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Investigating the Relationship Between the Cognitive and Affective Components of Empathy and Frontal Lobe Functioning in College Students

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INVESTIGATING THE RELATIONSHIP BETWEEN THE COGNITIVE AND AFFECTIVE COMPONENTS OF EMPATHY AND FRONTAL LOBE FUNCTIONING IN COLLEGE STUDENTS

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Title: Investigating the Relationship Between the Cognitive and Affective Components of Empathy and Frontal Lobe Functioning in College Students

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Prior research has implicated the frontal lobes and associated executive functions in clinical populations showing impairment in empathy, including those diagnosed with an autism spectrum disorder, traumatic brain injury, and fronto-temporal dementia. Limited research has investigated executive abilities and variability in empathy in the normative population. The current investigation evaluated empathy and executive functioning in 219 male and female college students. Empathy was evaluated using the Interpersonal Reactivity Index (Davis, 1980), Baron-Cohen's Theory of Mind in the Eyes test (2001), and a variant of Happe's (1994) Strange Stories test. Executive functions were assessed using verbal and figural fluency and the Trail Making Test Part A and B (Lezak, Howieson, & Loring, 2004). The results of this study found that affective empathy scores on the Theory of Mind in the Eyes test and the Personal Distress Subscale of the Interpersonal Reactivity Index were found to have small but significant correlations with scores on the Trail Making Test part B, a measure of executive functioning and mental set switching. These results may reflect tendencies for affective empathy to be more sensitive to subtle fluctuations in executive functioning abilities. While the correlations observed in this study were significant they were not robust, given that executive abilities among college students likely do not mirror those among the general population, further research with a less restricted sample appears necessary.

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CHAPTER I

LITERATURE REVIEW

People are profoundly social beings. From birth, we rely on our interconnections with others for our survival. The ability to engage appropriately with others on a social level is a vital skill (von Hipple, Hasleton, &Forgas, 2007). We, as a society, often fail to notice just how important this skill is until we encounter those who do not or cannot follow social rules and engage with others in an appropriate and acceptable way. Due to recent increases in prevalence rates and the subsequent increase in popular media attention, Autism and autism spectrum disorders are salient examples of socially dysfunctional behavior (Hamilton, 2008). Primary symptomatic presentations in autism include social deficits, language difficulties, and sensory integration difficulties or stereotypic or repetitive behavioral patterns (DSM Characteristics, APA, 2002). In addition to these social, linguistic, sensory and cognitive differences in individuals with autism spectrum disorders, there are also marked difficulties with emotional understanding and regulation. These aforementioned limitations often present significant difficulties with interpersonal and daily functioning.

Individuals with Autism have been shown to demonstrate impairments with the social and emotional components of empathy (Stone, Baron-Cohen, & Knight, 1998). Empathy is an individual's tendency to understand and appreciate the nature of another's emotional and cognitive perspective and experience (Davis, 1983; Decety& Jackson, 2004). Difficulties with empathy and social information processing have been demonstrated as a source of social difficulty and dysfunction in individuals with autism spectrum disorders (Stone, Baron-Cohen, & Knight, 1998; Oberman, Pineda, Ramachandran, 2007) as well as with college students (Gallese, Keysers,&Rizzolatti, 2004).

Neurologically, the aforementioned impairments in empathy and empathy related tasks have been associated with impairments in a complex network of brain structures known as the human mirror neuron system (hMNS, Oberman, Pineda, Ramachandran, 2007; Iacobini&Dapretto, 2006). The hMNS primarily has been associated with activation in the parietal and frontal lobes when the individual views actions of another (Iacobini&Dapretto, 2006). Additionally, activity in the orbitofrontal cortex has also been associated with the cognitive aspects of empathy and social perspective taking (Samson, Apperly, & Humphreys, 2007; Stone, Baron-Cohen, & Knight, 1998). Dysfunction in these brain areas has been associated with neuropsychological disorders marked by deficits in empathy and social facility and the appropriate social interactions (Samson, Apperly, & Humphreys, 2007).

Currently, much of the literature evaluating the neurological correlates of empathy and the relationship between the cognitive and emotional aspects of empathy has addressed individuals from a clinical or neurologically impaired population. This limitation in scope also presents a limited understanding of the relationship between the emotional and cognitive components of empathy and neurological functioning. Are these constructs related in a primarily linear fashion where mild deficits on one domain produce similarly mild deficits on the others, or are there more complex relationships whereby behavioral deficits are noted only following significant or profound impairment? By studying the relationship between empathy, and neurological functioning in non impaired individuals, a more comprehensive view of the relationship between these variables can be found. Possessing a greater and more detailed understanding of the relationship between the cognitive and emotional aspects of empathy and neurological functioning will facilitate a better understanding of individuals with impairments on

these domains and can promote more adaptive treatment modalities for individuals with related disorders such as autism.

History of Empathy Research

Empathy is a complex, multidimensional construct that is relevant to a variety of psychological fields and areas of study. Coined by Titchener in 1909, the term empathy which he defined as a "process of humanizing objects, of reading or feeling ourselves into them" was a derivation of the German word Einfuhlung (Titchener, 1924 p. 417, as quoted in Duan& Hill, 1996). The word Einfuhlung essentially describes the process where individuals project genuine feelings or emotions into the objects that they perceive (Duan& Hill, 1996). This initial definition appears to capture the construct from the most simplistic and overarching phenomenological perspective. Throughout the following century, this definition has been expanded and made more layered and specific by various psychological researchers, theorists, and clinicians. The literature and scholarly research involving empathy has covered a variety of areas including therapy and how empathy pertains to the helping or healing professions (e.g. Rogers, 1958, Kohut, 1977, as cited in Duan& Hill, 1996; Starcevic&Pointek, 2001; May &Alligood, 2000; Reynolds, 2000), how empathy relates to social or interpersonal interactions (e.g. Davis, 1983, Giancola, 2003, Miller & Eisenberg, 1988, Toi& Batson, 1982), the development of social abilities and language (eg. Iacoboni&Dapretto, 2006; Oberman, Pineda, Ramachandran, 2007), the neurological correlates of empathy (e.g. Shamay-Tsoory, Shur, Harari, Levkovitz, 2007, Perry, Rosen, Kramer, Beer, Levenson, & Miller, 2001, Stuss& Alexander, 2000, Eslinger, 1998) and the relationship between mental illness or abnormal behavior and empathic ability (e.g. Marsh & Blair, 2008; Chalmers & Townsend, 1990, Hamilton, 2008, Robinson, Roberts, Strayer, &Koopman, 2007).

Given the broad and varied scope of the literature, conceptual definitions of the construct of empathy have been likewise varied. The breadth of the conceptual understanding of empathy is particularly problematic when areas of the literature diverge or disagree. This issue is salient when one attempts to understand the overall nature of empathy, some theorists conceptualize empathy as dispositional (Druhn, Diehl, Rebucal, Lumley, Labouvie-Vief, 2008; Knafo, Zahn-Waxler, VanHulle, Robinson, HyunRhee, 2008)), others view it as depending on situational or environmental factors (Yamada &Decety, 2009), and still others view empathy as an interpersonal process (Egan, 2004, Rogers, 1968).

The dispositional view of empathy is the position that empathy, particularly the individual's tendency to be empathic is a function of an innate disposition (Duan& Hill, 1996). This view does not delineate between innate or learned tendencies, but instead maintains that empathy is purely a function of the individual and individual predispositions. From this viewpoint, a person displays the same levels of empathy regardless of the situation and that this tendency is reasonably stable across ones lifespan (Duan& Hill, 1996; Knafo, VanHulle, Zahn-Waxler, Robinson, Hyun Rhee, 2008). A key component of this view is that an individual's behavioral tendency towards empathy can be learned or is a function of development and life experiences; however the individual's ability to engage empathically does not depend on specific situations or others (Knafo et al., 2008). For example, an individual would display the same empathic response towards a distressed individual regardless of the person or the situation. This example may initially be difficult to reconcile as the potential emotional and cognitive components of a situation can change as the situation itself changes. Witnessing a motorist stranded on the side of the road in a thunderstorm evokes different emotional reactions than witnessing that stranded motorist on a clear and temperate day, and as a result it is tempting to

discount a dispositional approach. However, while the situation may alter the emotional content of the scene it does not alter the individual tendency to be able to understand and appreciate the quality and intensity of the other's internal state. Within this example, the dispositional component refers to the ability or tendency to effectively understand that the motorist stranded in a thunderstorm is likely experiencing a significant degree of distress and the motorist stranded on a nice day is likely not nearly as upset or anxious; individuals are not more or less likely to empathize with the motorist depending on the situation.

Alternatively is the conceptualization that empathy, specifically one's tendency to engage empathically is dependent on situational factors (Duan& Hill, 1996). This type of stance would most adequately explain why an individual can better empathize with an individual who is experiencing something that they themselves had experienced. An example of this would potentially be that an individual's ability to engage empathically with an individual who was recently divorced will differ depending on their own marital history. While the exemplar addressed the notion of familiarity as a situational influence, from this stance there are a number of other potential environmental influences, such as social or cultural acceptability that may alter the individual's expression of empathy (Duan& Hill, 1996).

The interpersonal process of empathy is primarily considered by those conducting research on therapeutic or helping professions and the development of an empathic connection with another person. This approach is seen primarily as a function of a therapeutic stance or interaction as opposed to an overarching conceptualization of the construct (Duan& Hill, 1996). From this viewpoint, empathy is a function of the interaction between two individuals and the connection that occurs between them and not related innate or situational factors (Duan& Hill, 1996).

The varied descriptions of the psychological construct of empathy highlights a common difficulty within the scholarly literature. Empathy as a blanket term has been used to describe a variety of overlapping yet fundamentally different constructs and as a result the field of literature is populated with a many different approaches and conceptualizations. Several authors have suggested utilizing more specific descriptors and terminology when conducting research to reconcile the confusing trends within the literature and to provide a distinction between various theoretical perspectives (e.g. Duan& Hill, 1996; Davis, 1983).

When considering the various approaches to empathy, it is possible to conceptualize the interpersonal or interactional viewpoint as a unique facet of the situational approach where the specific interaction is in itself a situation that increases the tendency for empathy in individuals. From this stance, the overarching conceptualizations of empathy polarize between innate and unilateral tendencies and situation dependent tendencies. Overall, it is more likely that individual tendencies towards empathy are a function of both innate and situational factors, whereby in general individuals have a dispositional tendency towards greater or lesser degrees of empathy but that tendency is moderated by the influence of various situational or contextual factors like familiarity. However, much of the literature has focused primarily on the dispositional facets of empathy. This is likely due to research design constraints as the specific situations that influences empathy and the degree to which these situations exert their influence are unique for each individual and thus present a significant difficulty with effective study and experimental control. Conversely, the dispositional approach to empathy presents a more stable construct for measurement and experimental evaluation. With that in consideration, for the purposes of this inquiry, empathy will be evaluated from a dispositional perspective with a

selective focus on the relationship between empathy and neurological activity, and the impact that these factors have on an individual's social relationships and social dispositional tendencies.

Components of Empathy

When considering the factors that comprise the construct of empathy, some relevant issues arise. Is empathy a psychological process of its own, or is it a byproduct of another mental task? Are individuals able to empathically engage with others because they themselves have experienced a similar situation and as such, empathy is a function of memory? However, the idea that memory is the primary driving force behind empathy fails to adequately address how individuals are able to empathize with others who are experiencing something novel to the observers. An alternative view to this is that empathy is a form of emotional contagion, whereby individuals are "caught up" in the emotion states of others (Davis, 1996, Stotland, 1969). The most common example of emotional contagion is witnessed in young children who appear to express similar emotional states as their surrounding others or peers without any cognitively appreciable reasoning as to why. However, this emotional contagion fails to adhere to current definitions of empathy that highlight an understanding or appreciation for the emotional experience of another without actually experiencing that emotional state.

Ickes (1997) describes empathy as a psychological process that utilizes aspects of memory, knowledge, reasoning, observation, essentially all aspects of human awareness to provide insight into the cognitive and emotional experience of others. From these definitions of empathy, the current theoretical perspective is that there are three psychological facets that comprise the construct of empathy. These views of empathy stress a multidimensional conceptualization that includes emotional and cognitive components. This conceptualization stresses both the traditionally accepted process of understanding or vicariously experiencing the

affective state of another (Goldstein & Michaels, 1985; Davis, 1980), as well as a cognitive understanding that includes aspects of social and interpersonal perspective taking (Mead, 1934; Piaget, 1968; Cited in Eslinger, 1998). The primary components of empathy include cognitive and affective components (Davis, 1980, 1983) an additional component that includes a self-other distinction has become a function of many more recent theoretical approaches to empathy (Ruby &Decety, 2004; Decety& Jackson, 2006, Vollm et al., 2006; Starcevic&Pointek, 1997, Jackson, Meltzoff, &Decety, 2005). One recent study describes a model of empathy that utilizes three core processes. These processes of empathy include an intuitive feeling of having a commonality with another that hinges on shared emotional experiences, cognitive perspective taking, and maintaining an interpersonal separation between the self and other. (Schulte-Ruther et al., 2007).This three component model reduced down to simplest form includes cognitive, affective, and separation components to comprise the psychological construct of empathy.

Empathic understanding is more than recognizing and understanding what it is like to experience the affective state of another, one must also be able to cognitively understand the situational factors that influence the expression of those states as well as the intrapersonal cognitions that the other may be experiencing (Reik, 1949 as cited in Ruby &Decety, 2004;Batson, 1987; Wispe, 1986, Rogers, 1975). The bulk of the empathy literature to date has focused primarily on the cognitive aspect of this construct. Cognitive perspective taking and "Theory of Mind" (ToM) are the processes of understanding the inner mental states and perceptions of other people (Vollm et al., 2006, Premack& Woodruff, 1978). These inner mental states can extend to cognitive processes, beliefs, thoughts, motivation, intention, and perceptions. The key cognitive component of this process is that one must overcome a tendency towards egocentricity and consider the unfamiliar perspective another person. One does not need to share

the beliefs, views, or perceptions of another to cognitively understand them. To effectively understand another's perspective one must be able to cognitively evaluate the variety of social, motivational, intrapsychic, and situational factors that contribute to the other person's mental and emotional state. Within this perspective, an understanding of social norms and typical individual reactions is vital to being able to effectively understand another (Stone, Baron-Cohen, Knight, 1998). For example, in a situation that is clear cut and congruent such as a fender bender with two screaming drivers, a bystander could empathize and make the cognitive inference that both individuals are angry because they are inconvenienced by having to pay for automotive repairs and blame the other individual for inconveniencing them. However, if the same fender bender occurs and one driver appears happy and pleased, this abnormal response would require that one seek out additional information to understand why that driver is so happy. Perhaps viewing the happy individual's car leads us to assume that he is happy because several previously obtained dents will be repaired and covered by his insurance. The overarching picture of cognitive empathy is of a rational or logical understanding of the factors that influence another's mental state and how those factors interplay to influence emotions.

The affective or emotional component of empathy is crucial to the overarching definition of the construct; however limited research has been conducted on this area. This lack of comprehensive research is likely due to the difficulty studying a construct that is problematic to measure objectively. The overarching understanding of this component of empathy includes the ability to recognize emotion states in others and to have a vicarious appreciation for those emotion states (Decety& Jackson, 2006; Yamada &Decety, 2009, Ruby &Decety, 2004, Schulte-Ruther et al., 2007, Eslinger, 1998). The use of the terminology vicarious appreciation is deliberate and important because it implies that the individual is not directly experiencing the

emotional states of others, however they are able to understand the quality and intensity of those emotions. For example, one does not need to experience grief to empathize with an individual who is grieving; it is important to recognize that the individual is experiencing intense, overwhelming, and unpleasant emotional states.

In addition to the cognitive and emotional aspects of empathy, the process of empathy includes the component that while recognizing and understanding the emotional states in others, there must remain a distinct separation between one's own emotional state and the recognition of another's affective state (Reik, 1949; as cited in Ruby &Decety, 2004;Batson, 1987; Wispe, 1986, Rogers, 1975). Within this paradigm there must remain a clear distinction between oneself and the other and not an interpersonal affective merge. The key here is to consider empathy a process of understanding what another's emotional experience is like, not to merge and experience the emotions simultaneously (Ruby &Decety, 2004). This separation of experience has also been described and termed as "emotion regulation" in some of the literature (e.g. Decety& Jackson, 2006). This ability to regulate one's perspective is crucial to the overall utility of the construct of empathy. The inability to maintain a distinction between self and other and to essentially experience what another individual is experiencing would be wholly problematic, particularly when witnessing another in pain.

While some research has adopted a biased stance towards either the cognitive or affective aspects of empathy, essentially positing that one approach is more equipped to explain the phenomenon of empathy, Decety& Jackson state that both approaches "are two sides of the same coin" (p.54, 2006). Decety& Jackson maintain that people share a tendency to utilize either cognitive or affective processing unequally when engaging in empathic interaction, this is accomplished by conceptualizing the process of empathy as either occurring from a top- down or

bottom-up perspective (p. 54, 2007). Individuals engage in top-down or bottom-up processing depending upon how the empathic process is triggered (Decety& Jackson, 2006). Individuals are more likely to engage in bottom-up processing when they initiate the process of empathy from a primarily affective standpoint. For example, one can witness another individual who is incredibly sad, appreciating this intense unpleasant emotional state; they then seek to understand why this individual is so sad. Conversely, from a top-down perspective, individuals understand the cognitive and motivational factors that are influencing another and make inferences about their emotional states. An example of this would be if one learned that someone had been fired from his job, was declaring bankruptcy, and had recently been evicted from his residence, the top-down approach would include taking the perspective of this unfortunate individual and making judgments that the individual was likely experiencing a variety of negative and unpleasant emotions like fear, worry, panic, and guilt.

