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Theory of Mind and Visual Spatial Memory

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Theory of Mind and Visual Spatial Memory

Richard Francis Gallini

University of Connecticut (2014)

Theory of mind (TOM) is the ability to understand the thoughts, feelings and intentions of others. While research has established a link between TOM and language skills, the link between TOM and visual-spatial memory (VSM) has not been explored. Given the importance of TOM as a construct, this study explored the link between these two constructs in a public school setting. Despite a relatively small n (41), a marginal link was found between TOM and VSM. Implications and limitations of this research are discussed.

Richard Francis Gallini – University of Connecticut (2014)
Theory of Mind and Visual Spatial Memory

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Introduction

Theory of Mind (TOM) represents a complex construct for understanding social thinking processes. A widely researched construct (Lecce, Caputi, & Hughes, 2011), TOM research ranges from its development in childhood (Baron-Cohen, Leslie & Frith, 1985, Muller, Zelazo, Imrisek, 2005) to its decline in disease and old age (Kemp, Despres, Sellal & Dufour, 2012). Most often studied in children with autism (Walker & Shore, 2011), increasingly TOM impairment is being considered in a number of additional populations, (Converse, Lin, Keysar, & Epley, 2008; Porter, Coltheart, & Langdon, 2008; Turkstra, 2008; Russell, Schmidt, Doherty, Young, & Tchanturia 2009; Kim, Kwon, & Chang, 2011; Shahaeian, Peterson, Slaughter & Wellman, 2011; Kemp, Despres, Sellal, Dufour, 2012) such as those with depression, eating disorders and neurocognitive problems. Interestingly, with regard to children, TOM impairment has not been considered in children without special needs nor has it been considered in the context of visual spatial skills.

Children with Non-Verbal Learning Disabilities (NVLD) provide an example of individuals with intact language functioning, and deficits in the skills associated with TOM and deficits in visual-spatial skills (Rourke, 1995). Children with Autism, another population with impaired TOM skills (Walker & Shore, 2011), provide another example with deficits in visual scanning (Pelphrey, Sasson, Reznick, Paul, Goldman & Piven, 2002) and memory (Southwick, Bigler, Froehlich, DuBray, Alexander, Lange & Lainhart, 2011). Despite evidence indicating that TOM skills may not be linked to language (Premack & Woodruff, 1978; Swettenham, Baron-Cohen, Gomez, & Walsh, 1996; Farrar & Ashwell, 2012), there has been no consideration of a link between this construct and that of visual-spatial memory. Visual-spatial memory has simply not been considered. In this research study, TOM skills were considered as they are related to
visual-spatial memory (VSM) in an inclusion modeled (students with vs. students without known special needs are in the same classroom) public school population. With that purpose in mind, a general guide through the literature on TOM is presented, long with an examination of the methods used to assess TOM, a consideration of VSM, and its assessment using the Rey Complex Figure (RCF) and an argument is provided for a link between TOM and VSM. Finally, a rationale is provided for considering linkage between TOM and visual spatial skills as a reason for examining this construct in this context.

The scope of this research study is two-fold: to examine the presence of a link between visual-spatial memory and theory of mind and to examine this construct within a regular public school population of learners. In doing so, this research study seeks to determine if there is a significant link between TOM and VSM and if that link exists, to what degree does VSM help to predict deficit in Theory of Mind skills in a general public school population.
Chapter 2

Theory of Mind

Theory of Mind (TOM) represents the construct of being able to understand the thoughts, feelings, drives, and actions of others. Premack and Woodruff (1978) initially defined this construct, noting the skill of knowing other people have thoughts, feelings, wants and desires other than their own is critical to social success. Swettenham, Baron-Cohen, Gomez, and Walsh (1996) explain the following about individuals having difficulty with TOM:

have difficulties in understanding mental state concepts and in using concepts for predicting behavior and in communicating with others. For example, they are unable to understand that when a person holds a false belief, they will act on the basis of this misrepresentation rather than on the basis of reality.” (p. 74).

Baron-Cohen (1997) noted TOM difficulties can be experienced in even relatively common social exchanges and can become much more complex in more complicated situations. As a result, for individuals with deficits in TOM, understanding the world around us can become complicated – even frightening. More recently, Ronald, Happe and Plomin, (2005) refined the definition further including the “ability to attribute mental states (such as beliefs, desires, and intentions) to oneself and to other people, as a way of making sense of and predicting behavior” (p. 664). While there is debate regarding this skill as a “theory” or a result of general skills of inference (Stone, Baron-Cohen and Knight, 1996) the term “TOM” is the most commonly used to describe this specific construct.

Relative to children, one critical area of application of TOM involves individuals on the autism spectrum. In fact, Walker and Shore (2011) noted that autism is one of the most important areas where TOM research and understanding can provide important utility by enhancing our understanding of how people fully understand, interact and relate to others. Baron-Cohen, Leslie and Frith (1985) identify this difficulty in children with Autism Spectrum
Disorders as so pervasive that their immediate environment can feel difficult to predict, to understand, or to deal with emotionally. With the rate of Autism steadily rising over the past decade, according to the Centers for Disease Control (CDC), from one in 150 in 2000 to one in 68 in 2010 (http://www.cdc.gov/ncbddd/autism/data.html, Retrieved March 29, 2014), understanding, and intervening in the lives of individuals with TOM impairment is critical.

Considering TOM deficits outside the context of Autism is not new. Tchanturia, Happe, Godley, Treasure, Bara-Carril & Schmidt (2004) considered TOM with individuals with Anorexia, Santos and Deruelle (2009) examined TOM in individuals with William’s Syndrome and Dodd, Hare and Hendy (2008) considered TOM in a population with Intellectual Disabilities. TOM errors are also commonly seen in people with Depression and Anxiety (McKinnon, Cusi & MacQueen, 2010), and individuals with ADHD (Sibley, Evans & Serpell, 2010). Difficulty with TOM can also come as a result from brain injury (Muller et al., 2010), neurodegenerative diseases (Peron, Vicente, Leray, Drapier, Drapier, Cohen, Biseul, Rouaud, LeJeune, Sauleau and Verin 2009; Bora, Yucel and Pantelis, 2009), stroke (Happe, Brownell, & Winner, 1999), mental illness such as Schizophrenia (Brune, 2005), Bipolar Disorder (McKinnon, Cusi and MacQueen, 2010) and psychopathy (Richell, Mitchell, Newman, Leonard, Baron-Cohen and Blair, 2003). Even the basic process of aging has also been shown to impact Theory of Mind (Slessor, Philips and Bull, 2008).

Semrud-Clikeman and Hynd (1991) indicate that popular children have been shown to have better TOM skills, as they are more skilled at effectual communication, initiating conversations, and the ability to be aware and empathize with the emotional state of others. Happe, Winner, and Brownell (1998) identify TOM as a skill crucial to academic success. As children learn from the process of play and observation, understanding others’ mental states is evident as a
critical skill to learn from the feedback provided in those interactions. Amsterlaw, Lagattuta, and Meltzoff (2009) found that children as young as five understand the difference between negative emotional and physiological states. These children also recognized that negative emotional states have an adverse impact on school performance. Miller and Shannon (1984) found that children as young as four could predict that someone could listen better to their mother if the environment was quieter.

Development of Theory of Mind: TOM in Children

The development of the skills associated with TOM is gradual and consistent (McGlamery, Ball, Henley, & Besozzi, 2007). This development is predictable, both in time span, and across cultures, and culminates with children understanding beliefs, false beliefs and desires (Happe, Brownell, & Winner, 1999). Stone, Baron-Cohen, and Knight (1998) provided a timeline outlining TOM development. Around 18 months, children develop the skills known as joint attention and proto-declarative pointing. Joint attention is the recognition that others see what the child does and protodeclarative pointing shows the child’s understanding that pointing can focus others’ attention to objects that are wanted by the child. Between 18 months and two of age, children begin to understand the concept of pretend and begin to master the concept of desire (i.e., Billy wants the blocks). Throughout the third and fifth year, most children master the false belief task, or understanding that one character in a story has an incorrect belief about a circumstance or situation. Children then learn to understand that others have different knowledge and that some may have incomplete or incorrect facts, and as a result may hold a belief that is incorrect or false. Wimmer and Perner (1986) found that in their false belief task, a majority of four – five year old subjects could not accurately complete a false belief task, while the majority of six – nine year old subjects were able to do so.
During this time the emergence of problem solving abilities are also seen (McGlamery, Ball, Henley, & Besozzi, 2007). Between the sixth and seventh year, children begin to understand that others can also understand the mental states of others. This represents what is often called “second-order false belief”, or ‘belief about belief” (Stone, Baron-Cohen, & Knight, 1998, p. 641). Finally, between the ages of nine and eleven, children develop the ability to understand and recognize faux pas or a story in which a character makes a comment or statement that is inappropriate to the situation or insulting. It is critical to note that TOM is not a solitary skill nor is it a skill that either is or is not present. Growth of TOM can cease or become delayed at any stage of its progress as is frequently seen with children with developmental disorders (Colle, Baron-Cohen, & Hill, 2007).

While the general process of TOM development is clear, cultural differences in some of the sequences of TOM have been demonstrated. Shahaeian, Peterson, Slaughter and Wellman (2011) studied TOM development in three – six year old Australian and Iranian children. Citing differences in the acquisition of steps of TOM development in a Chinese sample that was previously studied, their work looks at the question of whether cultural differences might lead to differences in the order or timing of TOM mastery. Interestingly, the same work also suggests a reversal in acquisition of two TOM skills, the ability to understand that people can be “knowledgeable or ignorant” (Shahaeian, Peterson, Slaughter, & Wellman, 2001, p. 7) and the understanding that opinions may vary depending on the person, suggesting the order of TOM development may be influenced by culture. In their work, they found that Iranian children understood that others can be knowledgeable before recognizing that opinions may vary dependent upon the person. Children from Australia (all of whom were demographically
similar) demonstrated mastery of these steps in the opposite order, which was consistent with previous findings found in China.

