effects that are present in normally developed individuals but absent in prosopagnosics are typically assumed to play a key role in face recognition. The inversion effect is a widely accepted marker of configural processing that is present in the normal population but absent in prosopagnosics; therefore, researchers have concluded the lack of configuralprocessing in prosopagnosics is one cause of their face recognition deficits (Farah et al., 1995). In another example, Esins et al. (2016) found that prosopagnosics showed significantly more impaired performance on face recognition and configural processing tasks but not on object recognition tasks. Therefore, the researchers concluded that configural processing is related to face recognition but not to object recognition (Esins et al., 2016). However, Susilo et al. (2010) presented a contrary case. The researchers observed normal configural processing in the prosopagnosic patient S.P., which calls into question the assumption that poor face recognition is the result of an interruption in configural processing (Susilo et al., 2010). Additionally, Le Grand et al. (2006) found that seven of eight prosopagnosics they tested displayed normal configural processing.

Even in a normal population, researchers do not consistently agree on whether a relationship exists between face recognition and configural processing. Some researchers failed to find a relationship between face recognition and configural processing (Konar et al., 2010; Le Grand et al., 2006; Susilo et al., 2010; Verhallen et al., 2017). Other researchers concluded that a significant relationship exists but is weak (Wang et al., 2012), and yet other researchers suggest that a relationship exists that is both significant and moderate in strength (DeGutis et al., 2013; Engfors et al., 2017; Esins et al., 2016; McGugin et al., 2012; Richler et al., 2011). With such diverse findings, it is difficult to say without doubt that a link between face recognition and configural processing either does or does not exist.

Personality

As previously stated, the purpose of my study was to begin answering the question of why some people are better than others at recognizing faces. There are many different ways I could have approached this question. Because of personal interest in the topic and because there is a great need in the literature, I decided to focus my research on individual differences in personality and the impact they have on face recognition. This is a topic that has been studied in the past but only limitedly, and the results of past research are controversial at best (Li, Tian, Fang, Xu, Li, and Liu, 2010; Curby, Johnson, & Tyson, 2012; Megreya & Bindemann, 2013). It was my aim to provide clarity on the inconsistent results of past research while at the same time offering support for a possible causal link between personality and face recognition.

There are multiple approaches to the study of personality that have been adopted over time. Two famous approaches include Freud's emphasis on the role of the unconscious in guiding behavior and Carl Jung's research on type-based personality, which led to the formation of a widely-used personality inventory called the Myers-Briggs Type Indicator (McAdams,

1997). However, one of the most pervasive theories of personality has origins in Allport and Odbert's work on personality traits (Allport & Odbert, 1936). In the 1930s, Allport and Odbert (1936) created a list of what they believed were all possible personality traits. The list was so long that the subset used by Cattell (1943) still had 4,500 traits on it. Through the use of factor analysis, Cattell (1943, 1945a, 1945b) was able to group together similar and opposite traits in order to reduce the list of over 4,500 trait terms first to 35 traits and finally to 12. Due to measurement errors, researchers later concluded that the final list of 12 personality traits was not statistically supported. However, this line of research lead Tupes and Christal (1992) to take a closer look at the list of 35 items and conduct further analyses using those items. These researchers reanalyzed the correlation matrices from Cattell's (1943, 1945a, 1945b) research and found strong support for five distinct and recurring factors (Tupes & Christal, 1992). These factors became what is now known as the Big Five.

The Big Five is a five-factor model of personality in which every individual is assumed to have some degree of each of five personality traits- open-mindedness[1], conscientiousness, extraversion, agreeableness, and negative emotionality[2]. The five personality traits are measured on a spectrum. For example, for the extraversion trait, on one end of the spectrum is extraversion while on the other end is introversion. Every person falls somewhere on the spectrum between extraversion and introversion. All five variables are independent of one another, and a report of the scores for each trait is used to summarize a person's personality (Costa & McCrae, 1992; De Raad, 2000).

Tupes and Christal (1992) provided a thorough description of each of the five personality

[1] Some research uses the term 'openness to experience' rather than 'open-mindedness'.
[2] Some research uses the term 'neuroticism' rather than 'negative emotionality'.

traits. To summarize, someone who scores high on the open-mindedness trait is typically characterized by high levels of curiosity, intellect, creativity, and openness to new ideas. For those who score high on the conscientiousness trait, they are typically associated with being organized, punctual, precise, and dependable. People who score high on the extraversion trait are usually outgoing, energetic, and comfortable in social situations. Someone who scores high on the agreeableness trait is typically considered tolerant, sensitive, trustworthy, and kind. And finally, someone who scores high on the negative emotionality trait is usually associated with being anxious, moody, and short-tempered.

There has been considerable debate as to whether the Big Five is the best tool for measuring personality because some researchers believe a five-factor model of personality is incomplete (Oswald & Hough, 2011). However, when first studying individual differences in personality, the Big Five serves as a useful starting point precisely because of how broad and simple it is. While the Big Five makes broad distinctions and does not capture every aspect of personality, it does capture the majority of the variance in personality (Goldberg, 1990). Additionally, research shows that the Big Five is a significant predictor of several life outcomes. Examples include juvenile delinquency, adult and childhood psychopathology, academic success, and job performance. The consistency of the traits over time in combination with the prediction of important life outcomes provides evidence for the validity of the Big Five as a measure of personality (John & Srivastava, 1999).

Adapted measures of the Big Five now exist which assess not only the five domains of the Big Five but also several more specialized facets within each domain. In the present study, I utilized one of these measures, which allowed me to study personality broadly using the personality domains but also more narrowly using the facets. Additionally, because past

research most often focused on the relationship between face recognition and the personality traits of extraversion and negative emotionality, I also focused the present study on these two personality traits.

Extraversion

Extraversion is often misunderstood as meaning sociability, and introverts, the counterparts to extraverts, are often misunderstood as being "anti-social." Sociability is certainly an important aspect of extraversion because it describes extraverts' tendency to surround themselves with other people. However, it would be inaccurate to say that extraversion is only defined as sociability (Lucas, Le, & Dyrenforth, 2008). A more general definition of extraversion is the tendency to obtain gratification from other people, which results in extraverts acting social, talkative, energetic, impulsive, and assertive (Hogan, Johnson, & Briggs, 1997).

Researchers do not always agree on a common underlying cause of extraversion, but several strong theories exist. For example, an early theory suggests extraverts are energized by people and social situations. In this theory, extraverts gravitate toward people because of the energy they receive in return. Interacting with people drains the energy from introverts, however, causing introverts to engage less in social situations (Jung & Hinkle, 1991). The weakness of this theory is it does not explain why extraverts are energized by social interaction in the first place. A more biologically-based theory of extraversion relates to the brain's reward system. This theory supposes that extraverts have a higher sensitivity to reward and, therefore, seek out rewarding situations. Positive social interactions provide many rewards such as friendship, warmth, comradery and accountability. As a result, extraverts engage more in social interactions because they are more sensitive to the rewards they get from the interactions (Gray, 1970). Additionally, social interaction provides several rewards that are not dependent upon

positive social interaction. In a review of social integration research, Seeman (1996) concluded that social integration leads to several benefits including a lower risk of mortality and a better state of mental health. While these rewards are strengthened by the quality of social integration, they are not exclusively limited to quality social integration (Seeman, 1996).

Another theory of the cause of extraversion originated with German psychologist Hans Eysenck. According to this theory, extraverts have lower levels of resting cortical arousal than introverts. Because of this, extraverts seek out additional stimulation in order to increase arousal while introverts avoid too much stimulation because it is overwhelming. As it relates to sociaility, extraverts seek out social situations because of the stimulation they provide; introverts avoid social situations because the provided stimulation overwhelms the already aroused introverts. In other words, the cause of extraversion is low cortical arousal, and sociability, being full of stimulation, is merely a byproduct of that cause (Eysenck, 2006). While there has been some debate over the theory, there are several studies that support it (Eysenck, 1967; Gale, 1973; Smith et al., 1995; Stelmack, 1981; Sternberg et al., 1992; Stenberg, 1992). Further, Matthews and Gilliland (1999) argue that the evidence favors Eysenck's arousal theory despite some inconsistencies in the literature. To test the arousal theory of extraversion, one would need to place introverts and extraverts in an arousing situation, such as listening to thrilling music. Introverts in such an arousing situation should attempt to avoid additional stimulation, performing worse on any task that provides stimulation. On the other hand, extraverts should perform better when placed in an arousing situation because they perform optimally when receiving high levels of stimulation. This is the methodology I selected for use in the present study to differentially affect the performance of introverts and extraverts.

Regarding face recognition, there is considerable debate as to whether a relationship

exists between extraversion and face recognition. Some researchers have found evidence to suggest that extraversion is unrelated to face recognition and cannot be used to predict performance on a face recognition task (Thompson & Mueller, 1984; Megreya & Bindemann, 2013), and yet other researchers have found just the opposite. For example, Li et al. (2010) were interested in studying the extent to which extraversion predicts face recognition ability. In their study, participants were shown a series of faces and flowers throughout a training phase. Then, during testing, participants were shown some of the same faces and flowers but also several new faces and flowers. The participants were asked to judge whether the faces and flowers in the testing phase had also been present in the training phase. Additionally, a self-reported score of extraversion was obtained through use of the NEO Personality Inventory, and the results indicated that extraverts were better than introverts at recognizing faces but there was no difference between extraverts and introverts for recognizing flowers. Out of the extraversion facets, this result was found only for sociability[3] (Li et al., 2010).

In a more recent study, Lander and Poyarekar (2015) examined the relationship between extraversion and both famous face recognition and face matching. The results showed a significant positive correlation between extraversion and famous face recognition but failed to find a significant correlation between extraversion and face matching. The researchers concluded that extraversion is linked specifically to the retrieval of highly familiar faces from long term memory but not necessarily to general face recognition (Lander & Poyarekar, 2015).

Most recently, Satchell, Davis, Julle-Daniere, Tupper, and Marshman (2018) asked the question, “Do Big Five personality traits relate to individual differences in face memory recognition?”. These researchers use a 10-item personality inventory to measure extraversion

[3] Some research uses the term ‘gregariousness’ rather than ‘sociability’.

and a widely used face recognition test to measure face recognition. Overall, the results showed that extraversion was positively correlated with performance on the face recognition test; however, the researchers recognized one weakness of the study as being the small and limited inventory used to measure personality. Satchell et al. (2018) recommended future researchers attempt to replicate their results using a larger and more complete personality inventory.

Negative Emotionality

Negative emotionality is characterized by anxiety, depression, and emotional volatility (Soto & John, 2017). Recent research has linked increased both emotional state and the negative emotionality personality trait to weaker configural processing abilities (Curby et al., 2012; Megreya & Bindemann, 2013). First, Curby et al. (2012) influenced the emotional state of participants through video clips of happy, sad, and neutral situations. The researchers measured performance on a configural processing task both before and after inducing the emotional state, and the results demonstrated that both emotional states and changes in emotional state correlated with configural processing (Curby et al., 2012). Second, Megreya and Bindemann (2013) used one measure and one sub-measure of the Big Five to assess the personality trait of negative emotionality. These researchers examined the relationship between negative emotionality and a face identification task, and the results suggest that low tension, low anxiety, and high emotional stability, which are all aspects of negative emotionality, are related to face recognition (Megreya & Bindemann, 2013). These results, in conjunction with the results of Curby et al. (2012), offer support for a relationship between negative emotionality and face recognition. In particular, they indicate that increased negative emotionality is related to decreased face recognition abilities.

While a relationship between negative emotionality and face processing may exist, little is known about what causes it. However, research does show that when placed under high stress

situations, emotionally negative individuals tend to use avoidance style coping techniques (Boyes & French, 2010). This indicates that, when faced with high anxiety social situations, emotionally negative individuals are likely to avoid social interaction altogether in order to cope with the stress. For example, Lopes, Salovey, and Straus (2003) found evidence of a positive correlation between poor emotion regulation and low quality social interaction, and Vittengl and Holt (1998) found evidence of a negative correlation between both anxiety and quality of social interaction and negative affect and quality of social interaction.

Because emotionally negative individuals are likely to associate social interactions with anxiety and negative affect (Vittengl & Holt, 1998), negatively emotional individuals are also likely to avoid social interactions (Boyes & French, 2010). This may explain why negatively emotional individuals show poorer face processing abilities than positively emotional individuals (Megreya & Bindemann, 2013). If emotionally negative individuals engage in avoidance style coping techniques when facing stressful situations (Lopes et al., 2003; Boyes & French, 2010), they will avoid the stressful stimulus altogether, disrupting the processing of that stimulus. Therefore, if face processing is accompanied by a stressful situation, which it often is due to the amount of social interaction, negatively emotional individuals are likely to avoid the face or faces in order to cope with the associated anxiety. Over time, the repeated avoidance of facial stimuli would lead to the development of weak face processing abilities.

To test this, one would need to place negatively emotional and positively emotional individuals in a stressful situation, such as watching a tense movie. Negative emotional individuals in such a stressful situation should engage in avoidance style coping techniques, performing worse on any task that presents stimuli. On the other hand, emotionally positive individuals should perform about the same when placed in a stressful situation because they do

not engage in avoidance style coping techniques and should not avoid the stimuli associated with the stressful situation. This is the methodology I used in the present study to differentially affect the performance of emotionally positive and emotionally negative individuals.

Hypotheses

In my study I hoped to find support for the presence of a relationship between extraversion and negative emotionality on the one hand, and face recognition on the other. As discussed, previous literature suggests that extraverted individuals are better at recognizing faces than introverted individuals (Li et al., 2010) and emotionally positive individuals are better at recognizing faces than emotionally negative individuals (Curby et al., 2012; Megreya & Bindemann, 2013).

Based on the arguments presented above, I expected to find several results upon completion of my study. First, I expected to find a significant positive relationship between configural processing and face recognition. These two processes are both aspects of face processing as a whole, and some research suggests that there is a positive relationship between the two (e.g., Richler, Cheung, & Gauthier, 2011) although it has not been found by others (e.g., Verhallen et al., 2017. Second, I expected to find a significant relationship between extraversion and these same two aspects of face processing: configural processing and face recognition. Specifically, I predicted that extraverted individuals would perform better on a configural processing task and on a face recognition task than would introverted individuals. Third, I expected to find a significant relationship between negative emotionality and configural processing as well as negative emotionality and face recognition. However, I predicted that emotionally negative individuals would perform worse on a configural processing task and on a face recognition task.

Fourth, in regard to extraversion, I expected to find evidence that increased excitement would impact both extraverts' and introverts' performance on two different tasks: a configural processing task and a face recognition task. Accordingly, I predicted that increased excitement in introverts would negatively impact their performance while increased excitement in extraverts would positively impact their performance. Fifth, in regard to negative emotionality, I expected to find evidence that increased anxiety in emotionally negative individuals would impact their performance on the same two tasks but increased anxiety in emotionally positive individuals would not impact performance. Specifically, I predicted that increased anxiety in emotionally negative individuals would result in decreased performance on both tasks.