The Development of Empathy and Theory of Mind

When discussing how empathy develops in individuals one can conceptualize empathy as an individual characteristic that can develop and mature as the individual grows and matures(Druhn, Diehl, Rebucal, Lumley, Labouvie-Vief, 2008; Knafo, Zahn-Waxler, VanHulle, Robinson, HyunRhee, 2008). Given that a primary component of empathy is cognitive, it is clear that developmental theories of empathy will parallel cognitive developmental theories. The cognitive component, primarily theory of mind, has been described at length by developmental theorists the most famous of which is Piaget. The ability for a child to effectively take another's perspective and to move beyond egocentricity is a touchstone of cognitive development and has been found to be influenced by a number of factors. The most overarching factor from Piagetian standpoint is experience, particularly social and interactional experiences. The development of

theory of mind can be measured by false belief tasks, where essentially the task participant knows information that an actor does not. The participant then must predict how the actor will behave in a situation, where the information that the actor does not have would be an influencing factor. For example, a child would witness an actor place an item in a drawer, the item is then moved without the actor's knowledge but in full view of the child, the child must then predict where the actor would look for the item. Individuals who have developed and intact Theory of Mind skills would recognize that the actor is unaware that the item has been moved and look in the original location. Those who are unable to take the perspective of another would assume that essentially all individuals share their viewpoint and that the actor would look for the item where the child knows it is. (Piaget; Stone, Baron-Cohen, Knight, 1998).

A significant amount of developmental literature has focused on cognitive development and there is a disparity regarding the individual emotional development, particularly with respect to the multifaceted construct of empathy. Hughes, Tingle, and Sawin (1981), attempted to detail the process by which children develop and begin to utilize more sophisticated approaches concerning the emotional or affective component of empathy. These researchers determined that several factors relate to the emotional maturity of a child; specifically they have found that younger children utilize significantly more environmental cues when considering and making emotional attributions whereas older children consider these situational cues but additionally make a more complex psychologically based evaluation (Hughes et al., 1981). For example, a younger child would be able to state that the boy is sad because he did not get to have birthday cake; conversely an older child would state that the boy is sad because he is disappointed that he did not get to have the cake that he had really been looking forward to. In this example, the older child's process includes more internalized and emotionally based attributions for another's

emotional state. Hughes et al., (1981) also found that this emotional development is influenced by increasing the child's introspection into their own emotional states when considering the perspective or experience of another. This finding is congruent with Youniss's (1975) position that children attempt to understand others by considering and understanding their own experience. From this, the development of self understanding facilitates the understanding of others. This position is particularly salient and has significant implications for the theoretical understanding of empathy as well as for the direction of potential therapeutic interventions that target empathy.

From the prior developmental descriptions of these two components of empathy, it is clear that both developmental approaches focus on situationally learned abilities. The cognitive and affective components of empathy are honed via experience. Despite this position, one may still question if empathy, as a dispositional factor, is innate or purely a function of learning. Despite clear theoretical positions that empathy is developed as a function of experience, there is evidence that supports empathy as a stable dispositional construct. Empathy, as a trait, has been shown to be relatively stable across an individual's lifespan; where scores on an empathy measure remain stable as the person ages (Druhn, Diehl, Rebucal, Lumley, Labouvie-Vief, 2008; Knafo, Zahn-Waxler, VanHulle, Robinson, HyunRhee, 2008). The stability of the empathy trait is also noted across situations, specifically research has shown that children displayed similar levels of empathy when viewing their own mother as well as a stranger (Knafo, Zahn-Waxler, VanHulle, Robinson, HyunRhee, 2008). Children who display high levels of empathy do so consistently, regardless of the individual with whom they are empathizing. While there is strong support for the position that empathy is dispositional (Davis, 1983; Knafo et al., 2008), there is little reliable evidence that empathy is entirely genetically determined (Knafo, et al., 2008). In a

twin study, Knafo et al. (2008) found that there was a stronger correlation between environmental factors and individual empathy scores than with genetic markers. These findings lend support to the position that the individual expression of empathy and empathic tendencies are more clearly influenced by environmental and situational factors and individual experiences as opposed to individual heredity and genetics. It may be tempting to argue the disparity between situational and dispositional components of empathy, a possible reconciliation of the experience driven versus trait views may be to conceptualize early trait empathy as developmental potential that is then molded by the child's experiences and stabilizes as the child matures.

Measurement of Empathy

Much of the prior research on empathy has utilized one of three empirically studied, supported, and validated measures that evaluate individual levels of empathy. The Interpersonal Reactivity Index (IRI) (Davis, 1980), the Hogan Empathy Scale (HES) (Hogan, 1969), and the Questionnaire Measure of Emotional Empathy (QMEE) (Mehrabian& Epstein, 1972). Of these three, further evaluation has found that the HES appears to focus primarily on the emotional aspects of empathy whereas the QMEE addresses primarily the cognitive perspective taking aspects (Cliffordson, 2001; Chlopan, McCain, Carbonell, & Hagen; 1985). Conversely, the IRI utilizes a factorial structure that addresses four factors that Davis, (1980) theorized to comprise empathy. Given the multifaceted conceptualization of the construct of empathy, and the usage of this measure in the majority of empathy literature; the IRI appears to be an effective and appropriate measure to utilize to evaluate individual empathy.

The IRI adopts a dispositional approach, evaluating individual levels on four areas of empathy; perspective taking, empathic concern, fantasy, and personal distress. These four areas

correlate with individual scales on the IRI (Davis, 1980; Cliffordson, 2001). These four scales each tap a unique aspect of empathy and are consistent with the current conceptualization of empathy as a multifaceted construct. The empathic concern subscale (ES) addresses the extent to which and individual experiences emotional concern for another, whereas the perspective taking (PT) subscale evaluates the cognitive tendency to adopt the perspective of another individual (Pulos, Elison& Lennon, 2004). These two subscale divisions are consistent with the idea that the construct of empathy is primarily comprised of both emotional and cognitive components. Additionally the fantasy (Fa) and personal distress (PD) subscales address the tendency for an individual to emotionally identify with individuals within movies, books, or works of fiction, and to experience negative feelings when viewing the distress of others respectively (Pulos, Elison, &Lennon, 2004; Davis, 1980). These two subscales further address both the emotional and cognitive perspective taking components, but include an additional factor of emotional regulation and a measure of empathic tendencies in an applied context. Of these four subscales, further factor analysis found higher order associations between the ES, PT, and Fa subscales indicating a pure representation of the construct of empathy. An emotional regulation factor was found to be positively associated with the perspective taking subscale and negatively associated with the personal distress subscale (Pulos, Elison& Lennon, 2004). This emotional regulation factor is consistent with current conceptualizations of empathy including an component that focuses on an individuation or remaining separate within the experience and not melding emotional experiences with another. The pattern of a positive relationship with a perspective taking scale and a negative association with the personal distress scale is consistent with the tendency to understand and appreciate the viewpoint of another, but to maintain emotional separation and distance.

Overall, the 28 item, self report, IRI provides a multidimensional conceptualization of empathy and has significant prior support within the literature addressing issues of validity and utility of this measure (Pulos, Elison, & Lennon, 2004; Cliffordson, 2001; Chlopan, McCain, Carbonell, & Hagen; 1985; Davis, 1980).

Objective Measures of Cognitive and Affective Empathy

Following a paradigm presented in Rowe, Bullock, Polkey, & Morris (2001) participants were presented a series of first and second order false belief tasks as well as measures tapping the ability to make inferences based on information, and fact and memory questions. These task domains were evaluated through a series of vignettes and questions requiring the consideration of both first and second order false beliefs, inferential abilities, informational recall, and overall memory will be presented based on those vignettes. A subset of Happe's*Strange Stories Task* (1994) were used to evaluate TOM and perspective taking in college students. Happe's original study was designed to evaluate more complex theory of mind functioning in individuals with autism. Prior to this task development, Theory of Mind was predominantly evaluated using a false belief task such as the "Smarties" task (Perner, Frith, Leslie, &Leekam, 1989) where children were shown a box of candies, typically Smarties and asked to predict the contents. These children were then shown that the box contains coins and finally asked to predict what another child would initially predict or believe. Happe's rationale and motivation behind her original study was based on the phenomenon where higher functioning children with autism would successfully pass a simple TOM task like the Smarties test, but still exhibit significant social deficits. Happe's initial study (1994) used a control group of typically functioning average adults. Within the study, participants completed 24 vignettes that focused on 12 story types including a lie, a white lie, a joke, pretend, a misunderstanding, persuasion, figure of

speech, sarcasm, forget, double bluff, appearance/reality, and contrary emotions. Further, the participants completed several 'physical' control stories to gauge reading comprehension, motivational, and attentional factors. Overall findings from Happe's original work demonstrated that high functioning individuals with autism performed significantly more poorly on these tasks than did normal controls or individuals with intellectual disabilities but no social deficits (Happe, 1994). This methodology has since been extensively replicated and utilized in the literature with most recent findings indicating a positive correlation between measures of executive functioning, including phonemic and semantic fluency, Trails (A & B), and TOM performance (Charlton, Barrick, Markus, & Morris, 2009). Further, Charlton et al. (2009) used a reduced number of vignettes but did use a scoring methodology that was similar to that used by Happe (1994).

Some of the emotional or affective aspects of empathy were measured by the "Reading the Mind in the Eyes Test" which was originally designed by Baron-Cohen, Wheelwright, and Jolliffe (1997) and was an attempt at a measure of social cognition related to theory of mind and social intelligence. Within this measure individuals are tasked with selecting an appropriate emotional word that best describes an image of a person's eyes (Baron-Cohen, Wheelwright, Hill, Raste. & Plumb, 2001). The original iteration of this measure was designed for participants to view images of an individual's face that was enacting an emotional state, and to select the correct mental state from a pair (Baron-Cohen, et al., 1997). For a simplified example, the participant would view an image of a woman smiling and be required to select between *Happy vs. Angry*. Subsequent revisions of this test were designed to increase complexity of the test to make it appropriate to use with higher functioning individuals and to improve the sensitivity of the measure (Baron-Cohen et al., 2001). The revised version of this accomplished this by reducing the area of focus within the image and instead focused only on the eye region of the

emoting individual, and increased the number of distracter choices to four instead of two. Further, complex emotional states were also used, including Flirtatious, Pensive, and Distracted. These changes increased the sensitivity of the measure by reducing the likelihood that a participant would select the correct option by chanced alone as well as allowed for normative data for male and female college students.

Neurological Correlates of Empathy

The connection between empathy, social behavior, and neurological functioning was initially seen in a manner that was consistent with early neuropsychological research, whereby individuals would experience some neurological insult, display altered behavior and key symptomology, and subsequent evaluation of the injury usually through autopsy would reveal the damaged neurological region. From these findings, researchers and physicians could extrapolate the function of the damaged neurological areas. An example of this is Harlow's study of Phineas Gage's frontal lobe injury. Gage, a railroad worker experienced significant personality and behavioral changes following a penetrating head injury that damaged portions of the frontal lobe, and his case study has laid the foundation for subsequent inquiry into these issues (Eslinger, 1998). Myriad studies of various groups and populations have found an overarching trend; damage or alterations to prefrontal regions result in disruption of social and emotional functioning. These disruptions of functioning can take a variety of incarnations and occur over widespread neurological regions; however the linkage between prefrontal activity and social and emotional functioning is clear (Studies cited in a review by Eslinger, 1998).

Utilizing measures that assess neurological functioning, researchers have found several trends. In populations of individuals who displayed typical levels of functioning prior to some neurological insult or lesion to the frontal lobes, empathy scores were found to be impaired

following frontal lobe damage (Grattan &Eslinger, 1989). A correlation was noted between measures of executive functioning such as cognitive flexibility and fluency with empathy. Grattan &Eslinger found that there was a positive relationship between measures of verbal associative fluency and empathy scores and an inverse relationship between levels of impaired cognitive flexibility and empathy (1989). These results indicate that impaired levels of frontal lobe functioning are associated with impaired levels of empathic functioning, or conversely, intact frontal functioning is associated with intact empathic functioning. Grattan and Eslinger (1989) posit that this relationship between cognitive flexibility and verbal fluency and empathy is related to the cognitive empathy.

A more direct structural relationship has been uncovered for the specific brain regions associated with the two primary aspects of empathy, namely cognitive and affective. Specifically, "the dorsolateral frontal region has been shown to be more related to the cognitive aspects of empathy and interpersonal understanding and for engaging in tasks such as role taking, whereas the orbitofrontal regions are more related to the emotional facets of empathy such as tasks of emotional responsiveness and sensitivity" (Eslinger, 1998, p.198). This position is supported by much of the neurological empathy literature. Stone, Baron-Cohen, and Knight (1998) found that individuals with bilateral orbitofrontal lesions, as determined by neuroimaging, had similar performance on perspective taking false belief tasks and tests of mental understanding in a social context as individuals with Asperger's syndrome, a high functioning form of autism marked by primary deficits in social and emotional functioning, implicating the orbitofrontal cortex in tasks of social emotional reasoning and perceptions. Impairments on this type of task performance was found to be consistent with behaviors marked by inappropriate speech and problems with analyzing and effectively navigating social situations, and is indicative

of the orbitofrontal cortex involvement in both autism symptomology as well as within sophisticated social interactions and reasoning (Stone, Baron-Cohen, & Knight, 1998).

The cognitive aspects of theory of mind have been related neurologically to functioning in the frontal lobes (Stone, Baron-Cohen, Knight, 1998), the amygdala (Stone, Baron-Cohen, Calder, Keane, & Young, 2003) and the left temporo-parietal junction (Samson, Apperly, Chiavarino, &Humpheries, 2004; all as cited in Samson, Apperly, & Humphreys, 2007). These findings are lending support to a complex fronto-parieto-temporal network that is involved in theory of mind functioning (Samson, Apperly, Humphreys, 2007). Further findings implicate the orbitofrontal cortex in theory of mind tasks that require the inclusion of emotional reasoning or consideration (e.g. cited in Samson, Apperly, & Humphreys, 2007). Lamm, Batson, &Decety (2007) evaluated a complex neurological network that was activated during tasks of witnessing others in pain, imagining their perspective, and cognitively evaluating the individual's position. Within this study, activation in the orbitofrontal cortex was associated primarily with the cognitive or top down processing of the stimuli, additional activation in parietal regions, the amygdala, and the insula were noted during the primarily emotional evaluation and emotional perspective taking tasks (Lamm, Batson, &Decety, 2007).

Given that many prior research paradigms evaluating empathy had only included separate cognitive and affective task components, researchers Vollm, Taylor, Richardson, Corcoran, Stirling, McKie, Deakin, and Elliott (2006) sought to evaluate neurological activity on a singular task that was designed to activate both cognitive and overarching empathy components. Vollm et al., (2006) found that activation in areas of the medial prefrontal cortex, the temporo-parietal junction, and the middle and inferior temporal gyri was common between cognitive theory of mind tasks and empathy tasks, such as the false belief and detection of faux pas in vignettes

tasks. Additional activations in the orbitofrontal cortex, fusiform gyrus, and lingual gyrus were common during both theory of mind and empathy conditions (Vollm et al., 2006). These findings are consistent with the idea that theory of mind is a component of empathy or that theory of mind and empathy are highly entwined and correlated. Additionally, these results provide further neurological evidence and support for the overarching neurological correlates of empathy. Recent research on imitation has discovered a neurological system that is activated as a function of interacting with and viewing others (Iacobini&Dapretto, 2006). This process has clear implications for interpersonal relationships and the overarching construct of empathy.

The Mirror Neuron System

The psychological process of empathy takes place subconsciously, or without directed effort. Prinz (1997) describes an automatic process detailed as a part of the common-coding theory whereby witnessing another's actions automatically activates the individual's neurological processes that correspond with the neurological representations of those actions . Witnessing another engage in an activity activates the same brain processes that would be involved if the witness was engaging in that activity themselves. Adolphs (2003) has demonstrated that witnessing emotional states in others activates the same neurological processes and regions that are responsible for generating those emotions. Similarly, Adolphs and colleagues (2000) have demonstrated that damage to the somatosensory cortex impairs both individual recognition and expression of emotions. Studies evaluating the neurological activation when viewing other's expressions of pain and disgust have shown that similar neurological areas are activated during a task that involves viewing another's expression of pain or disgust as processing one's own experience of those emotions (Singer et al., 2004; Wicker et al., 2003; as cited in Schulte-Ruther et al., 2007). These findings are consistent with the

aforementioned data that supports the position that similar neurological regions are activated when one directly experiences an emotion and when one views another experiencing this emotion. This tendency has clear implications for the affective component of empathy, particularly, an evaluation by Singer and colleagues. (2004) found that the comparative levels of activation of these overlapping neurological regions during observational and direct experiences of pain or disgust was correlated with an individual differences in empathic abilities. Essentially, the higher one scores on measures of empathy the more activity is seen in these overlapping regions that are associated with the experience of emotions.