Theory of Mind Across the Life Span: TOM in Adults

Studying TOM in adults may add to the knowledge base of TOM development and the factors critical to its development. Apperly, Samson and Humphries (2009) cited a general paucity in adult research in TOM. In adults, impairment of some executive functions does not necessarily result in impairment on “false-belief reasoning” (Apperly, Samson, & Humphries, 2009, p. 194). This result is highly dependent on the severity and location of the impairment and the related skills that are impacted. However, TOM is well researched in a number of adult diseases and processes. Understanding how different pathologies impact TOM skills may also aid in the understanding of how TOM skills develop or how TOM skills are associated with other more common skills.

Pathology and Theory of Mind

Schizophrenia is a commonly studied pathology in which patients suffer from TOM difficulties (Pousa, Duno, Brebion, Ruiz, & Obiols, 2008). Brune (2005) reviewed the literature on Schizophrenia and TOM and found that patients have difficulties in a number of skills associated with TOM. Brune (2005) further asserted that these difficulties with TOM may influence the way that these patients use or interpret language. Brune (2005) also stated that individuals with Schizophrenia are rarely successful at manipulating others or cheating, have compromised functioning in the community, and that these symptoms are often present in childhood. Bora, Yucel and Pantelis (2009) in a review of research studying TOM impairment in patients with Schizophrenia found that TOM impairment seems to be present even in patients whose Schizophrenia was remitted. Although the level of impairment was reduced from when...
they were more ill, the presence of TOM impairment remained, demonstrating TOM impairment as a significant aspect of Schizophrenia.

Pousa et al. (2008) found that TOM may be necessary for patients with few obvious behavioral symptoms to attribute their symptoms to something other than their mental illness. The research by Pousa et al. (2008) may indicate that TOM skills play an important role in one’s ability to attribute qualities or conditions in general. Equally interesting, they found that TOM and insight did not demonstrate significant associations. Pousa et al (2008) also found that patients who had more severe Schizophrenia symptoms and had poorer TOM, were more likely to be medication compliant. These results indicate that even when TOM is better (in patients with fewer overt signs) the overall continued impairment in TOM continues to adversely impact the individual.

Degenerative disorders such as Frontotemporal Dementia and Huntington’s disease have also been shown to have an adverse impact on TOM (Snowden et al.). More specifically, both patients with Frontotemporal Dementia and Huntington’s Disease have difficulty interpreting humorous cartoon and story vignettes. Patients with Frontotemporal Dementia were more significantly impacted and often responded in ways that were more concrete or demonstrated greater numbers of omissions. The patients with Huntington’s group provided full descriptions of events but did so in a concrete manner failing to provide inferences beyond that provided in the story. Often, when Huntington’s patients did draw inferences, their inferences were incorrect and sometimes directly contrary to information that was provided in the story. On the story task, similar errors were found to be made by patients with Frontotemporal Dementia providing more concrete responses. One important difference was that the patients with Frontotemporal Dementia had difficulty on a task requiring the patient to determine the direction of eye gaze in a
picture; where as, patients with Huntington’s Disease did not have difficulty. These differences highlighted that TOM skills are not unitary and that impairment in one aspect does not singularly provide insight into TOM skills holistically.

Social understanding in persons with severe chronic disease may vary. In Schizophrenia, Frontotemporal Dementia and Huntington’s Disease individuals are more often withdrawn and fail to interact with others. Williams syndrome, however, provides for a contrast of TOM skills. Santos and Deruelle (2009) argued that the compromised social understanding in person’s with Williams syndrome is different. Instead of withdrawal and an absence of behaviors (negative symptoms), individuals with TOM deficits who have William’s syndrome results in an unusually high level of friendly, engaging, and outgoing behavior. This study is especially relevant to the present study, as the researchers divided TOM tasks into verbal and visual tasks. Their findings, that individuals with William’s syndrome performed as accurately as controls on Verbal TOM tasks, but more poorly on Visual TOM tasks, suggest a division verbal and non-verbal division in skills associated with TOM. This is further supported when looking more closely at the visual-spatial tasks presented. These tasks were intentionally kept more simple, with less demand on attention and memory (given difficulties in attention and concentration often present in individuals with Williams syndrome) (Osborne, Soder, Shi, Poder, Costa, Scherer, & Tsui, 1997) which as a result indicates a fundamental impairment in this area. The language based tasks in this study were provided orally, meaning that the participants had to sustain attention, hold the information in memory and maintain the sequence of events provided.

Finally, individuals with Bipolar Disorder also experience difficulty with TOM even when age, intelligence, and executive functions were controlled (Wolf, Brune & Assion, 2010). McKinnon, Cusi, and MacQueen (2010) demonstrated that the cognitive load and duration of
illness were significantly related to the degree to which these individuals experienced difficulty with TOM. Furthermore, the more severe the symptom set, the greater the severity of TOM.

Assessment of TOM

There are many ways in which TOM is assessed. The earliest ways to measure TOM relied solely on language as individuals were read stories and asked to intuit the thoughts, feelings or knowledge of another person. A number of other methods of assessment, however, have been developed since Wimmer and Perner (1983) described the first so-called “false belief task.” Before this type of task was developed, TOM was assessed through deception tasks (Wimmer & Perner, 1983).

Regardless of modality, TOM is assessed on one of two complexity levels. Those levels are referred to as First and Second-Order tasks (Apperly, 2012). Simply stated, First-order TOM tasks ask the individual to intuit the thoughts or feeling of another person, from their perspective. Second-order tasks ask the individual to intuit the perspective of one person about a second person. As such, the person being assessed must set aside their beliefs and knowledge of a situation, understand the perspective and knowledge set of a second person and then provide information about how that person might understand the thoughts, feelings and drives of a third person (Apperly, 2012)

First-order TOM Tasks

Winner and Perner (1983) were the first to employ the false belief task in researching TOM. In a false belief task, the subjects must understand, identify, and suppress certain knowledge of a situation, in order to demonstrate that a character in the story would lack the same knowledge. For example, Winner and Perner described one of their stories as follows:

“A story character, Maxi, puts chocolate into a cupboard x. In his absence his mother displaces the chocolate from cupboard x into cupboard y. Subjects have to indicate the box
where Maxi will look for the chocolate when he returns. Only when they are able to represent Maxi’s wrong belief (‘Chocolate is in x’) apart from what they themselves know to be the case (‘Chocolate is in y’) will they be able to point correctly to box x.” (1983, p. 106).

In this classic, first-order, false belief task, the subject must be able to understand that Maxi would have no way of knowing that the chocolate was moved from x to y, identify that Maxi would have no knowledge of the movement, suppress the knowledge of the move and provide that Maxi would think the chocolate had not moved.

The “Faux-Pas Test” was utilized by Kemp, Despres, Sellal, and Dufour (2012) in their assessment of TOM in both normally aging patients and patients with neurodegenerative processes. This task can provide a mix of first and second order processes and requires the individual to determine a number of aspects of what occurred by understanding social settings, relationships and social rules and boundaries. In many presentations, the subject must correctly determine if the individual in the presentation said something they should not have said, then, if faux-pas was committed, determine who committed the faux-pas, what they think should have occurred, what they may or may not have known and how the person or people involved might have felt (Gregory, Lough, Stone, Erzinclioglu, Martin, Baron-Cohen & Hodges, 2002; Stone, Baron-Cohen & Knight, 1998). The faux-pas questions are followed by a series of additional questions requiring the subject to explain why they should not have said what they said, explain why they said what they did say, determine “did X know that Y …?, and how do you think Y felt?” (Kemp, Despres, Sellal & Dufour, 2012, p. 214).

Richell et al. (2003) utilized a first-order TOM task in assessing psychopathic individuals’ abilities to read emotions based on pictures of actors’ eyes. After viewing a photograph of an individual’s eyes, the subject is forced to choose from a selection of descriptors. This task is especially interesting given its linkage to neurological anatomical correlates. More specifically,
Richell et al. (2003) identified that this task increased activation in areas of the brain such as the
dorsolateral prefrontal and left medial frontal cortices in addition to the superior temporal gyrus
and left amygdala – areas also associated with TOM skills and aggressive behavior.

Generally speaking, first-order TOM tasks are plentiful and a number of varieties are utilized
in research. They have been utilized in large numbers such as Buitelaar et al. (1999) who
utilized six in their study including: The first TOM task was a picture sequencing measure
where-in a child is asked to sequence a series of pictures. The second TOM task was an
appearance-reality task where-in the subject is presented with a situation that is then changed to
look different. The subject is then asked which it looks like (appearance) vs. which it really is
(reality). Baron-Cohen (1989c) uses the example of showing a subject that it is day time, then
showing a picture. In the picture, the lights are shut and curtains closed. The subjects are then
asked what time of day it looks like (night) but what is it actually (day). The third TOM task
was a mental-physical distinction task (Baron-Cohen, 1989c) in which the subject is first
introduced to four dolls and asked their names. They are then presented with a story similar to:
“This is Sam. He likes biscuits. He is hungry, so his mother gives him a biscuit. This is Kate.
She is hungry, but she is all alone. She is thinking about a biscuit.” (Baron-Cohen, 1989c, p.
584). The subject is then required to identify which child could eat a biscuit, demonstrating the
ability to distinguish between mental and physical. The fourth TOM task was the M&M false
belief task consists of a tube or box with an M&M logo printed on the outside being presented to
the subject. Subjects are asked what they think will be in the tube or box. When opened it is
revealed that a pencil or some other item is inside the container. The container is then closed and
the subject is asked again what is inside. After responding appropriately, the subject is asked
what they thought was inside before it was opened. The fifth TOM task was the “Sally-Ann”
false belief task where Sally puts her ball in a place and another child moves the ball. The subject is asked where Sally-Ann would look for the ball. Peterson and Slaughter (2009) utilized two TOM tasks in their study looking for a link between eye-reading and false belief understanding. In this research, Peterson and Slaughter (2009) used two previously described First-Order TOM tasks and tracked the eye movements in subjects to better understand what they were attending to during the presentation of the scenarios utilized.