Sixth, I expected to find evidence of a relationship between sociability, a facet of the extraversion trait, and face processing. Because I predicted that increased extraversion would be related to both increased configural processing and increased face recognition, I also predicted that I would find the same result for the sociability. Seventh, I expected to find evidence of a relationship between anxiety, a facet of the negative emotionality trait, and face processing. Because I predicted that increased negative emotionality would be related to both decreased configural processing and decreased face recognition, I predicted that I would find the same result for anxiety.

And eighth, I predicted that any result I found differentiating between extraverts and introverts and emotionally negative and emotionally positive individuals would be unique to face recognition when compared to nonface object recognition. As previously discussed, nonface object recognition does not typically occur under highly stimulating conditions; therefore, it is unlikely introverts and extraverts have developed significantly different nonface object processing abilities throughout development. Additionally, object recognition does not typically

occur under high-anxiety conditions, so it is also unlikely emotionally negative and emotionally positive individuals have developed significantly different nonface object processing abilities throughout development.

2. METHOD

Experiment 1

Participants

I recruited a convenience sample of 205 English-speaking students from the undergraduate psychology research pool at the University of Alabama. Seven participants were excluded from the data analysis because of obvious errors in their responses (i.e. there were too many missing responses or the responses were the same on all trials). Therefore, the final sample size consisted of 198 participants. All PY 101 students at the University of Alabama are required to complete 12 research credits during the semester in which they are enrolled in PY 101. Participants in this experiment received two and a half research credits for participating. Two credits were awarded for completion of the experimental session and a half credit was awarded for completion of the online portion of the study. There were no restrictions placed on age, gender, or ethnicity; however, all participants were required to have normal-to-corrected vision and normal-to-corrected hearing. All participants were between the ages 18 and 22 (M = 19.08, SD = 1.06). 84.3% of them were Caucasian while 10.1% were African American; the remaining 5.5% were of other ethnicities. Due to an oversight when collecting demographic information, participants were not asked to report their genders; as such, gender information is not available.

Materials

Experience With People Survey. To quantify the amount of experience each participant had with viewing faces throughout development, I created a survey that consists of a series of questions regarding exposure to people (Appendix A). Because all people have faces, the more exposure to people a person has, the more experience with faces that person should have. A sample item from the Experience With People Survey is the open-ended question, "How many people make up the family you grew up in?". In total, the survey consists of eight questions; six questions ask about exposure to people, one question asks about age, and one question asks about ethnicity. It should be noted that the Experience With People survey was called the Experience With Faces survey during the time participants completed the survey and was subsequently renamed to more accurately reflect its content.

Big Five Inventory-2 (BFI-2). To measure personality, participants completed the Big Five Inventory-2 (BFI-2), which is a personality inventory that evaluates an individual on five key personality domains in addition to 15 specific facets of those five personality domains (Soto & John, 2017). The inventory consists of 60 items, and the five personality domains it assesses are: open mindedness, conscientiousness, extraversion, agreeableness, and negative emotionality. It is important to note the BFI-2 uses the term 'open mindedness' instead of the more commonly used term 'openness to experience' and the term 'negative emotionality' instead of the more commonly used term 'neuroticism'. The items on the BFI-2 consist of statements that participants respond to using a Likert scale from one (disagree strongly) to five (agree strongly). A sample item from the BFI-2 is the statement "tends to be disorganized." Half of the items (30 of the 60 items) are reverse worded to control for threats to internal validity.

Composite Task. To measure configural processing, I used the Richler et al. (2011) complete design composite task (Appendix B). The stimuli consisted of 20 pictures of female faces cut in half and randomly combined so that the top half of each picture was paired with the bottom half of either the same or a different picture. Participants were told to ignore the bottom halves of the pictures and only focus on the top halves. There was a white line separating the top and bottom halves of the pictures designed to encourage selective attention.

Each trial consisted of a study face and a test face. Participants first viewed the study face for 200ms before a blank screen appeared for 200ms. Then, participants viewed a test face for 200ms before a second blank screen appeared. This second blank screen remained for 10s, during which participants responded on their answer sheets with an A if the two faces (study face and test face) matched or a B if the two faces did not match. In all, there were 160 trials with a 20s break after the first 80 trials. This task required 30 minutes to complete.

There were two conditions (aligned vs. misaligned) with four trial types in each condition (same-congruent, same-incongruent, different-congruent, and different-incongruent). In the aligned condition, both the top and bottom halves of the faces were centered with the top halves directly on top of the bottom halves. In the misaligned condition, the bottom halves of the faces remained centered while the top halves were shifted 1cm to the right of center, which resulted in the top and bottom halves being misaligned. Of the 160 trials, 80 trials were aligned and 80 trials were misaligned.

Within each condition, there were 20 trials of each of the four trial types (same-congruent, same-incongruent, different-congruent, and different-incongruent). Same trials consisted of faces in which the top halves of the study and test faces matched while different trials consisted of faces in which the top halves of the study and test faces did not match.

Congruent trials consisted of faces in which the responses to the bottom halves of the faces would, if asked about, be congruent with the responses to the top halves of the faces. In incongruent trials, the responses to the bottom halves of the faces would, if asked about, be incongruent with the responses to the top halves of the faces. Therefore, in same-congruent trials, both the top and bottom halves of the study faces matched the top and bottom halves of the test faces. In same-incongruent trials, the top halves of the study and test faces matched but the bottom halves did not match. In different-congruent trials, neither the top nor bottom halves of the study and test faces matched. And in different-incongruent trials, the bottom halves of the test and study faces matched but the top halves did not match.

Cambridge Face Memory Test (CFMT). To measure face recognition ability, I employed a widely-used measure of face recognition ability known as the Cambridge Face Memory Test (Richler et al., 2011; Appendix C). This task was broken up into three different phases: the learn phase, the novel phase, and the noise phase. In the learn phase, participants studied six target faces. To do so, participants viewed each target face individually through a series of pictures of the target face. Each picture depicted a different viewpoint of the face (head-on, 30 degrees to the left, and 30 degrees to the right). Each viewpoint was displayed for two seconds. Immediately after studying a target face, participants were tested on that face. To do so, participants viewed three faces at once, two of which were distractors and one of which was the just-learned target face. Participants were asked to identify the target face by responding with the appropriate letter on the answer sheet. Participants completed three of these test trials before moving on to the next target face. This process was repeated for all six target faces. Following the last target face, participants viewed a review slide, which displayed all six target faces simultaneously, for 20s.

After the learn phase was the novel phase. In this phase, participants repeated the test portion of the learn phase using all novel stimuli for the distractor faces. Participants viewed three faces at once, two of which were distractors and one of which was a target face. The three faces were labeled with either an A, a B, or a C, and participants were asked to identify the target face by responding with the appropriate letter on the answer sheet. There were 30 trials in the novel phase. After the last trial, participants again viewed the review slide, which displayed all six target faces simultaneously, for 20s.

Finally, the last phase was the noise phase, which consisted of 24 trials. This phase was set up identically to the novel phase with two exceptions: (1) there were 24 trials instead of 30, and (2) Gaussian noise was placed overtop each image. Adding noise increased the difficulty of the task and reduced the ease at which identifying features could be detected (Richler et al., 2011). In all, this task required 20 minutes to complete.

Cambridge Car Memory Test (CCMT). To measure object recognition, I used the Cambridge Car Memory Test, which was created and used by Dennett et al. (2012). This task is identical to the Cambridge Face Memory Test with the only difference being the use of car stimuli instead of face stimuli (Appendix D). Like the Cambridge Face Memory Test, this task required 20 minutes to complete.

Experimental Manipulation

To manipulate excitement, I employed the Continuous Music Technique (Eich, 1995; Eich & Metcalfe, 1989). I randomly assigned each experimental session to one of two conditions: excited or neutral. In the excited condition, I induced a state of excitement by consistently playing thrilling background music throughout the duration of the experimental session. The music was a compilation of swift-tempoed, heroic-sounding orchestra pieces

(https://www.youtube.com/watch?v=DeXoACwOT1o). According to Kumari, Williams, and Gray (2004), thrilling music raises a person's excitement level. In the neutral condition, I played calming, neutral background music throughout the duration of the experimental session. The music was a compilation of soft, soothing, and slow-tempoed instrumental pieces (https://www.youtube.com/watch?v=XlNhbhavMyg). The neutral condition served as a control condition.

Procedure

Before participating in the experimental portion of the study, all participants were required to complete the BFI-2 and the Experience With People Survey online. At the start of doing so, participants viewed an introduction page that provided a basic overview of the study and asked for the participants' informed consent (Appendix E). All participants were required to give informed consent before moving on. Upon providing informed consent, participants were then asked to complete the BFI-2 followed by the Experience With People Survey. Participants who did not complete the online portion of the study were not permitted to participate in the experimental portion of the study. In total, the online portion of the study required approximately 30 minutes to complete.

Each experimental session tested groups of 1-10 participants. The experiment room was equipped with enough desks for at least 10 participants, a computer, and a projector screen. Participants were seated at a desk in one of the middle two columns and one of the first five rows to ensure each participant had a central view of the projector screen. Previous research used this approach and failed to find an effect due to seating position (Worley & Boles, 2016).

Before beginning each experimental session, the researcher provided the participants with a brief overview of the experiment. During this introduction, the participants were informed that

they could leave the experiment at any time without consequence and were asked to provide written informed consent before moving forward with the experiment (Appendix F). Once the researcher received written informed consent from each participant, the researcher provided the participants with test packets. The test packets consisted of four scantron answer sheets, and the participants were told to start with the first scantron in the test packet. On the first scantron, participants were asked to answer the question "How excited do you feel right now?" using a Likert scale from one to five with one being "not excited at all" and five being "very excited." Once all participants had answered this question, the researcher told the participants to move to the second scantron for the next portion of the experiment. While the participants were changing scantrons, the researcher began playing music through the computer at a volume loud enough for all participants to hear. The music was either neutral or exciting depending on which experimental condition was taking place. After starting the music, the researcher began instructing the participants on how to complete either the composite task, the Cambridge Face Memory Test, or the Cambridge Car Memory Test. After providing instructions, the researcher proceeded with administering the task. The three tasks were counterbalanced across experimental sessions to control for sequence effects. Before starting each task, the researcher instructed the participants on how to complete that task. For each task, a different scantron was used. After each task, the researcher told the participants to return to the first scantron and answer the question "How excited do you feel right now?" once again. After all participants completed all tasks, the researcher collected the test packets. Once the researcher collected all test packets, the researcher provided each participant with a debriefing sheet that discussed the study in further detail (Appendix G). At the same time, the researcher also provided each participant with a consent form on which each participant indicated whether that participant

would allow his or her data to be used during data analysis (Appendix H). Once these consent forms were completed by the participants and collected by the researcher, the researcher dismissed the participants from the experiment. In total, each experimental session required approximately one hour and 15 minutes to complete.

Experiment 2

Participants

I recruited a convenience sample of 200 English-speaking students from the undergraduate psychology research pool at the University of Alabama. Ten participants were excluded from the data analysis because of obvious errors in their responses (i.e. there were too many missing responses or the responses were the same on all trials). Therefore, the final sample size consisted of 190 participants. All were PY 101 students, and received two and a half research credits for participating. Two credits were awarded for completion of the experimental session and a half credit was awarded for completion of the online portion of the study. There were no restrictions placed on age, gender, or ethnicity; however, all participants were required to have normal-to-corrected vision and normal-to-corrected hearing. All participants were between the ages 18 and 29 (M = 19.17, SD = 1.30). 82.6% of them were Caucasian while 8.9% were African American; the remaining 8.5% were of other ethnicities. Again, due to an oversight when collecting demographic information, participants were not asked to report their genders; as such, gender information is not available.

Materials

The same materials that were used in Experiment 1 were used again in Experiment 2. This included the BFI-2, the Experience With People Survey, the composite task, the Cambridge Face Memory Test, and the Cambridge Car Memory Test.

Experimental Manipulation

To manipulate anxiety, I randomly assigned each experimental session to one of two conditions: anxious or neutral. In the anxious condition, I induced a state of anxiety by playing a dramatic one-minute video found to increase anxiety levels in viewers (Giron & Almeida, 2010). This short video depicted a hit-and-run accident in which a young child was the victim of said tragedy. In the neutral condition, I played a calming one-minute video shown to have no effect on anxiety level. The neutral video followed behind a man as he ran through Central Park in New York City. The neutral condition served as a control condition.

Procedure

The online portion of Experiment 2 was identical to the online portion of Experiment 1, and the experimental portion was identical with three exceptions. First, the experimental question in Experiment 1 was “How excited do you feel right now?”. In Experiment 2, the question was “How anxious do you feel right now?”. Second, the researcher in Experiment 2 did not play background music throughout the experimental section and instead showed a one-minute video clip before administering the first task. And third, because the researcher showed a video clip rather than playing background music, the question in Experiment 2 (“How anxious do you feel right now?”) was asked immediately after the video clip was shown. Therefore, participants answered the experimental question one more time in Experiment 2 than they did in Experiment 1.

3. RESULTS

Experiment 1

Scoring

Experience With People. The first four questions of the survey were open-ended. Participants were asked to quantify the amount of exposure they had to people in various situations while growing up. The last two questions required participants to provide the frequency at which they were involved in social activities. Participants responded using a Likert scale from one to five with one corresponding to “never” and five corresponding to “frequently.” I first standardized each participant’s response to each question by converting the responses to z-scores. Then, I calculated the sum of each participants’ standardized scores to provide each participant with an overall score for experience with people.

Extraversion. Extraversion scores were obtained from the BFI-2. Participants rated each of 12 extraversion-specific statements using a Likert scale from one to five with one corresponding to “disagree strongly” and five corresponding to “agree strongly”. Half of the statements were reverse-worded and were therefore reverse scored by subtracting each response from six. To calculate extraversion for each participant, I took the sum of each participant’s responses to the 12 statements. Therefore, the minimum score a participant could receive was 12, and the maximum score a participant could receive was 60.

In order to separate participants into two groups, introverts and extraverts, I performed a median split. The median score for extraversion was 43. 96 participants scored below a 43 and

were placed into the introversion group. 102 participants scored a 43 or higher and were placed into the extraversion group.

Sociability. Sociability scores were obtained from the BFI-2. Of the 12 extraversion-specific statements, four statements were specific to sociability. Two of these statements were reverse-worded and were therefore reverse scored by subtracting each response from six. To calculate sociability for each participant, I took the sum of each participant's responses to the 4 statements. Therefore, the minimum score a participant could receive was 4, and the maximum score a participant could receive was 20.

Baseline Excitement. Before beginning the experimental session, participants were asked to answer the question "How excited do you feel right now?" using a Likert scale from one to five with one being "not excited at all" and five being "very excited." Each participants' response to this question was used as that participants' baseline excitement score.

Change in Excitement. After completing each task, participants were asked to again answer the question "How excited do you feel right now?". There were three tasks, so participants answered this question three additional times. I first calculated the average of these three responses. To obtain a change in excitement score, I subtracted the average of the three excitement scores from the baseline excitement score.

d'. Before discussing the scoring procedure for d', I must first discuss an error that was made concerning the composite task which affected its scoring. In the composite task, there are four trial types within each of two conditions; the four trial types are same-congruent, same-incongruent, different-congruent, and different-incongruent, and the two conditions are aligned and misaligned (See Appendix B for an example of each of the four trial types and both conditions.). There are supposed to be 20 trials of each trial type within each condition.