Botvinick, Jha, Byslma, Fabian, Solomon, and Prkachin (2005) found further support for the position that viewing another's behavior activates similar neurologic regions as the direct expression of that behavior. Botvinick et al., (2005) were specifically interested in the expression of pain and how this specific behavior would translate neurologically to active and observed situations. Utilizing neuro-imagery Botvinick et al., found that there was an overlap in activation in areas when experiencing pain and when viewing others expressions of pain. Two particular regions that were activated in both experienced and observed conditions were the anterior cingulate cortex and the bilateral insulae (Botvinick et al., 2005). Additional activations in the orbitofrontal cortex and the amygdala were noted during the observation conditions (Botvinick et al., 2005) indicating that these regions may be associated with the perception of emotional states in others and empathy (Singer et al., 2004).

Much of the discussion of neurological overlap is consistent with the common coding model of perception and action and the activation of the Human Mirror Neuron System (hMNS). The Mirror Neuron System was first discovered in primates, researchers discovered that the motor cortex in primates would become active when viewing another primate engage in a motor

task, despite concurrent physical non activity (Rizzolati&Craighero, 2004). The regions of the motor cortex that were activated were those same regions that would be activated if the primate was engaging in that activity directly (Rizzolatti&Craighero, 2004; Iacoboni&Dapretto, 2006). Current research describes that the primate mirror neuron system is limited in its activity to motor actions and activity as opposed to the increased activation that is seen in a larger variety of tasks in the human mirror neuron system (Rizzolatti&Craighero, 2004). Conversely, studies of the human mirror neuron system (hMNS) have shown mirror neuron activity during both motor activity and emotional activity, instead of only motor activity. Witnessing another engage in a motor action and witnessing another's emotional state are both activities that activate the hMNS (Iacoboni&Dapretto, 2006; Oberman, Pineda, &Ramachandran, 2007; Molenberghs, Cunnington, &Mattingley, 2009; Decety&Lamm, 2006; Rizzolatti&Craighero, 2004). Recent research has posited that the hMNS is vital to individual social development and has evolutionary roots associated with observational learning and social interactions. Theories of the hMNS posit that the neurological mirroring of the emotional aspects of viewed actions serve to cue the observer to the intentions, thoughts, and feelings that motivated the viewed action (Oberman, Pineda, &Ramachandran, 2007). This mirroring of affective states in addition to understanding the motivation and intentions of another individual is consistent with the current theoretical understanding of empathy (Decety& Jackson, 2006). Structurally, the hMNS is a complex system that involves multiple brain regions (Decety&Lamm, 2007; Molenberghs, Cunnington&Mattingley, 2009). Within the primate system, the key areas of neurological activity are within the frontal premotor region and the parietal lobe (Rizzolatti&Craighero, 2004). Similarly, within the hMNS, neurological activity is found in the throughout the frontal and parietal lobes as well as the premotor area (Decety&Lamm, 2006).

Considering the significant impact that the hMNS has on promoting effective social interactions by providing information into the internal cognitive and emotional states of others the evolutionary value of this neurological system is clear. Additionally, the combined motor and social imitation aspects of the hMNS demonstrates clear implications for the development and effective usage of language within humans as well as with learning (Iacoboni&Dapretto, 2006). The potential impact that the hMNS has on the development and utilization of language, social interactions, and imitation abilities has directed researchers to consider the potential linkage between dysfunctions in the hMNS and autism (Iacobone&Dapretto, 2006; Decety&Lamm, 2006; Oberman, Pineda, Ramachandran, 2007).

The common coding model that essentially describes the functioning of the hMNS posits that the perception of an action and the completion of an action share common cognitive and neural codes. Essentially, from this position, viewing and perceiving behavior in another automatically activates one's own representations of that behavior (Prinz, 1997; Viviani, 2002, as cited in Ruby &Decety, 2004). This has clear implications for the overall understanding of the neurological correlates of the affective component of empathy. However, simply activating overlapping neurological regions does not adequately account for the unique construct of empathy and separate it from the concept of emotional contagion. One might theorize that having a similar neurological activation would result in a similar experience of the witnessed emotion, which is more consistent with ideas of emotional contagion whereby an individual gets caught up and similarly experiences the emotional state of another, instead of the currently accepted view of empathy as an overall cognitive and affective appreciation of the others emotional state while maintaining emotional distance or remaining separate from the overall experience.

Within the process of empathy one must also consider that while recognizing and understanding the emotional states in others there must remain a distinct separation between one's own emotional state and the recognition of another's affective state (Batson, 1987; Wispe, 1986, Rogers, 1975; Reik, 1949; as cited in Ruby &Decety, 2004). A study by Ruby &Decety (2004) provides crucial insight into the process of neurologically distinguishing between the self and the other when cognitively and emotionally processing information. The researchers have found that the fronto-polar, somatosensory, and inferior parietal cortices play a role in distinguishing between the self and other perspectives when processing a variety of emotional, motor, and cognitive processes (Ruby &Decety, 2004). Additionally, the activation of the frontal cortices during an imagined third party perspective taking task is theorized to be associated with an inhibitory process whereby the frontal lobes inhibit aspects of the somatosensory cortex as a neurological means of maintaining the self- other distinction. (Ruby &Decety, 2004). The somatosensory cortex is activated when an individual experiences (or imagines experiencing) a stimuli directly. However, during third party imagining where an individual imagines what it would be like to experience something from another's perspective the frontal lobe activation serves to inhibit some of the direct somatosensory activation and provide or reinforce that self-other distinction (Ruby &Decety, 2004).

Overall the bulk of the aforementioned research indicates that neurological activity in the frontal lobes as a part of the human mirror neuron system activity or as a function of neurological inhibition to maintain self-other distinctness has been associated with the construct of empathy as well as with effective human social interactions and the development of social skills such as language. This research provides overarching support for the position that neurological activity, specifically in the frontal lobes, is connected to individual social

functioning and the construct of empathy. This linkage also demonstrates clear implications for the role of the frontal lobe and the hMNS in the symptomatic presentation of autism spectrum disorders.

Neurological Findings in Impaired Populations

A recently proposed theory of autism that involves the hMNS is known as the "broken mirror" theory of autism whereby researchers attribute a dysfunctional mirror neuron system to the behavioral and psychological symptoms associated with autism spectrum disorders (Iacobini&Dapretto, 2006). These symptoms of autism include impairments in social interaction, language development, and stereotypic behaviors or abnormal sensory responses (DSM IV criterion, APA 2000). Proposed deficits in social imitation and mimicry that would be consistent with deficits in the hMNS may play a role in deficits noted in social behavior, and language development; additionally, deficits in both the parietal and frontal regions of the brain may be the source of difficulties with sensory processing and impulse control and higher order and abstract thinking that are also consistent with autism spectrum disorders. Further, research has uncovered differential levels of mirror neuron system activity in individuals with autism spectrum disorders when compared to normal controls using functional magnetic resonance imaging (Nishitani, Awikainen, &Hari, 2004; Cited in Iacobini&Dapretto, 2006); indicating that individuals with autism display decreased levels of hMNS activity when compared to typically developing individuals. This and similar findings suggest that dysfunction in the hMNS may be a key component of the diffuse neurological differences that are associated with the symptomatic presentation of Autism Spectrum Disorders (Iacobini&Dapretto, 2006). This theoretical stance has been dubbed the "broken mirror" theory of Autism, as dysfunction in the hMNS has been found in individuals with Autism (Iacobini & Dapretto, 2006).

In contrast, Hamilton (2008) argues that this "broken mirror" approach oversimplifies the highly complex symptomatic presentation of autism. Hamilton's position adopts a more complex conceptualization whereby individuals with autism perform poorly on "meaningless" tasks of mimicry, but are able to effectively understand and copy goal directed behavior (2008). Essentially, individuals often are unable to directly mimic an action such as tapping a table, but are able to emulate a goal directed behavior like picking up a cup (Hamilton, 2008). Hamilton's approach posits that the mirror neuron function of direct mimicry is impaired in individuals with autism, and not the overall understanding of directed goals and planning (2008) which would be associated with an understanding of another's internal state. Despite contrasting views, it is clear that further research into the role of the hMNS in autism symptomology is vital.

While autism is currently receiving much focus in research and the popular media, there are additional neurological disorders and conditions that present with deficits in social and emotional regulation and understanding. Researchers attempting to find a greater understanding of the underlying neurological processes that are associated with particular symptomatic presentation are examining the neural structures of individuals who present with fronto-temporal dementia (FTD) or frontotemporal lobar degeneration (Schroeter, Raczka, Neumann, Von Cramon, 2008). The overarching paradigm that these authors are adhering to is that the symptomatic deficits that are associated with FTD are consistent with other areas of deficits in other disorders and syndromes and are attempting to understand the underlying neurological correlates of the symptom clusters. General symptoms of frontotemporal dementia include a decrease in social and interpersonal conduct, and inability to moderate one's personal behavior, lack of insight, and affective blunting or restriction (diagnostic core features, Neary et al., 1998). A key consideration of this neurological condition is that within the domain of frontotemporal

degeneration and dementia, there is a marked degeneration of behavioral, interpersonal, and affective components, over any impairment in the language domain (Neary et al., 1998; Snowden et al., 1996). This symptomatic presentation is crucial as temporal lobe functioning is typically associated with language abilities, memory, and facial recognition among others (Lezak, Howieson, Loring, 2004), however in FTD the socio-behavioral deficits are the more salient symptomatic issue (Schroeter et al., 2008).

In a meta-analytic overview of the recent literature, Schroeter et al., determined that there were several key neurological areas that were involved in the presentation of the neurologic symptomology in FTD of impaired social understanding, lack of insight, emotional blunting, and impaired interpersonal behavior. The anterior medial frontal cortex was found to have marked alterations in functioning and form in individuals with FTD (Schroeter et al., 2008), this region has been associated with Theory of Mind, the process of "metalizing" or attributing mental states and intentions to others (Frith&Frith, 2003; Gallagher &Frith, 2003) and in impaired populations with difficulties in attributing mental states to others or "mindblindedness" (Baron Cohen, 1995).

Areas of the anterior cingulate cortex have been associated with the perception of emotion and pain (Frith&Frith, 2003; Vogt, 2005), however the neurological correlates of emotion and pain perception have shown an additional number of neurological regions that may be involved in these processes. This finding that there may be additional neurological areas associated with the perception of emotion and emotional regulation, such as the anterior insula and orbitofrontal cortex (Vogt, 2005), is not unusual given the complex and multi faceted nature of emotion and the role that emotion plays in a variety of human functions.

The polar region of the medial anterior prefrontal cortex was found to be affected in individuals with FTD (Schroeter et al., 2008). This region has been associated with the

purposive evaluation or introspection of one's own internal states, (Christoff&Gabrieli, 2000), these processes are active during moral, social, or evaluative judgments. Essentially these neurological areas are active during tasks that require one to reflect upon their own internal state when making a judgment.

Researchers, Torralvia et al., (2007) have investigated the role of the orbitofrontal cortex the key neurobehavioral symptoms and the associated deficits of functioning of individuals presenting with fronto-temporal dementia. These researchers have focused primarily on the orbitofrontal cortex and the role that it plays in optimal decision making and theory of mind tasks. Prior literature has demonstrated a linkage between lesions on the orbitofrontal cortex and poor performance on staged gambling tasks, indicating that there may be impairments in decision making in individuals with orbitofrontal lesions or damage such as those with fronto-temporal dementia (Bechara, Damasio, Damasio& Anderson, 1994). Additional literature has linked limitations in theory of mind to those with neurological impairments. Specific theory of mind tasks such as detecting deception and cheating have been found to be impaired in those with orbitofrontal lesions (Stuss, Gallup, & Alexander, 2001; Stone et al., 2002). These two areas, social decision making and theory of mind, are likely functions that are fundamentally related to the top-down processing perspective (Ruby &Decety, 2004) and the cognitive aspects of empathy and as such provide further evidence to the neurological linkage of empathy.

Overall, there appears to be significant associations between deficits in social behaviors like perspective taking and understanding the cognitive and affective states of others and an associated inability to effectively navigate social situations in individuals who are diagnosed with autism, and those who have neurological damage such as fronto-temporal dementia. Additional literature has found similar neurological activity between individuals with autism and

those with orbitofrontal lesions (Schulte-Ruther, et al., 2007). All of these studies provide significant weight to the argument that neurological functioning in specific areas including the frontal lobes is associated with the ability to understand and appreciate other's emotional states and impairment in these regions is associated with dysfunction and deficits in social behavioral functioning.

Often, personality changes will result following a traumatic head injury or neurological insult, these personality changes will alter the typical behavioral patterns of that individual increasing the likelihood that the individual will engage in socially inappropriate behaviors such as aggression and violence (e.g., Marsh & Blair, 2008). A clinical example of this tendency is seen in individuals with acquired sociopathy; which is the development of antisocial behavior and general sociopathic tendencies following a traumatic brain injury without having previous diagnoses for psychopathy or antisocial personality disorder (Brower & Price, 2001). A diagnosis of acquired sociopathy is not dependent upon damage to a specific neurologic region, instead is primarily related to behavioral and personality changes following a neurologic insult (Brower & Price, 2001). A study by Blair and Cipolotti (2000) suggests that those with acquired sociopathy tend to lack clear knowledge of appropriate social behavior. Individuals diagnosed with acquired sociopathy following a brain injury display an impairment that is characterized by Grafman (1994) as "an inability to access social schema knowledge" which impairs the individual's ability to react appropriately within a social situation. This tendency is congruent with other deficits observed in individual's with acquired sociopathy, specifically with deficits in Theory of Mind. Theory of mind, as a component of empathy, is essentially how well or appropriately the individual is able to judge the emotion states of others (Baron-Cohen, 1995). Lacking theory of mind can also impair social functioning as the individual with acquired

sociopathy does not realize the harm or mental discomfort they may be placing the other party in and will subsequently fail to alter or inhibit that aggressive or violent behavior.

The ability to read the social cues of others, particularly those who are experiencing distress has been shown to be an influential factor on the expression of aggression (Blair, 2003; Montagne et al., 2005), additionally viewing distress cues in others has been shown to inhibit the expression of aggression and antisocial behavior (Blair, 2001; Nichols, 2001; Price et al., 2004). By extension, neurological impairments in empathic abilities such as theory of mind and the ability to read and recognize affective cues in others has been associated with increases in aggressive, antisocial, or social deviant behavior (Marsh & Blair, 2008).

Researchers have determined that individuals with bilateral ventromedial prefrontal damage were shown to display high rates of problems associated with a lack of insight, inappropriate affect, low frustration tolerance, apathy, lability, irritability, and socially inappropriate behaviors (Barrash, Tranel, Anderson, 2000). Bilateral ventromedial prefrontal damage was also associated with emotional insensitivity and cognitive and behavioral inflexibility (Barrash, Tranel, Anderson, 2000). These behaviors that are associated with the damage to the bilateral ventromedial prefrontal cortex have been also associated with an increased likelihood towards behaving aggressively or in a socially inappropriate fashion (Barrash, Tranel, Anderson, 2000), as well as being associated with empathy related functions. By extension one can see further support to the linkage between neurological impairment, decreased empathy, and an increase in antisocial or aggressive behaviors. It is also crucial to note that in these studies the behavioral impairments were noted following the neurological insult that resulted in neurological damage and impairment (Barrash, Tranel, Anderson, 2000).

Measures of Executive and Frontal Lobe Functioning

The literature has demonstrated a significant linkage of empathy to neural, specifically frontal lobe, functions (Eslinger, 1998). There are a wide variety of neuropsychological measures that could potentially evaluate individual neural functioning of the frontal lobes. In general, measures of neuropsychological functioning are related to an individual's performance on tasks that have been associated with a particular neurological region (Lezak, Howieson, &Loring, 2004). For example, frontal lobe functioning is evaluated through measuring performance on tasks that are related to frontal lobe functions like planning or problem solving. By evaluating an individual's performance on tasks of problem solving or planning, it is possible to determine overall level of neurological functioning based on the idea that impaired task performance is related to impaired neurological functioning (Lezak, Howieson, &Loring, 2004).

Given the associations in the literature between empathy and verbal fluency as well as cognitive flexibility (Eslinger, 1998) information obtained in these areas of frontal functioning would prove valuable in evaluating. Additionally, in a meta analysis of the sensitivity of various tests of executive functioning, Demakis (2004) posited that a trend in the literature indicates that the Trail Making Test is an instrument that is sensitive to frontal lobe damage and dysfunction. The Trail Making Test is at a basic level, a task of visual scanning, sequencing, planning, and rapid cognitive processing, (Lezak, Howieson, &Loring, 2004), all of which are typically viewed as being executive functions.

Select neuropsychological tests including The Trail Making Test Parts A and B, The Controlled Oral Word Association Test, and A Design Fluency Test provided information about planning abilities, verbal and design fluency skills, level of behavioral inhibition, and cognitive flexibility (Lezak, Howieson, &Loring, 2004).