**Second-Order TOM Tasks**

Second-order TOM tasks attempt to assess the TOM skills set in a more complex manner. Apperly (2011) explains that once children master first-order “mindreading” tasks, they are “embellished” (p. 15) requiring that “beliefs can take other beliefs as their object” (p. 15). This is better understood by the example provided by Apperly (2011)

“A second-order mindreading task requires reasoning about one person’s thoughts about another person’s thoughts. After placing her object, Sally leaves the room, but observes Andrew surreptitiously moving the object to the other container. When Sally returns, participants are asked to predict Andrew’s false belief that Sally has a false belief about the object’s location” (p. 16).

Similarly, Winner and Perner (1983) also provided a task that might be referred to as a second order false belief task (Stone, Baron-Cohen and Knight, 1998). Again, using Maxi from the first story, in the second and third stories Maxi has to tell his brother the incorrect location, and in a third iteration of the story Maxi has to tell his grandfather the truth about where the chocolate is located. In the second and third stories, the subjects have to be able to think about what Maxi would be thinking about what the other character in the story would be thinking– a more complex task to complete. Buitelaar et al. (1999) presents one such task in which the subject is presented a picture of a town and told of a story with two children. At the end, the subject is
asked to predict the first child’s beliefs about a second child’s location and then is asked why the first child would hold that belief (a belief attribution task).

Modality of TOM Assessment

Generally, two types of tasks are provided to individuals to assess TOM skills, language based tasks and visual spatial tasks. While there is a long history of TOM tasks being language based, (Wimmer & Perner, 1986), a number Visual-Spatial tasks have since been developed and utilized to assess TOM. One task that has been frequently used in understanding and studying TOM are those in which subjects are required to recognize emotions in peoples’ faces (Golan, Baron-Cohen & Golan, 2008) and those that require people to determine emotion when viewing the eyes of another person (Baron-Cohen, Jolliffe, Mortimore and Robertson, 1997; Richell, et al., 2003, Peterson & Slaughter, 2009). Richell, et al. (2003) utilized a task where in the participants are required to place themselves in the position of the person in the photo they are viewing. They must then attribute their feeling to one of four complex feeling words printed around the outside of the picture. While this task certainly depends on some level of language understanding, the requirement to decode the emotions from the eyes presented is the key skill being assessed. These tasks help to eliminate the impact of language on so many TOM measures and as a result may provide critical additional information about this construct. Any visual task relies, on some level, on the previous acquisition of associated skills and information. As such, considering the modality to which experience translates to knowledge (memory) is essential.

Visual-Spatial Memory

Visual-Spatial Memory (VSM) is the ability to “retain and or process an object’s identity and spatial location” (McAfoose & Baune, 2009, p. 130). Most basically, VSM provides information on how to navigate through the world, the positions of threats or the location of food or water. In
mobile beings, VSM allows for basic navigation, recognition of familiar versus non-familiar people places and objects, and is critical in a number of skills in life. The manner in which VSM is conceptualized varies.

Models of VSM processing are consistently broken into two processes that work in coordination. Perceptually, information is said broken into top-down and bottom-up models (McAfoose & Baune, 2009). In the bottom-up processing model, the belief is that sensory information is processed sequentially through the visual cortex. A number of specific theories have been postulated to better understand the specifics. The theories in McAfoose and Baune’s (2009) work go beyond the current scope of this research. The top-down model, highlights the higher order cognitive functions (involving memory, executive functions etc.) and the sequential processing of acquired sensory information. These two processes, working together, seem to provide the ability to accurately and quickly perceive objects especially in environments with rapid changes in the visual-spatial field.

Physiologically, two pathways have been identified with distinct functions in visual spatial perception (McAfoose & Baune, 2009, Slotnick & Moo, 2006). Slotnick and Moo (2006) found that the left prefrontal cortex is associated with categorical VSM with the right prefrontal cortex associated with coordinate (near or far) information. McAfoose and Baune clarify that “the two visual streams are often classified as the ‘what’ and the ‘where’ visual streams” (2009, p. 131).

VSM additionally plays a critical role in the theoretical model of working memory. Baddeley and Hitch (1994) put forth a multicomponent model of working memory in which information is divided into the verbal and visual-spatial modalities. The modalities are accountable for storage and processing of associated information. Though less well understood in comparison to the
auditory counterpart, Baddeley and Hitch (1994) put forth evidence through dual-tasks and citing neuropsychological research.

In support of the importance of VSM, research provides a number of significant associations in connection with pathology. In a study of the impact of anxiety on VSM, Visu-Petra, Tincas, Cheie and Benga (2010) found children with higher level of anxiety tend to be slower on a facial recognition task. Their work also confirmed a developmental difference in terms of speed and accuracy on VSM tasks. They also found that higher “executive loads” (Visu-Petra, Tincas, Cheie & Benga, 2010, p. 234) had an adverse impact on VSM performance. Additionally, the emotion being witnessed had a range of impacts on speed of performance depending on the level of anxiety being experienced.

Individuals with Bipolar Disorder are demonstrated to have deficits in VSM (Moreira, Neves, Schlottfeldt, Abrantes, de Moraes, Romano-Silva, Correa, Malloy-Diniz, 2010). More specifically, they found that on measures of VSM using the Rey Complex Figure, patients with Bipolar Disorder had difficulty with a recognition portion of the test, an especially significant finding in that it removes the motor portion of the measure that could be attributed to motivation. This finding was once again reinforced in Lera-Miguel, Andres-Perpina, Calvo, Fatjo-Vilas, Lourdes and Lazaro (2011) who also found significant difficulty on the copy and immediate recall portions of the Rey Complex Figure. They cite known weaknesses in copy encoding and visual learning as possible reasons for this result.

VSM has been identified as a construct that is able to distinguish those with deficits from those without. In a review of the research, Manji, Pei, Loomes and Rasmussen (2009) found VSM deficits can discriminate between those with Fetal Alcohol Syndrome (FAS) and controls. More impressively, research found VSM task to be more sensitive to FAS symptoms. Research
also found individuals with FAS have greater difficulty reproducing spatial arrangements, recognizing faces, and resulting in “substantial” (Manji, Pei, Loomes & Rasmussen, 2009, p. 241) distortions in the reproductions.

Assessment of VSM: The Rey Complex Figure

Davies, Field, Andersen and Pestell (2011) present a review of the Rey Complex Figure’s (RCF) general use and its validity. They found that in most recent research with regard to its usage, the RCF was ranked 8th in the top 40 neuropsychological instruments and 2nd among the top 40 instruments measuring executive functioning (Davies, Field, Andersen & Pestell, 2011). The measure’s “dependence on visuoperceptual, visuoconstructional, graphomotor, and visual memory functions and the executive functions of planning and organization” are reasons for its high positive regard (Davies, Field, Andersen & Pestell, 2011, p. 820).

Bora, Yucel, Pantelis, and Berk (2011), Levy, Monzani, Stephansky, and Weiss (2008), and Seidman, Lanca, Kremen, Faraone, and Tsuang (2003) utilized the RCF in their exploration of VSM in individuals with Bipolar Disorder. As a measure with multiple levels of assessment (both studies utilized the copy, recall and recognition aspects of the tests), it is a comprehensive tool, and as mentioned previously, widely used in research (Davies, Field, Andersen & Pestell, 2011). Davies, Field, Anderson and Pestell (2011) provide one final observation relevant to the current study. They cite that despite its widespread use and the support for validity, the RCF has not been connected to real-world activities such as school or home functioning.

Linking VSM and TOM

A link between visual-spatial skills and social understanding is well established in the work of those engaged in exploring nonverbal learning disabilities (Rourke, 1995). Characterized by a significant difference between verbal and nonverbal skills (especially on measures such as the
Wechsler Scales; Rourke, 1995) individuals with NLD frequently have difficulties with motor skills, visual perceptual skills, coordination, dealing with novel situations (Rourke, et al. 2002) and perceiving social judgment and social perceptions (Semrud-Clikeman, Walkowiak, Wilkinson & Christopher, 2010). Semrud-Clikeman and Hynd (1991) cite a number of non-language based skills as essential to the development of social-perception. They recognize the identification of visual-motor patterns as one of the early critical skills developed before language that is essential to social understanding. Furthermore, they identify the ability to recognize and label emotions which impact maternal relationships. If a child has difficulty interpreting facial expressions and gestures, the adverse impact of those dysfunctional interactions would result in a disruption in the earliest and “most important relationship” (p. 605).

Buitelaar, van der Wees, Swaab-Barneveld, and van der Gaag (1999) highlight the critical nature of visual-spatial skills, as difficulty with these skills seems to negatively impact the development of facial recognition and gestural expression. Colle, Baron-Cohen and Hill (2007) reinforce the critical nature of visual spatial skills in TOM in their finding that children with Speech and Language Impairments alone do not have TOM deficits, suggesting that language does not determine TOM skill or impairment. This study helps to clarify this issue as these individuals who have language deficits were able to demonstrate sufficiently developed TOM skills.