However, during the creation of the task, I created a disproportionate number of trial types in the misaligned condition. The result of my error was 21 same-congruent trials, 38 same-incongruent trials, 4 different-congruent trials, and 17 different-incongruent trials. To correct for this error, I excluded the misaligned trials from the scoring of d' and analyzed only the aligned condition.

Throughout previous literature, several researchers have supported the use of the aligned condition alone. First, Richler, Mack, Gauthier, and Palmeri (2009) argue that the advantage of using the composite task is it allows the measurement of configural processing directly without needing to compare aligned and misaligned trials. Because of this, Richler et al. (2009) conducted a study looking at exposure duration, which utilized only the aligned trials of the composite task. Second, Richler, Floyd, and Gauthier (2014) argue using only the aligned condition will result in the most compact and reliable measure of configural processing. These authors make the claim that the reliability of the composite task is limited by the use of the misaligned condition. In studies that utilize the misaligned condition, configural processing was measured as a difference score (aligned congruency effect - misaligned congruency effect), the congruency effect was measured as a difference score (congruent trials - incongruent trials), and the performance measure itself was measured as a difference score (d' = zHit - zFalse Alarm). If configural processing can be measured by congruency alone, which the authors argue it can be, eliminating the misaligned condition eliminates one of the difference scores, which, in turn, results in higher reliability. Finally, Richler et al. (2014) conducted a meta-analysis using several composite task studies in which the misaligned condition was utilized. The researchers found little shared variance between the congruency effects in the aligned and misaligned conditions, and, therefore, they concluded "for the purpose of quantifying the effect across subjects, there is virtually nothing to be gained by devoting testing time to measuring a control

condition that is not correlated with the variance of interest" (p. 13). To elaborate, in the aligned condition, configural processing was present, but in the misaligned condition, it was not; misalignment disrupted configural processing regardless of whether congruency was present or not.

There was also an error made during the creation of the aligned condition which resulted in 21 same-congruent trials and 19 same-incongruent trials. This imbalance was not so great that an expectancy could form with respect to congruency, and 19 or 21 trials makes little difference as a basis for calculating d'. Therefore, a correction to the aligned condition was not needed.

Now, I will proceed with the scoring procedure for d'. For each participant, I first calculated the number of hits, misses, correct rejections, and false alarms. To be a hit, participants must have correctly determined the two faces were the same. To be a miss, participants must have determined the two faces were different when they were actually the same. To be a correct rejection, participants must have correctly determined the two faces were different. And to be a false alarm, participants must have determined the two faces were the same when they were actually different. Then, I calculated the percentage of hits and the percentage of false alarms. I calculated the hit rate by dividing the number of hits by the sum of the number of hits and the number of misses. I calculated the false alarm rate by dividing the number of false alarms by the sum of the number of false alarms and the number of correct rejections. Next, I calculated difference scores using the hit and false alarm rates. To do this, I calculated the inverse of the cumulative standardized normal distribution first for the percentage of hits and second for the percentage of false alarms, and then I subtracted the z-scores for false alarms from the z-scores for hits. I completed this process once for the congruent trials and a second time for the incongruent trials. Finally, I subtracted the difference score of the

incongruent trials from the difference score of the congruent trials. This new difference score, d', was used to measure the congruency effect.

For example, one participant had 8 hits, 13 misses, 4 false alarms, and 16 correct rejections for the congruent trials. That same participant had 7 hits, 12 misses, 5 false alarms, and 15 correct rejections for the incongruent trials. For the congruent trials, to calculate the percentage of hits, I divided the number of hits by the sum of the number of hits and misses (8/(8+13) = .38); to calculate the percentage of false alarms, I divided the number of false alarms by the sum of the number of false alarms and correct rejections (4/(4+16) = .20). Then, I calculated the inverse of the cumulative standardized normal distribution for the percentage of hits (z = -.30) and again for the percentage of false alarms (z = -.84) and subtracted the z-score for the percentage of false alarms from the z-score for the percentage of hits (-.30 - -.84 = .54). For the incongruent trials, to calculate the percentage of hits, I divided the number of hits by the sum of the number of hits and misses (7/(7+12) = .37); to calculate the percentage of false alarms, I divided the number of false alarms by the sum of the number of false alarms and correct rejections (5/(5+15) = .25). Then, I calculated the inverse of the cumulative standardized normal distribution for the percentage of hits (z = -.34) and again for the percentage of false alarms (z = -.67) and subtracted the z-score for the percentage of false alarms from the z-score for the percentage of hits (-.34 - -.67 = .33). Finally, to obtain d', I subtracted the difference score for the incongruent trials from the difference score for the congruent trials (.54 - .33 = .21).

CFMT/CCMT. I first determined whether each participant correctly or incorrectly identified the target face/car on each trial. Then, I calculated the number of correctly identified faces/cars for each participant. Finally, I determined the percentage of correctly identified

faces/cars for each participant by dividing the number of correctly identified faces/cars by the total number of trials.

For a summary of the overall descriptive statistics for each measure presented above, see Table 1.

Table 1. Overall means and standard deviations of the variables used in Experiment 1.

Measure	*N*	*Mean*	*Standard Deviation*
Experience With People	198	.00	2.99
Extraversion	198	42.56	7.83
Sociability	198	13.90	3.74
Baseline Excitement	198	2.56	1.11
Change in Excitement	198	-.25	1.02
d’	198	1.25	1.49
CFMT	198	.76 (76%)	.14 (14%)
CCMT	198	.73 (73%)	.14 (14%)
Open Mindedness	198	43.29	8.59
Intellectual Curiosity	198	15.16	2.93
Aesthetic Sensitivity	198	13.60	3.91
Creative Imagination	198	13.54	3.24
Conscientiousness	198	43.27	6.68
Organization	198	14.63	3.39
Productivity	198	14.23	3.00
Responsibility	198	14.41	1.96
Assertiveness	198	13.80	3.19
Energy Level	198	14.85	3.04
Agreeableness	198	45.80	6.61
Compassion	198	15.78	2.80
Respect	198	16.40	2.47
Trust	198	13.62	2.67
Negative Emotionality	198	32.48	8.98
Anxiety	198	12.87	3.32

Depression	198	9.66	3.59
Emotional Volatility	198	9.95	3.46

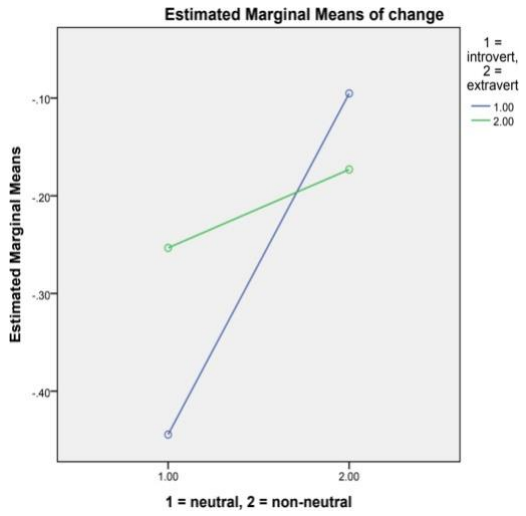
Manipulation Check

I conducted an independent samples *t* test to determine whether extraverts (n = 102) and introverts (n = 96) reported significantly different baseline excitement scores. I failed to find a significant difference in baseline excitement for these two groups, t(196) = -.171, p = .864. This result indicates that extraverts and introverts report statistically similar baseline excitement scores (extraverts: M = 2.57, SD = 1.13; introverts: M = 2.54, SD = 1.08). Nor did extraversion, left as a continuous variable, correlate to baseline excitement, r(198) = .017, p = .810.

To increase excitement I played stimulating music throughout the experimental session. Participants were randomly assigned to one of two conditions: excited or neutral. In the neutral condition, I played calming music that was not supposed to increase excitement, and in the excited condition, I played exciting music that was supposed to increase excitement. I conducted a univariate analysis of variance (ANOVA) testing the influence of two independent variables (extraversion, condition) on change in excitement scores. Extraversion consisted of two levels (extravert, introvert), and condition consisted of two levels (excited, neutral). No effects were statistically significant at the .05 significance level. The non-significant main effect for extraversion yielded an F ratio of F(1,194) = .152, p = .697. This result indicates that whether a person is an extravert or an introvert does not impact that person's self-reported change in excitement (extraverts: M = -.21, SD = 1.05; introverts: M = -.29, SD = .99). The non-significant main effect for condition yielded an F ratio of F(1,194) = 2.188, p = .141. This result indicates that whether a person receives exciting (n = 94) or neutral (n = 104) stimulation does not impact that person's change in excitement (exciting: M = -.14, SD = 1.10; neutral: M = -.35,

SD = .93). The interaction between extraversion and condition was also non-significant, F(1,194) = .858, p = .355 (Figure 1).

Figure 1. Change in Excitement (Experiment 1).



In addition to the ANOVA described above, I was interested in examining the influence of extraversion and condition on change in excitement scores without separating participants into two groups, introverts and extraverts. Therefore, I conducted a linear regression using extraversion as a continuous variable (without the median split) and condition as a categorical variable. A non-significant regression equation was found (F(3,194) = 1.094, p = .353), indicating that extraversion, condition, and their interaction failed to predict the change in excitement scores.

Together, these results indicate the experimental manipulation failed to differentially influence extraverts and introverts. However, because excitement scores were self-reported and because extraverts and introverts reported similar baseline excitement scores, the failure of the experimental manipulation may have been the result of participants' poor abilities to self-report excitement levels. Future research would benefit from the utilization of a different measure of excitement, one that does not rely on participants' abilities to self-report excitement levels.

Experience With People

First, I conducted a Pearson product-moment correlation coefficient to assess the relationship between experience with people and extraversion. I found a significant positive correlation between these two variables, $r(198) = .208$, $p < .05$. Second, I conducted the same analysis using sociability instead of extraversion. I found a significant positive correlation between these two variables, $r(198) = .145$, $p = .041$. Because these two correlations are weak in strength, these results indicate a person's experience with people is weakly related to their degree of extraversion as well as their degree of sociability. Further, because the correlations are positive in direction, these results indicate the more extraverted a person is and the more social a person is, the more experience that person has with people.

In addition to extraversion and sociability, I conducted a correlation analysis using experience with people and each of the remaining personality variables. I found six significant correlations. I found significant positive correlations between experience with people and productivity ($r(198) = .144$, $p < .05$), assertiveness ($r(198) = .147$, $p < .05$), and energy level ($r(198) = .204$, $p < .005$). I found significant negative correlations between experience with people and negative emotionality ($r(198) = -.162$, $p < .05$), depression ($r(198) = -.223$, $p < .005$), and emotional volatility ($r(190) = -.155$, $p < .05$). See Table 2 for a list of all correlations relating to experience with people.

Table 2. Correlation matrix for all correlations relating to experience with people (Experiment 1).

		Experience With People
Open Mindedness	Pearson Correlation	.040
	Sig. (2-tailed)	.579
Intellectual Curiosity	Pearson Correlation	-.012
	Sig. (2-tailed)	.867

Aesthetic Sensitivity	Pearson Correlation	.015
	Sig. (2-tailed)	.830
Creative Imagination	Pearson Correlation	.098
	Sig. (2-tailed)	.171
Conscientiousness	Pearson Correlation	.122
	Sig. (2-tailed)	.087
Organization	Pearson Correlation	.052
	Sig. (2-tailed)	.471
Productivity	Pearson Correlation	.144*
	Sig. (2-tailed)	.043
Responsibility	Pearson Correlation	.106
	Sig. (2-tailed)	.138
Extraversion	Pearson Correlation	.208*
	Sig. (2-tailed)	.003
Sociability	Pearson Correlation	.145*
	Sig. (2-tailed)	.041
Assertiveness	Pearson Correlation	.147*
	Sig. (2-tailed)	.039
Energy Level	Pearson Correlation	.204*
	Sig. (2-tailed)	.004
Agreeableness	Pearson Correlation	.038
	Sig. (2-tailed)	.593
Compassion	Pearson Correlation	-.022
	Sig. (2-tailed)	.754
Respect	Pearson Correlation	.089
	Sig. (2-tailed)	.212
Trust	Pearson Correlation	.036
	Sig. (2-tailed)	.616
Negative Emotionality	Pearson Correlation	-.162*
	Sig. (2-tailed)	.023
Anxiety	Pearson Correlation	-.036
	Sig. (2-tailed)	.619

Depression	Pearson Correlation	-.223*
	Sig. (2-tailed)	.002
Emotional Volatility	Pearson Correlation	-.155*
	Sig. (2-tailed)	.029
N = 198		

Hypotheses

This experiment used a between-groups experimental design, and it measured four independent variables and three dependent variables. The independent variables were experience with people, extraversion, sociability, and condition. The dependent variables were configural processing, face recognition, and object recognition. In Experiment 1, Hypotheses Two, Four, and Six were addressed, and in Experiment 2, Hypotheses Three, Five, and Seven were addressed. Hypotheses One and Eight were addressed in both experiments.

Hypothesis One: I expect to find a significant positive relationship between configural processing and face recognition. I conducted a Pearson product-moment correlation coefficient to assess the relationship between performance on a configural processing task (d') and performance on a face recognition task (CFMT). I failed to find a significant relationship between these two variables, $r(198) = .005$, $p = .940$. This result indicates a person's ability to process things configurally is unrelated to a person's ability to recognize faces.

Hypothesis Two: I expect to find a significant relationship between extraversion and two aspects of face processing: configural processing and face recognition. First, I assessed the relationship between extraversion and configural processing. I conducted a Pearson product-moment correlation coefficient to assess the relationship between degree of extraversion and performance on a configural processing task (d'). I failed to find a significant relationship between these two variables, $r(198) = .075$, $p = .292$. Second, I conducted the same analysis

using face recognition (CFMT) instead of configural processing. I failed to find a significant relationship between these two variables, r(198) = .043, p = .548. Together, these two results indicate the degree to which a person is extraverted is unrelated to either that person's ability process things configurally or that person's ability to recognize faces. See Table 3 for a list of all correlations relating to extraversion.

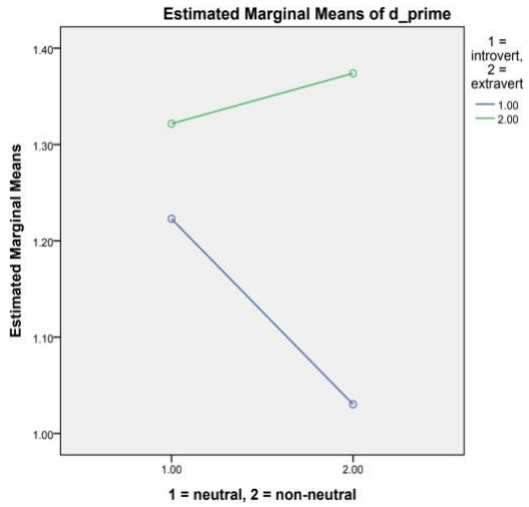
Table 3. Correlation matrix for all correlations relating to extraversion and its facets (Experiment 1).