The Relationship Between Theory of Mind and Affective Empathy

As has been previously described on a theoretical level, empathy is described as a three component construct that is made up of cognitive, affective, and interpersonal distancing facets (Ruby &Decety, 2004). Within this definitional framework the cognitive component is most clearly theoretically aligned with the highly researched Theory of Mind (Bull, Phillips, & Conway, 2008). Cognitively based theory of mind tasks have been most associated with executive functioning and higher order top down processing perspectives (Decety& Jackson, 2006). Conversely, the affective component of empathy has been associated with the "bottom up" or more viscerally based emotional processing (Decety& Jackson, 2006). The literature has primarily conceptualized both processes, affective and cognitive, to be overlapping and highly intertwined within the neurological structures (Schroeter, Rakzca, Neumann, & Von Cramon, 2008; Hynes, Baird, & Grafton, 2006), and that the use of either the "top down" or "bottom up" processing is dependent on the situational components that are triggering the response (Decety& Jackson, 2006).

The current bulk of the literature supports the connection and overlap between the cognitive and affective components of empathy and understanding another's internal state (Decety& Jackson, 2006; Ruby & Decety, 2004, Hynes, Baird, & Grafton, 2006; Torralvia et al, 2007). For example, individuals with an autism spectrum disorder have been shown to display impairments in facial emotional recognition (Baron-Cohen, Wheelwright,&Jolliffe, 1997) indicating a deficit in complex emotional recognition and processing in individuals with autism, in addition they do similarly poor on tasks that test cognitive empathy, or Theory of Mind (Baron-Cohen, Ring, Wheelwright, Bullmore, Brammer, Simmons, & Williams, 1999). However there are some crucial instances where the relationship between the emotional and

cognitive components of empathy does not appear to be as closely entwined or interrelated. The most salient and socially relevant example of this phenomenon is related to the construct of sociopathy, which is often referred to in the literature as psychopathy or an Anti-social personality disorder or characteristics (Brower & Price, 2001; Blair, 1995). Deficits in prefrontal neurological activity and volume have been associated with increases in violence, aggression, impulsivity, and gambling (Brower & Price, 2001). Similarly, individuals who are classified as psychopaths, or sociopaths, and those that have been diagnosed with Antisocial personality disorder have been found to display decreased frontal lobe activity (Brower & Price, 2001; Blair, 1995; Raine, Lencz, Bihrle, LaCasse, &Colettiio, 2000).

As a construct, Psychopathy is considered to be a personality disorder that is marked primarily by affective personality disturbances that include manipulative tendencies, shallow or absent emotional responses, and callous interpersonal styles in addition to a behavioral tendency to engage in antisocial or rule breaking, destructive behaviors (Harris, Rice, &Quinsey, 1994; Raine et al., 2000). This diagnostic category differs from the current DSM- IV- TR iteration of antisocial personality disorder because it highlights the emotional impairment and affective restriction as well as the callous and manipulative behavioral style over the antisocial behavioral tendencies (APA, 2002). Antisocial or psychopathic individuals have been shown to display deficits in processing and recognizing facial affect in others, and as a result are less likely to inhibit aggressive and violent behaviors (Marsh & Blair, 2008). Additionally, individuals who are characterized as psychopaths have impaired self emotion recognition and appear to have overarching emotional impairments (Marsh & Blair, 2008; Blair, 1995, Raine et al., 2000). However, those characterized as psychopaths do tend to display manipulative tendencies that rely on the understanding of other's mental states to more effectively manipulate and control the

situations and others' behavior (Blair, 1995; Brower & Price, 2001). From this, it appears that individuals who are deemed to be psychopaths are able to cognitively understand social and interpersonal situations and settings and utilize these skills to manipulate interpersonal situations; however they lack the more affective component of empathy that includes an emotional understanding and recognition of emotions in others and subsequently experience difficulty inhibiting antisocial and hurtful behaviors.

This limited, but important, subset of the population and the literature presents an interesting consideration; are empathy and theory of mind overlapping and interrelated constructs or do they differ on the degree that change in neurological functioning impacts level of functioning. Will the cognitive and affective components of empathy differ to the same degree dependent on different levels of neurological functioning or will one domain be more sensitive to changes and gradations in functioning than the other. Despite comprising a small subset of the overarching literature detailing neuro-behavioral functioning, the questions raised by considering the difference in affective and cognitive functioning in psychopathic or antisocial individuals are too important to ignore. As a result it is important to investigate the potentially differential relationship that the emotional and cognitive aspects of empathy may share with frontal lobe functioning.

Overall, these prior studies conducted on clinically based populations highlight an important relationship in the research indicating that brain injury and frontal lobe functioning deficits have been associated with deficits in both the cognitive, or Theory of Mind, and the emotional, or affective, components of empathy. Of current importance is a further understanding of the nature of these relationships in a collegiate population to determine if these differences in ability are a demonstration of one extreme of a continuum of socio-emotional

neural functioning or if individuals with these deficits are a unique population.

Research Hypotheses and Rationale

Overall, there is significant evidence linking the cognitive and affective components of empathy and neurological functioning (Ruby &Decety, 2004), and the affective components of empathy and Theory of Mind (Bull, Phillips, & Conway, 2008), however much of this research, particularly the research that attempts to combine the domains, is completed on populations of individuals with neurological or behavior impairments like autism (Iacobini&Dapretto, 2006), frontotemporal dementia (Schroeter et al., 2008), or acquired sociopathy (Brower & Price, 2001). As a result of the narrowed focus of the previous research, the understanding of the overarching relationship between these three constructs is limited.

Do the relationships posited by the prior literature extend to the normal population? Or are they limited to the extreme ranges of functioning or only following significant impairment. For example, significant deficits in empathy are found following significant brain injury and as a result deficits in empathy are associated with impaired neurological functioning (Schroeter et al., 2008). However is it also evident that minor impairments in empathy are also associated with similar impairments in neurological functioning, or similarly do individuals who display lower than average functioning on neurological tasks perform similarly poor on measures of empathy? Or are these deficits in functioning only apparent following a significant degree of injury or impairment?

Assuming that individual performance on measures of the cognitive and affective aspects of empathy and frontal lobe functioning tasks are normally distributed; evaluating these constructs in a normal or typically developing population of college freshmen will allow increased insight into the nature of the relationship between empathy, frontal lobe functioning,

and social interactions and as a result provide potential directions for the understanding and treatment of individuals in the impaired populations.

Primary Research Hypothesis

Individual variability on measures of frontal lobe functioning will be associated with similar variability on measures of emotional empathy and Theory of Mind. *It is hypothesized that as scores on measures of frontal lobe functioning increase, scores on measures of both emotional empathy and Theory of Mind will similarly increase.*

Secondary Hypotheses

Theory of Mind, the cognitive aspects of empathy will display a higher degree of correlation with overall frontal lobe functioning than will the affective aspects of empathy.

Tertiary Hypotheses

Gender. Given that gender differences in empathy and interpersonal interactions have been demonstrated in college aged individuals, whereby females were found to have significantly higher scores on measures of empathy and interpersonal interactions (Reiff, Hatzes, Bramel, & Gibbon, 2001). *It is hypothesized that females will have higher empathy scores than males.*

Substance Usage. Alcohol usage is a factor that has been demonstrated to impair or alter frontal lobe functioning (Lezak, Howieson, Loring, 2004). *It is hypothesized that reported alcohol usage will be associated with impaired performance on frontal lobe and empathy tasks*.

CHAPTER II

METHODS

Participants

Two hundred nineteen participants completed this study, one hundred eleven females and one hundred eight males from the Indiana University of Pennsylvania Participant Pool. Due to potential legal issues regarding consent, participant age was be restricted to those above the age of 18. Additionally, restricting the age range to 18 years of age and above controlled for variation in the degrees of frontal lobe maturation in individual participants, whereby frontal lobe maturity is typically attained between the ages of 18 and 22 (Lezak, Howieson, &Loring; 2004).

Dependent Measures

To evaluate individual differences on levels of affective and cognitive empathy and frontal lobe functioning several measures were utilized for comparison.

Empathy

Empathy was measured using three established measures, the self- report Interpersonal Reactivity Index (IRI, Davis, 1980), the Baron-Cohen Theory of Mind in the Eyes test (TOM EYES, 2001), and a variation on Happe's Strange Stories Task (SSTV, 1994). The IRI is a self-report scale that evaluates an individual's self perception of their empathic tendencies. The IRI is a 28-item, 5-point likert scale questionnaire that is comprised of four scales, Fantasy, Emotional Control, Perspective Taking, and Personal Distress. Each scale is composed of 7 items (Davis, 1980). Davis calculated Cronbach's alpha values to evaluate the reliability of each of the 4 subscales, they are as follows α=.64 for Perspective Taking, α=.76 for Fantasy, α=.70 for Emotional Control, and α=.69 for Personal Distress (1980). Overall internal reliability scores

ranged between .71 and .77. On this measure, higher scores on the scales reflect higher levels of empathy.

The TOM EYES test is a performance based empathy test that requires participants to identify emotion states based on images, this measure is predominantly nonverbal, however it does require sufficient vocabulary and verbal sophistication to identify more complex emotions like “aghast”(Baron-Cohen et al., 2001). The TOM EYES is a 36-item measure that provides 4 emotion selection options for each target eyes image. Initial normative data from a sample of 103 college students at a rigorous European academic setting describes an average student score of 28 items correct with a standard deviation of 3.5 items for this cognitively advanced normative group. Further normative data from a group of 122 average controls describes an average score of 26.2 and a standard deviation of 3.6 (Baron-Cohen et al., 2001).

The SSTV is a measure that requires participants to read vignettes and write out responses to questions regarding complex emotional states, false belief paradigms, and faux pas situations (Happe, 1994). Happe’s (1994) Strange Stories Task was adapted as a performance based measure for this project. Thirteen questions were compiled and Happe’s two question paradigm was utilized for each question introducing a possible maximum score of 26. Given that this measure was modified from other iterations, there are no pre-existing normative or psychometric data.

Executive Functioning

Verbal fluency is measured by participant’s ability to rapidly generate words when presented by a phonemic or letter cue and is associated with frontal functioning. Verbal fluency was evaluated using the standard “F-A-S” stimulus data using a one minute time limit. Normative data produced by Tombaugh and colleagues (1999) utilizing an overall sample of 895

participants with an identical F-A-S stimulus paradigm reflect an average of 39.3 words produced with a standard deviation of 12.0 words for the 19 participants who fell in the 16-19 age range, and an average of 41.2 words produced (sd 9.2) for the 106 participants who fell within the 20-19 age range (Tombaugh et al., 1999). Further, normative data produced by Demakis (1999) utilizing a sample of 22 undergraduate students aged 22.5 years (sd.7.99) with the standard F-A-S stimulus paradigm reflect an average of 37.8 words produced (sd.11.1).

Design fluency was evaluating using the "free form" condition where participants were instructed to construct novel designs that had no pre-established name e.g. a square, or would be considered scribbles within a 5 minute time span. Normative data for this measure indicates an average of 15.5 unique drawings with a standard deviation of 6.1 (Lezak, Howieson, &Loring, 2004).

The Trail Making Test parts A and B are a timed, pencil-and-paper measure of visual scanning and sequencing, as well as switching. Normative data reflects average performance times of 21.48 (sd. 6.44) for Trails A completion and 48.77 (sd. 18.66) for Trails B completion in young adult population groups.

Procedures

Selection

Participants were randomly selected from the IUP participant pool, participation was voluntary. Students participate in the participant pool as a requirement of their Introduction to Psychology course; students are permitted to opt out of participation and complete an alternative read and review assignment to meet the research requirement.

Contact

Participants were contacted via email according to participant pool guidelines and evaluation times were scheduled. Testing occurred in the Uhler Hall Basement Research rooms and was administered by trained IUP Clinical Psychology doctoral students.

Informed Consent

Participants were provided information regarding the nature of and the design of the study. No deception was utilized, nor information other than the research hypothesis withheld. The research hypothesis was only discussed in the debriefing form to avoid potential biased responding to self report measures. All information provided was anonymous and stripped of identifying characteristics, other than limited demographic information related to gender, age, ethnicity, and a limited neuropsychological history.

Self-report Measures

Following informed consent, individuals were administered a packet of self-report measures, including the empathy measure the Interpersonal Reactivity Index (Davis, 1980). Additional demographic information associated with gender, age, race, and brief prior neuropsychological history related to autism spectrum disorder, ADHD, or Traumatic Brain Injury was obtained. The brief neuropsychological history was be utilized to address potential confounds to the research design related to additional factors that may potentially influence the neuropsychological test scores. The self report measures took approximately 25 to 30 minutes to complete.

Participants were also presented with a variation on Happe's (1994) Strange Stories Task to evaluate false belief understanding, theory of mind, and the ability to make inferences based

on story information. Participants also viewed and completed Baron-Cohen's Theory of Mind in the Eyes Test (Baron-Cohen et al., 2001).

Neuropsychological Measures

Following completion of the self report packet, individuals were administered neuropsychological measures, taking approximately 15 minutes to complete, by doctoral trainees from the IUP Clinical Psychology program. These doctoral trainees had received graduate level training in psychological assessment and have received additional training on the proper administration and scoring of the specific neuropsychological instruments. As per psychology doctoral program policy, all doctoral trainees had necessary government clearances and liability insurance.

Debriefing

Following completion of all measures, individuals were given debriefing forms that described the purpose of the study and provided resources should they desire further information, psychological services, or assistance.

Data Analysis

Data were collected across 4 weeks during the spring semester of 2010. Self report packets and neuropsychological test data were collected, assigned a blind code number, and stored. Following completion of all evaluation and testing, the test measures were coded and scored. The Strange Stories Task Variant, demographic data, and figural fluency measures were all hand scored by the principal investigator to ensure consistency as they require clinical judgment. Data were entered into statistical software, SPSS version 13, and a series of statistical evaluations were run.

Correlational analyses were used to evaluate the associations between variables including cognitive and affective empathy, the subscales of the IRI, and measures of executive functioning. Analyses of variance and *t*-tests were conducted to evaluate how demographic factors including gender, alcohol use, and neuro-medical history influenced performance on the dependent measures. These procedures were be utilized to address several design issues. Since the scores on the measures of empathy and frontal lobe functioning were continuous and assumed to be distributed normally across the population, a correlational analyses was the most effective methods to evaluate the relationship between these variables. Further, to address the experiment wise error rate and to limit the potential for type 1 error, a Bonferroni correction was applied for the analyses evaluating each hypothesis.

CHAPTER III

RESULTS

General and Demographic Data

The sample was comprised of 219 participants, 108 males and 111 females. Mean age of participants was 19.26(Sd- 1.724). Mean age of females was 18.93 (Sd- 1.29) and for males the mean age was 19.60 (Sd- 2.02). The demographic breakdown of participants was as follows, 168 reported Caucasian, 18 indicated African American, 4 identified as Latino, and 5 participants indicated Other or failed to report demographic data. With respect to alcohol usage, 44 (20%) reported no alcohol usage, 99 (45%)participants reported mild (2 to 5 drinks per week) alcohol usage while 47 (21%) participants reported moderate (between 6 and 10 drinks) usage, and 29 (15%) reported heavy usage (more than 11 drinks per week). With respect to head injury, of the 219 participants, 135 (62%) reported no prior concussion or traumatic brain injury diagnoses or symptoms, 84 (38%) reported either a diagnosis of a concussion or traumatic brain injury or associated post concussive symptomology following a severe injury or accident including blurred or double vision, headaches, memory problems, and dizziness**.**

Internal Consistency of Measures

Empathy Measures

Self report measures of empathy demonstrated significant correlation among sub scales of the Interpersonal Reactivity Index (IRI). Within the current population, the Fantasy subscale correlated moderately with Emotional Control, Perspective Taking, and Personal Distress. Emotional Control subscale scores correlated with Perspective Taking, and Personal Distress subscale scores. The Perspective Taking subscale scores also correlated with the Personal Distress subscale scores. Participant performance on the cognitive measure of empathy, the

Strange Stories Test variant (SSTV), was also correlated significantly with the Emotional Control Subscale of the IRI and the Perspective Taking Subscale of the IRI. The Strange Stories Test variant and the Theory of Mind in the Eyes (TOM Eyes) test both correlated moderately. For specific correlation values see table 1. Overall, subscales of the IRI correlated modestly among the scales. The cognitive empathy measure, the Strange Stories Test Variant correlated with both an emotional empathy scale, the Emotional Control subscale, as well as a cognitive empathy subscale, Perspective Taking. The performance based affective empathy measure; the TOM Eyes test did not correlate with any scales of the IRI, but did correlate with the SSTV.

Reliability measures for the IRI were calculated using Cronbach's Alpha. The Cronbachs' Alpha value across the 4 scales of the 28 item IRI was $\alpha = .662$. Descriptive data for the performance based EYES and SSTV tasks are listed in table 2.

Table 1*: Empathy Measures Internal Consistency Correlations*

	Emotional Control	Perspective Taking	Personal Distress	Fantasy	SSTV	TOM Eyes
Emotional Control	1	r=.271 ** p=.000	r=.394 ** p=.000	r=.307 ** p=.000	r= .156 * p=.021	r=.100 NS
Perspective Taking		1	r=.245 ** p=.000	r=0.241 ** p=0.000	r=.153 * p=.023	r=.084 NS
Personal Distress			1	r=0.349 ** p=0.000	r= .079 NS	r=.045 NS
Fantasy				1	r=.114 NS	r=.099 NS
SSTV					1	r=.401 ** p=.000
TOM Eyes						1

*- Significant at the $p<0.05$ level, **- significant at the $p< 0.01$ level.