Buitelaar, van der Wees, Swaab-Barneveld, and van der Gaag (1999) also provide support for the critical nature of visual spatial skills in social communication, citing research that has showed young babies early social communication indicates comprehension of adult gaze. Toddlers continue their growth though using information from the eyes to interpret and identify
the intention of others’ otherwise ambiguous behavior. Furthermore, they found that Performance IQ was a major predictor of TOM skills. Suggesting a connection between TOM and visual-spatial knowledge.

Understanding facial expressions and other socially relevant information from the face is a well documented and fundamental skill in interpersonal relationships (Pelphrey et al.). Snow, Ingeholm, Levy, Caravella, Case, Wallace and Martin (2011) studied visual scanning in individuals with high-functioning Autism Spectrum Disorders (ASD). They found that individuals with ASD demonstrated greater fixation durations on the eyes, nose and mouth at the expense of other areas of the face. Interestingly, they were able to better recognize electric fans than faces, suggesting a face specific deficit. More specifically, they found that their subjects had fewer eye movements outside of the eyes, nose and mouth than control subjects – a pattern not demonstrated on the electric fans (Snow et al., 2011).

Snow et al. (2011) also discuss difficulty generalizing this result as their work was restricted to the study of visual scanning of electric fans. Furthermore, they found continued confusion with regard to a fixation on one part of the face in comparison to others (i.e. Research on a greater fixation on the eyes vs. the mouth is mixed) as their subjects had the greatest fixation duration (time of eyes on a single area) on the eyes in the pictures. The participants of the study had above average IQ’s, something unusual in both the ASD population and in the general population. Regardless, the less effective visual scanning demonstrated in those with ASD in both Pelphrey et al., and Snow et al. solidly demonstrate that this population does not visually scan in the same way as neurotypical peers. Gladwell (2007) presents a clear narrative of the scanning pattern of one such individual. In this narrative, the researcher, Ami Klin of Yale’s
Child Study Center is tracking Peter’s (an individual with autism) eye movements while watching a scene *Who’s afraid of Virginia Woolf?:*

Klin had Peter put on a hat with a very simple, but powerful, eye-tracking device composed of two tiny cameras. One camera recorded the movement of Peter’s fovea – the centerpiece of the eye. The other camera recorded whatever it was Peter was looking at, and then the two images were superimposed. This meant that on every frame of the movie, Klin could draw a line showing where Peter was looking at the moment. He then had people without autism watch the movie as well, and he compared Peter’s eye movements with theirs. In one scene, for example, Nick (George Segal) is making polite conversation, and he points to the wall of host George’s (Richard Burton’s) study and asks, “Who did that painting?” The way you and I would look at that scene is straightforward: our eyes would follow the direction that Nick is pointing, alight on the painting, swivel back to George’s eyes to get his response, and then return to Nick’s face, to see how he reacts to the answer. All of that takes place in a fraction of a second, and on Klin’s visual-scanning picture, the line representing the gaze of the normal viewer form a clean, straight-edged triangle from Nick to the painting to George and back again to Nick. Peter’s pattern though, is a little different. He starts somewhere around Nick’s neck. But he doesn’t follow the direction of Nick’s arm, because interpreting a pointing gesture requires, if you think about it, that you instantaneously inhabit the mind of the person doing the pointing. You need to read the mind of the pointer, and, of course, people with autism can’t read minds. ‘Children respond to pointing gestures by the time they are twelve months old,’ Klin said. ‘This is a man who is forty-two years old and very bright, and he’s not doing that. Those are the kinds of cues that children are learning naturally – and he just doesn’t pick up on them.’

So what does Peter do? He hears the word “painting” and “wall”, so he looks for the paintings on the wall. But there are three in the general vicinity. Which one is it? Klin’s visual-scanning pictures show Peter’s gaze moving frantically from one picture to the other. Meanwhile, the conversation has already moved on. The only way Peter could have made sense of that scene is if Nick had been perfectly, verbally explicit – if he had said, ‘Who did that painting to the left of the man and the dog?’ In anything less than a perfectly literal environment, the autistic person is lost.” (p. 216 – 218).

Golan, Baron-Cohen and Hill (2006) reinforce the critical nature of Visual-Spatial Skills in their finding that individuals with Asperger Syndrome had greater difficulty identifying emotions in faces than in voices. Their work is especially important given that the subjects were presented a film depicting emotions in faces (rather than static pictures, which, according to the authors, allowed for the assessment of more complex emotional
concepts) and that this modality of presentation more closely represents that which is encountered in life.

As Semrud-Clikeman and Hynd (1991) explain

“Thus, the child who experiences significant difficulties in processing and retaining visual-spatial and auditory stimuli as well as in the prediction of temporal events is likely to experience deficits in the understanding of human expressions and interactions as well as in the development of exploratory behaviors, cognitive reorganization, and individuation necessary for subsequent social-skill development.” (p. 605)

This research seeks to determine if there is a relationship between Theory of Mind and Visual Spatial Memory in a general population in a public elementary school population.
Chapter 3

METHODS

Research Questions

Although there has been extensive research with regard to a linkage between TOM and language, no research is available linking TOM to visual spatial skills despite a number of hypotheses to this effect. As an increase in awareness of TOM and the associated skills is critical to school and life success, better understanding of TOM as it relates to other cognitive skills and measures which can help practitioners to predict difficulties with TOM will be essential to helping children with deficits in TOM. Toward this end, understanding if there is a link between TOM and VSM is a valuable avenue of research to clarify existing questions in the research and to help identify other individuals who may be impacted by the effects of TOM deficits. Given these gaps in the literature and research the following research questions were established:

1. Is there a significant relationship between TOM and VSM?
2. To what degree does VSM predict TOM development?

Design

NEPSY-II Theory of Mind test and the Rey Complex Figure and Recognition Trial’s Short-Term Recall scores were utilized to determine if a relationship existed between Theory of Mind and Visual Spatial memory. After attaining permission from a medium-sized suburban school district, an introductory letter and two copies of the consent were sent home to elicit volunteers. The children of parents who provided a copy of a signed informed consent were then scheduled by the researcher in coordination with the students’ teachers to complete the two tests to that were utilized. Consent forms and study data were stored separately with consent forms stored in
a fire resistant safe and data stored in a separate file cabinet. After being scored, scaled scores were converted to percentiles as the TOM test results are provided as a percentile ranking. These percentile ranks were then analyzed as bivariate correlations to determine if a relationship existed among the available variables.

Instrumentation

**NEPSY II: Theory of Mind**

According to Korkman, Kirk, and Kemp (2007), the NEPSY-II is a standardized assessment that was normed based on census data gathered in October 2003. The normative sample consisted of 1200 total cases with 100 children in age groups from three through 12 years of age. Ages 13 – 14 and 15 – 16 were considered two groups. Those age groups were further split into two halves with 50 children from each half of the year. Furthermore, the norm group was broken down by race, geographic region, and parent education level based according to data from the 2003 census survey. Reliability and stability were demonstrated to be high on each of the tests. As the TOM test was new to the NEPSY-II, a correlation could not be made to the previous version of the test. Correlations between the TOM test and other measure vary depending on the measure, an expected finding given the difference between TOM and many other measures (See Appendix A1 through A5, Korkman, Kirk, & Kemp, 2007).

The Theory of Mind test on the NEPSY-II is a measure of the construct of Theory of Mind. It utilizes a combination of nine constructs commonly referenced in the literature. These include false belief tasks, seeing leads to knowing tasks, recognizing mental states, imitating / pretending, mental / physical distinction, bluff, double bluff, appearance – reality, and understanding figurative language (Korkman, Kirk & Kemp, 2007).
The Theory of Mind test is divided into two sections and provides two scores, one for the “Verbal” portion in which there is language involvement. The “Verbal” task presents examinees with questions (e.g., like which of three children would be able to hug a bear: one at a zoo, one in a bed with a teddy bear or one reading about bears in a book), pictures and situations about which they must infer information to come to a conclusion. The second portion requires the examinee to look at a large picture and choose which of four pictures of a child’s face most likely represents the way the child in the large picture feels.

Demonstrating validity with the Theory of Mind test on the NEPSY-II is a complex task given the absence of tests and tasks that measure similar skills. Validity of the NEPSY-II TOM task is presented through three other measures: the Wechsler Individual Achievement Test – Second Edition (Table A1), the Differential Abilities Scales – Second Edition (Table A2), and Bracken Basic Concept Scale – Third Edition: Receptive (Table A3). These measures were included because of the well-established connection between language and TOM. As these are highly language dependent tasks, one would expect a high correlation between the two tasks due to the high level of language involved.

The reliability of the Theory of Mind test on the NEPSY-II is also complex (Table A4). The complexity of this task comes as a result of the development of these skills. Specifically these skills are expected to be developed fully by age seven. “After age seven, the distribution is highly skewed because a majority of the children successfully perform the task. The reliability of this score is much higher in younger age groups than in older age groups, where the skewed score distribution and range restriction is reflected in the change from a scaled score to a percentile.” (Korkman, Kirk & Kemp, 2007, p. 52). The Theory of Mind: Verbal score (all ages) and Theory of Mind: Total (ages 7 – 16) scores are presented as percentile rankings due to
skewed score distributions. As a result, the reliability classification of those scores is placed into one of three categories: less than or equal to 10\textsuperscript{th} percentile, 11\textsuperscript{th} to 75\textsuperscript{th} percentile and above the 75\textsuperscript{th} percentile (Korkman, Kirk & Kemp, 2007). Table A5 provides information about the decision consistency for placement into one of the categories.