		Extraversion	Sociability	Assertiveness	Energy Level
d'	Pearson Correlation	.075	.116	.062	-.014
	Sig. (2-tailed)	.292	.105	.845	.845
CFMT	Pearson Correlation	.043	.014	.021	.071
	Sig. (2-tailed)	.548	.843	.769	.320
N = 198					

Hypothesis Four: I expect to find evidence that increased arousal in introverts influences two aspects of face processing: configural processing and face recognition. First, I assessed the effect of increased arousal in extraverts and introverts on configural processing. I conducted a univariate ANOVA testing the influence of two independent variables (extraversion, condition) on performance on a configural processing task (d'). Extraversion consisted of two levels (extravert, introvert), and condition consisted of two levels (exciting, neutral). No effects were statistically significant at the .05 significance level. The non-significant main effect for extraversion yielded an F ratio of F(1,194) = 1.077, p = .301. This result indicates that whether a person is an extravert or an introvert does not impact that person's configural processing ability (extraverts: M = 1.35, SD = 1.58; introverts: M = 1.14, SD = 1.38). The non-significant main effect for condition yielded an F ratio of F(1,194) = .108, p = .742. This result indicates that whether a person receives exciting or neutral stimulation does not impact that person's

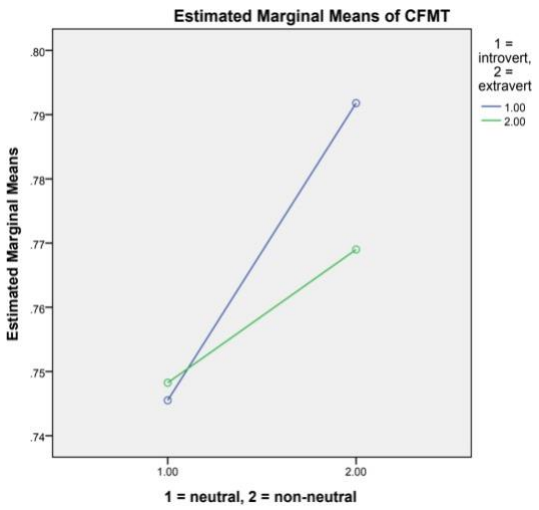
configural processing ability (exciting: M = 1.22, SD = 1.60; neutral: M = 1.27, SD = 1.40). The interaction between extraversion and condition was also non-significant, F(1,194) = .330, p = .566 (Figure 2).

Figure 2. Configural Processing (Experiment 1).



Second, I conducted the same analysis but with face recognition (CFMT) instead of configural processing. The non-significant main effect for extraversion yielded an F ratio of F(1,194) = .264, p = .608. This result indicates that whether a person is an extravert or an introvert does not impact that person's face recognition ability (extraverts: M = .76, SD = .14; introverts: M = .77, SD = .13). The marginally significant main effect for condition yielded an F ratio of F(1,194) = 2.955, p = .087. This result indicates that whether a person receives exciting or neutral stimulation may or may not impact that person's face recognition ability (exciting: M = .78, SD = .13; neutral: M = .75, SD = .14). The interaction between extraversion and condition was non-significant, F(1,194) = .429, p = .513 (Figure 3).

Figure 3. Face Recognition (Experiment 1).



Similar to before, I was interested in examining the influence of extraversion and condition on without separating participants into groups, so I conducted two linear regressions using extraversion as a continuous variable and condition as a categorical variable. In the first regression, I used configural processing as the dependent variable, and the regression equation was non-significant ($F(3,194) = .448$, $p = .719$). I used face recognition as the dependent variable in the second regression. Once again, a non-significant regression equation was found ($F(3,194) = .989$, $p = .399$). These outcomes indicate that extraversion and condition, and their interaction, do not impact performance on face recognition tasks.

Hypothesis Six: I expect to find a significant relationship between sociability, a facet of the extraversion characteristic, and two aspects of face processing: configural processing and face recognition. First, I assessed the relationship between sociability and configural processing. I conducted a Pearson product-moment correlation coefficient to assess the relationship between degree of sociability and performance on a configural processing task (d'). I failed to find a significant relationship between these two variables, $r(198) = .116$, $p = .105$. Second, I performed the same analysis using face recognition (CFMT) instead of configural

processing. Again, I failed to find a significant relationship between these two variables, r(198) = .014, p = .843. Taken together, these two results indicate the degree to which a person is sociable is unrelated to either that person's ability to process things configurally or that person's ability to recognize faces. See Table 3 for a list of all correlations relating to the facets of extraversion.

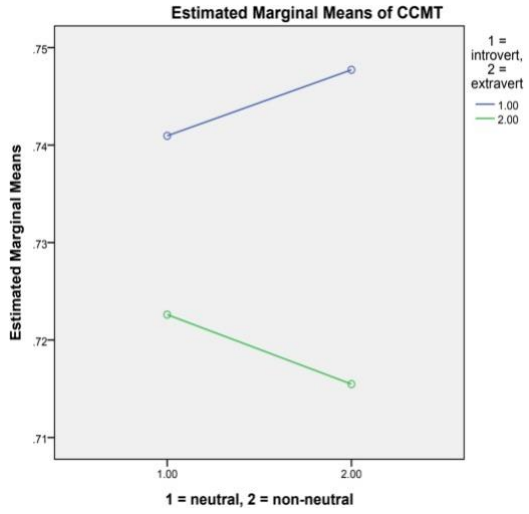
Hypothesis Eight: I predict that any result I find differentiating between extraverts and introverts will be unique to face recognition when compared to object recognition. I conducted two Pearson product-moment correlation coefficients to assess the relationships that exist between object recognition (CCMT) and two different variables. The two variables were configural processing (d') and sociability. I failed to find a significant relationship between object recognition and either of these two variables (d': r(198) = .049, p = .493; sociability: r(198) = -.094, p = .187). These results indicate that a person's ability to recognize objects in unrelated to that person's ability to process things configurally or that person's degree of sociability. See Table 4 for a list of all correlations relating to object recognition.

Table 4. Correlation matrix for all correlations relating to object recognition (Experiment 1).

		CCMT
d'	Pearson Correlation	.049
	Sig. (2-tailed)	.493
CFMT	Pearson Correlation	-.045
	Sig. (2-tailed)	.530
Extraversion	Pearson Correlation	-.069
	Sig. (2-tailed)	.336
Sociability	Pearson Correlation	-.094
	Sig. (2-tailed)	.187
N = 198		

I also conducted a univariate ANOVA testing the influence of two independent variables (extraversion, condition) on performance on an object recognition task (CCMT). Extraversion consisted of two levels (extravert, introvert), and condition consisted of two levels (exciting, neutral). No effects were statistically significant at the .05 significance level. The non-significant main effect for extraversion yielded an F ratio of $F(1,194) = 1.612$, $p = .206$. This result indicates that whether a person is an extravert or an introvert does not impact that person's object recognition ability (extraverts: $M = .72$, $SD = .15$; introverts: $M = .74$, $SD = .12$). The non-significant main effect for condition yielded an F ratio of $F(1,194) = .000$, $p = .993$. This result indicates that whether a person receives exciting or neutral stimulation does not impact that person's object recognition ability (exciting: $M = .73$, $SD = .14$; neutral: $M = .73$, $SD = .14$). The interaction between extraversion and condition was also non-significant, $F(1,194) = .122$, $p = .728$ (Figure 4).

Figure 4. Object Recognition (Experiment 1).



Like before, I conducted a linear regression to examine the influence of extraversion and condition on object recognition without first separating participants into two groups. I failed to find a significant regression equation ($F(3,194) = .510$, $p = .676$), strengthening my conclusion

that receiving exciting or neutral stimulation does not impact a person's ability to recognize objects.

In summary, Hypothesis Eight states that any significant result I find for object recognition (CCMT) will differ from the results I find for face recognition (CFMT). The purpose of including this hypothesis is to determine whether the CCMT can be used as a control task to distinguish general object recognition from face-specific recognition. None of the analyses for either face recognition or object recognition were significant (except for one marginally significant main effect for condition); therefore, in one sense this hypothesis is not supported. That being said, I also failed to find a significant correlation between face recognition and object recognition, which suggests the two processes are unrelated. As such, even though the results of the CCMT did not differ from the results of the CFMT, the results of the present study suggest that face-specific recognition is unrelated to general object recognition and the CCMT can be used as a control task when used with the CFMT.

Remaining Personality Characteristics

One benefit of the experimental design is it allowed me to assess the relationship between the other Big 5 personality characteristics, as well as their facets, and the three dependent variables: configural processing (d'), face recognition (CFMT), and object recognition (CCMT). Further, it allowed me to do so using a large sample size. I found three significant correlations. First, I found a significant positive correlation between open mindedness characteristic and face recognition, $r(198) = .159$, $p < .05$. Second, I found a significant positive correlation between aesthetic sensitivity, a facet of the open mindedness characteristic, and face recognition, $r(198) = .181$, $p < .05$. And third, I found a significant negative correlation between organization, a facet of the conscientiousness characteristic, and face recognition, $r(198) = -.153$, $p < .05$. No other

correlations were significant at the .05 level. See Tables 5-8 for a list of all correlations relating to the remaining personality variables.

Table 5. Correlation matrix for all correlations relating to openness mindedness and its facets (Experiment 1).

		Open Mindedness	Intellectual Curiosity	Aesthetic Sensitivity	Creative Imagination
d'	Pearson Correlation	.118	.047	.113	.134
	Sig. (2-tailed)	.098	.511	.114	.059
CFMT	Pearson Correlation	.159*	.111	.181*	.101
	Sig. (2-tailed)	.026	.120	.011	.157
CCMT	Pearson Correlation	.014	-.010	.029	.011
	Sig. (2-tailed)	.847	.892	.690	.878
N = 198					

Table 6. Correlation matrix for all correlations relating to conscientiousness and its facets (Experiment 1).

		Conscientiousness	Organization	Productivity	Responsibility
d'	Pearson Correlation	.013	.094	-.110	.049
	Sig. (2-tailed)	.857	.188	.124	.491
CFMT	Pearson Correlation	-.090	-.153*	-.070	.064
	Sig. (2-tailed)	.206	.032	.326	.370
CCMT	Pearson Correlation	-.016	-.036	.017	-.019
	Sig. (2-tailed)	.823	.615	.808	.792
N = 198					

Table 7. Correlation matrix for all correlations relating to agreeableness and its facets (Experiment 1).

		Agreeableness	Compassion	Respect	Trust
d'	Pearson Correlation	.026	.021	-.026	.065
	Sig. (2-tailed)	.720	.770	.720	.362

CFMT	Pearson Correlation	-.030	-.036	-.046	.007
	Sig. (2-tailed)	.677	.616	.517	.925
CCMT	Pearson Correlation	-.020	-.109	-.008	.073
	Sig. (2-tailed)	.780	.125	.907	.305
N = 198					

Table 8. Correlation matrix for all correlations relating to negative emotionality and its facets (Experiment 1).

		Negative Emotionality	**Anxiety**	**Depression**	**Emotional Volatility**
d'	Pearson Correlation	.043	.065	-.030	.081
	Sig. (2-tailed)	.545	.360	.675	.257
CFMT	Pearson Correlation	.091	.018	.140	.075
	Sig. (2-tailed)	.210	.805	.050	.291
CCMT	Pearson Correlation	-.111	-.113	-.094	-.083
	Sig. (2-tailed)	.119	.112	.190	.245
N = 198					

Experiment 2

Scoring

Negative Emotionality. Negative Emotionality scores were obtained from the BFI-2. Participants rated each of 12 negative emotionality-specific statements using a Likert scale from one to five with one corresponding to "disagree strongly" and five corresponding to "agree strongly". Half of the statements were reverse-worded and were therefore reverse scored by subtracting each response from six. To calculate negative emotionality for each participant, I took the sum of each participant's responses to the 12 statements. Therefore, the minimum score a participant could receive was 12, and the maximum score a participant could receive was 60.

In order to separate participants into two groups, emotionally negative participants and emotionally positive participants, I performed a median split. The median score for negative emotionality was 36. 97 participants scored below a 36 and were placed into the positive emotionality group. 93 participants scored a 36 or higher and were placed into the negative emotionality group.

Anxiety. Anxiety scores were obtained from the BFI-2. Of the 12 statements specific to negative emotionality, four statements were specific to anxiety. Two of these statements were reverse-worded and were therefore reverse scored by subtracting each response from six. To calculate anxiety for each participant, I took the sum of each participant's responses to the 4 statements. Therefore, the minimum score a participant could receive was 4, and the maximum score a participant could receive was 20.

Baseline Anxiety. Before beginning the experimental session, participants were told to answer the question "How anxious do you feel right now?" using a Likert scale from one to five with one being "not anxious at all" and five being "very anxious." Each participants' response to this question was used as that participants' baseline anxiety score.

Change in Anxiety. After watching the video and completing each task, participants were told to again answer the question "How anxious do you feel right now?". There was one video and three tasks, so participants answered this question four additional times. I first calculated the average of these four responses. To obtain a change in anxiety score, I subtracted the average of the four anxiety scores from the baseline anxiety score.

d', CFMT, and CCMT were scored the same way in Experiment 2 as they were scored in Experiment 1. For a summary of the overall descriptive statistics for each measure presented above, see Table 9.

Table 9. Overall means and standard deviations of the variables used in Experiment 2.

Measure	*N*	*Mean*	*Standard Deviation*
Negative Emotionality	190	35.47	7.53
Anxiety	190	12.87	3.32
Baseline Anxiety	190	2.06	1.07
Change in Anxiety	190	.20	1.11
d’	190	.87	1.09
CFMT	190	.78 (78%)	.14 (14%)
CCMT	190	.72 (72%)	.11 (11%)
Experience With People	190	.00	3.04
Open Mindedness	190	39.43	7.57
Intellectual Curiosity	190	13.51	2.79
Aesthetic Sensitivity	190	13.08	3.49
Creative Imagination	190	12.84	3.54
Conscientiousness	190	38.71	5.73
Organization	190	13.01	2.81
Productivity	190	12.65	2.41
Responsibility	190	13.05	2.10
Extraversion	190	39.24	6.78
Sociability	190	13.24	2.96
Assertiveness	190	12.59	2.69

Energy Level	190	13.42	2.92
Agreeableness	190	41.43	7.14
Compassion	190	14.17	3.02
Respect	190	14.34	3.25
Trust	190	12.92	2.02
Depression	190	11.49	3.43
Emotional Volatility	190	11.10	2.64

While the participants in Experiment 2 completed the Experiences with People Survey, only the demographic information (age and ethnicity) was used in Experiment 2's primary data analysis. The hypotheses in Experiment 1 were specific to the personality characteristics of extraversion and sociability, which both concern a person's experience with other people. The hypotheses in Experiment 2, however, were specific to negative emotionality and anxiety, which do not concern a person's experience with other people. Therefore, the information from the Experience with People Survey was only included in the form of exploratory analyses in Experiment 2.