Table 2: *Objective Empathy Means and Standard Deviations*

	Mean (n=219)	Standard Deviation
Baron-Cohen Theory of Mind in the Eyes test	23.85	4.171
Happe's Strange Stories Test Variant	21.15	3.071

Executive Function Measures

Overall, participant performance on measures of executive functioning was significantly correlated. Higher scores on the controlled oral word association test (COWAT) were significantly correlated with scores on the figural fluency test (FIG). Further COWAT scores were negatively correlated with completion times on the Trail Making Test A (TMTA) and B (TMTB), the negative values reflect that increased performance on measures of verbal fluency is associated with faster performance times, or smaller time values, for TMT A and B completion. Figural fluency was also correlated with TMT A completion times, but not with TMTB completion time. Finally, TMTA and TMT B scores demonstrated a moderate degree of significant association. For values see table 3. Descriptive sample data regarding means and standard deviation scores for executive functioning measures are listed in table 4.

Table 3: *Executive Function Measures Correlations*

	COWAT	FIG	TMTA	TMTB
COWAT	1	r=.251 ** p=.000	r=-.166 ** p=.014	r=-.189 ** p=.005
FIG		1	r=-.169 ** p=.012	r=-.024 p=.7 NS
TMTA			1	r=.364 ** p=.000
TMTB				1

*- Significant at the p<0.05 level, **- significant at the p< 0.01 level

Table 4: *Executive Function Measures Means and Standard Deviations*

	Mean (n=219)	Standard Deviation
COWAT (# words)	36	8.8
FIG (# figures)	22	12.6
TMTA (# seconds)	26.1	9.09
TMTB (# seconds)	62.9	25.26

Research Hypotheses

Hypothesis 1. *As scores on measures of frontal lobe functioning increase, scores on measures of both emotional empathy and cognitive empathy would similarly increase.*

Preliminary, exploratory analyses revealed associations between the Trail Making Test Part B and measures of empathy over the other measures of executive functioning, Verbal and Figural Fluency. This trend is consistent with the established literature that has predominantly utilized a switching trails test or other similar measures of set switching ability (e.g., Eslinger, 1998; Dinn, Harris, Aycicegi, Greene, & Andover, 2002; Torralvia et al., 2007; Rankin, Kramer, Miller, 2005). Given this, and in an attempt to reduce the potential for aggregating type 1 error, the analysis between empathy and executive function were limited to the TMTB measure compared against both performance based empathy measures the EYES and the SSTV and the scales of the IRI. For these 6 analyses a Bonferroni Correction of p=.008 and p=.0016 was applied which is consistent with significance at standard level of p=.05 and p=.01, respectively.

The Trail Making Test Part B correlated significantly with both the performance based emotional and cognitive empathy measures. TMTB performance correlated significantly with participant performance on the TOM eyes test with a small but significant correlation of r= -.219 (p=.001). The negative correlation is indicative that higher scores on the TOM Eyes test are associated with faster completion times on the TMT B measure. TMTB scores were also significantly associated with the personal distress subscale scores, a self-report measure of affective empathy with a value of r=-185, (p=.006). For a full listing of correlations see table 5.

TABLE 5: *Executive Functioning and Empathy Correlates*

	TOM Eyes	SSTV	Fantasy	Perspective Taking	Emotional Control	Personal Distress
TMTB	r= -.219 ** (p=.001)	r= -.164 (p=.015)	r= -.062 (p=.365)	r= -.063 (p=.351)	r= -.028 (p=.685)	r= -.185* (p=.006)

*- Significant at the p<.008 level, **- significant at the p<.0016 level.

Hypotheses 2. *Theory of Mind, the cognitive aspects of empathy will display a higher degree of correlation with overall frontal lobe functioning than would the affective aspects of empathy.*

The measures of affective empathy correlated significantly with frontal lobe functioning whereas measures of cognitive empathy did not withstand more stringent criteria for significance. TOM Eyes scores and the Personal Distress scale scores correlated significantly with TMTB performance. Please refer to table 5.

Hypothesis 3. *Gender will be associated with significant variation on measures of empathy and frontal lobe functioning.*

Data were analyzed for differences across groups with respect to empathy and performance on the TMTB subtest. To address the potential aggregation of type 1 error, a Bonferroni Correction was applied. For these 7 analyses a Bonferroni Correction of p=.0071 and p=.0014 was applied which is consistent with significance at standard level of p=.05 and p=.01, respectively.

A series of T- tests were conducted evaluating group differences between males and females across empathy measures and executive functioning measures. Females were found to have significantly higher scores on the TOM Eyes test ($t(217)=3.027$, p=.003, $\omega= .20$), the Strange Stories Variant ($t(217)=3.607$, p=.000, $\omega= .24$), and the Personal Distress ($t(217)=4.047$, p=.000, $\omega= .29$) and the scale of the IRI. No significant differences for gender and performance on executive functioning measures were noted. For a further listing of scores see table 6.

Table 6: *t- tests Comparing Empathy and Executive Functioning Across Gender*

Variable	Group	N	Mean	Stand Dev	*t* (217)	Significance	Effect
TOM EYES	Males	108	23.00	4.19	3.027*	p=.003	ω= .20
	Females	111	24.68	4.00			
SSTV	Males	108	20.41	3.41	3.607 **	p=.000	ω= .24
	Females	111	21.86	2.51			
Fantasy	Males	108	19.40	4.09	2.066	p=.04	ω= .14
	Females	111	20.50	3.83			
Emotional Control	Males	108	20.91	2.95	1.979	p=.049	ω= .13
	Females	111	21.65	2.57			
Personal Distress	Males	108	18.16	3.50	4.047**	p=.000	ω= .29
	Females	111	20.19	3.32			
TMTB	Males	108	66.68	28.63	2.196	p=.029	ω= .15
	Females	111	59.24	20.97			

*- Significant at the p< .0071 level, **- significant at the p <.0014 level.

Hypothesis 4. *Alcohol usage will be associated with variance across measures of empathy and frontal lobe functioning.*

An analysis of variance was conducted to evaluate the differences in scores across measures of empathy, Eyes, SSTV, and the IRI subscales, and Frontal Lobe Functioning as measured by the TMTB across different levels of alcohol consumption. To control for the aggregation of error, Bonferroni Corrections were applied. For these 7 analyses a Bonferroni Correction of p=.0071 and p=.0014 was applied which is consistent with significance at standard level of p=.05 and p=.01, respectively.

Of the seven analyses, the self-report of severity of alcohol usage was not significantly associated with group differences across empathy or executive functioning performance. The data did indicate a slight trend that reflected that participants in the heavy usage group, more than 11 drinks per week, demonstrated lower scores on the TOM Eyes Measure than did those who endorsed moderate (between 6 and 10 drinks) and mild (between 2 and 6 drinks) alcohol usage. Please refer to table 7 and 8 for specific details.

Table 7: *Analysis of Variance for Empathy and Executive Functioning Performance by Quantity of Alcohol Use*

		Sum of Squares	df	Mean Square	F	Sig.
TOM EYES	Between Groups	187.64	3	62.54	3.731	.012
	Within Groups	3604.38	215	16.76		
SSTV	Between Groups	22.80	3	7.60	.804	.493
	Within Groups	2032.52	215	9.45		
Fantasy	Between Groups	28.84	3	9.61	.600	.616
	Within Groups	3445.78	215	16.02		
Emotional Control	Between Groups	19.36	3	6.45	.831	.478
	Within Groups	1671.08	215	7.77		
Perspective Taking	Between Groups	8.48	3	2.82	.214	.886
	Within Groups	2837.16	215	13.19		
Personal Distress	Between Groups	12.35	3	4.11	.323	.809
	Within Groups	2738.96	215	12.73		
TMT B	Between Groups	2160.39	3	720.13	1.130	.338
	Within Groups	136981.78	215	637.12		

* significant at the p<0.05 (p=.007) level, **- significant at the p< 0.01 (p<.0014) level.

Table 8: *TOM Eyes Scores Across Alcohol Usage Groups*

Alcohol Usage	N	Mean	Std. Deviation
No Usage	44	23.57	4.315
Mild Usage	99	24.24	3.731
Moderate Usage	47	24.64	4.260
Heavy/Severe Usage	29	21.66	4.647
Total	219	23.85	4.171

Hypothesis 6: *Prior head injury status will be associated with variation across measures of empathy and frontal lobe functioning.*

Participants were asked to report if they had previously experienced or been diagnosed with a concussion or other traumatic brain injury. Further they were asked to report on potential symptomatic markers of traumatic brain injury or concussion to ensure that individuals who had indeed experienced a concussion but who had never been formally diagnosed or treated, such as high school athletes would be accounted for. From these, data were compiled regarding prior diagnosis or positive symptom status, where participants were classed into two discrete groups of no prior reported TBI and reported TBI or significant TBI symptom presentation. Participants who positively endorsed suffering an injury after which they had experienced symptoms of headaches, dizziness, or blurry vision, or experiencing a serious automobile accident were included in the TBI group.

A series of t-tests were conducted to evaluate the differences in scores between TBI and non TBI groups across measures of empathy, Eyes, SSTV, and the IRI subscales, and Frontal Lobe Functioning, using all measures including verbal and figural fluency and the TMT A. To control for the aggregation of error, Bonferroni Corrections were applied. For these 10 analyses a Bonferroni Correction of p=.005 and p=.001 was applied which is consistent with significance at standard level of p=.05 and p=.01, respectively. These results reflected no significant effects for prior history of a TBI on measures of empathy or executive function. For results see table 9.

Table 9: *t- tests Comparing Traumatic Brain Injury History Across Empathy and Executive Functioning*

(No TBI: n=135) (TBI: n=84)	*t* (217)	Sig. p=
TOM EYES	.577	.565
SSTV	1.51	.132
Fantasy	.886	.377
Emotional Control	1.56	.119
Perspective Taking	.805	.422
Personal Distress	.989	.324
COWAT	.418	.677
Figural Fluency	.272	.786
Trails A	1.72	.087
Trails B	.854	.394

* significant at the p=.005 level, **- significant at the p<.001 level.

CHAPTER IV

DISCUSSION

Overall these results highlight some relationships between empathy, specifically affective empathy, and frontal functioning in collegiate populations. The majority of the prior literature has addressed the relationship between these constructs within abnormal or impaired populations (Ruby &Decety, 2004; Bull, Phillips, & Conway, 2008; Iacobini & Dapretto, 2006; Schroeter et al., 2008; Brower & Price, 2001). The bulk of those findings implicate a significant association between empathy and executive or frontal functions within these clinical populations. The results of this current study are unique as they focus on the relationship between empathy and executive functioning in normative or non clinical populations.

The results of this study indicate a small but significant relationship between executive functioning and performance and ratings on affective empathy measures. Specific executive functions include those assessed by performance on the Trail Making Test part B which reflects abilities to switch mental set (Lezak, Howieson, &Loring, 2004). Switching performance was significantly correlated with both objective and self report measures of affective or emotional empathy. It is important to note, however, that while there were significant correlational values they were quite small (.2). Within this sample, scores on measures of executive functioning and empathy were generally consistent with respect to both mean value and variation within scores or standard deviation when compared against established normative data in the literature (Davis, 1980; Baron-Cohen et al., 2001; Lezak, Howieson, & Loring, 2004). However, the majority of these normative studies were also conducted on populations of college students. Given the potential restriction of range associated with a college population, the small correlational values found within this study may be a function of the limitations associated with a restricted sample,

and therefore within a larger population with more variability of functioning, this correlation value may be larger.

In addition to evaluating the relationship between empathy and executive functioning, several additional tertiary analyses were conducted to evaluate potential influencing factors associated with gender, drug and alcohol usage, and neuropsychiatric history. Group differences across the domains of empathy and executive functioning were found with respect to gender, and but not with concussion or traumatic brain injury history, alcohol or substance use. However some sampling limitations associated with a restricted range of a collegiate population may have influenced these group results.

Empathy and Frontal Lobe Functioning

Both objective and self-report measures of affective empathy demonstrated small but significant correlations with frontal lobe functioning tasks. Trails B performance, a task of alternating set and mental switching, was significantly associated with affective empathy self-reports and performance. These findings are supported by the significant body of literature that demonstrates an association between measures of executive functioning and empathy. These prior studies link measures of empathy to performance on executive functioning tasks within impaired or clinical populations including those with a traumatic brain injury history, frontotemporal dementia, and autism (e.g. Bull, Phillips, Conway, 2008; Decety& Jackson, 2006; Ruby &Decety, 2004; Schroeter et al., 2008; Rosen et al, 2002). In addition to utilizing impaired populations, the majority of the aforementioned studies utilized neural imaging techniques to directly link differences neurological activation to differences in clinical presentation. Samson, Apperly and Humphreys (2007) described the relationship between cognitive empathy and perspective switching and self perspective inhibition in clinically impaired populations. These

results (Sampson, Apperly, and Humphreys, 2007), while specifically addressing cognitive empathy in impaired populations demonstrate that key areas of functioning, specifically those associated with switching and inhibition are also associated with general empathy performance. The results found in impaired populations are consistent with those found in the current study that associate executive switching with empathy performance. The current findings are relevant as they demonstrate this significant relationship within the normal population. From this, it is possible that within the population, a person's level of affective empathy and their level of executive functioning is correlated in a manner that is relatively continuous across various levels of clinical presentation or normative functioning. Within this, higher levels of executive functioning are associated with higher levels of affective empathy. Studies utilizing measures of executive functioning in college students have demonstrated variable and normative ranges of functioning within this restricted sample (Demakis, 2004; Lezak, Howieson, Loring, 2004; Dinn, Harris, Aycicegi, Greene, & Andover, 2002). This is important, as despite the potential limitations associated with a cognitively restricted sample of a college population, this study was able to demonstrate normative levels of functioning and trends of variability across task performance that are consistent with the established normative data (Davis, 1980; Baron-Cohen et al., 2001; Lezak, Howieson, & Loring, 2004). The significant association between a set shifting or switching task performance and empathy has been addressed by prior research using similar measures of executive functioning (Eslinger, 1998; Dinn, Harris, Aycicegi, Greene, & Andover, 2002; Torralvia et al., 2007; Rankin, Kramer, Miller, 2005), however the conclusions provided within these studies are varied. Within these studies, population, design, and methodology all widely differed, however all utilized populations of impaired individuals. However, across the two studies, both utilized measures that, although slightly different, evaluate

a consistent underlying executive function of switching ability (Lezak, Howieson, &Loring, 2004). Overall, the association between impairments in empathy and executive functioning were consistent across the majority of all research reviewed.

Prior research has demonstrated the association between impaired levels of executive functioning and impairments across measures of empathy and attributed these impairments to difficulties with cognitive flexibility or switching set (Torralvia et al., 2007; Rankin, et al., 2005; Grattan et al., 1994). Further, some aspects of the literature have utilized methodologies that are somewhat consistent with this current research. In a study by Torraliva and colleagues (2007), researchers utilized Baron-Cohen's Eyes protocol and compared functional performance on neuropsychological measures within populations of individuals with fronto-temporal dementia. Within this afforementioned research methodology, the specific neuropsychological measures differed from those utilized in this current study, where researchers utilized letter number sequencing from the Wechsler Adult Intelligence Scale to evaluate switching and perspective taking instead of the TMTB test (Torralvia, et al., 2007). The current findings lend further support to the position that the "set switching" abilities evaluated through Trails B performance is an important aspect of perspective taking and the ability to alternate between one's internal experience and the imagined or supposed experience of another (Decety, 2011; Ruby &Decety, 2004; Torralvia et al., 2007). Recent research by Decety (2011) discussed the complex nature of empathy and described the necessity for individuals to be able to alternate between self and other perspectives to effectively and efficiently utilize empathic processes. Further, this research concluded that empathy is a highly complex process that is reliant upon many components that include perspective taking, and cognitive and affective processing (Decety, 2011). They concluded that empathy abilities have been associated with activation in the prefrontal and

frontal cortices. Within this current research, the concurrent associations between both cognitive and affective empathy and switching performance reflects that this switching ability which was measured via Trails B performance is more complex than a solely cognitively based perspective shifting task where individuals' deliberately evaluate the potential experiential state of another. Instead these results reflect that empathy and set shifting likely encompass and include more complex aspects of unconscious emotional functioning. Overall, this Trail Making Test B performance potentially represents a complex cognitive and emotional perspective taking process that has a small but significant association with empathy performance and self- rating (Decety, 2011).

