Spring 2010

I Don’t Think I Know: Uncertainty Monitoring During a Mind Reading Task

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I Don't Think I Know: Uncertainty Monitoring During a Mind Reading Task

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April 13, 2010
Abstract

The purpose of the present experiment was to test individual metacognitive knowledge of theory of mind abilities. Male and female college students (N = 73) took the Reading the Mind in the Eyes test (RMET) developed by S. Baron-Cohen two consecutive times. This test is composed of picture clips of human eyes which are expressing different complex emotions and tests first order theory of mind (attribution of mental state). On the first trial (choice trial) participants were allowed to leave questions “Blank;” on the second trial (forced trial) participants were required to answer all of the questions on the test. Forty-three of the 73 students tested were used in the data analysis. There were no statistically significant differences in the number of participants who left “Blanks” on the choice trial as a function of gender. However, a gender difference was seen in the frequency of “Blanks” on the choice trial. Statistical analysis yielded support for the hypothesis that participants would leave questions “Blank” on the choice trial that they would answer correctly on the forced trial, that is, they knew more than they thought they knew when it came to the RMET. The study also revealed that participants did not use the option to leave questions “Blank” as effectively as they should have, meaning they decided to answer questions on the choice trial and answered them incorrectly. These results suggest that the participants tested had poor metacognitive knowledge in regards to their theory of mind abilities and highlight a previously unidentified role of under-confidence in this phenomenon.
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I Don’t Think I Know: Uncertainty Monitoring During a Mind Reading Task

Humans are inherently self reflective as well as social beings. Not only do they have the ability to experience their own minds, what they know and feel and think, but they have the capability to understand the thoughts and feelings of those around them. The interaction between personal awareness of one’s own knowledge about the mental states of others (metacognition or metacognitive knowledge) and actual ability to know what others are thinking and feeling (theory of mind or mindreading) is a fascinating topic being studied today, one which has applications for all different types of social interactions.

The awareness of ability, whether it be complex such as the ability to know another person’s mental state, or as simple as the ability to add and subtract, is akin to metacognition, thinking about thinking (Dimaggio, Lysaker, Carcione, Giuseppe, & Semerari, 2008). Metacognition allows humans to actively observe and evaluate their own knowledge, and it allows them to distinguish between what they know and what they do not know. Humans may be unaware that they possess certain abilities, or they may overestimate the abilities that they have (Washburn, 2005). For example, a person may be unaware of his or her ability to run a mile in 6 minutes until he or she gets timed running on a track. In this situation, the metacognitive assessment of abilities underestimates the actual capabilities that he or she possesses. The relationship between self-assessment and actual ability as applied to the interpretation of emotional states of others, termed theory of mind, has previously been addressed in the literature by Ickes (1993).
Reflecting upon or observing any social interaction clearly illustrates the need for researching a person’s ability to understand the emotions and expressions of another with whom he or she is interacting. Furthermore, for science to identify theory of mind (the ability to read people) is useless if an individual is unaware that he or she possesses that ability. Social situations require the need for humans to make an accurate assessment of what the other person they are interacting with is thinking and feeling. This is twofold: first being able to determine what the person is thinking or feeling and second the assessment, understanding that indeed it is known what the other person is feeling. For example, at work a person might be trying to discern from a facial expression if his or her boss is angry, sad, or joking about a new change in office protocol. Ascertaining the emotion of the boss (the ability) and then assessing that the discerned emotion is indeed the one that the boss is expressing (the awareness [metacognition]), will allow for an appropriate response which is vital for social interaction. Understanding the internal states of others not only helps better understand what an individual means by what he or she says, but it also gives the listener an important guideline for what is appropriate and inappropriate for any given situation (Salovey & Mayer, 1990).