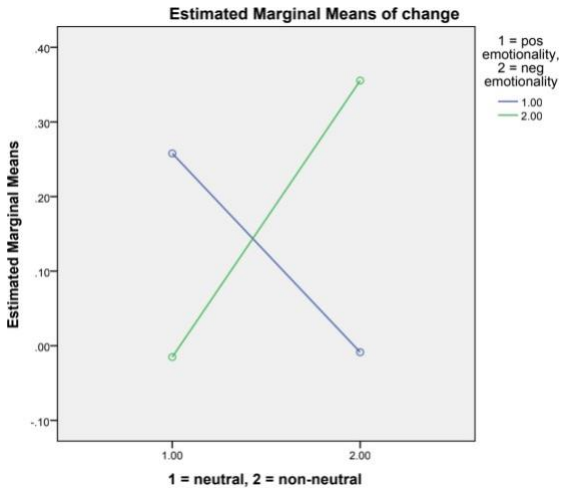
Manipulation Check

I conducted an independent samples *t* test to determine whether emotionally negative individuals (n = 97) and emotionally positive individuals (n = 93) reported significantly different baseline anxiety scores. I failed to find a significant difference in baseline anxiety for these two group, $t(188) = .424$, $p = .672$. This result indicates that emotionally negative and emotionally positive individuals report statistically similar baseline anxiety scores (negative emotionality: M = 2.03, SD = 1.07; positive emotionality: M = 2.10, SD = 1.06). The correlation between

negative emotionality, when left as a continuous variable, and baseline anxiety was also non-significant, $r(190) = .048$, $p = .508$.

To increase anxiety I showed a tense movie at the beginning of the experimental session. Participants were randomly assigned to one of two conditions: anxious or neutral. In the neutral condition, I showed a calm movie that was not supposed to increase anxiety, and in the anxious condition, I played a tense movie that was supposed to increase anxiety. I conducted a univariate ANOVA testing the influence of two independent variables (negative emotionality, condition) on change in anxiety scores. Negative emotionality consisted of two levels (emotionally negative, emotionally positive), and condition consisted of two levels (anxious, neutral). The non-significant main effect for negative emotionality yielded an F ratio of $F(1,186) = .071$, $p = .791$. This result indicates that whether a person is emotionally negative or emotionally positive does not impact that person's self-reported change in anxiety (emotionally negative: $M = .23$, $SD = 1.12$; emotionally positive: $M = .17$; $SD = 1.10$). The non-significant main effect for condition yielded an F ratio of $F(1,186) = .093$, $p = .761$. This result indicates that whether a person is placed in an anxious ($n = 97$) or neutral ($n = 97$) situation does not impact that person's change in anxiety (anxious: $M = .24$, $SD = 1.02$; neutral: $M = .16$, $SD = 1.19$). The interaction between negative emotionality and condition was marginally significant, $F(1,186) = 3.458$, $p = .065$ (Figure 5). This result suggests the experimental manipulation may or may not have been effective at differentially affecting emotionally negative and emotionally positive participants. If the manipulation was effective, the results indicate that emotionally negative individuals report a greater increase in anxiety after being placed in an anxious situation.

Figure 5. Change in Anxiety (Experiment 2).



In addition to the ANOVA described above, I was interested in examining the influence of negative emotionality and condition on change in anxiety scores without separating participants into two groups, emotionally positive individuals and emotionally negative individuals. Therefore, I conducted a linear regression using negative emotionality as a continuous variable and condition as a categorical variable. I found a non-significant regression equation ($F(3,186) = .510$, $p = .676$, indicating that neither negative emotionality nor condition, nor their interaction, influenced participants' self-reported change in anxiety. Together, these results indicate emotionally negative and emotionally positive individuals do not report significantly different baseline anxiety levels but may be differentially affected by being placed in an anxious situation.

Hypotheses

This experiment used a between-groups experimental design, and it measured three independent variables and three dependent variables. The independent variables were negative emotionality, anxiety, and condition. The dependent variables were configural processing, face recognition, and object recognition.

Hypothesis One: I expect to find a significant positive relationship between configural processing and face recognition. I conducted a Pearson product-moment correlation coefficient to assess the relationship between performance on a configural processing task (d') and performance on a face recognition task (CFMT). I failed to find a significant relationship between these two variables, $r(190) = .063$, $p = .388$. This result indicates a person's ability to process things configurally is unrelated to a person's ability to recognize faces.

Hypothesis Three: I expect to find a significant relationship between negative emotionality and two aspects of face processing: configural processing and face recognition. First, I conducted a Pearson product-moment correlation coefficient to assess the relationship between degree of negative emotionality and performance on a configural processing task (d'). I failed to find a significant relationship between these two variables, $r(190) = .067$, $p = .362$. This result indicates the degree to which a person is emotionally negative is unrelated to a person's ability to process things configurally. Second, I conducted the same analysis using face recognition (CFMT) instead of configural processing. I found a marginally significant negative correlation between these two variables, $r(190) = -.128$, $p = .080$. This result indicates the degree to which a person is emotionally negative may or may not be related to a person's ability to recognize faces. If these two variables are related, the relationship would be negative, which would indicate that people who are more emotionally negative demonstrate poorer face recognition abilities. See Table 10 for a list of all correlations relating to negative emotionality.

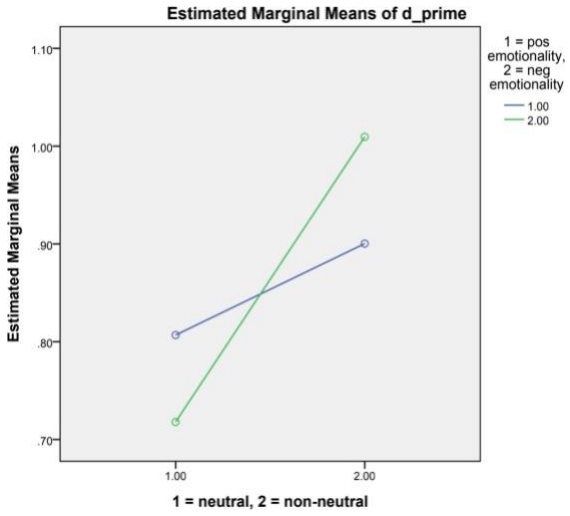
Table 10. Correlation matrix for all correlations relating to negative emotionality and its facets (Experiment 2).

		Negative Emotionality	Anxiety	Depression	Emotional Volatility
d'	Pearson Correlation	.067	.032	.054	.080
	Sig. (2-tailed)	.362	.665	.460	.272

CFMT	Pearson Correlation	-.128	.012	-.128	-.212*
	Sig. (2-tailed)	.080	.872	.078	.003
N = 190					

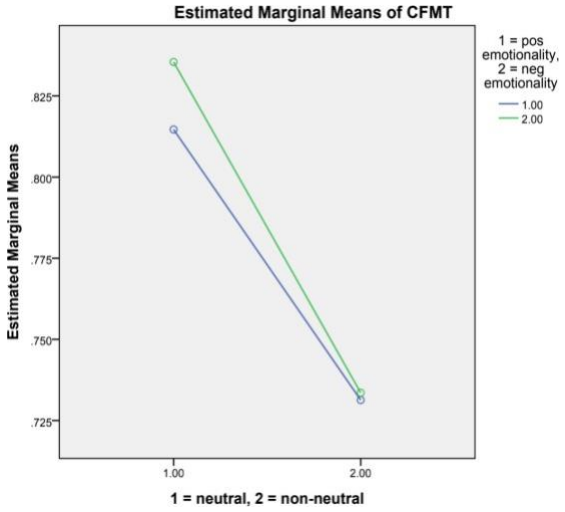
Hypothesis Five: I expect to find evidence that increased anxiety in negatively emotional individuals influences two aspects of face processing: configural processing and face recognition. First, I assessed the effect of increased anxiety in emotionally negative and emotionally positive individuals on configural processing. I conducted a univariate ANOVA testing the influence of two independent variables (negative emotionality, condition) on performance on a configural processing task (d'). Negative emotionality consisted of two levels (emotionally negative, emotionally positive), and condition consisted of two levels (anxious, neutral). No effects were statistically significant at the .05 significance level. The non-significant main effect for negative emotionality yielded an F ratio of $F(1, 186) = .004$, $p = .952$. This result indicates that whether a person is emotionally negative or emotionally positive does not impact that person's configural processing ability (emotionally negative: $M = .91$, $SD = 1.06$; emotionally positive: $M = .84$, $SD = 1.12$). The non-significant main effect for condition yielded an F ratio of $F(1, 186) = 1.303$, $p = .255$. This result indicates that whether a person is placed in an anxious situation or a neutral situation does not impact that person's configural processing ability (anxious: $M = .98$, $SD = 1.07$; neutral: $M = .78$, $SD = 1.10$). The interaction between negative emotionality and condition was also non-significant, $F(1, 186) = .345$, $p = .558$ (Figure 6).

Figure 6. Configural Processing (Experiment 2).



Second, I conducted the same analysis but with face recognition (CFMT) instead of configural processing. The non-significant main effect for negative emotionality yielded an F ratio of $F(1, 186) = .301$, $p = .584$. This result indicates that whether a person is emotionally negative or emotionally positive does not impact that person's face recognition ability (emotionally negative: $M = .77$, $SD = .13$; emotionally positive: $M = .79$, $SD = .15$). The significant main effect for condition yielded an F ratio of $F(1, 186) = 19.46$, $p < .001$. Participants placed in the neutral condition performed better on the face recognition task ($M = .82$, $SD = .13$) than participants placed in the anxious condition ($M = .73$, $SD = .14$). This result indicates that face recognition ability is negatively impacted when participants are placed in an anxious situation. The interaction between negative emotionality and condition was non-significant, $F(1, 186) = .195$, $p = .659$ (Figure 7).

Figure 7. Face Recognition (Experiment 2).



As before, I was interested in examining the influence of negative emotionality and condition without separating participants into groups, so I conducted two additional linear regression analyses. In each one, I used negative emotionality as a continuous variable and condition as a categorical variable. In the first regression, I used configural processing as the dependent variable, and in the second analysis I used face recognition as the dependent variable. The first regression equation was non-significant ($F(3,186) = .683$, $p = .564$) while the second regression equation was significant ($F(3,186) = 7.023$, $p < .001$). However, in the second regression analysis, the model indicates that none of the independent variables were significant predictors of face recognition (negative emotionality: ß = -.067, $p = .603$; condition: ß = .017, $p = .966$; negative emotionality * condition: ß = .282, $p = .438$). Therefore, the significant regression equation is likely the result of high multicollinearity between the independent variables. Additionally, the tolerance statistic for condition is .031, and the tolerance statistic for negative emotionality is .037. Both of these values are below .2, which is indicative of high multicollinearity. To test this, I conducted a linear regression using only the interaction between negative emotionality and condition as the independent variable since Hypothesis 5 focuses on

the interaction specifically. The regression equation was significant, ($F(1,188) = 20.162$, $p < .001$), so I followed this analysis with two separate correlations: the first correlation was between negative emotionality and CFMT using only participants in condition 1, and the second correlation was between negative emotionality and CFMT using only participants in condition 2. Neither correlation was significant (condition 1: $r(190) = .064$, $p = .531$; condition 2: $r(190) = -.052$, $p = .619$). These results suggest that the significant regression equation is the result of intercorrelated measures but cannot be attributed to a specific combination of negative emotionality and condition.

Hypothesis Seven: I expect to find a significant relationship between anxiety, a facet of the negative emotionality characteristic, and two aspects of face processing: configural processing and face recognition. First, I conducted a Pearson product-moment correlation coefficient to assess the relationship between degree of anxiety and performance on a configural processing task (d'). I failed to find a significant relationship between these two variables, $r(190) = .032$, $p = .665$. Second, I conducted the same analysis using face recognition (CFMT) instead of configural processing. Again, I failed to find a significant relationship between these two variables, $r(190) = .012$, $p = .872$. Together, these two results indicate the degree to which a person is anxious is unrelated to either that person's ability to processing things configurally or that person's ability to recognize faces. See Table 10 for a list of all correlations relating to the facets of negative emotionality.

Hypothesis Eight: I predict that any result I find differentiating between negatively emotional individuals and stable individuals will be unique to face recognition when compared to object recognition. I conducted two Pearson product-moment correlation coefficients to assess the relationships that exist between performance on an object recognition

task (CCMT) and two different variables. The variables were configural processing (d') and anxiety. I found a marginally significant negative correlation between object recognition and each of these variables (d': r(190) = -.139, p = .055; anxiety: r(190) = -.132, p = .070). These two results indicate a person's ability to recognize objects may or may not be related to either that person's ability to process things configurally or that person's degree of anxiety. If either of these relationships exist, the relationship would be negative, which would indicate that people who demonstrate more configural processing or experience more anxiety also demonstrate poorer object recognition abilities. See Table 11 for a list of all correlations relating to object recognition.

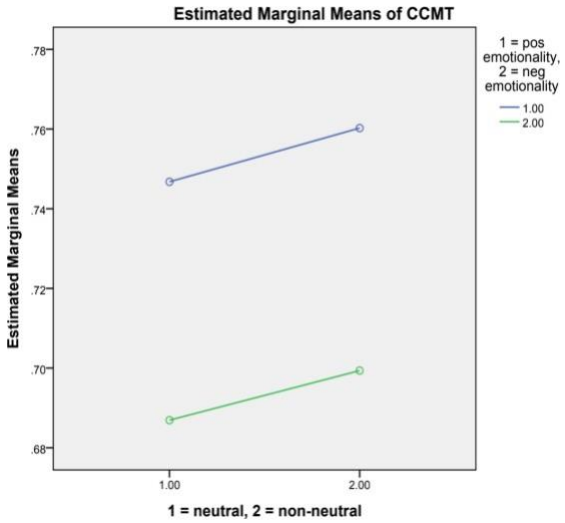
Table 11. Correlation matrix for all correlations relating to object recognition (Experiment 2).

		CCMT
d'	Pearson Correlation	-.139
	Sig. (2-tailed)	.055
CFMT	Pearson Correlation	.025
	Sig. (2-tailed)	.728
Negative Emotionality	Pearson Correlation	-.206*
	Sig. (2-tailed)	.004
Anxiety	Pearson Correlation	-.132
	Sig. (2-tailed)	.070
N = 190		

I also conducted a univariate ANOVA testing the influence of two independent variables (negative emotionality, condition) on performance on an object recognition task (CCMT). Negative emotionality consisted of two levels (emotionally negative, emotionally positive), and condition consisted of two levels (anxious, neutral). Only one effect was statistically significant

at the .05 significance level. The significant main effect for negative emotionality yielded an F ratio of F(1, 186) = 12.154, p = < .01. This result indicates that being emotionally negative or emotionally positive impacts object recognition ability. Specifically, emotionally positive individuals perform better on object recognition tasks (M = .75, SD = .11) than do emotionally negative individuals (M = .70, SD = .12). The non-significant main effect for condition yielded an F ratio of F(1, 186) = .560, p = .455. This result indicates that whether a person is placed in a neutral situation or an anxious situation does not impact that person's object recognition ability (anxious: M = .72, SD = .11; neutral: M = .73, SD = .12). The interaction between negative emotionality and condition was non-significant, F(1, 186) = .001, p = .976 (Figure 8).