The bulk of the literature supports a more significant association between cognitive empathy and executive functioning specifically within individuals with neurological or psychological impairments including traumatic brain injury, focused lesions, or fronto-temporal dementia (Ruby & Decety, 2004; Schulte-Ruther, et al., 2007; Schroeter, Rakzca, Neumann, & Von Cramon, 2008; Hynes, Baird, & Grafton, 2006; Decety & Jackson, 2006; Grattan et al., 1994). Conversely, the current investigation has demonstrated a small but significant association between the set shifting or switching aspect of executive functioning and emotional or affective empathy scores. Limited research (Torralvia et al., 2007; Eslinger,1998) has demonstrated a significant relationship between switching and affective empathy. Research conducted by Torralvia and colleagues (2007) demonstrated a significant association between impaired emotional decision making, theory of mind and executive functioning in populations of individuals with frontotemporal dementia. These studies produced significant results that detail the associations between performance on a mental set shifting task, letter number sequencing on the Wechsler Adult Intelligence Scale III, and performance on the Baron-Cohen Eyes task

(Torralvia, et al., 2007). This prior research supports the current findings of set shifting or switching tasks being associated significantly with affective empathy performance. Further, this research also demonstrated that there were limited association between cognitive empathy theory of mind tasks and measures of executive functioning or judgment (Torralvia et al., 2007). These researchers posited that affective empathy and theory of mind and cognitive empathy were subsumed by distinct neurological regions. Further, they conclude that aspects of empathic decision making, specifically cognitive empathy or theory of mind performance is complex and not likely linked with one aspect of executive functioning or decision making based on the pattern of results that reflect association between set shifting or switching and measures of emotional empathy(Torralvia, et al., 2007). However the strength of this relationship when compared against measures of affective empathy has not been investigated at length nor has it been investigated within normal or non clinical populations.

Within the current investigation, a small but significant and unexpected association between various measures of affective, over cognitive, empathy has been demonstrated with executive functioning tasks of set switching. There has been limited direct research into this specific relationship between affective empathy and executive functioning. The majority of prior research detailing affective empathy appeared to occur when the initial aim of the study addressed other topic areas including cognitive empathy and theory of mind processing and executive functioning (e.g., Torralvia et al., 2007). A potential explanation for the stronger association between affective empathy and executive functioning may be related to the initial aim of the study, to evaluate empathy and executive functioning in the normal population. The overwhelming majority of the prior literature has investigated empathy and executive functioning within impaired or clinical populations, and impairments were frequently noted with

equal severity across both cognitive and affective measures of empathy (Samson et al., 2007; Torralvia et al., 2007; Schulte-Ruther et al., 2007; Schroeter et al., 2008; Grattan et al., 1994). It is possible that the current investigation has highlighted a difference that is only apparent in normally functioning populations. Considering the underlying nature of both cognitive and affective empathy, both processes are highly complex, however cognitive empathy appears to be highly reliant on many factors including memory, language, social norms and situational understanding, as well as perspective taking (Iacoboni&Dapretto, 2006; Ruby &Decety, 2004; Decety& Jackson, 2006; Eslinger, 1998). Whereas affective empathy appears to be reliant upon more singular aspects of emotional processing that are less reliant on other cognitive factors (Iacoboni&Dapretto, 2006; Ruby &Decety, 2004; Decety& Jackson, 2006; Eslinger, 1998).

Conversely, affective empathy appears to be a similarly complex but more singular process that is dependent on emotional information processing (Iacoboni&Dapretto, 2006; Ruby &Decety, 2004; Decety& Jackson, 2006; Eslinger, 1998). Given the multifaceted nature of cognitive empathy, it is possible that with a substantial number of factors and cognitive skill areas to utilize that mild deficits on one or a few of these domains can be ameliorated by compensatory actions of the remaining domains. As a result, the cognitive aspects of empathy are more resilient to changes in levels of functioning and less strongly associated with frontal functioning tasks like switching. Conversely, affective empathy that has fewer factors to rely on for compensatory actions is more susceptible to variations in levels of executive or neurological functioning.

This position may be supported by the limited literature evaluating the efficacy and potential utility of therapeutic and rehabilitative strategies addressing empathy abilities. These treatment methods are reliant upon re-developing empathy skills by retraining patients with

cognitive empathy strategies (Turner-Brown, Perry, Dichter, Bodfish, Penn, 2008; Golan &Baron-Cohen, 2006). The position that other cognitive functions and underlying neurological regions can accommodate and compensate for injured areas with limited functions supports the idea of cognitive empathy as multifaceted and more resilient to variations in functioning. Therapeutic interventions aimed at remediating deficits in empathy and interpersonal understanding within populations of individuals who are diagnosed with Asperger's disorder, or high functioning autism have attempted to utilize underlying cognitive skills to overcome some aspects of empathy functioning deficits (Turner-Brown, Perry, Dichter, Bodfish, Penn, 2008). Within the initial conceptualization, these interventions were based upon the assumption that individuals with autism spectrum disorders can have significant social and interpersonal deficits with intact or above average levels of intellectual functioning (Turner-Brown, et al., 2008). This intervention was designed to train social and interpersonal skills and to explicitly describe and train the top down processing procedures that take place within theory of mind and cognitive empathy processes (Turner-Brown, et al., 2008). Similarly, an intervention designed to tap deficits in emotion recognition or affective empathy utilizes and attempts to explicitly train individuals with higher functioning autism spectrum disorders to cognitively recognize and identify emotional states in others (Golan, Baron-Cohen, 2006). This affective empathy based intervention utilizes a similar Mind in the Eyes protocol as designed by (Baron-Cohen et al., 2001) and trains participants in recognizing and identifying emotional states based upon facial cues. The authors describe utilizing the participants' highly developed "systemizing" skills to develop their ability to recognize emotions in others, (Golan & Baron-Cohen, 2006). Within this, the researchers are attempting to utilize cognitive skills to compensate for limitations in affective empathy abilities. This limited sampling of treatment approaches for rehabilitating

empathy abilities lends further support to the idea that cognitive empathy is likely a multifaceted and multidimensional construct that as a result is more resilient to damage or impairments. As a result, cognitive empathy abilities can compensate for the less resilient and more unitary affective empathy abilities.

Influence of Demographic Factors

An evaluation of the impact of group membership, related to the demographic factors of gender, substance usage, as well a prior neuropsychological or psychiatric treatment on levels of empathy, neurological functioning, and social relationships was conducted. Statistical analyses evaluating these various domains demonstrated significant findings across groups based on gender, traumatic brain injury history, and reported alcohol usage.

Group membership based on gender presented a series of differences. Consistent with the literature, females demonstrated significantly higher scores on measures of affective empathy, cognitive empathy, and overall self reported empathy for both cognitive and affective empathy scales (Toussaint & Webb, 2005; Eisenberg & Lennon, 1983; Schulte-Ruther, Markowitsch, Shah, Fink, &Piefke, 2008) and support prior research detailing differential performance across gender for aspects of emotion recognition and expression. Further debate regarding potential societal or causative forces will be left for future theoretical debate that is not the current focus of this study. Schulte-Ruther and colleagues (2008) demonstrated that on a neurological basis, fundamental differences across gender exist. Utilizing neuro imaging techniques, researchers demonstrated differential and increased activity within the hMNS of females when viewing empathy and emotion inducing stimuli compared with males (Schulte-Ruther et al., 2008).

Self reported alcohol usage levels were not significantly associated with group differences across affective empathy scores. However a trend within the data indicated that participants who reported consuming a heavy amount of alcohol, more than 11 drinks per drinking week, demonstrated impairment in performance on measures of affective empathy and not on any other measure or domain. This trend may support that affective empathy abilities are unique in and they may potentially be more sensitive to changes in level of neuropsychological functioning.

Group differences across measures of empathy and executive functioning were not noted for individuals who reported experiencing a prior traumatic brain injury or concussion, or who endorsed significant post concussive type symptoms when compared against those who reported no prior TBI or symptoms. A potential factor accounting for this lack of group influence when the bulk of the literature supports the significant association between an experience of a brain injury and impaired functioning across measures of executive functioning and empathy, may be related to neuro-plasticity and injury recovery as well as restriction of range. Many individuals who experience a mild traumatic brain injury, such as a concussion, return to normal levels of premorbid functioning following their injury (Giza &Hovda, 2001). Moreover, individuals who have experienced a past TBI and who are currently functioning in a collegiate setting are likely representative of the majority of individuals who recover to normal and prior levels of neurological and cognitive functioning following the recovery period associated with their injury. Given that all participants were participating in collegiate level courses, it not surprising that any potential influence that a past TBI would present was minimal. Further, sample composition of individuals who had previously experienced a traumatic brain injury at any point in their life was 38% of the entire sample. While not an exceptionally small sampling, a larger

sample with a more current and comprehensive injury history may demonstrate a different pattern of results.

Internal Consistency of Measures

The clinical measures utilized within this study demonstrated consistent interrelations across underlying domains or factors. With respect to measures of empathy, subscales of the Interpersonal Reactivity Index demonstrated significant inter-correlations. Further, reliability data obtained within this study is generally consistent, but slightly lower than those produced in normative and standardization studies supporting the validity of the scores on these measures (Davis, 1980; Cliffordson, 2001). The accepted standard for reliability is generally at .7, (Fields, 2005) the reliability scores for this measure which fall at .66 are consistent with, but slightly lower than this standard. Overall, the reliability data produced by this study evaluating the self-report IRI are generally consistent but slightly lower than expected from normative studies and established standards, therefore the data obtained from this measure should be considered reasonably valid, yet be viewed with a slight degree of caution. With respect to internal consistency of the subscales, there was not a significant degree of overcorrelation among the subscales indicating that the individual scales were indeed assessing related, yet fundamentally different aspects of empathy.

Empathy Measures

Further, the performance based measure of cognitive empathy, the Strange Stories Task Variant, was significantly correlated with both an affective and cognitive subscales on the IRI. However, the performance based affective measure, the Theory of Mind in the Eyes test was not significantly correlated with any IRI subscales, however it did correlate significantly with the performance based cognitive empathy task. These puzzling results may reflect that these

measures, while assessing a consistent underlying core construct are evaluating significantly different aspects or facets of that construct, however limited research has been conducted to address this. Further, the self report measure of empathy requires more sophisticated levels of self reflection as well as language based cognitive processing to effectively complete (Davis, 1981; Cliffordson, 2001). Additionally, the SSTV task also requires that the participant utilize self reflection as well as language based cognitive processing (Happe, 1994). Conversely, the affective empathy TOM Eyes test requires limited language processing and utilizes more non verbal emotion processing when identifying emotion states (Baron-Cohen, 2001). Within this framework, the correlations between subscales on the IRI and the SSTV task may reflect higher order and self reflective cognitive and language based processing, whereas the TOM Eyes taps more bottom up or visceral emotion based processing. A study by Milders and colleagues posits a similar higher order cognitive and language based system at work within a cognitive perspective taking empathy task (Milders, Ietswaart, Crawford, Currie, 2006). Overall, the IRI is a self report measure that may be dependent on aspects of internal perspective and communicative language (Davis, 1980). These components may also be associated with factors influencing performance on the SSTV task, but not the TOM Eyes performance, and as a result a significant statistical relationship is noted. Further, the TOM Eyes task is a predominantly non-verbal, visually-based measure that taps areas of functioning that are significantly different from the language based IRI and SSTV. However, while the TOM Eyes measure is predominantly nonverbal, it still requires an aspect of verbal skill and a well developed vocabulary. Given this, level of cognitive functioning with respect to the ability to effectively define the target emotion words and subsequently apply them to the correct target image may have influenced overall

performance on the measure. Within this, scores on the TOM eyes measure may have been influenced by level of cognitive functioning or verbal ability.

Executive Functioning Measures

Measures of executive functioning displayed significant associations that reflect the trends established in the significant body of literature (Lezak, Howeison, &Loring; 2004). An interesting result with respect to the consistency of the executive functioning measures was the correlation between figural fluency scores and Trails A performance, but not between figural fluency and Trails B performance. This most likely indicates that within this sample figural fluency scores are evaluating overall effort, rather than pure frontal lobe functioning. Given that TMT A is a simple graphomotor task of scanning and sequencing and requires less executive functioning than TMTB that includes a switching and working memory component to the task, TMT A and Fig fluency scores are likely an indicator of effort and motivation and less of a frontal measure (Lezak, Howeison, &Loring; 2004).

Limitations

Overall, the results of this study demonstrate a small but significant association between affective empathy and executive functioning. Specifically, performance on the TOM eyes test and switching abilities demonstrated by performance on the Trail Making Test part B were significantly correlated. The cognitive measures of empathy were not significantly associated with the frontal lobe measures. These findings are in contrast to the bulk of the literature that describes relationship between frontal measures and cognitive empathy or theory of mind abilities in impaired or clinical populations. Despite a significant pattern of results implicating the association between affective empathy and executive functioning, it is important to remember that the correlational values, while statistically significant, are quite small. While the

small correlation may indeed reflect the degree of association between performance on the two measures, however it may also be the result of normal variation or error within the sample or due to the limited range of functioning variability within a collegiate sample. To address this potential issue, future analysis with a wider range of the population is warranted.

While these results present a position that has some underlying theoretical support in the applied literature (Turner-Brown, Perry, Dichter, Bodfish, Penn, 2008; Golan & Baron-Cohen, 2006; Iacoboni & Dapretto, 2006; Ruby &Decety, 2004; Decety& Jackson, 2006; Eslinger, 1998) related to differential resiliency or resistance to fluctuation in level of neurological functioning within the different types of empathy. However, it is possible that limitations in the design have influenced these findings. Specifically, these results may be limited by the sensitivity of the measures to objectively measure empathy; the current measures may be unable to delineate subtle variations within the level of empathy functioning in normal populations. A potential limitation with respect to cognitive empathy may have been associated with the measurement of the construct. The Davis IRI (1980) is a measure that, while designed to measure both cognitive and affective empathy, specifically addresses self-report, or self-perception, of empathy. Factors associated with self and social desirability tendencies may have influenced participants to respond as they would like to see themselves rather than their actual tendencies. Moreover, overall participant effort may present a significant factor in the current results. The performance based SSTV utilized a free response format. Often brief or vague participant responses were scored as incorrect for items based on the rater's inability to clearly determine if the participant was able to accurately understand the various interpersonal or theory of mind based issues within the vignettes. As a result, participants may have performed poorly based on effort, the brevity of their answers, or a genuine difficulty with the task. The variability

associated with measurement error may be masking any true associations between cognitive empathy and other measures. Further, the affective empathy measure required less direct effort associated with formulating and articulating a written response and instead utilized a multiple choice format. The significant associations between executive functioning and affective empathy and not between cognitive empathy and executive functioning may be a reflection of differential styles in evaluation. However, it is important to consider that the self report measure of empathy, the IRI, which required consistent levels of effort across both the cognitive and affective empathy scales demonstrated a significant correlation between levels of affective empathy and executive functioning, or task switching, behaviors and not between cognitive empathy scales and switching. This lends some increased support to the aforementioned position of affective empathy levels being more strongly associated with variations in executive functioning. The TOM Eyes measure, while predominantly a visual and non-verbal task may inadvertently be confounded by vocabulary ability and subsequently level of intellectual functioning. Some target emotion words were at a more linguistically sophisticated level that may have skewed participant performance based on verbal intelligence and not empathy ability.

With respect to cognitive abilities, the variation in participant cognitive abilities may play a role in differentially influencing the scores on the measures. It was expected that the study's participants were able to function and meet the requirements of a collegiate setting. However above this base level criterion it is difficult to comprehensively evaluate level of cognitive functioning utilizing a brief research protocol. A possible means of evaluating level of cognitive functioning would have been to utilize reported grade point average; however; given the various potential confounding factors including strength of course load as well as effort and motivation influencing academic performance and not accurately representing underlying cognitive ability,

student grade point average would not have provided useful information on that domain. Therefore, in future research attempting to control for differential cognitive or intellectual functioning, more formal measurement of intellectual functioning may be necessary.

In addition to the aforementioned limitations with respect to measurement, there are some aspects of the current design that reduce the generalize-ability of these results to the overarching population. Given that the sample was restricted, by design, to college students to investigate functioning in individuals who are members of a non clinical or non neurologically impaired population, these current results are limited by this sample composition. While the design benefited from a restricted range, the confounding factor that all participants were comprised of a subset of the normal population that represents more highly functioning college students presents a limitation with respect to range of normal cognitive ability. Specifically, individuals who attend college are selected specifically into that sub population based on cognitive and academic abilities. Further, participating college students were functioning at a level that allowed them to attend classes and complete required research participation, as well as to respond to communication and to make and keep scheduled appointments. With respect to the restriction of range, it is clear that college students vary with degrees of academic success which may reflect varying levels of cognitive functioning. Further, given that the sample was comprised of students within introductory psychology classes whom are typically first year students, the individuals who may be functioning at below-average levels may not yet have been removed or withdrawn from courses due to issues associated with lower levels of functioning. Therefore, this sample may reflect a wider range of cognitive functioning than expected. However, variation in cognitive ability of participants is likely restricted at some level by entrance criteria for college admission where lower levels of normative cognitive functioning are

not typically represented by individuals who are admitted to, attend, and successfully participate in collegiate academics.

There were expected design limitations with respect to sampling for evaluating demographic or situational factors that were addressed in the tertiary hypotheses. As a result, the small and unequal sample sizes for various groups including alcohol use tendencies as well as prior TBI history reduces the ability of this study to fully investigate those factors. With respect to alcohol use, at the more extreme usage levels, for example drinking large quantities of alcohol, group N's were markedly unequal and small. Given that these factors were included as tertiary analyses dependent upon random sample composition, it was difficult to effectively and reliably analyze data trends due to the resultant unequal and small group sizes. Therefore, to effectively address limitation presented by sampling within this current evaluation, pre-screening participants and selecting individuals to adequately fill a predetermined group number would provide better quality data regarding these demographic factors, empathy and frontal functioning.