Current research that will contribute to a better understanding of the relationship between metacognition and theory of mind is needed in order for applications of these two topics to be effectively implemented into everyday life. Dimaggio, et al. (2008) expanded by saying that the metacognition and ToM are widely represented in the literature as separate phenomena and called for further experimentation. Projects that consider both metacognition and ToM will more
accurately contribute to an understanding of the topics as they often occur interdependently outside of the laboratory. The following research seeks to assess the accuracy of individual awareness, metacognition, when considering the ability to correctly identify emotional expressions from picture clips of the eye region, a task that tests theory of mind abilities by using the *Reading the Mind in the Eyes* test, developed by Baron-Cohen in 1997 and revised in 2001.

**Theory of Mind**

When the definition of theory of mind (ToM) was first introduced by Premack and Woodruff (1978), it was twofold, including the awareness of one’s own mind as well as the minds of others. It opposes Descartes’ idea: “I think therefore I am,” that all an individual can know is that his or her own mind exists because he or she can contemplate its existence. Theory of mind takes a less skeptical approach and insinuates that if humans have an experience or “theory” of their own minds (understanding that their own minds exist and in that existence there is an “experience” of emotions, thoughts, beliefs and feelings), it cannot be separated completely from the understanding that other individuals also have a similar experience of mind. More recently, the term theory of mind has been used to describe the ability to read others’ thoughts, feelings, beliefs, and intentions (Maylor, Moulson, Muncer, & Taylor, 2002), which is equivalent to the expression “mindreading” which often appears in the literature. The terms “social-intelligence”
and "social-cognition" are often inaccurately used synonymously with ToM. theory of mind, such as being able to accurately label the emotions of a stranger, is a core social capacity, essential to social or emotional intelligence (Mayer 2000), but not equivalent to it. Realo (2003) labeled theory of mind a key ingredient in a much larger set of abilities that come together to make social competence (social-intelligence).

From an evolutionary perspective, the ability to know and understand another individual's state of mind, an entirely distinct and separate entity, is important to the degree in which it aids in survival and reproduction. Skuse (2003) revealed that humans have neural circuits specifically devoted to the detection of fear in others which were evolutionarily developed to recognize potentially life-threatening situations. The ability to detect fear is no less adaptive today than when it first evolved, but social demands have placed an even greater emphasis on being able to detect emotions in others beyond that of fear. Gavita (2005) emphasized the difficulty and importance of mind reading for social interaction saying, "Mind reading is one of the most difficult cognitive tasks people have to face. When people fail to read others' minds, they form incorrect impressions, take ineffective or inappropriate actions, and generally fail to coordinate their behavior with the attitudes and behavior of those around them" (Gavita, 2005, p 163). As external pressures change, it is no longer as necessary for humans to be able to outrun a tiger; instead they are required to climb the corporate ladder, a task that requires a different set of skills.

Ickes et al. in the 1980s and 1990s spent a substantial amount of time researching what they termed "empathic accuracy." Much like any other topic,
empathic accuracy has been defined differently depending on the author defining it. Ickes et al. (1990) tried to identify the main accepted components that constituted empathic accuracy: “The common elements in these definitions suggest that empathic accuracy is (a) a skill, ability, or facility (b) to understand, apprehend, infer, interpret (c) with accuracy (d) the private, covert, subjective (e) phenomenological reality, mental experience, thoughts and feelings (f) of some other person” (Ickes, 1990, p 733). This definition seems to be synonymous with the currently accepted definition for theory of mind, and it highlights the fact that ToM is a skill.

Realo (2003) identified theory of mind, at least at a “rudimentary level,” as an innate ability that all people share, with the exception of people suffering from psychological disorders. Baron-Cohen (1995) also concluded that theory of mind is innate. In addition Baron-Cohen recognized a unique course of development for ToM abilities. Children begin to develop basic theory of mind abilities around age 4, and those abilities have been shown to increase through age 11 (Baron-Cohen, O’Riodradan, 1999). The relationship of theory of mind and aging throughout the lifespan has presented another appealing area of study for psychologists. Phillips, McLean, and Allen (2002) found that older adults performed worse than young adults on the ToM eyes task (Baron-Cohen et al., 2001), in which mental state judgments must be made about pictures of the eye region. Slessor, Phillips, and Bull (2007) used two visual tasks, a video task by Sullivan and Ruffman (2004) and the Reading the Mind in the Eyes task by Baron-Cohen et al. (2001) to test for differences in younger adults (M=20.08 years) and older adults (M= 66.95 years). They found that on both of
the visual tasks, older adults scored significantly lower than the younger adult group (see Phillips et al., 2002; Sullivan & Ruffman, 2004 for similar findings).