Figure 8. Object Recognition (Experiment 2).



Again, I conducted a linear regression to examine the influence of negative emotionality and condition on object recognition without first separating participants into two groups. I found a significant regression equation (F(3,186) = 3.212, p < .05), and I found that negative emotionality was a significant predictor of object recognition (ß = -.318, p < .05). Neither condition (ß = -.318, p = .352**)** nor the interaction between negative emotionality and condition

(ß = .292, p = .435) was significant. This result strengthens my conclusion that being emotionally negative or emotionally positive impacts a person's ability to recognize objects.

In conclusion, Hypothesis Eight states that any significant result I find for object recognition (CCMT) will differ from the results I find for face recognition (CFMT). Consistent with Experiment 1, the purpose of including this hypothesis is to determine whether the CCMT can be used as a control task to distinguish general object recognition from face-specific recognition. Several but not all of the analyses for face recognition differed from those of object recognition. Further, as in Experiment 1, I failed to find a significant correlation between face recognition and object recognition. As such, even though the results of the CCMT did not differ entirely from the results of the CFMT, the results of the present study suggest that face-specific recognition is unrelated to general object recognition and the CCMT can be used as a control task when used with the CFMT.

Experience with People

Consistent with Experiment 1, I found significant positive correlations between experience with people and both extraversion ($r(190) = .191$, $p < .01$) and sociability ($r(190) = .215$, $p < .005$). No other correlations were significant at the .05 level (Table 12).

Table 12. Correlation matrix for all correlations relating to experience with people (Experiment 2).

		Experience With People
Open Mindedness	Pearson Correlation	-.025
	Sig. (2-tailed)	.731
Intellectual Curiosity	Pearson Correlation	.012
	Sig. (2-tailed)	.867
Aesthetic Sensitivity	Pearson Correlation	-.053
	Sig. (2-tailed)	.468
Creative Imagination	Pearson Correlation	-.011

	Sig. (2-tailed)	.878
Conscientiousness	Pearson Correlation	.063
	Sig. (2-tailed)	.389
Organization	Pearson Correlation	.073
	Sig. (2-tailed)	.320
Productivity	Pearson Correlation	.084
	Sig. (2-tailed)	.252
Responsibility	Pearson Correlation	-.022
	Sig. (2-tailed)	.765
Extraversion	Pearson Correlation	.191*
	Sig. (2-tailed)	.008
Sociability	Pearson Correlation	.215*
	Sig. (2-tailed)	.003
Assertiveness	Pearson Correlation	.092
	Sig. (2-tailed)	.206
Energy Level	Pearson Correlation	.140
	Sig. (2-tailed)	.054
Agreeableness	Pearson Correlation	-.108
	Sig. (2-tailed)	.138
Compassion	Pearson Correlation	-.075
	Sig. (2-tailed)	.303
Respect	Pearson Correlation	-.099
	Sig. (2-tailed)	.172
Trust	Pearson Correlation	-.108
	Sig. (2-tailed)	.137
Negative Emotionality	Pearson Correlation	.032
	Sig. (2-tailed)	.663
Anxiety	Pearson Correlation	.069
	Sig. (2-tailed)	.343
Depression	Pearson Correlation	-.009
	Sig. (2-tailed)	.904
Emotional Volatility	Pearson Correlation	-.015

	Sig. (2-tailed)	.833
N = 190		

Remaining Personality Characteristics

While I only found three significant correlations in Experiment 1, I found 16 significant correlations in Experiment 2. First, regarding the open mindedness characteristic, I found a significant correlation between configural processing and open mindedness ($r(190) = -.232$, $p < .005$), configural processing and aesthetic sensitivity ($r(190) = -.227$, $p < .005$), configural processing and creative imagination ($r(190) = -.186$, $p < .05$), face recognition and open mindedness ($r(190) = .163$, $p < .05$), and face recognition and intellectual curiosity ($r(190) = .201$, $p < .01$). Regarding the conscientiousness characteristic, I found a significant correlation between face recognition and conscientiousness ($r(190) = .219$, $p < .005$), face recognition and organization ($r(190) = .168$, $p < .05$), and face recognition and responsibility ($r(190) = .281$, $p < .001$). Regarding the extraversion characteristic, I found a significant correlation between configural processing and assertiveness ($r(190) = -.156$, $p < .05$). Regarding the agreeableness characteristic, I found a significant correlation between face recognition and agreeableness ($r(190) = .305$, $p < .001$), face recognition and compassion ($r(190) = .281$, $p < .001$), and face recognition and respect ($r(190) = .360$, $p < .001$). Lastly, regarding the facets of the negative emotionality characteristic not previously discussed, I found a significant correlation between face recognition and emotional volatility ($r(190) = -.212$, $p < .005$), object recognition and depression ($r(190) = -.192$, $p < .01$), and object recognition and emotional volatility ($r(190) = -.172$, $p < .05$). The significant positive correlation between face recognition and open mindedness is the only replication in positive outcome I found across the two experiments. See Tables 13-16 for a list of all correlations relating to the remaining personality variables.

Table 13. Correlation matrix for all correlations relating to openness mindedness and its facets (Experiment 2).

		Open Mindedness	Intellectual Curiosity	Aesthetic Sensitivity	Creative Imagination
d'	Pearson Correlation	-.232*	-.111	-.227*	-.186*
	Sig. (2-tailed)	.001	.128	.002	.010
CFMT	Pearson Correlation	.163*	.201*	.070	.121
	Sig. (2-tailed)	.025	.005	.336	.096
CCMT	Pearson Correlation	.131	.070	.071	.154
	Sig. (2-tailed)	.072	.335	.327	.034
N = 190					

Table 14. Correlation matrix for all correlations relating to conscientiousness and its facets (Experiment 2).

		Conscientiousness	Organization	Productivity	Responsibility
d'	Pearson Correlation	-.100	-.072	-.045	-.124
	Sig. (2-tailed)	.170	.320	.541	.087
CFMT	Pearson Correlation	.219*	.168*	.079	.281*
	Sig. (2-tailed)	.002	.021	.279	.000
CCMT	Pearson Correlation	.021	.034	-.055	.074
	Sig. (2-tailed)	.779	.643	.450	.311
N = 190					

Table 15. Correlation matrix for all correlations relating to extraversion and its facets (Experiment 2).

		Extraversion	Sociability	Assertiveness	Energy Level
d'	Pearson Correlation	-.089	.010	-.156*	-.072
	Sig. (2-tailed)	.224	.893	.032	.321
CFMT	Pearson Correlation	.102	.044	.080	.118
	Sig. (2-tailed)	.163	.549	.275	.104
CCMT	Pearson Correlation	.080	.061	.058	.070

	Sig. (2-tailed)	.275	.404	.424	.340
N = 190					

Table 16. Correlation matrix for all correlations relating to agreeableness and its facets (Experiment 2).

		Agreeableness	**Compassion**	**Respect**	**Trust**
d'	Pearson Correlation	-.038	-.087	.000	-.003
	Sig. (2-tailed)	.605	.233	.998	.966
CFMT	Pearson Correlation	.305*	.281*	.360*	.079
	Sig. (2-tailed)	.000	.000	.000	.277
CCMT	Pearson Correlation	.042	-.013	.038	.107
	Sig. (2-tailed)	.565	.853	.598	.143
N = 190					

4. DISCUSSION

The purpose of the present study was to determine what relationship, if any, exists between personality, specifically the personality characteristics of extraversion and negative emotionality, and face processing. Further, by manipulating participants' levels of excitement and anxiety, my goal was to show a causal link between personality and face processing. Despite the limited number of significant results, the results I obtained when paired with the results of past research shed light on what relationships might and might not exist between personality and face processing.

Personality and Face Recognition

In Experiment 1, I examined the relationship between extraversion and face recognition. I also examined the relationship between sociability, a facet of extraversion, and face recognition. In both analyses, the results were non-significant, suggesting meaningful relationships between face recognition and these two aspects of personality do not exist. These results are consistent with those of other researchers, specifically Thompson and Mueller (1984) and Megreya and Bindemann (2013), both of whom determined extraversion is unrelated to face recognition. However, the results of my study are inconsistent with the results found by Li et al. (2010) who performed a comparable study. These researchers found that extraverts tended to recognize faces more often than introverts, and specifically, extraverts with stronger social skills were the most accurate at recognizing faces. In a study with similar conclusions, Saito et al. (2005) found that extraverts were faster at making present/absent judgments when searching

arrays for target faces. This led the researchers to conclude personality and face recognition are related, and extraverts are better than introverts at recognizing faces (Saito et al., 2005).

In Experiment 2, I examined the relationship between face recognition and negative emotionality as well as the relationship between face recognition and anxiety, a facet of the negative emotionality characteristic. I found a marginally significant correlation between face recognition and negative emotionality but failed to find a significant correlation between face recognition and anxiety. Therefore, I concluded there is not a meaningful relationship between face recognition and anxiety but that more research is needed to determine whether there is a meaningful relationship between face recognition and negative emotionality. As with Experiment 1, some past research is consistent with the results I obtained in the present study while some is not. Consistent with my results, Saito et al. (2005) found a significant relationship between negative emotionality and response time on a face recognition test. Additionally, Megreya and Bindemann (2013) found a significant relationship between face identification accuracy and two aspects of personality, low anxiety and high emotional stability. However, the results of the current study are inconsistent with those of Li et al. (2010) who failed to find a significant relationship between negative emotionality and face recognition. The inconsistent results found in the literature along with the marginally significant correlation I obtained in the present study indicate the relationship between face recognition and negative emotionality is not yet fully understood.

Regardless of the many non-significant results found in this study, I obtained one marginally significant result and one significant result which relate to the experimental manipulations I used. First, in Experiment 1 I found a marginally significant main effect for condition when I tested the impact of excitement on face recognition. All participants were

placed into one of two conditions: excited or neutral. The excited condition involved exciting music, which was used to raise the excitement levels of both extraverts and introverts while the neutral stimulation, the calm music, was intended to have little to no impact on excitement. Because extraverts need higher excitement levels to perform optimally and because introverts need lower excitement levels to perform optimally (Eysenck, 1967; Gale, 1973; Smith et al., 1995; Stelmack, 1981; Sternberg et al., 1992; Stenberg, 1992), I expected to find a significant interaction effect between condition and extraversion on face recognition. I did not find such an effect, which suggests excitement level does not differentially impact extraverts and introverts and no combination of excitement and extraversion significantly affects face recognition. Despite this, I did find a marginally significant main effect for condition. This result suggests that increasing excitement in participants, regardless of whether that person is an extravert or an introvert, may positively impact that person's performance on face recognition tests.

In Experiment 2, I found a significant main effect of condition for face recognition. In this experiment, all participants were placed into one of two conditions: anxious or neutral. The anxious condition, the tense movie, was used to raise participants' anxiety level. The neutral condition, the calm movie, was intended to have little to no impact on anxiety level. Therefore, because emotionally negative individuals are more susceptible to changes in states of anxiety (Soto & John, 2017), I expected participants high in negative emotionality to exhibit poor face recognition performance when placed in the high anxiety condition. I was looking to find a significant interaction effect between condition and negative emotionality on face recognition. I did not find such an effect but instead found a significant main effect for condition. This significant result indicates that increasing anxiety in participants, regardless of whether they are

emotionally positive or emotionally negative, has a detrimental effect on their performance on face recognition tests.

It is worth noting that both of the significant/marginally significant ANOVAs in Experiments 1 and 2 represented the results of the experimental manipulations. Therefore, they demonstrate that the manipulations were successful at influencing performance even if they were unsuccessful at influencing participants' self-reported levels of excitement or anxiety. However, while they were successful at influencing performance overall, they were not successful at differentially influencing the performance of extraverts and introverts or emotionally positive and emotionally negative individuals. In other words, while both past and present research suggest that face recognition may be unrelated to a person's personality traits, the present research also suggests that a person's excitement level and/or anxiety level may be related to that person's performance on a face recognition test.

Personality and Configural Processing

Little research has been conducted on the subject of individual differences in personality and the effect they have on configural processing. One aim of the current study was to add to the small body of research on this topic. To do so, I examined the relationship between configural processing and two different personality characteristics. In Experiment 1 I focused on the personality characteristic of extraversion, and in Experiment 2 I focused on the personality characteristic of negative emotionality. While I failed to obtain significant results in either experiment, I succeeded at adding to the body of research regarding the effect of individual differences in personality on configural processing.

In both experiments, I expected to find evidence of a relationship between personality and configural processing. This expectation was based on the results of Cheung et al. (2010)

who studied the relationship between extraversion and configural processing by utilizing electroencephalography (EEG) and photos of faces. During an EEG session, participants viewed photos of upright and inverted faces. The results showed a face inversion effect, a common marker of configural processing, for extraverts but not introverts. Therefore, the results of Cheung et al. offer support for stronger configural processing in extraverts when compared to introverts. Despite this, the results of Experiments 1 and 2 failed to provide evidence for a relationship between personality and configural processing. Due to a number of methodological differences, the significant results obtained by Cheung et al. may be the product of an unrelated effect. First, Cheung et al. recruited a sample size of only 24 participants and tested them individually in one-on-one sessions whereas I recruited much larger sample sizes (198 participants in Experiment 1 and 190 participants in Experiment 2) and tested them small groups of up to 10 participants. Second, Cheung et al. used different tasks to measure personality and configural processing than I did in the present study. And third, Cheung et al. utilized EEG while I did not.

Face Recognition and Configural Processing

To date, several studies have been conducted which examine the relationship between face recognition and configural processing within a normally-developed population. That being said, the conclusions are varied and controversial. Some research, like mine, failed to find a relationship between face recognition and configural processing (Konar et al., 2010; Verhallen et al., 2017). Other research suggests a significant relationship exists but is weak (Wang et al., 2012), and yet other research suggests a relationship exists that is both significant and moderate in strength (DeGutis et al., 2013; Engfors et al., 2017; McGugin et al., 2012; Richler et al., 2011).

Based on the literature, it is unclear whether the type of composite task used may influence the presence of a meaningful relationship between configural processing and face recognition. In the so-called *partial design*, face tops can be the same or different but face bottoms are always different. This results in only two trial types: same-incongruent and different-congruent (see Appendix B for examples). In this version of the task, the congruency effect alone cannot be used as a measure of configural processing because congruency is confounded with trial type – only different trials can be congruent while same trials are always incongruent. For this reason, misaligned trials must be included in the partial design because configural processing is measured by the interaction between congruency and alignment. In summary, the partial design includes only same-incongruent trials and different-congruent trials but in both conditions (aligned and misaligned).

In the *complete design*, both face tops and face bottoms can be the same or different. The result of this design is four trial types: same-congruent, same-incongruent, different-congruent, and different-incongruent. Since congruency is not confounded with trial type, congruency alone can be used to measure configural processing and the use of misaligned trials is not necessary. When misaligned trials are used, the complete design includes all four trial types in both conditions (aligned and misaligned). As previously discussed, the present study used the complete design but the misaligned trials were excluded. Therefore, the present study consisted of all four trial types but only in the aligned condition.