Future Directions

Any of the findings associated with tertiary hypotheses and analyses regarding the various domains including gender, TBI history, substance use, or alcohol usage would present an interesting avenue for further primary research. For a possibility, investigating the role of empathy, substance usage, and executive functioning within college populations may provide interesting insight into behaviors that may be associated with risk as well as social interactions. The insight into these factors influencing problem behaviors like drug use, or strengths like pro social interactions could serve to identify sources of resiliency or need and provide a direction to focus college-based interventions.

Further replication of these study results are necessary to lend support to the finding regarding the association between affective empathy and executive functioning or perspective switching, as well as the apparent sensitivity of affective empathy abilities to fluctuations in levels of neurocognitive functioning. Research investigating this relationship further may benefit from utilizing populations of individuals who are experiencing changing levels of neurocognitive functioning, but whom have typically experienced and are expected to return to normal levels of functioning due to a mild traumatic brain injury or a concussion. Post-concussive symptoms experienced by those who have suffered a mild traumatic brain injury or a concussion present with a sequelae of symptoms that are associated with cognitive, emotional, and physical symptoms (Aubry, Cantu, Dvorak, Graf-Baumann, Johnston, Kelly, Lovell, McCrory, Meeuwisse, Schamasch, 2002;McCrory, Johnston, Meeuwisse, Aubry, Cantu, Dvorak, Graf-Baumann, Kelly, Lovell, Schamasch, 2005; McCrory, Meeuwisse, Johnston, Dvorak, Aubry, Molloy, Cantu, 2009; Giza &Hovda, 2001).

Individuals who experience a mild TBI, such as those who have suffered a sport related concussion, typically experience mild deficits in neurocognitive functioning across domains of verbal and visual memory as well as reaction time and processing speed directly following their injury (McCrory et al., 2005; 2009; Giza &Hovda, 2001; Aubry et al., 2002). Further, these individuals tend to progress through improvement and recovery within a relatively brief span of time and typically return to normative levels of cognitive functioning (McCrory et al., 2005; 2009; Giza &Hovda, 2001; Aubry et al., 2002) within several weeks. Evaluating empathy abilities across the recovery time span and correlating these scores with the changing levels of cognitive functioning may provide further insight and understanding into the neurocognitive nature of empathy abilities in typically functioning individuals.

Further research into this domain may be aided by a more standardized administration and scoring process for the Strange Stories Task Variant, or similar cognitive empathy or theory of mind measure. Within the current design, responses were provided freely by participants in written form in a setting with limited direct monitoring. Further, some participant responses tended to be vague or brief and it was unclear if the responses demonstrated appropriate interpersonal understanding or were incorrect due to fundamental misunderstanding or misperception. Incorporating a standardized multiple choice or selection based response option, or implementing a standardized administration protocol that utilizes prompts or queries to clarify participant responses will increase the specificity and potential utility of this measure in delineating more specific gradations in cognitive empathy functioning. Further, considering multiple assessments of functioning across time would require several parallel forms of the various empathy measures to address potential practice effects. Moreover, in addition to including more formal measures of executive functioning and switching, utilizing ecological or situational measures that evaluate interpersonal behavior and set switching abilities within a more naturalistic setting may provide insight into the constructs beyond those found with formal measures of EF. These behavioral, or performance based, measures administered within a more naturalistic paradigm would eliminate some aspects of measurement bias or participant difficulty with test completion or responding.

Overall, further inquiry into the primary hypotheses presented within this study within populations who are experiencing mild and transient levels of cognitive impairment, using more standardized measures of empathy and EF, or measures that are more ecologically appropriate within a wider range of the population will be useful and beneficial further research.

This research extends the scope of understanding found in prior studies that have evaluated empathy and executive functioning in neurologically impaired or psychiatrically ill populations. By investigating empathy and executive function in normal populations, this research provides insight into the differing aspects of empathy. Moreover it initiates a greater level of understanding regarding the differing neuropsychological correlates associated with empathy. Overall, these initial insights within normative populations may be able to provide a solid foundation and starting point for future lines of inquiry into empathy and executive functioning within the normal population.

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Appendix A: **Informed Consent Form**

Indiana University of Pennsylvania
Department of Psychology

You are invited to participate in this research study. The following information is provided to help you make an informed decision whether or not to participate. If you have any questions, please do not hesitate to ask. You are eligible to participate because you are a student in the General Psychology course at Indiana University of Pennsylvania.

The purpose of this survey is to evaluate the relationship between individual tendencies towards empathy, specifically cognitive and affective aspects, and frontal lobe neurological functioning as measured through non invasive, individually administered, brief, pencil and paper tasks.

Your participation in this study is voluntary. You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with the research investigators at IUP. Your decision will not result in any loss of benefits to which you are otherwise entitled. If you choose to participate, you may withdraw at any time by notifying the researcher or informing the person administering the survey. Upon your request to withdraw, all information pertaining to you will be destroyed. If you choose to participate, all information will be held in strict confidence and will have no bearing on your academic standing or services you receive from the University. The survey is anonymous and will not be used to identify individuals in need of psychological treatment. The information you provide us will be considered only in combination with that of other participants. The information obtained in the study may be published in scientific journals or presented at scientific meetings but your identity will be kept confidential.

If you are willing to participate in this study, please sign the statement below and return it to the person administering the survey. When you complete the survey, you will be given an information sheet that will provide contact information if you wish to receive results of the study, and with referral sources if you would like to receive counseling regarding any issues that may arise from participating in this study.

_____ _____

Participant Name Date

_____

Participant Signature

Student Researcher:
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This project has been approved by the Indiana University of Pennsylvania Institutional Review Board for the Protection of Human Subjects (Phone: 724/357-7730)

Appendix B: Debriefing

Indiana University of Pennsylvania
Department of Psychology

The following information is provided to you so that you will know the purpose of the research study, to identify areas of potential concern you may have about yourself, and to provide a list of counseling referrals if you find you would like to talk with someone further about your experience here today. You have just completed a packet of questionnaires designed to gather information about your tendencies towards empathy and your social relationships. Additionally you also completed neuropsychological measures that evaluated frontal lobe or executive functioning. It is hypothesized that increased tendencies towards empathy, and increased frontal lobe functioning are associated with improved and more adaptive social relationships.

Empathy. You completed a commonly used measure of trait empathy that assessed four different domains of empathy. Additionally, read and answered questions based on several vignettes designed to evaluate the cognitive aspects of empathy.

Frontal Lobe Executive Functioning. You completed a widely-used measure of executive functioning that assesses performance on tasks related to frontal lobe functioning.

Many times in life people experience some amount of disappointment or concern with their behavior. You may be wondering if you have a problem or problems with any of the domains of life that were examined today. There is no easy way to determine that – it depends on whether you think it's a problem and if other people, such as family and friends, have told you they see a problem. If you would like to discuss your concerns with a professional, we have provided the following list of counseling service agencies. Feel free to contact them if you would like. You are under no obligation to do so. If you choose to contact any of the agencies, you are responsible for initiating appointments, and for paying any fees associated with services. The IUP Student Counseling Center is free to students.

IUP Student Counseling Center: Suites on Maple East, G31, 901 Maple Street
Indiana, PA15705
Phone: 724-357-2621

Center For Applied Psychology: 210 Uhler Hall, IUP, Indiana, PA15705
Phone: (724) 357-6228

Indiana County Guidance Center: 699 Philadelphia St, Indiana Pa 465-5576

The research project is sponsored by the Indiana University of Pennsylvania Department of Psychology. The primary investigator is Alicia Puskar, M.A. and the faculty sponsor is William Meil, Ph.D. If you would like to receive the results of this research when it is completed, please give your name and contact information to Alicia Puskar, or email her at sfhp@iup.edu.

Appendix C: Measures

Demographics: Gender_____ Age_____ Ethnicity (Circle): African American; Caucasian; Asian/Pacific Islander; Latino/South American; Other _____

Medical and Psychosocial History

Have you ever been diagnosed with the following? (Y/N)

Attention deficit hyperactivity disorder ____ Autism spectrum disorder _____
Pervasive developmental disorder ____ Learning disability _____
Oppositional Defiant Disorder ____ Impulse Control Disorder _____

Do you experience any of the following (Y/N)

Depression _____ Anxiety _____ Panic Attacks _____
Excessive Worry _____ Excessive Stress _____ Sleep Problems _____

Do you currently use alcohol? (Y/N) _____

If yes, what is the most you drink on a given occasion (Circle one)

0-2 drinks, 3-5 drinks, 6-10 drinks, 11-15 drinks, 16-20 drinks, 20 or more.

On average how often do you drink per week _____

What is the most you drink per month (circle one)

0-5 drinks, 6-10 drinks, 11-15 drinks, 16-20 drinks, 20 or more.

Have you ever used any of the drugs listed below? Please check as many as you have used in your lifetime, within the last year, within the last month, or use daily. Please put a "P" in the box if the drug is/was prescribed for you.

Drug Usage	Lifetime	Last Year	Last Month	Daily Use
Marijuana or Hash				
Crack cocaine				
Powder cocaine				
Methamphetamine (crank)				
Amphetamines (speed)				
Tranquilizers (i.e., valium, xanax)				
Heroin				
Oxycontin				
Other pain pills (i.e., percodan)				
LSD				
Other hallucinogens (i.e., shrooms)				
Ecstasy (MDMA)				
Ritalin/Adderall				
Anabolic steroids				
Cigars				
Chewing tobacco				
Cigarettes				

Have you ever experienced a concussion or a traumatic brain injury (Y/N) _____

Have you ever been in a serious car accident? (Y/N) _____

Have you ever suffered a injury after which you experienced headaches, dizziness, and/or blurry vision (Y/N)

If yes to any… did you have any of the following (check those that apply)?
Loss of consciousness _____ Memory loss ____ Recurrent headaches _____Sleep problems _____

Any additional problems related to the injury (please describe briefly)?
_____
_____

INTERPERSONAL REACTIVITY INDEX (IRI) (Davis, 1981)

The following statements ask about your thoughts and feelings in a variety of situations. For each item, show how well it describes you by choosing the appropriate number on the scale at the top of the page: **READ EACH ITEM CAREFULLY BEFORE RESPONDING.** Answer as honestly as you can.

ANSWER SCALE:

1	2	3	4	5
DOES NOT DESCRIBE ME WELL				**DESCRIBES ME VERY WELL**

__ 1. I daydream and fantasize, with some regularity, about things that might happen to me.
__ 2. I often have tender, concerned feelings for people less fortunate than me.
__ 3. I sometimes find it difficult to see things from the "other guy's" point of view.
__ 4. Sometimes I don't feel very sorry for other people when they are having problems.
__ 5. I really get involved with the feelings of the characters in a novel.
__ 6. In emergency situations, I feel apprehensive and ill-at-ease.
__ 7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it.
__ 8. I try to look at everybody's side of a disagreement before I make a decision.
__ 9. When I see someone being taken advantage of, I feel kind of protective towards them.
__ 10. I sometimes feel helpless when I am in the middle of a very emotional situation.
__ 11. I sometimes try to understand my friends better by imagining how things look from their perspective.
__ 12. Becoming extremely involved in a good book or movie is somewhat rare for me.
__ 13. When I see someone get hurt, I tend to remain calm.
__ 14. Other people's misfortunes do not usually disturb me a great deal.
__ 15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.
__ 16. After seeing a play or movie, I have felt as though I were one of the characters.
__ 17. Being in a tense emotional situation scares me.
__ 18. When I see someone being treated unfairly, I sometimes don't feel very much pity for them.
__ 19. I am usually pretty effective in dealing with emergencies.
__ 20. I am often quite touched by things I see happen.
__ 21. I believe that there are two sides to every question and try to look at them both.
__ 22. I would describe myself as a pretty soft-hearted person.
__ 23. When I watch a good movie, I can very easily put myself in the place of a leading character.
__ 24. I tend to lose control during emergencies.
__ 25. When I'm upset at someone, I usually try to "put myself in his shoes" for a while.
__ 26. When I'm reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me.
__ 27. When I see someone who badly needs help in an emergency, I go to pieces.
__ 28. Before criticizing somebody, I try to imagine how I would feel if I were in their place

Happe' (1994) Strange Stories Task Variant
Please read these vignettes and answer the questions following each. Please be sure to briefly explain the reasoning behind your answers.

1. Katie and Emma are playing in the house. Emma picks up a banana from the fruit bowl and holds it to her ear. She says to Katie, "look, this banana is a telephone"

    A. Is it true what Emma says?
    B. Why does Emma say this?

2. Today James is going to Claire's house for the first time. He is going over for tea, and he is looking forward to seeing Claire's dog, which she talks about all the time. James likes dogs very much. When James arrives at Claire's house Claire runs to open the door, and her dog jumps up to greet James. Claire's dog is huge, it's almost as big as James! When James sees Claire's huge dog he says, "Claire, you haven't got a dog at all. You've got an elephant!"

    A. Is it true, what James says?
    B. Why does James say this?

3. One day, while she is playing in the house, Anna accidentally knocks over and breaks her mother's favorite crystal vase. Oh dear, when mother finds out she will be very cross! So when Anna's mother comes home and sees the broken vase and asks Anna what happened, Anna says, "The dog knocked it over, it wasn't my fault!"

    A. Was it true, what Anna told her mother?
    B. Why did she say this?

4. Helen waited all year for Christmas, because she knew at Christmas she could ask her parents for a rabbit. Helen wanted a rabbit more than anything in the world. At last Christmas Day arrived, and Helen ran to unwrap the big box her parents had given her. She felt sure it would contain a little rabbit in a cage. But when she opened it, with all the family standing round, she found her present was just a boring old set of encyclopedias, which Helen did not want at all! Still, when Helen's parents asked her how she liked her Christmas present, she said, "It's lovely, thank you. It's just what I wanted."

    A. Is it true, what Helen said?
    B. Why did she say that to her parents?

5. Emma has a cough. All through lunch she coughs and coughs and coughs. Father says, "Poor Emma, you must have a frog in your throat!"

    A. Is it true, what Father says to Emma?
    B. Why does he say that?

6. During the war, the Red army captured a member of the Blue army. They want him to tell them where his army's tanks are; they know they are either by the sea or in the mountains. They know that the prisoner will not want to tell them, he will want to save his army, and so he will certainly tie to them. The prisoner is very brave and very clever, he will not let them find his tanks. The tanks are really in the mountains. Now when the other side asks him where his tanks are, he says, "They are in the mountains."

    A. Is it true what the prisoner said?
    B. Where will the other army look for his tanks?
    C. Why did the prisoner say what he said?

7. Ann's mother has spent a long time cooking Ann's favorite meal; fish and chips. But when she brings it in to Ann, she is watching TV, and she doesn't even look up, or say thank you. Ann's mother is cross and says, "Well that's very nice, isn't it! That's what I call politeness!"

    A. Is it true, what Ann's mother says?
    B. Why does Ann's mother say this?

8. Jill wanted to buy a kitten, so she went to see Mrs. Smith, who had lots of kittens she didn't want. Now Mrs. Smith loved the kittens, and she wouldn't do anything to harm them, though she couldn't keep them all herself. When Jane visited she wasn't sure she wanted one of Mrs. Smith's kittens, since they were all males and she had wanted a female. But Mrs. Smith said, "If no one buys the kittens I'll just have to drown them!"

    A. Was it true, what Mrs. Smith said?
    B. Why did Mrs. Smith say this to Jane?

9. Jeanette bought her friend Anne a crystal bowl for a wedding gift. Anne had a big wedding and there were a lot of presents to keep track of. About a year later, Jeanette was over one night at Anne's for dinner. Jeanette dropped a wine bottle by accident on the crystal bowl, and the bowl shattered. "I'm really sorry, I've broken the bowl," said Jeanette. "Don't worry, " said Anne, "I never liked it anyway. Someone gave it to me for my wedding."

    A. Did someone say something they shouldn't have said?
    B. Who said something they shouldn't have said?
    C. Why shouldn't they have said it?

10. Helen's husband was throwing a surprise party for her birthday. He invited Sarah, a friend of Helen's, and said, "Don't tell anyone, especially Helen." The day before the party, Helen was over at Sarah's, and Sarah spilled some coffee on a new dress that was hanging over her chair. "Oh!" said Sarah, "I was going to wear this to your party!" "What party?" said Helen. "Come on," said Sarah, "Let's go see if we can get the stain out."

    A. Did someone say something they shouldn't have said?
    B. Who said something they shouldn't have said?

C. Why shouldn’t they have said it?

11. Simon is a big liar. Simon's brother Jim knows this, he knowsthat Simon never tells the truth! Now yesterday Simon stoleJim's ping-pong bat, and Jim knows Simon has hidden it somewhere,though he can't find it. He's very cross. So he finds Simonand he says `Where is my ping-pong bat? You must have hiddenit either in the cupboard or under your bed, because I've lookedeverywhere else. Where is it, in the cupboard or under yourbed?' Simon tells him the bat is under the bed.

    - Was it true, what Simon told Jim?'
    - `Where will Jim look for his ping-pong bat?'
    - `Why will Jim look there for his bat?'