Aside from age differences, a few other traits have been linked to ToM abilities. Around age 4, sex differences favoring females are seen in theory of mind tasks (Baron-Cohen, O’Riodradan, 1999) and Thomas and Fletcher (2003) have found that overall women accomplish mindreading tasks more accurately than men. The results of a study by Niedenthal et al. (2000) supported previous findings that on average women decode facial expressions better than men do, but surprising they identified an exception. Anger seemed to be the one expression that men were more capable of recognizing and decoding than women. The female’s enhanced mindreading ability seems to stay consistent throughout the lifespan, although gender and age alone are not enough to account for the variability seen in theory of mind tasks. Dimaggio et al. (2008) have searched for another piece of the puzzle and discovered that increased self-awareness is positively correlated with the ability to describe the emotional state of another. There has recently been evidence to link certain personality traits with ToM abilities. Matsumoto and Ekman (2000) developed a test called the Japanese and Caucasian Brief Affect Recognition Test (JACBART) to measure emotion recognition ability. They tested 363 college students with the newly designed test. In addition every participant completed the Big Five Inventory – 54 (John, 1989) which assesses each individual’s conscientiousness, openness, neuroticism, extraversion, and agreeableness. The results revealed that, in general, individuals who score high on openness, conscientiousness, and extraversion and low on neuroticism are more successful in recognizing emotional expressions.
Deficits in theory of mind abilities are a common thread in a number of psychological conditions that include a component of abnormal or impaired social interactions, as seen in cases of autism (Baron-Cohen, Leslie, & Firth, 1995; Baron-Cohen 1997), schizophrenia, (Brune, 2005) and affective bipolar disorder (Kerr, 2003). Baron-Cohen (1997) made the distinction that people with autism do not suffer from general cognitive deficiencies, but rather specifically struggle with mindreading. In 2001, when Baron-Cohen created and tested the revised Reading the Mind in the Eyes test (RMET), no correlation was found between IQ and RMET scores. This re-establishes Baron-Cohen’s findings in 1997 that mindreading, as a component of social intelligence, is distinct from other forms of intelligence or cognitive abilities. Further research is needed to explore the relationship between theory of mind and specific cognitive abilities. In studying schizophrenia, Lysaker, (2007); Dimaggio et al. (2008) have concluded that impaired theory of mind could possibly be explained by the inability of schizophrenic patients to recognize their own emotions. Lane and Schwartz (1987) noted that, as the level of emotional awareness increases, the differentiation of self from other becomes more detailed. Researchers continue to speculate that human beings need the ability to recognize emotions in themselves in order to be able to recognize emotions in the expressions and voices of others (Dimaggio et al., 2008).

Although suggestions about ways to enhance theory of mind abilities have been made, the exact mechanisms by which humans are able to understand the mental states of others are still not completely understood. The actual solution to enhance theory of mind is largely dependent on which of the two main theories, if either, is
correct. The “Simulation Theory” (ST) and the “Theory Theory” (TT) both seek to explain how humans have the ability to know the mind of another (Abu-Akel, 2003). The Simulation Theory suggests that humans understand minds outside their own by recreating or simulating the thoughts of another within their own minds. Simulation Theory suggests more than a “theory” of mind; we have a biological predisposition, a neurological mechanism which allows us to understand the minds of others. ST would say that viewing a sad emotional expression would cause the viewer to at least mentally replicate the emotion, and perhaps physically with his or her own face (facial mimicry). The viewer would thus begin to experience the emotion of sadness because those neural circuits were being activated in the brain. The Simulation Theory seems to be in direct congruence with the recent discovery of mirror neurons (Di Pellegrino, Fadiga, Fogassi, Gallese, & Rizzolatti, 1992). Mirror neurons are specific cells that were found to be activated in the brain of a monkey whether the monkey was physically carrying out a grasping task or watching an experimenter carry out that same task (Gallese, & Goldman, 1998). This discovery has perplexed and revolutionized neuropsychology because in essence it shows that, at least on a neuronal level, there is no way to differentiate between doing something and watching it be done. Further, evidence for mirror neurons has shown that they play a key role in understanding emotions such as pain (Singer, 2004) and disgust (Wiker, 2003).