**Instrumentation: Rey Complex Figure**

The Rey Complex Figure and Recognition Trial is a measure of visual-spatial memory that utilizes a copy trial, a short-term recall trial and long-term recall trial (only the copy and short-term trials were utilized for this study with short-term scores included in the data). The RCF demonstrates a high level of inter-rater reliability ($r=.94$) for total raw scores. Temporal stability, the idea of change over time, was also demonstrated to be strong with test-retest reliability also exhibited as being strong (Immediate Recall $r=.759$, 91.7\% agreement of clinical interpretation; Delayed Recall $r=.888$, 91.7\% agreement of clinical interpretation) (Meyers & Meyers, 1995). Appendix A demonstrates validity in a number of ways. Specifically, the high degree of test-retest reliability indicates that the RCF measures a stable skill set. A stable skills set is one that changes consistent with the sampling which in this case is developmental.

The RCF utilizes a brain-damaged sample for much of the validity information and comparisons. The purpose of utilizing a brain-damaged sample is that it provides data from a variety of clinical conditions. Information from this variety of conditions inevitably highlights validity in a manner that demonstrates the utility of the measure in the population with which the tool will provide the most valuable feedback. Table A6 demonstrates inter-correlations among the targeted RCF variables and subtests from the WAIS-R from a Brain-Damaged Sample (Meyers & Meyers, 1995). Table A7 provides inter-correlations among the targeted RCF variables and a variety of Neuropsychological Measures from a Brain-Damaged Sample (Meyers
& Meyers, 1995). Tables A7 and A8 provide information on Factor Loadings of selected RCF Variables from a Normative Sample and Brain-Damaged sample respectively (Meyers & Meyers, 1995).

Subjects

Participants were volunteer students between ages 6 and 12 from classrooms where teachers volunteered to participate in the research. The sample population was of mixed gender and from one of two elementary schools from which their principal agreed to allow this research in their school. The school district generally is considered high Socioeconomic Status (SES), based on income level, parental education and type of employment, although individuals who do not fit this description also reside within the district.

Procedure

Volunteer students, with informed consent and assent, were assessed with the Rey Complex Figure Copy and Short-Term Recall Trial and the Theory of Mind Test from the NEPSY-II. Students were taken from their class to a private room provided by the school, after consultation with their teacher to ensure minimal impact on their school day and academic learning. Tests were then administered which usually took between 15 and 20 minutes. This examiner, on raw data sheets, recorded only scores and the student’s age. Scores were then converted to percentile ranks, so that scores between measures could be compared, entered into a Microsoft Excel spreadsheet, then analyzed using SPSS.

Scoring

The Theory of Mind test on the NEPSY-II scoring is provided on the test protocol. The subject receives between zero and two points depending on the question. Those scores are added together to create two raw scores (one for the Verbal portion and one Total score) which is then
entered into the NEPSY-II scoring program. The Verbal portion provides scores in percentile ranks in one of seven age categories (<2; 2-5; 6-10; 11-25; 26-50; 51-75; and >75). As such, when coded for input into SPSS, the percentile range was averaged, with the mean being the number that was coded in SPSS for comparison. The Total Score is provided in Scaled Scores (Ranging from 1 – 19) and single percentile rankings (Korkman & Kemp, 2007).

The Rey Complex Figure and Recognition Trial, short-term, provides 18 scoring units that value from zero to two points. That raw score is converted into a T-Score and Percentile (Meyers & Meyers, 1995).
Chapter 4

RESULTS

The purpose of this quantitative study was to determine if there is a significant statistical relationship between TOM and VSM. By examining the relationship between scores obtained on the Rey Complex Figure Short-Term recall trial and Theory of Mind test on the NEPSY-II, an examination of the presence of a link between these two constructs was sought. No previous research has explored this question or considered a connection between TOM and VSM. Additionally, and unique to this study, is the potential to link the Rey Complex Figure to a real life skill or construct (TOM). Again this has not been documented in previous research. Finally, a link between these two constructs may aid in providing an alternative method of determining TOM deficits in children and adolescents or minimally providing a tool to help provide a possible indication of TOM deficits. This study also utilized a general public school population in an effort to highlight the fact that TOM deficits exist in populations beyond those that are identified as having deficits or in need of special services.

Permission to conduct research was gained from the Assistant Superintendent of Schools, Director of Special Education and Pupil Services and three building principals. After obtaining approval from the University of Connecticut Institutional Review Board, the School Principals of the two participating schools were contacted and days arranged to present the research at a staff meeting. Two schools were chosen due to the timing of the research with a third school held in reserve for the following school year if the minimum number of subjects was not reached.

The research presentations took place on May 17 and 26, 2012, once for each school. A presentation was given to the faculty in each of the target schools and consent forms and explanations offered to all staff that were willing to participate. Over the next month following
each presentation each school was visited and consent forms were collected. From May 24 through June 20, students were tested. This examiner spent one day between the hours of 2:30PM and 3:15PM working with students for whom permission and assent had been gained.

Table 1.1 reports the Demographic information (i.e. number of subjects tested, number of releases returned, number of releases provided and the gender of the subjects).

Table 1.1

Demographic Data

<table>
<thead>
<tr>
<th></th>
<th>School 1</th>
<th>School 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information packets provided</td>
<td>220</td>
<td>240</td>
</tr>
<tr>
<td>Information packets returned</td>
<td>29</td>
<td>32</td>
</tr>
<tr>
<td>Participation Rate</td>
<td>13.1%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Subjects Utilized</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>Percent of Subjects Utilized</td>
<td>79.6%</td>
<td>56.3%</td>
</tr>
<tr>
<td>Male subjects</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Female subjects</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Percent subjects of total</td>
<td>56%</td>
<td>44%</td>
</tr>
</tbody>
</table>

Those scores were entered into SPSS software which calculated mean, standard deviations and Spearman’s Rho correlations for the short term-recall from the Rey Complex Figure, The Verbal score from the Theory of Mind test and the Total Score from the Theory of Mind test. The $t$-test calculations for significance were interpreted by the researcher. Those results and interpretations of those results follow.
Findings

During the spring of 2012, forty-one students were administered the Rey Complex Figure Copy, Short-Term Recall and Theory of Mind test from the NEPSY-II in a single sitting by the author. The entire process for each student took approximately 20 minutes. All 41 students were able to complete all aspects of both measures and no assessments were interrupted by difficulty experienced by the examinees. Again, the 41 participants came as a result of approximately 240 returned and properly endorsed consent forms. This resulted in a participant rate of 17% (in comparison to the number of consent forms distributed) in the two schools utilized in this study. The third school was held in reserve if the first two schools could not attain the minimum subject population. Upon completion of the assessments in the first two schools there was insufficient time remaining in the school year to utilize the third school to raise the subject pool in this study.

After being scored and tabulated, data were entered into SPSS and examined. The results from the Short-Term recall of the Rey Complex Figure data showed this population’s performance with a M = 39.134 with a SD = 29.813. The Verbal Total of the NEPSY-II Theory of Mind test data showed a M = 46.159 with a SD = 24.354. The Total Score of the NEPSY-II Theory of Mind test data showed M = 42.71 with a SD = 26.757. Comparison between mean data collected in this study and mean for the testing measure are presented in Table 1.2. Spearman’s Rho for nonparametric data was utilized to explore the relationship between these variables with results reflected in Table 1.3.
Table 1.2

Mean data for current subject pool, Short-Term Rey, Verbal TOM and Total TOM

<table>
<thead>
<tr>
<th></th>
<th>Current Mean</th>
<th>S.D.</th>
<th>Test Mean</th>
<th>S.D.</th>
<th>Difference btw Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Term Rey Complex Figure</td>
<td>39.134</td>
<td>29.813</td>
<td>50</td>
<td>10</td>
<td>-10.866</td>
</tr>
<tr>
<td>NEPSY-II Theory of Mind Verbal</td>
<td>46.159</td>
<td>24.354</td>
<td>50</td>
<td>10</td>
<td>-3.841</td>
</tr>
<tr>
<td>NEPSY-II Theory of Mind Total</td>
<td>42.71</td>
<td>26.757</td>
<td>50</td>
<td>10</td>
<td>-7.29</td>
</tr>
</tbody>
</table>

* The NEPSY-II provides a range for TOM score; as such the median of the average range was utilized.

The mean data demonstrate an approximate difference between the population utilized as part of this study in comparison to the expected mean of the test utilized. The Rey Complex Figure Mean represents a difference that is likely to indicate a significant difference between subject pools. This score, if demonstrated by a single subject would indicate performance in the Mildly Impaired range. The results of the NEPSY-II Theory of Mind Verbal portion of the test indicate a performance that is likely to be consistent with that of the test subject pool as the performance would fall in the average range indicating an overall expected level of development from the subjects utilized in this pool. The results of the NEPSY-II Theory of Mind Total test indicate a performance, if completed by a single individual, would rank within the average range indicating TOM development at an expected level and as a result is likely consistent with that of the subject pool.
Table 1.3

**Correlations for Short-Term Rey and Verbal TOM and Total TOM**

<table>
<thead>
<tr>
<th></th>
<th>Short-Term</th>
<th>Verbal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman’s Rho</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-Term Correlation Coefficient</td>
<td>1.000</td>
<td>0.284</td>
<td>0.297</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>-</td>
<td>0.072</td>
<td>0.059</td>
</tr>
<tr>
<td>N</td>
<td>41</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>Verbal Correlation Coefficient</td>
<td>0.284</td>
<td>1.000</td>
<td>0.818</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>0.072</td>
<td>-</td>
<td>0.000</td>
</tr>
<tr>
<td>N</td>
<td>41</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>Total Correlation Coefficient</td>
<td>0.297</td>
<td>0.818</td>
<td>1.000</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>0.059</td>
<td>0.000</td>
<td>-</td>
</tr>
<tr>
<td>N</td>
<td>41</td>
<td>41</td>
<td>41</td>
</tr>
</tbody>
</table>

The results of the $t$-test measures indicate a marginally significant result between Short-Term Recall on the Rey Complex Figure and the Total Score on the Theory of Mind test ($p=.059$). The Short-Term Recall on the Rey Complex Figure showed a non-significant level of correlation with Verbal TOM ($p=.072$). The Verbal Portion of the NEPSY showed a high level of correlation with the Total score on the same test ($p=.000$). Thus the Rey Complex Figure Short-Term recall is marginally correlated with results from the Total Score on the NEPSY-II Theory of Mind test.