12. Sally is in the garden. She is sowing seeds, so that next year she will have lots of vegetables in her garden. She sows seeds for carrots, lettuces and peas. She sows the seeds well, but when she goes inside after sowing them, the birds fly down and eat up all Sally's seeds! Poor Sally, not one of her seeds is left!

    A. Is it true that Sally sowed seeds for turnips and radishes?
    B. Why will Sally not have any vegetables in her garden?

13. Betty has been making arrangements for her wedding. She is very happy about the sculpture she has organized for the head table at the reception-a big glittering swan carved out of ice. On the morning of the wedding the weather looks perfect. But as the day continues it gets hotter and hotter and people in the church looks sweaty and uncomfortable. Just before the ceremony the reception center calls Betty to warn her that the air-conditioning unit has broken down but they are installing fans to cool off her guests when they arrive. The ceremony goes smoothly and everyone drives to the reception in good spirits. When they arrive, the room looks beautiful and everyone praises Betty’s taste. But when she goes to sit down at the head table, the table-cloth is soaking and the napkins are soggy. There is a big puddle on the tile floor.

    A. Why is there so much water on the head table?
    B. What effect would the broken air-conditioner have had?

Baron-Cohen Reading the Mind in the Eyes Test (2001) SAMPLE ITEMS

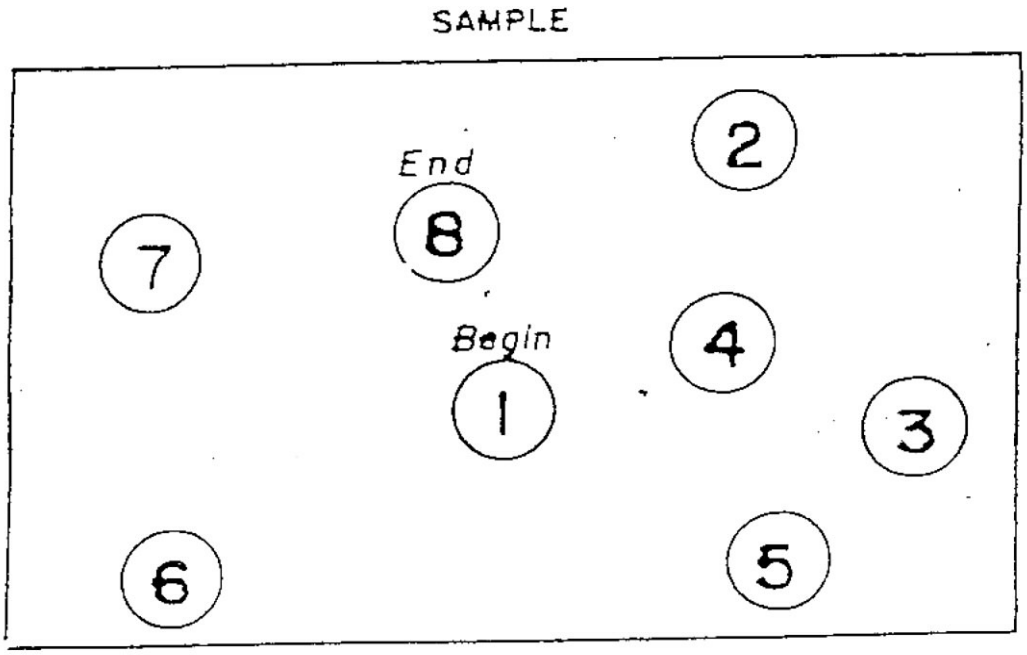
For each pair of eyes, choose which word best describes what the person in the picture is thinking or feeling.
Most people surprise themselves by how well they do in this test. Even if you think you don't have a clue, just choose the one that 'feels' right.

1		○ playful	○ comforting	○ irritated	○ bored
2		○ terrified	○ upset	○ arrogant	○ annoyed
3		○ joking	○ flustered	○ desire	○ convinced
4		○ joking	○ insisting	○ amused	○ relaxed
5		○ irritated	○ sarcastic	○ worried	○ friendly
6		○ aghast	○ fantasizing	○ impatient	○ alarmed

EYES Answer Blank Please mark the word that corresponds with your answer for each question.

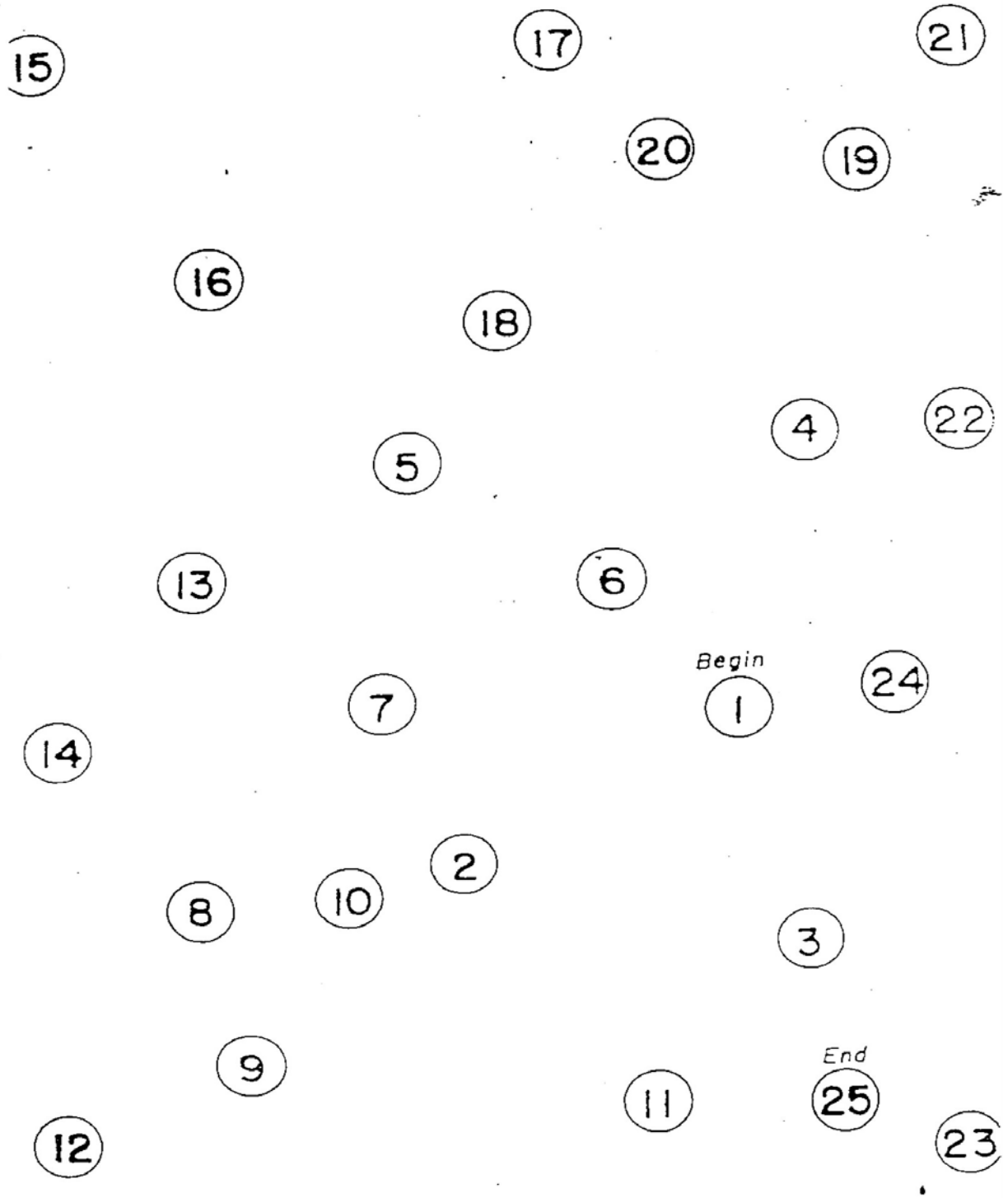
1.	playful	comforting	irritated	bored
2.	terrified	upset	arrogant	annoyed
3.	joking	flustered	desire	convinced
4.	joking	insisting	amused	relaxed
5.	irritated	sarcastic	worried	friendly
6.	aghast	fantasizing	impatient	alarmed
7.	apologetic	friendly	uneasy	dispirited
8.	despondent	relieved	shy	excited
9.	annoyed	hostile	horrified	preoccupied
10.	cautious	insisting	bored	aghast
11.	terrified	amused	regretful	flirtatious
12.	indifferent	embarrassed	sceptical	dispirited
13.	decisive	anticipating	threatening	shy
14.	irritated	disappointed	depressed	accusing
15.	contemplative	flustered	encouraging	amused
16.	irritated	thoughtful	encouraging	sympathetic
17.	doubtful	affectionate	playful	aghast
18.	decisive	amused	aghast	bored
19.	arrogant	grateful	sarcastic	tentative
20.	dominant	friendly	guilty	horrified
21.	embarrassed	fantasizing	confused	panicked
22.	preoccupied	grateful	insisting	imploring
23.	contented	apologetic	defiant	curious
24.	pensive	irritated	excited	hostile
25.	panicked	incredulous	despondent	interested
26.	alarmed	shy	hostile	anxious
27.	joking	cautious	arrogant	reassuring
28.	interested	joking	affectionate	contented
29.	impatient	aghast	irritated	reflective
30.	grateful	flirtatious	hostile	disappointed
31.	ashamed	confident	joking	dispirited
32.	serious	ashamed	bewildered	Alarmed
33.	embarrassed	guilty	fantasizing	concerned
34.	aghast	baffled	distrustful	terrified
35.	puzzled	nervous	insisting	contemplative
36.	ashamed	nervous	suspicious	indecisive

Trail Making Test Parts A & B
INSTRUCTIONS
(show participant the stimulus page, practice side)
TMT part A

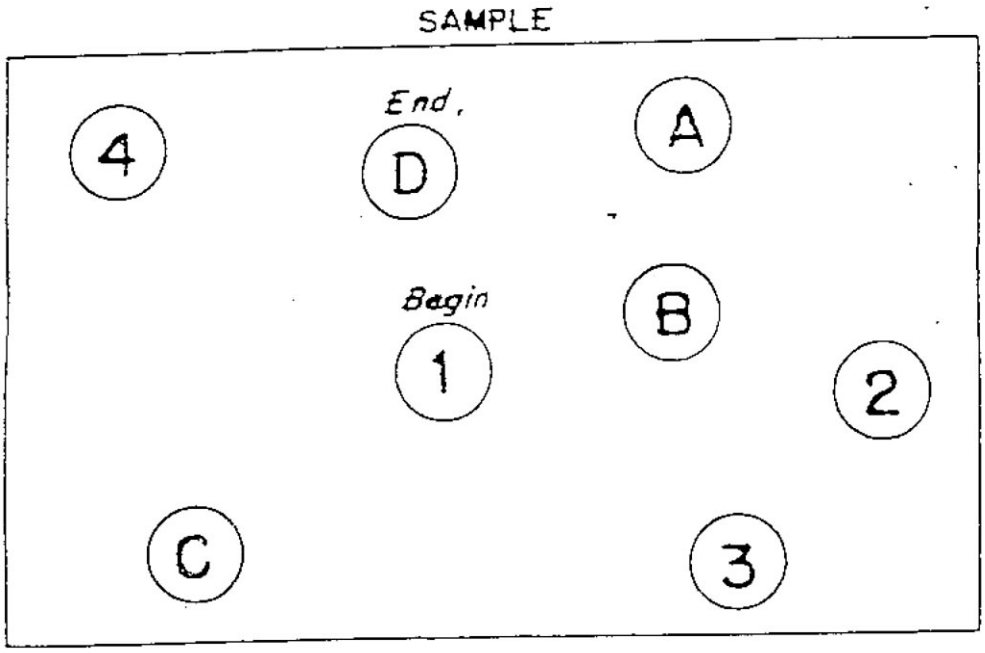


On this page are some numbers . Begin with number 1 and draw a line from 1 to 2, 2 to 3, 3 to 4, and so on. Draw the lines as fast as you can, ready, begin. (turn the page) Now do these in the same way you did the last set, ready, begin. (record completion time)

Trail Making Test Part A

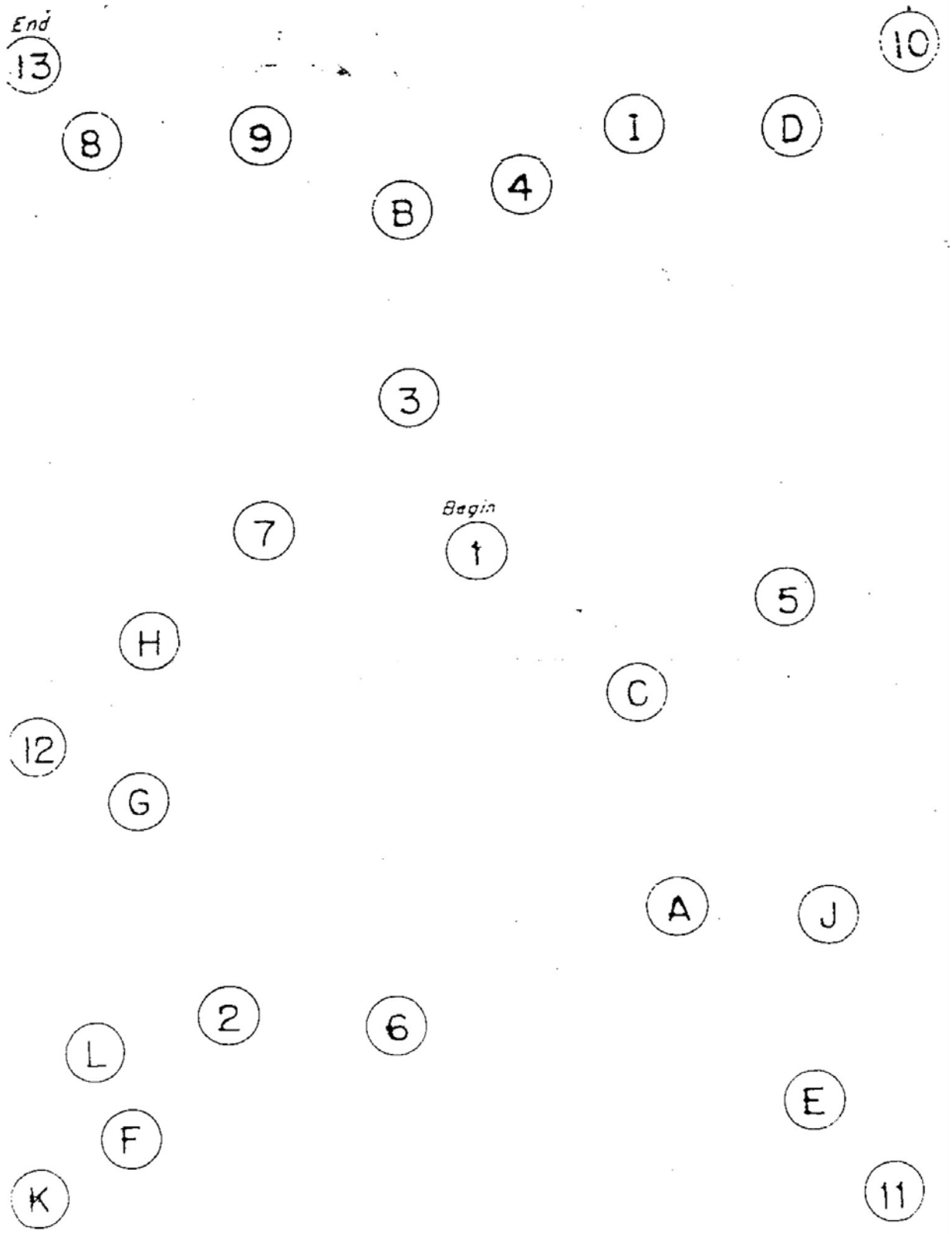


Trails B (Show participant the stimulus page, practice side)



On this page are some numbers and letters. Begin at number 1 and draw a line from 1 to A, A to 2, 2 to B, B to 3, 3 to C, and so on, in order, until you reach the end. Remember first you have a number, then a letter, then a number, then a letter, and so on. Draw the lines as fast as you can. Ready, Begin. (turn the page) Now do these in the same way you did the last set, ready, begin. (record completion time)

Trail Making Test Part B



Verbal Fluency

I will say a letter and you are to tell me all the different words that you can think of that begin with that letter. Leave out proper names like Bob or Barbara, names of places like Boston or Baltimore, and numbers like two and twenty two. They must be different words, not the same word with different endings. Do you understand? For example if I said the letter "T" what words could you think of that begin with the letter "T"? (get a few examples) Ok, Great. Are you ready, Tell me what words begin with _____ . Go ahead. I will tell you when to stop. (60 seconds/letter)

	F	**A**	**S**
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			

DESIGN FLUENCY Materials (Blank paper, pencil, stopwatch)
INSTRUCTIONS:
You are to make up as many different drawing as you can in 5 minutes. Don't draw any pictures of actual objects, a boat, for example, or any pattern that can be named such as a square. Also, scribbling doesn't count because scribbles look too much alike.
Here are some examples: (demonstrate examples of two legal drawings and two not allowed drawings)
Now make as many different drawings as you can. You have five minutes.