The Theory Theory (TT), on the other hand, is called so to emphasize that humans have a “theory,” an idea of another’s mind not based upon a direct biological or neurological mechanism which functions in understanding the self. The TT is
based on what are believed to be basic truths and unspoken rules which develop independently from the concept of self and allow humans to understand the minds of other humans. In essence the TT states that humans understand the minds of others independently of understanding their own minds. Because it is more ambiguous and harder to study scientifically, the Theory Theory has seen much less attention in the literature. However, Vogeley, et al. (2001) conducted a study using functional Magnetic Resonance Imaging (fMRI) to view the activation of brain regions during self-reflective tasks and theory of mind tasks. The group discovered that although there is some overlap in the brain regions used to complete these two tasks. In the discussion of this research Vogeley et al (2001, p 176) concluded, “The fact, that differential brain loci in different brain lobes are activated associated with the attribution of SELF or with “mind-reading” of others (TOM) suggests that these components are implemented at least in part in different brain modules and thus constitute distinct cognitive processes.” This research supports the Theory Theory and lends itself to the explanation of the ability to distinguish between two minds, for a person to recognize that as an observer his or her emotions may not be congruent with the emotions of the actor. TT can also recognize the difference in the feeling or experience that accompanies carrying out an action as opposed to watching it be performed. In contrast, the Simulation Theory has difficulty accounting for the different “experience” of acting something out or watching it be done. For example, if a daughter is asked to clean the bathroom, she has a very different experience actually cleaning it than watching her brother clean it.
As is often the case, a combination of the two theories is likely to best explain theory of mind.

**Neurobiology of Theory of Mind**

If theory of mind is separate from general intelligence or other cognitive experiences, modern neuropsychology should, in theory, be able to identify particular areas of the brain that are active (receiving a greater supply of oxygen-rich blood) while executing theory of mind tasks that are distinct from other cognitive tasks. Recent brain imaging studies have pointed to the amygdala, often referred to as the emotion center of the brain, as a key structure in theory of mind tasks. Allman and Brothers (1994) identified the amygdala as essential for processing eye gaze and the expression of emotion. FMRI studies have supported the role of the amygdala by revealing that the autistic brain, which struggles with mindreading, shows no activity in the amygdala during the eye-reading tasks (Baron-Cohen 1999). Further, Kling and Brothers (1992) conducted a bilateral removal of the amygdala in monkeys, which resulted in significant decreases in social and affective behavior. Outside the amygdala, a number of other brain regions have been shown to play a role in ToM. This activity seems to be substantial in "structures in posterior and anterior regions of brain most consistently being the superior temporal sulcus and the medial prefrontal cortex, respectively. "Limbic–paralimbic structures have also been suggested to be part of the ToM circuitry most notably being the orbitofrontal cortex and the amygdala" (Abu-Akel, 2003, p 35). This neurobiological evidence supports theory of mind as a distinct ability which can be viewed and studied scientifically.
Testing Theory of Mind