The results of this study provides a foundation for better understanding of this construct. The link established enables positing questions and identifying areas for further research. While
there are differences between the current population and a more broad population, this research is the first step to asking questions that had previously not been considered.
Chapter 5

Discussion

The following is a discussion of the findings of this dissertation research. The results are discussed in relation to the research questions and reported research on the association between Theory of Mind and Visual-Spatial Memory. Conclusions from the research are explained, explored and suggestions for future research are discussed.

Discussion

The primary purpose of this study was to identify if a link exists between the construct of Theory of Mind (TOM) and Visual Spatial Memory. Identification of a link between these two constructs might enable the exploration of different ways to identify TOM difficulties, create new modalities for intervention, new interventions, and new treatments for more severe difficulties. Additionally, understanding TOM as a more general construct would allow consideration of these skills in individuals across age ranges. Again, understanding a link between these two constructs provides for an important link for a skill that must be understood across the life span.

The primary question that was the focus of this study was, is there a link between visual-spatial memory and theory of mind in a regular public school population? It was hypothesized that a significant relationship existed between these two constructs and that the relationship would be positive.

Conclusions

This study found a marginally significant result \( p = 0.059 \) indicating the presence of a relationship between these two constructs as measured by the Total Score of the NEPSY Theory.
of Mind test and the Rey Complex Figure (RCF). It is important to note that this marginal relationship was demonstrated with a relatively small sample (N = 41). Given that smaller samples create lower levels of strength, it is likely that a larger sample would produce a higher level of significance and power (W. Neace, personal communication, July 28, 2012). The relationship between the Verbal portion of the NEPSY Theory of Mind test and the RCFT was lower (p = 0.072). The significance between the Verbal and Total portions of the NEPSY Theory of Mind test (p = .818) demonstrates a high level of similarity, which is expected since verbal scores are included in the total score.

As a result of these findings, several conclusions can be drawn. While marginal, there is a connection between Theory of Mind and Visual-Spatial memory skills. As such, this study also made the first connection between performance on the Rey Complex Figure and the Theory of Mind measure. Additionally, there is a difference in the skills utilized between the Theory of Mind Visual portion of the test and the Total Score, demonstrating that the second portion of this measure assesses different skills and may be a valuable separate assessment.

An hypothesized link between Theory of Mind and visual spatial-spatial skills provides for a number of considerations. This link provides for the ability to consider Theory of Mind in a manner not previously tested in the research. Theory of Mind currently has few methods of assessment outside of research (McKinnon, Cusi & MacQueen, 2010). The NEPSY Theory of Mind test is the only commercial, standardized way to consider TOM (Caputi, Lecce, Pagin, & Banerjee, 2012). Given the link between TOM and Visual-Spatial skills, practitioners can utilize the RCF to help explore the possibility of TOM deficit and as a result, consider this construct as a target for intervention and treatment.
A link between TOM and Visual-Spatial skills also provides for a new avenue in consideration of treatment and intervention when working with any individual (Gil-Sanz, Fernandez-Modamio, Bengochea-Seco, Arrieta-Rodriguez & Perez-Fuentes, 2014). Identifying the most efficacious intervention is key. Many interventions are language-based and provide scripts for children to learn to understand the intentions of others (Gupta, Tramel & Duff, 2012). The link between these two constructs is instructive with regard to utilizing visual-spatial modalities with regard to instruction of TOM based skills. Instruction with regard to facial expression and body language may be more critical than instruction with a verbal explanation regarding others’ thoughts and intentions, which is the hallmark of TOM. If reading and recalling body posture is a critical part of understanding intention (as the connection between visual-spatial skills and TOM implies), failure to instruct in this modality will fail to provide the real learning that is necessary to help individuals to grow and advance their TOM skills. Given the critical nature of TOM, understanding the construct and broadening the audience who can intervene in its growth may importantly aid in the development of social skills at all ages.

As mentioned previously, the Rey Complex Figure (RCF), a measure of visual-spatial memory and visuo-motor integrations skills is a popularly utilized measure (Meyers & Meyers, 1995). Prior to this study, no previous research has made a link between the RCF and everyday skills. The current study, finding a marginal connection between these two constructs, provides a connection between this measure and the critical Theory of Mind skill. As such, this connection offers utility to a measure that had previously no connections to an everyday skill. This connection links TOM to an extraordinarily important life skill.
Limitations

While the results of this study illustrate many important points, the limitations provide for future areas of research, study, and consideration. The present study had a small sample population that came from a wealthy, primarily Caucasian school district. The sample size was limited by the timing of the study, which took place at the end of a school year and with a single examiner completing the tests that were part of the study. A larger sample size, (with its resulting higher power level and lower possibility of error rate due to greater sampling) is likely to have provided a greater level of significance. Additionally, a larger sample size would have also attained a larger variety of skills within the population. The relative homogeneity of the population in this study also limits the generalizability of the findings.

The present study utilized two portions of the Rey Complex Figure. Utilizing the whole of the test may aid in demonstrating a connection in a different manner. Examining a connection between the long-term memory portion and the recognition portion of the measure may also provide information in understanding Theory of Mind and other cognitive constructs that might be associated and connected to this construct.

In order to make a comparison between scores on the RCF, scores from the NEPSY Theory of Mind test had to be converted from the range that is provided by the test, to a single score that was determined by the median of the two scores provided in the range. As an example, if the TOM test scored an average score as within the 25th – 75th percentile, the score of 50 was utilized to create a single data point rather than a range. Necessarily, this created inaccuracy in the scores provided and as a result in the scores utilized to make a comparison. It is difficult, with any accuracy, to predict the actual impact of this conversion on the outcome of this study.
Implications for Future Research

Future consideration needs to be made in areas that expand research beyond diagnosable disorders. Many children who do not fall into one of the categories in the Diagnostic and Statistical Manual – Fifth Edition (DSM-V) may also likely to have difficulty with TOM given the knowledge that adults with disorders such as bipolar, eating disorders and schizophrenia demonstrate this deficit (Tcanturia, Happe, Godley, Treasure, Bara-Carril, & Schmidt, 2004; Brune, 2005; Bora, Yucel, & Pontelis, 2009; Wolf, Brune, & Yucel, 2010). Considering these individuals and the difficulties that they experience will be an important consideration given the critical nature of this skill. Children with Depression, Attention Deficit Hyperactivity Disorder, Anxiety Disorders and other similar issues are also likely to demonstrate TOM difficulties (McKinnon, Cusi, & MacQueen, 2010). Future research considering whether issues such as Depression may be aggravated or possibly caused by TOM deficits will be an important ongoing consideration. Consider for a moment the perceptual differences that individuals with depression often have and the attribution differences that occur. For example, individuals with Depression frequently attribute the behaviors of others in a manner that reinforces a negative self-worth. Might some of those differences come as a result of TOM difficulties, whether inherent to the individual or as a result of the disorder?

Continued research understanding the neurological correlates is also necessary. While it seems clear that a number of diffuse areas of the brain are involved in TOM, the impact of damage to these areas is not well understood (Kim, Kwoon, & Chang, 2011; Gupta, Tranel, & Duff, 2012). This is particularly poorly understood considering the different ways that TOM is assessed (buitelaar, van deer Wees, Swaab-Barneveld, & van der Gaag (1999). Additionally, the modality through which these TOM problems are posed to subjects is another variable for
consideration. Given the fact that the brain processes information, rather than constructs, different areas of the brain would show involvement in processing different TOM (Gupta, Tranel, & Duff, 2011; Kemp, Despres, Sellal, & Dufour, 2012). Understanding the common areas of brain processing, however, would help to demonstrate the critical areas of the brain that are at the heart of responsibility for TOM. While it is important to know that there may be a significant difference given these different modalities, this difference would help to unveil that TOM may in fact be a result of the collection of neurological areas working in concert (Muller, Liebermann-Finestone, Carpendale, Hammond, & Bibok, 2012) rather than a unitary, separate function.

Contemporary theories are highly dependent on current research. Research understanding early development of TOM skills is clear (Shahaeian, Peterson, Slaughter, & Wellman, 2011). But an understanding of all of the underlying skills necessary for that development is less so (Muller, Liebermann-Finestone, Carpendale, Hammond, & Bibok, 2012). More poorly understood is how the skills involved in TOM actually develop. While early skills develop in the first fourteen months of a toddler’s development, understanding foundational skills, like visual spatial skills, and how they impact TOM development will be critical to develop early interventions for children who have difficulty with TOM skills and the social relationships that are so important (Baron-Cohen, 1988; Zaki, Bolger, & Ochsner, 2009).