Of the studies that failed to find a link between face recognition and configural processing, both used the partial design of the composite task (Konar et al., 2010; Verhallen et al., 2017). Additionally, Richler et al. (2011) used both the partial design and the complete design of the composite task; using the partial design, Richler et al. (2011) failed to find evidence

of a relationship between face recognition and configural processing, but using the complete design, they found evidence of a moderate relationship. However, my study which used the complete design of the composite task failed to find a link between face recognition and configural processing while the study conducted by Engfors et al. (2017) which used the partial design of the composite task successfully found evidence of such a link.

If it is not the type of composite task used, perhaps it is the choice of face recognition test that can explain the inconsistent results in the literature. There are three studies in addition to my own that used the complete design of the composite task to measure configural processing and the Cambridge Face Memory Test to measure face recognition (DeGutis et al., 2013; McGugin et al., 2012; Richler et al., 2011). The problem lies in the fact that I failed to find a significant relationship between configural processing and face recognition while the other three studies found a significant relationship of moderate size. Even still, it is possible sample size played a role in influencing these results. Of the three studies that found a significant relationship, two used a small sample size (Degutis et al., 2013: n = 43; Richler et al., 2011: n = 38) and one used a moderate sample size (McGugin et al., 2012: n = 109). In contrast, I recruited a large sample size for my study with 198 participants in Experiment 1 and 190 participants in Experiment 2. Because of the larger sample size, my study should have more power than past studies; therefore, I feel confident in concluding that configural processing is unrelated to face recognition despite the past research that has found evidence of a significant relationship.

Sample size aside, the biggest difference between my study and the three studies that found a significant moderate relationship between configural processing and face recognition (DeGutis et al., 2013; McGugin et al., 2012; Richler et al., 2011) is I did not include performance on the misaligned trials of the composite task when generating a measure for configural

processing. In my study, I used a pure congruency effect to measure configural processing, and I failed to find a significant relationship between configural processing and face recognition. In the other three studies, configural processing was measured by the interaction between congruency and alignment. This suggests the alignment manipulation introduces an artifact that can be confused as configural processing.

It is always a possibility that outliers may affect the presence, or lack thereof, of a significant correlation. As previously mentioned, to control for carelessness I removed participants for which there were obvious errors in their data. After doing so, the means and standard deviations I obtained for each variable in the present study appears to fall in line with the means and standard deviations obtained in past studies. Taken together, the evidence presented above indicates the relationship between configural processing and face recognition is still poorly understood and additional research is needed to clarify the inconsistencies in the literature.

Object Recognition

In the present study, I was interested in studying the relationship between personality and face recognition independent of general object recognition. Therefore, I used a widely-accepted object recognition test known as the Cambridge Car Memory Test to serve as a control condition by which to compare face-specific recognition and general object recognition. I hypothesized that any significant result found for face recognition would be face-specific, and, therefore, I would not find the same result for object recognition. Further, I did not expect to find a significant relationship between face recognition and object recognition. These hypotheses were partially supported by the results of my study.

Regarding the relationship between face recognition and object recognition, I found a significant main effect of condition for face recognition in Experiment 2, which indicates increased anxiety impacts face recognition. As predicted, these results were unique to face recognition; anxiety did not significantly impact object recognition. Additionally, in both experiments I failed to find a significant correlation between face recognition and object recognition. These results offer support for the uniqueness of faces and offer support for my final hypothesis; these results also affirm the use of the Cambridge Car Memory Test as a control task when comparing face-specific recognition to general object recognition. Further, these results are mostly consistent with those of McGugin et al. (2012) who also failed to find a significant relationship between face recognition and object recognition[4].

One result of my study that I did not expect to find was a marginally significant correlation in Experiment 2 between object recognition and configural processing. One of the basic assumptions of configural processing, called into question by the results of my study, is that configural processing should be strongly linked to face-specific processing but not general object processing (Farah et al., 1995; Maurer, Le Grand, & Mondloch, 2002; Jansari et al., 2015; Esins et al., 2016; Engfors et al., 2017). Because of this assumption, I expected to find a significant correlation between configural processing and face recognition and a non-significant correlation between configural processing and object recognition. I found the opposite, which appears to contradict the findings of past research (Esins et al., 2016; Engfors et al., 2017).

In addition to configural processing, I was surprised to find evidence of a link between object recognition and personality in Experiment 2. First, I found a significant correlation

[4] In the study conducted by McGugin et al. (2012), a significant correlation between object recognition and face recognition was found when only non-living objects (i.e. cars) were used for males and only living objects (i.e. birds) were used for females.

between negative emotionality and object recognition. Second, I found a marginally significant correlation between anxiety and object recognition. And third, I found a significant main effect of negative emotionality for object recognition. These results suggest there is a meaningful relationship between personality and object recognition. Specifically, the degree to which a person is emotionally negative impacts that person's ability to recognize objects and the degree to which a person is anxious may or may not impact that person's ability to recognize objects. To date, few researchers have studied the relationship between object recognition and personality. There is only one study which is comparable to the present study. Davis et al. (2011) failed to find a significant correlation between social anxiety and object recognition. Because the correlation I obtained in Experiment 2 was only marginally significant, this result can be interpreted as being either consistent with or inconsistent with the results of Davis et al. (2011). Further, Davis et al. (2011) measured social anxiety specifically whereas I measured general anxiety, which is a clear difference in the present study and the study conducted by Davis et al. (2001). Together with the lack of research on the topic, the evidence I found for a meaningful relationship between object recognition and personality suggests additional research on the topic is needed.

Experience With People

I theorized that extraverts, who are more social than introverts, would display better face recognition because they had more experience with people throughout development. While I failed to find evidence that extraverts were better than introverts at recognizing faces, I did find evidence that extraverts report more experience with people than do introverts. I found a significant positive correlation between extraversion and experience with people, as measured by the Experience With People Survey, in both experiments. Participants with higher extraversion

scores also reported more experience with people. Further, I found another significant positive correlation between sociability, a facet of extraversion, and experience with people in both experiments. Together, these results suggest that extraverts interact more with faces throughout development than introverts do, and the relationship between extraversion and experience with people may be linked to sociability. It is important to note, however, that it is possible the Experience With People Survey is an imperfect measure of experience with faces. What the survey failed to take into account is the type of experience with faces that people may have outside of social interactions. For example, it is possible that introverts spend more time watching TV, and TV shows are filled with people who all have faces. Therefore, because all of the questions on the Experience With People Survey relate to social situations, the Experience With People Survey may actually be a better measure of sociability than of experience with faces. Additionally, while I succeeded at finding significant relationships between experience with people and these two personality characteristics, the correlations were quite small. In fact, of all of the significant correlations in the present study, only one exceeded .30 and most fell short of .20. Therefore, I must proceed with caution when concluding that a relationship exists between any of the variables used in this study. While statistically a significant relationship might exist, the smallness of the correlations indicate that only a small portion of the variance in the results can be explained by the variables in question, and one could argue that the smallness of the correlations calls into question the practical significance of the results.

In summary, these results combined with the research cited above suggests there is little consensus regarding what relationships, if any, exist between personality, face recognition, object recognition, and configural processing. While the results I obtained were mostly inconsistent with my predictions, they were not entirely inconsistent with the literature. This is

largely due to the inconsistent nature of this field of study and emphasizes the importance of conducting more research on the subject. Because of this, we are left with the question, "What can explain the significant results that some researchers have found?" The current study was not designed to address this question; therefore, this is a question future research will have to answer. That being said, there are two interesting results of the present study, either of which can serve as the starting point of this task.

Future Directions in Face Recognition Research

Configural Processing. As I have discussed, past research has failed to find a consistent relationship between configural processing and face recognition. This raises two questions. First, is it possible that faces are processed configurally but configural processing is either interrupted or reduced when people are focused specifically on recognizing faces and not generally on perceiving faces? For example, featural rather than configural processing may be used during face recognition if people focus on the features of the face in an attempt to determine which features make one face unique from another. Second, is it possible that the lack of consistent results amongst the research using both the composite task and the Cambridge Face Memory Test is actually due to shortcomings in the composite task as a measure of configural processing?

It is my belief that future research would benefit from exploring the relationships that exist between configural processing and different aspects of face processing (i.e. face perception, face recognition, face memory, face-name matching). However, before these relationships can be explored, a valid and reliable measure for configural processing must be found. In hindsight, I question the use of the composite task as a measure of configural processing. For example, while it is standard practice to include a white line separating the top and bottom halves of the

faces, it is possible that the mere presence of the white line disrupts configural processing. Since the trials are designed in such a way that configural processing is disrupted on half of that trials and not disrupted on the other half, the very basis of the composite task is compromised if the presence of the white line disrupts configural processing on every trial. Perhaps future research would benefit from blending the two faces together as is the case with many chimeric face stimuli (Worley & Boles, 2016) rather than separating the two faces by a white line. Another option worth considering is to use a task which measures the inversion effect, which has been widely used to measure configural processing (Farah et al., 1995; McKone, 2004; McKone, Martini, & Nakayama, 2003; Rossion 2008). In summary, future research should aim at finding the best possible measure of configural processing.

Remaining Personality Characteristics

The majority of research on individual differences in personality and face recognition has revolved around the personality characteristics of extraversion and negative emotionality. One benefit of the present study was that it allowed me explore the relationship between face recognition and several personality characteristics other than the two mentioned above. Further, because the present study was divided into two experiments, I was able to explore these relationships with two different data sets, each of a large sample size. A handful of significant correlations were found, but the only significant result that was found in both Experiment 1 and Experiment 2 was the significant positive correlation between open mindedness and face recognition. Further, the other significant correlations that were found were all quite small. The lack of consistency between the two studies coupled with the smallness of the correlations leads me to conclude that the only meaningful relationship worth exploring is the one between open

mindedness and face recognition. Therefore, future research should seek to better understand this relationship.

Anxiety

In Experiment 2 of the current study, there was a significant main effect of condition on face recognition. The manipulated condition was anxiety. As previously discussed, past research appears to support the idea that increasing anxiety impacts performance on face recognition tests (Bothwell et al., 1987; Megreya & Bindemann, 2013), which is consistent with the results I found in Experiment 2.

There is considerable research suggesting anxiety is linked to face recognition (Mueller et al., 1979; Nowicki et al., 1979; Deffenbacher et al., 2004; Valentine & Mesout, 2009; Megreya & Bindemann, 2013). Additionally, Bothwell et al. (1987) found that increasing arousal resulted in participants rating themselves higher on an anxiety scale, suggesting that increasing arousal also increases anxiety. Therefore, it is possible the relationship Bothwell et al. (1987) found between arousal and face recognition was actually detected because of the relationship between anxiety and face recognition. Further investigation into this issue would be beneficial toward better understanding the relationship between personality and face recognition.

However, because participants' self-reported levels of excitement and anxiety did not appear to show an effect on face recognition, I must entertain the possibility that the experimental manipulations affected performance for reasons other than changes in excitement or anxiety. For example, it is possible that participants who viewed the tense video continued to think about the outcome of the video clip throughout the remainder of the experimental session. Perhaps the decline in performance was the result of being distracted with thoughts of the video clip. Further, there is considerable research that suggests anxiety results in a reduction in short-

term memory capacity (Derakshan & Eysenck, 1998; Hayes, Hirsch, & Matthews, 2008; Lapointe, Blanchette, Duclos, Langlois, Provencher, & Tremblay, 2013). Therefore, it is also a possibility that performance was affected because short-term memory capacity was reduced, even after any increase in anxiety had passed.

Sex

The purpose of the current study was not to explore sex differences in face recognition, but future face recognition research would benefit from a deeper exploration of the topic. In the majority of the anxiety research discussed above, significant results were obtained only for female participants. For example, Megreya and Bindemann (2013) conducted two experiments looking at personality and sex differences in face recognition. In their first experiment, they found a significant correlation between face recognition and two personality subfactors: emotional stability and tension. However, these correlations were only significant for female participants, which is why Megreya and Bindemann (2013) limited their second experiment to only females. In the second experiment, another significant correlation was found - this time between anxiety and face recognition. The researchers concluded that females low in anxiety are better at recognizing faces than females high in anxiety (Megreya & Bindemann, 2013).

Additionally, studies of eyewitness identification have concluded that increased anxiety has a detrimental effect on identification accuracy in females (Deffenbacher et al., 2004; Valentine & Mesout, 2009) but little or no effect on identification accuracy in males (Nowicki et al., 1979; Deffenbacher et al., 2004; Valentine & Mesout, 2009). McLean et al. (2011) found that females typically have higher levels of self-reported anxiety, which was supported by the results of Megreya & Bindemann (2013). Therefore, it is possible that females experience higher

levels of anxiety on average than males and those higher levels of anxiety impact females' abilities to recognize faces.

Conversely, McGugin et al. (2012) found a significant relationship between configural processing and face recognition even when sex was factored out. Further, these researchers found that females were better than males at recognizing living objects. While faces specifically were not used in the living object category, it is logical to assume that faces would fall into the category of living objects and females would be better at recognizing them than males. However, the results of McGugin et al. (2012) contradict those of other researchers (Nowicki et al., 1979; Deffenbacher et al., 2004; Valentine & Mesout, 2009; Megreya & Bindemann, 2013); therefore, the influence of sex on face recognition is also worthy of future investigation.

In conclusion, the results of past research clearly indicate that face recognition is influenced by anxiety (Mueller et al., 1979; Nowicki et al., 1979; Bothwell et al., 1987; Deffenbacher et al., 2004; Valentine & Mesout, 2009; Megreya & Bindemann, 2013) and sex (Nowicki et al., 1979; Deffenbacher et al., 2004; Valentine & Mesout, 2009; Megreya & Bindemann, 2013). However, the full extent of these relationships is not yet understood, and future research would most benefit from exploring them at a deeper level. While my present study did not examine the relationship between face recognition and sex, it did provide support for a relationship between face recognition and anxiety as well as face recognition and open mindedness. Further, through the present study I sought to better understand the relationship between personality and face recognition. Because the results provide evidence for a relationship between anxiety and open mindedness, two aspects of personality, and face recognition, it is in pointing toward future research that I consider the present study a success.

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APPENDICES

Appendix A

Experience With Faces Survey

1. How old are you?

2. What is your ethnicity?

3. How many people make up the family you grew up in?

4. Growing up, how many friends did you interact with on a regular basis?

5. Growing up, did you play team sports?

6. Growing up, did you participate in group activities other than team sports?

7. How frequently did you play team sports/participate in group activities other than team sports?

    a. Never
    b. Rarely
    c. Sometimes
    d. Often
    e. Frequently

8. Growing up, how frequently did you attend parties/social gatherings?

    a. Never
    b. Rarely
    c. Sometimes
    d. Often
    e. Frequently

Appendix B

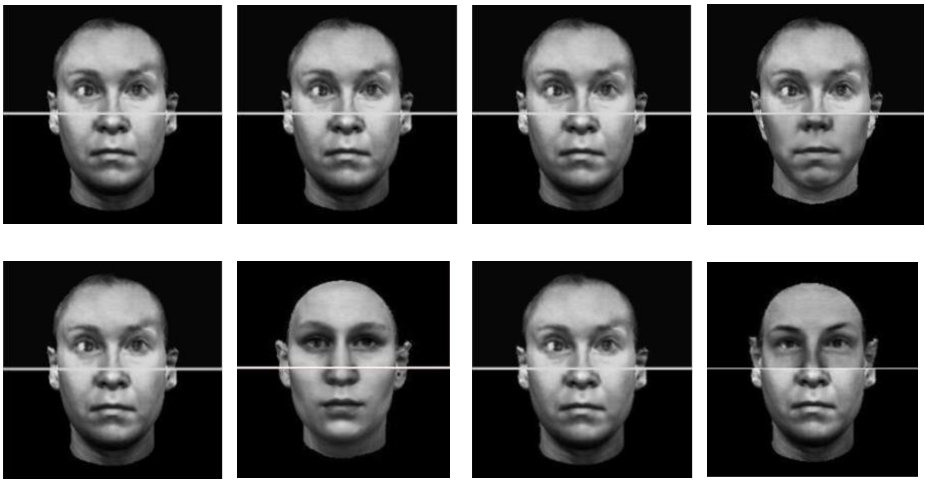
Composite Task

Aligned Condition

Congruent Incongruent

Same

Different

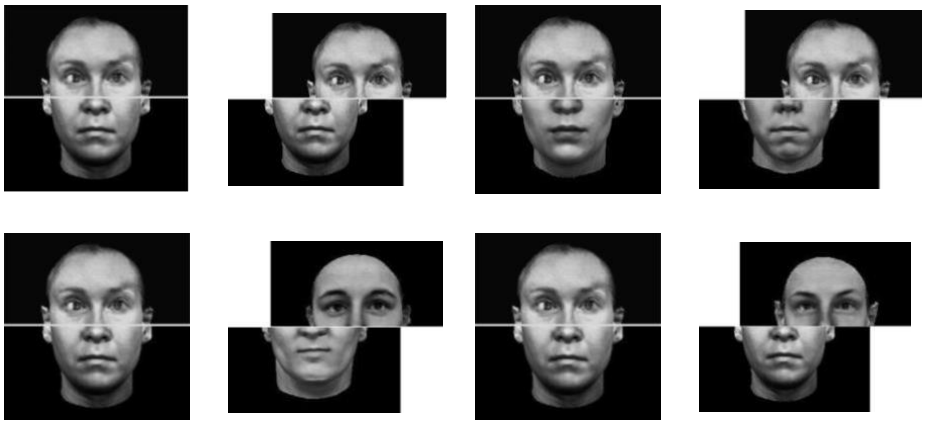


Misaligned Condition

Congruent Incongruent

Same

Different



Appendix C

Cambridge Face Memory Test

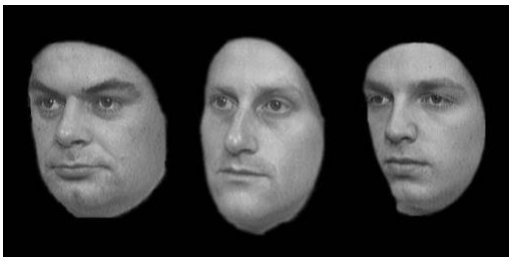
Study Phase

Viewpoint 1

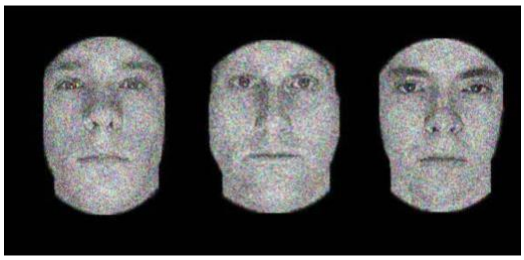
Viewpoint 2

Viewpoint 3

Test Phase - No Noise



Test Phase - With Noise



Appendix D

Cambridge Car Memory Test

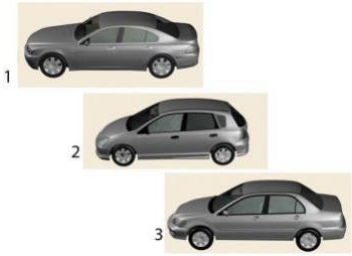
Study Phase

Viewpoint 1

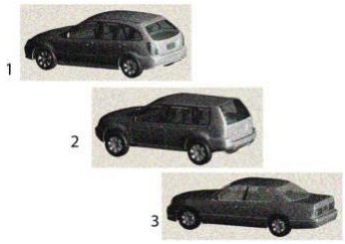
Viewpoint 2

Viewpoint 3

Test Phase - No Noise



Test Phase - With Noise



Appendix E

Informed Consent Form (Online)

RESEARCH INVITATION FOR A WEB SURVEY

McKensie Worley, Principal Investigator from the University of Alabama, is conducting a study called Individual Differences in Personality and Face Processing. She wishes to find out if face processing ability, specifically face recognition ability, is impacted by various personality traits.

Taking part in this study involves completing a web survey that will take about 30 minutes. You will rate your agreement with different statements using a pre-determined scale. This survey contains statements about your habits, your interests, and your actions in social situations.

We will protect your confidentiality by identifying your data with a subject number as opposed to your name. Your name will only be recorded in connection with your data until you complete the experimental portion of this study. After that time, your name will be replaced with your subject number and then evidence of your name will be destroyed. Only the investigator will have access to the data. The data are password protected. Only summarized data will be presented at meetings or in publications.

There will be no direct benefits to you. The findings will be useful to groups that depend on face recognition such as the military, police and security officers, and members of the legal system. These groups rely upon accurate face identification and would benefit from better understanding the type of person who excels at face recognition.

The chief risk is that some of the statements may make you uncomfortable. You may skip any statements you do not want to answer.

If you have questions about this study, please contact McKensie at (901) 292-9302 or by email at mmartin14@crimson.ua.edu. You may also contact McKensie's faculty advisor, Dr. David Boles, at (205) 393-9022 or by email at dboles@bama.ua.edu. If you have questions, concerns, or complaints about your rights as a research participant, contact Ms. Tanta Myles, the Research Compliance Officer, at (205) 348-8461 or toll-free at 1-877-820-3066. If you have complaints or concerns about this study, file them through the UA IRB outreach website at http://osp.ua.edu/site/PRCO_Welcome.html. Also, if you participate, you are encouraged to complete the short Survey for Research Participants online at this website. This helps UA improve its protection of human research participants.

YOUR PARTICIPATION IS COMPLETELY VOLUNTARY. You are free not to participate or stop participating any time before you submit your answers.

If you understand the statements above, are at least 18 years old, and freely consent to be in this study, click on the I AGREE button to begin.

Appendix F

Informed Consent Form (Experimental)

INFORMED CONSENT FOR A RESEARCH STUDY

You are being asked to be in a research study. This study is called "Individual Differences in Personality and Face Processing." This study is being conducted by McKensie Worley. She is a graduate student at the University of Alabama.

What is this study about?

When recognizing familiar faces, some people perform with great accuracy while others do not. Little is known about the factors that affect the development of face recognition ability. However, research suggests the development of face recognition ability, being an important aspect of social interaction, may be impacted by personality. This study will look closer at the relationship between two personality variables and attempt to answer the question of causation that has been missing from previous research.

Why is this study important—What good will the results do?

The findings will help psychological researchers and neuroscientists better understand the development of face processing abilities and will provide useful information to persons who frequently use face recognition.

Why have I been asked to take part in this study?

You responded to a posting on the Psychology Research Pool website at the University of Alabama. You meet the requirements of having normal-to-corrected vision and normal-to-corrected hearing in addition to being at least 18 years of age.

How many other people will be in this study?

The researcher hopes to recruit 400 participants throughout the course of the study.

What will I be asked to do in this study?

In this study you will be asked to complete several tasks involving faces. These involve judging facial identity and facial similarity. You will also complete a task involving the judgement ofcar identity and similarity. Instructions are given before the tasks. You should ask questions if you do not understand them. The procedures in the study are experimental in nature.

How much time will I spend being in this study?

The experimental session today should last no more than 1 hour and 30 minutes

Will being in this study cost me anything?

The only cost to you from this study is your time.

Will I be compensated for being in this study?

In appreciation of your time you will receive credit toward your PY101 Undergraduate Psychology Research requirement worth 2 credits.

What are the risks (problems or dangers) from being this study?

No risk or discomfort is expected in this study. A benefit you can expect is knowledge about research methods in psychology.

What are the benefits of being in this study?

There are no direct benefits to you unless you find it pleasant or helpful to participate in facial judgement tasks. In addition, you will gain valuable experience in psychology research methods.

How will my privacy be protected?

All data are confidential. No individual will be identified in reports of the results. Those will be given only in group summary form.

How will my confidentiality be protected?

Upon completion of this experimental session, there are two places where your name will appear in connection with this study. The first is on the Psychology Research Pool website, which only the researcher and the Research Pool coordinator have access to. The second is your signature on this consent form. All consent forms will be kept in a locked file drawer in the researcher's office, which is also locked when she is not there. Your data will be stored in a separate locked file cabinet in the researcher's office, and your data will not be labeled with your name

We will write research articles on this study but participants will be identified only as "students from the University of Alabama". No one will be able to recognize you.

What are the alternatives to being in this study?

The only alternative is not to participate.

What are my rights as a participant?

Being in this study is totally voluntary. It is your free choice. You may choose not to be in it at all. If you start the study, you can stop at any time. Even if you stop participating, you will still receive full credit for the study. Not participating or stopping participation will have no effect on your relationships with the University of Alabama.

The University of Alabama Institutional Review Board is a committee that looks out for the ethical treatment of people in research studies. They may review the study records if they wish. This is to be sure that people in research studies are being treated fairly and that the study is being carried out as planned.

Who do I call if I have questions or problems?

If you have questions about this study right now, please ask them. If you have questions later on, please call McKensie Worley at 901-292-9302. You may also contact the research's faculty advisor, Dr. David Boles by email at david.boles@ua.edu. If you have questions or complaints about your rights as a research participant, call Ms. Tanta Myles, the Research Compliance Officer of the University at 205-348-8461 or toll-free at 1-877-820-3066.

You may also ask questions, make a suggestion, or file complaints and concerns through the IRB Outreach Website at http://osp.ua.edu/site/PRCO_Welcome.html. After you participate, you are encouraged to complete the survey for research participants that is online there, or you may ask the researcher for a copy of it. You may also e-mail us at participantoutreach@bama.ua.edu.

You will be given a copy of this consent form for your records.

If you understand the information presented above and consent to participate in the research study, please sign here:

_____

Signature

_____

Date

Appendix G

Debriefing Form

DEBRIEFING FOR "Individual Differences in Personality and Face Processing"

Experimenter: McKensie Worley, M.A.

Faculty sponsor: Dr. David Boles

Hours: 2

The purposes of the study include the following: to determine the relationship between face processing ability and personality as a trait, to determine the relationship between face processing ability and personality as a state, and to determine whether personality has a unique relationship to facial stimuli when compared to non-face stimuli.

Experimental manipulations are used to address the first two purposes. Extraverts are energized by stimulation, such as loud music, bright lights, and social interaction. Introverts are overwhelmed by stimulation. Low levels of stimulation affect introverts and extraverts equally. Further, neurotic individuals are greatly affected by anxious situations whereas emotionally stable individuals are not affected. Again, low levels of anxiety affect neurotic and emotionally stable individuals equally.

Therefore, regarding extraversion, a low stimulation condition serves as a control condition. Because low levels of stimulation should not affect extraverts and introverts differently, the effects of extraversion as a pure, underlying personality trait can be studied in a low stimulation condition. In contrast, high levels of stimulation should affect extraverts and introverts differently, magnifying their personality difference in a state fashion. Thus the effects of extraversion as a state can be studied in a high stimulation condition.

Regarding neuroticism, a low anxiety condition serves as a control condition. Because low levels of anxiety should not affect neurotic and stable individuals differently, the effects of neuroticism as a pure, underlying personality trait can be studied in a low anxiety condition. In contrast, high levels of anxiety should affect neurotic and stable individuals differently, magnifying their personality differences in a state fashion. Thus the effects of neuroticism as a state can be studied in a high anxiety condition.

Finally, the last purpose of the study is addressed through the use of a control task that does not involve the processing of facial stimuli but rather involves the processing of car stimuli. The researchers are interested in studying whether personality affects face processing in a way that is

unique from the way it affects nonface processing. If face processing ability/performance is affected in a different way from that of nonface processing ability/performance, this would offer support for the suggestion that personality uniquely affects face processing when compared to nonface processing. Therefore, if the results of the face processing tasks are different from the results of the nonface processing task, the hypothesis will be supported. However, if the results of the face processing task are the same as the results of the nonface processing task, the hypothesis will not be supported.

Please note that participants in this study should be "naive." In other words, they shouldn't know in detail what it is about, since this might influence their results. We would appreciate you not speaking about the study in any detail with friends who might participate. Thanks!

Withdrawal of Results

The hypothesis for the study could not be divulged beforehand without running a risk of influencing the results. It could be argued that your willingness to participate may have been affected. If you wish, you may request that your data be withdrawn from the study. If you decide to have your data withdrawn, you will still receive the same amount of class credit. Please check one of the choices on the final sheet to indicate whether you wish your data used or not used and destroyed.

Contacts in Case of Questions

Experimenter: McKensie Worley
Phone Number: (901) 292-9302

If you have any questions about your rights as a research participant you may contact Ms. Tanta Myles, The University of Alabama Research Compliance Officer, at 205-348-8461.

Appendix H

Data Consent Form

Please check one of the following:

_____ I wish to have my data used.

_____ I wish not to have my data used, and that it be immediately destroyed.

Appendix I

IRB Approval Form

THE UNIVERSITY OF ALABAMA | *Office of the Vice President for* Research & Economic Development
Office for Research Compliance

November 23, 2016

McKensie Worley
Department of Psychology
College of Arts and Sciences
Box 870348

Re: IRB # 16-OR-410, "Individual Differences in Personality and Face Processing Ability"

Dear Ms. Worley:

The University of Alabama Institutional Review Board has granted approval for your proposed research.

Your application has been given expedited approval according to 45 CFR part 46. You have been granted the requested waiver of informed consent. You have also been granted the requested waiver of written documentation of informed consent for survey participants. Approval has been given under expedited review category 7 as outlined below:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your application will expire on November 21, 2017. If your research will continue beyond this date, please complete the relevant portions of the IRB Renewal Application. If you wish to modify the application, please complete the Modification of an Approved Protocol Form. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants. When the study closes, please complete the Request for Study Closure Form.

Please use reproductions of the IRB approved stamped consent forms to obtain consent from participants in the experimental group.

Should you need to submit any further correspondence regarding this proposal, please include the above application number.

Good luck with your research.

Sincerely,

Carpantato T. Myles, MSM, CIM, CIP
Director & Research Compliance Officer
Office for Research Compliance

358 Rose Administration Building | Box 870127 | Tuscaloosa, AL 35487-0127
205-348-8461 | Fax 205-348-7189 | Toll Free 1-877-820-3066