Research clearly demonstrates the necessity of visual skills in TOM (Martino, Strejilevich, Farssi, & Marengo, 2011). What is not as clear is the impact of visual memory and associate skills in the development of and demonstration of good TOM skills. It follows that in order to scan a person’s face or body and understand the meaning of what is seen, it is necessary to have had experiences that inform the individual that the associated information is useful (Meltzoff, &
Brooks, 2008). Necessarily, one must also encode that information in memory. It is additionally clear that different areas of the brain impact TOM differently (Gupta, Tramel, & Duff, 2012). Encoding what a face looks like when upset or happy is a process of learning and essential to that learning is intact memory. This proposition is supported by more the present research as well as by previous research (Golan, Baron-Cohen & Golan, 2008; Manji, Pei, Loomes, & Rasmussen, 2009).

Lind and Bowler (2009) completed a study where they determined that children around the age of 18 months with an Autism Spectrum Disorder were able to successfully demonstrate meta-representation skills. These skills require the child to hold their representation in memory and recognize it when altered slightly (through the placement of rouge on the child’s face which would require them to have to figure out that the person in the mirror was in fact, themselves). They suggested that the work should be replicated but reassessing the skill to determine if the children in the study are able to hold onto the meta-representational skill over a longer (extended) period of time. In essence, they question the spatial memory skills over a period of time greater than the three minutes in the work cited. This replicates the timeframe in the research in this study as well. As such, it would seem to be critical that visual-spatial memory be intact in order to demonstrate good TOM skills.

Given the importance of TOM skills it seems that intact TOM is essential to learning both academic (Lecce, Caputi, & Hughes, 2011) and social skills (Caputi, Lecce, Pagin, & Banerjee, 2012) in an optimal way. Therefore, research that can inform practitioners about the correlates of TOM can also help to predict which children may have these deficits. As a result these children can receive early intervention and necessary consideration for the skill difficulties that they may have.
Considering the current study and the limitations that were part of the study, future research looking at the performance of individuals with poor visual spatial memory on a TOM task would be beneficial. Considering the connection identified in this study, it would follow that individuals with VSM deficits would have more difficulty with TOM than the general population. Should these individuals indeed have greater difficulty with TOM the ability to identify this weakness in a more general manner would help to identify a specific population to target for intervention and a clear modality to utilize in that intervention (Meltzoff, & Brooks 2008).

This research is the first that investigates a link between Theory of Mind and a different cognitive construct. More importantly, this research identifies a link between these two constructs and establishes a link between a popular assessment measure and a real life skill (RCF and TOM). TOM is a construct that, when in deficit, produces significant difficulties as demonstrated in individuals with Autism. Additionally, it is likely a skill that becomes deficient in individuals with other disabling conditions like depression, ADHD, anxiety, even ageing (Kemp, Despres, Sellal, & Dufour, 2012). Considering the links demonstrated in this research, continued, expanded and reconsidered research on Theory of Mind is of paramount concern as we explore ways to intervene and work with individuals across the ability spectrum.
References


Baron-Cohen, S., Jolliffe, T., Mortimore, C., & Robertson, M. (1997). Another advanced test of
theory of mind: Evidence from very high functioning adults with autism or asperger syndrome.


Developmental Disorders, 37, 716 – 723.


Golan, O., Baron-Cohen, S., & Golan, Y. (2008). The ‘Reading the mind in films’ task (child


[www.asha.org/public/speech/development/Pragmatics.htm retrieved July 30, 2009](http://www.asha.org/public/speech/development/Pragmatics.htm)

Appendix A

NEPSY II: Concurrent Validity for Theory of Mind Test

Table A1

Correlations between Wechsler Individual Achievement Test – II (WIAT-II) subtests/COMPOSITES and the NEPSY-II Theory of Mind Test (Korkman, Kirk and Kemp, 2007)

<table>
<thead>
<tr>
<th>WIAT-II subtests/COMPOSITES</th>
<th>NEPSY-II Theory of Mind Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Reading</td>
<td>.36</td>
</tr>
<tr>
<td>Reading Comprehension</td>
<td>.36</td>
</tr>
<tr>
<td>Pseudoword Decoding</td>
<td>.22</td>
</tr>
<tr>
<td>Numerical Operations</td>
<td>.39</td>
</tr>
<tr>
<td>Math Reasoning</td>
<td>.26</td>
</tr>
<tr>
<td>Spelling</td>
<td>.29</td>
</tr>
<tr>
<td>Written Expression</td>
<td>.45</td>
</tr>
<tr>
<td>Listening Comprehension</td>
<td>.46</td>
</tr>
<tr>
<td>Oral Expression</td>
<td>.74</td>
</tr>
<tr>
<td>READING</td>
<td>.25</td>
</tr>
<tr>
<td>MATHEMATICS</td>
<td>.37</td>
</tr>
<tr>
<td>WRITTEN LANGUAGE</td>
<td>.29</td>
</tr>
<tr>
<td>ORAL LANGUAGE</td>
<td>.76</td>
</tr>
<tr>
<td>TOTAL COMPOSITE</td>
<td>.47</td>
</tr>
</tbody>
</table>
### Table A2

**Correlations between the Developmental Ability Scales - II (DAS-II) clusters / COMPOSITES and the NEPSY-II Theory of Mind Test** (Korkman, Kirk and Kemp, 2007)

<table>
<thead>
<tr>
<th>DAS-II: Clusters / COMPOSITES</th>
<th>NEPSY-II Theory of Mind Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal</td>
<td>.34</td>
</tr>
<tr>
<td>Nonverbal/Nonverbal Reasoning</td>
<td>.36</td>
</tr>
<tr>
<td>Spatial</td>
<td>.36</td>
</tr>
<tr>
<td>School Readiness</td>
<td>.38</td>
</tr>
<tr>
<td>Working Memory</td>
<td>.39</td>
</tr>
<tr>
<td>Processing Speed</td>
<td>.23</td>
</tr>
<tr>
<td>GENERAL CONCEPTUAL ABILITY</td>
<td>.44</td>
</tr>
<tr>
<td>SPECIAL NONVERBAL</td>
<td>.53</td>
</tr>
</tbody>
</table>

### Table A3

**Correlations between Bracken Basic Concepts Scale - 3: Receptive (BBCS:R) subtests/COMPOSITES and the NEPSY-II Theory of Mind Test** (Korkman, Kirk and Kemp, 2007)

<table>
<thead>
<tr>
<th>BBCS-3:R subtests / Composites</th>
<th>NEPSY-II Theory of Mind Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5 SRC</td>
<td>.34</td>
</tr>
<tr>
<td>Direction / Position</td>
<td>.39</td>
</tr>
<tr>
<td>Self / Social Awareness</td>
<td>.31</td>
</tr>
<tr>
<td>Texture / Material</td>
<td>.39</td>
</tr>
<tr>
<td>Quantity</td>
<td>.44</td>
</tr>
<tr>
<td>Time / Sequence</td>
<td>.35</td>
</tr>
<tr>
<td>RECEPTIVE SCHOOL READINESS</td>
<td>.32</td>
</tr>
<tr>
<td>RECEPTIVE TOTAL</td>
<td>.44</td>
</tr>
</tbody>
</table>
Table A4

Reliability Co-efficients by Age for NEPSY-II Theory of Mind: Total Score (ToM: Total) (Korkman, Kirk, Kemp, 2007)

<table>
<thead>
<tr>
<th>AGE</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-16 ToM: Total</td>
<td>.76</td>
<td>.76</td>
<td>.84</td>
<td>.84</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table A5

Decision Consistency Classification for the NEPSY-II Precentile Ranks by Age (Korkman, Kirk and Kemp, 2007)

<table>
<thead>
<tr>
<th>Age</th>
<th>3-4:11</th>
<th>5-6:11</th>
<th>7-8:11</th>
<th>9-10:11</th>
<th>11-12:11</th>
<th>13-16:11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory of Mind: Verbal</td>
<td>0.92</td>
<td>0.90</td>
<td>0.91</td>
<td>0.99</td>
<td>0.96</td>
<td>0.91</td>
</tr>
<tr>
<td>Theory of Mind: Total</td>
<td>-</td>
<td>-</td>
<td>0.96</td>
<td>0.99</td>
<td>0.96</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Table A6

Intercorrelations Among select RCFT Measures and WAIS-R Subtest / INDEXES for Brain Damaged Sample (Meyers and Meyers, 1995)

<table>
<thead>
<tr>
<th>WAIS-R</th>
<th>Immediate Recall</th>
<th>Delayed Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>.407*</td>
<td>.424*</td>
</tr>
<tr>
<td>Digit Span</td>
<td>.224</td>
<td>.152</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>.274</td>
<td>.287</td>
</tr>
<tr>
<td>Arithmetic</td>
<td>.250</td>
<td>.233</td>
</tr>
<tr>
<td>Comprehension</td>
<td>.373*</td>
<td>.363*</td>
</tr>
<tr>
<td>Similarities</td>
<td>.246</td>
<td>.208</td>
</tr>
<tr>
<td>Picture Completion</td>
<td>.375*</td>
<td>.323*</td>
</tr>
<tr>
<td>Picture Arrangement</td>
<td>.452*</td>
<td>.458*</td>
</tr>
<tr>
<td>Block Design</td>
<td>.455**</td>
<td>.451**</td>
</tr>
<tr>
<td>Object Assembly</td>
<td>.334</td>
<td>.370</td>
</tr>
<tr>
<td>Digit Symbol</td>
<td>.522***</td>
<td>.533***</td>
</tr>
<tr>
<td>Neuropsychological Measure</td>
<td>Immediate Recall</td>
<td>Delayed Recall</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>BVRT Total Correct</td>
<td>.493***</td>
<td>.491***</td>
</tr>
<tr>
<td>BVRT Error</td>
<td>.562***</td>
<td>.561***</td>
</tr>
<tr>
<td>RAVLT Trial 5</td>
<td>.548***</td>
<td>.532***</td>
</tr>
<tr>
<td>RAVLT Short Delay Free Recall</td>
<td>.470***</td>
<td>.492***</td>
</tr>
<tr>
<td>RAVLT Long Delay Free Recall</td>
<td>.445***</td>
<td>.458***</td>
</tr>
<tr>
<td>Benton Judgment of Line Orientation</td>
<td>.423</td>
<td>.434</td>
</tr>
<tr>
<td>Benton Visual Form Discrimination</td>
<td>.160</td>
<td>.142</td>
</tr>
<tr>
<td>Hooper Visual Organization Test</td>
<td>.345*</td>
<td>.381*</td>
</tr>
<tr>
<td>TMT Part A</td>
<td>.321**</td>
<td>.341**</td>
</tr>
<tr>
<td>TMT Part B</td>
<td>.486***</td>
<td>.494***</td>
</tr>
<tr>
<td>Token Test</td>
<td>.313**</td>
<td>.324**</td>
</tr>
<tr>
<td>Benton Sentence Repetition</td>
<td>-.069</td>
<td>-.062</td>
</tr>
<tr>
<td>Controlled Oral Word Fluency (FAS)</td>
<td>.150</td>
<td>.102</td>
</tr>
</tbody>
</table>

Note. BVRT= Benton Visual Retention Test; RAVLT= Rey Auditory Verbal Learning Test; TMT= Trail Making Test.
*p<.05. **p<.01. ***p<.001.
Table A8

Varimax Factor Loadings of select RCFT Variables for the Normative Sample (Meyers and Meyers, 1995)

<table>
<thead>
<tr>
<th>RCFT Variable</th>
<th>Visuospatial Recall</th>
<th>Visuospatial Recognition</th>
<th>Response Bias</th>
<th>Processing Speed</th>
<th>Constructional Ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate Recall</td>
<td>0.96111</td>
<td>0.08396</td>
<td>-0.05119</td>
<td>-0.03840</td>
<td>0.10154</td>
</tr>
<tr>
<td>Delayed Recall</td>
<td>0.94768</td>
<td>0.11941</td>
<td>-0.05327</td>
<td>-0.03627</td>
<td>0.15862</td>
</tr>
</tbody>
</table>

Note. Significant factor loadings are in bold print.

Table A8

Varimax Factor Loadings of select RCFT Variables for the Brain-Damaged Sample (Meyers and Meyers, 1995)

<table>
<thead>
<tr>
<th>RCFT Variable</th>
<th>Visuospatial Recall</th>
<th>Visuospatial Recognition</th>
<th>Response Bias</th>
<th>Processing Speed</th>
<th>Constructional Ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate Recall</td>
<td>0.93891</td>
<td>0.11742</td>
<td>0.17244</td>
<td>0.08204</td>
<td>0.22096</td>
</tr>
<tr>
<td>Delayed Recall</td>
<td>0.93703</td>
<td>0.10959</td>
<td>0.18503</td>
<td>0.09521</td>
<td>0.21702</td>
</tr>
</tbody>
</table>

Note. Significant factor loadings are in bold print.
Appendix B: Parental Informed Consent

University of Connecticut
Parental Permission Form for Participation in a Research Study

Principal Investigator: Orv Karan, Ph.D.

Student Researcher: Richard F. Gallini, M.S.

Study Title: Visual Spatial Memory Impacts Social Skills: Theory of Mind is Correlated With Visual Spatial Skills

Introduction
You and your child are invited to participate in a research study. The purpose of the study is to understand if a type of memory is related to the ability to understand that other people have thoughts and feelings different than ours, an idea called Theory of Mind. The researcher has been a School Psychologist for over 13 years. He currently works at Ridgefield High School.

Why is this study being done?
This research study is being done as part of the graduation requirement for the student researcher’s (Richard Gallini) Ph.D. program.

What are the study procedures? What will my child be asked to do?
Two tests will be given, a measure of Theory of Mind (this will take about 5 minutes to finish) and part of a memory test (this will take between 10 and 15 minutes to finish). Your permission will allow them to take both tests. Your permission only allows the researcher to use the scores that are part of these tests and your child’s age. You or your child will not be identified in any way.

What are the risks or inconveniences of the study?
The risk for taking the tests is very small. Your child may even find it fun. Your child will be taken out of class for approximately 20 minutes to finish both tests. This should not be unsettling as children move in and out of the classroom for many reasons. Your child’s teacher will make the final decision prior to their removal. So that your child’s privacy is protected, the testing will take place in a private room.
Because this researcher is not generally known to the community, being seen with this researcher is unlikely to be viewed negatively.

**What are the benefits of the study?**

While we hope this study will benefit our understanding of social skills and the impact of a type of memory on social skill development, your child will not directly benefit.

**Will my child receive payment for participation? Are there costs to participate?**

There are no costs to participate; there is no payment to be provided.

**How will my child’s information be protected?**

Your personal information will not be connected to the final research or the data after it is collected. The consent forms will be kept in a locked cabinet separate from the data. On each scoring sheet, the only information other than your child’s responses will be your child’s age in order to score the responses correctly and for statistics. After the test is scored, the scores and age will be copied into a spreadsheet. There are three scores that will be recorded. This sheet will be collected and kept separately. You or your child’s name will not be placed on the scoring sheet. At no time will any identifying information be included in the draft or final research. The final research will contain statistics representing all of the data, no single child’s scores of information will be included. Once the data is scored, it will not be able to be tracked to you or your child.

You should also know that the UConn Institutional Review Board (IRB) and the Office of Research Compliance may inspect study records as part of its auditing program, but these reviews will only focus on the researchers and not on your child’s responses or involvement. The IRB is a group of people who review research studies to protect the rights and welfare of research participants.

**Can my child stop being in the study and what are my and my child’s rights?**

Your child does not have to be in this study if you do not want them to participate. If you give permission for your child to be in the study, and later change your mind, you may withdraw your child at any time. There are no penalties or consequences if you decide that you do not want your child to participate.
Your child’s scores will not count toward their grade in school or shared on an individual basis with any school personnel other than the student researcher. Simply stated, your child’s test scores will in no way impact their education.

**Whom do I contact if I have questions about the study?**
Take as long as you like before you make a decision. We will be happy to answer any question you have about this study. If you have further questions about this project or if you have a research-related problem, you may contact the principal investigator, Dr. Orv Karan (860) 468-4031 or the student researcher Richard Gallini (203) 910-0000 or rgallini23@yahoo.com / rgallini@ridgefield.org. If you have any questions concerning your rights as a research subject, you may contact the University of Connecticut Institutional Review Board (IRB) at 860-486-8802.
Appendix C: Parental Consent Form

Parental Permission Form for Participation in a Research Study

University of Connecticut

Return Slip

Principal Investigator: Orv Karan, Ph.D.

Student Researcher: Richard F. Gallini, M.S.

Study Title: Visual Spatial Memory Impacts Social Skills: Theory of Mind is Correlated With Visual Spatial Memory

Documentation of Permission:

I have read this form and decided that I will give permission for my child to participate in the study described above. Its general purposes, the particulars of my child’s involvement and possible risks and inconveniences have been explained to my satisfaction. I understand that I can withdraw my child at any time. My signature also indicates that I have received a copy of this parental permission form. Please return this form to your child’s teacher by (insert date).

____________________  ____________________  __________
Child Signature:   Print Name:    Date:

____________________  ____________________  __________
Parent/Guardian Signature:  Print Name:    Date:

Relationship to Child (e.g. mother, father, guardian): ________________________________

____________________  ____________________  __________
Signature of Person   Print Name:    Date:

Obtaining Consent
Appendix D: Letter

Hi, my name is Rich Gallini. I am one of the two School Psychologists at Ridgefield High School and a Doctoral Student at the University of Connecticut. I’m writing because I am asking for parents to consider giving permission for their child to participate in a research study I am conducting.

To give you some background, I have been a School Psychologist for the past 13 years and have worked with children in all grade ranges. Though this is my second year in Ridgefield it has been a pleasure to work with the parents and students at the high school. Because of this I have been through all of the background checks of all permanent employees, in addition to having had the pleasure of spending time with your building principals. That said, my experience makes me believe that elementary aged students would help me to better demonstrate the purpose of my research. More on that in a minute…

First, it is important for you to know that your participation is completely voluntary. People choose not to participate for many reasons and this is an expected part of research. If you and your child choose to participate, and later change your mind, that is OK too. Again, the choice is yours at all times. What your child will do is some fun things for 15 to 20 minutes.

What am I asking? As I said, if you were to give me permission and your child also provides their assent after talking to your child’s teacher to find a good time, I will take your child for 15 to 20 minutes and administer two tests to them. Before doing that though, I would ask that you consider two issues. Children with significant language or fine motor issues will have difficulty participating. If those are not issues, in the first test they will look at a picture, copy it, and then redraw it a few minutes later. In the second test, they will look at pictures, listen to stories and give me answers to quick simple questions. The tests look at Visual-Spatial Memory and a concept called Theory of Mind (the idea that people understand that others have different thoughts and feelings). Finally, I would ask that participating students return their consent forms by ________________.

For your privacy your child’s name and/or any identifiable information will not be connected to the final research report. Your signed informed consent (the pages that follow) will be given a random three digit code which will also be placed on a protocol (the paper used to record responses) and those two documents will be maintained by me and kept separately. They are maintained to make certain that I have gained the proper permissions; in short they are maintained to protect you and your child. The consent (attached) form and researcher can provide more information.

Thank you for your time and consideration. If you have any questions please call me at (203) 910-0000 or email me (rgallini@ridgefield.org)

Rich Gallini, Student Researcher