Theory of mind allows individuals the ability to understand the relationships that exist between an external, observable state (such as body posture or a facial expression) and the internal state of the individual exhibiting the observable trait (Realo, 2003). The capacity for individuals to determine the state of mind of another person depending on which external cue is given can be tested in order to better understand the strengths, weaknesses, and individual differences that contribute to each person’s unique ToM abilities. A number of the different ways ToM has been tested in the past are alluded to above in describing the results of theory of mind studies. The majority of ToM studies have focused on children and populations with psychological disorders and more research on adults without disorders to understand the variability in theory of mind abilities, after the skill is acquired, would lead to a more comprehensive understanding of the topic. In general, theory of mind tasks involve reasoning about another person’s mental state. This could include beliefs, desires, emotions, or intentions (see Astington, Harris, & Olson, 1988; Baron-Cohen, Tager-Flusberg, & Cohen, 1993; Carruthers & Smith, 1996; Perner & Wimmer, 1985; Wimmer & Perner, 1983) which are the topics of interesting when testing individuals’ theory of mind.

Testing methods.

One of the most well-known theory of mind tasks for used to test children is called “false belief” tasks. These particular tests are used to identify at what age children have and established understanding that their mind is separate from other minds. False belief tasks are usually in story or picture-story form. Baron-Cohen et al.
used two characters, Sally and Anne. While Sally and Anne were both present in the same room, Sally placed a marble in her basket, location 1. Then, Sally left the room and Anne relocated the marble to her own basket, location 2. When Sally returned to the room the child was asked where Sally would look for the marble. If the child answered that Sally would look in her own basket, location 1, then the child passed the false belief task. This correct response indicated that the child understood that Sally did not know everything that the child knew. If the child answered Anne’s basket, location 2, the child failed the false belief task because the child did not understand the distinction between what he or she saw and knew and what someone else saw and knew (for an illustration of this experiment see Baron-Cohen et al., 1985). In this experiment Baron and Cohen found that 80% of autistic children failed the false belief task. This result was striking because the experiment also tested children with Down syndrome on the false belief task and only 14% of children with Down syndrome failed the test. This same type of task, with slight variations, is used in a number of experiments to establish the approximate age at which children develop theory of mind.

More specific to emotion recognition, Realo et al. (2003) used two tasks to assess mindreading ability through auditory and visual stimuli. The first task, Voice Expression Measure (VEM), asked participants to identify whether a spoken sentence (with neutral content) was expressed with anger, happiness, sadness, or no emotion. The visual task called the Facial Expression Measure (FEM) displayed slides from the JACFEE and JACNEUF (Matsumoto and Ekman, 1988). Each slide portrayed one of the 7 basic emotions: anger, contempt, disgust, fear, happiness, sadness, and surprise.
The participants were asked to check on answer sheets which one of the emotions was displayed for each slide (see Realo et al., 2003 for a more detailed description of ToM tasks used). Experiments also use video clips which show people acting out certain emotions as well as arranged one-on-one social interactions between two participants who had never been previously acquainted like the one used by Ickes (1993) described later. The FEM task used by Realo et al. (2003) is similar to the revised Reading the Mind in the Eyes test (RMET) that is used in the current study (described in methods section).

**Metacognition**

In day-to-day life situations, it is often necessary for humans to make self-assessments of and reflect on their personal knowledge, abilities, emotions, thoughts, and behaviors. The process of reflection, of thinking about thinking, is identified as metacognition. Flavell (1979) introduced the term metacognition as “knowledge and cognition of cognitive phenomena” (Flavell, 1979, p. 906). This definition requires an understanding of what processes are considered “cognitive phenomena,” a list that has continued to grow and change throughout the years. Flavell (1979) specifically identified memory and comprehension as two cognitive phenomena and noted that metacognition is a key component of processes such as language acquisition, attention, and social-cognition along with many others (see Flavell, 1979 for a complete list).
Scannell and Grouzet (2009) clarified metacognition and distinguished it from primary cognition (called cognitive phenomena by Flavell, 1979): “perceptions and evaluations are primary cognitions, or direct thoughts about objects, experiences, and people, metacognitions are secondary, higher-order cognitions in which we attend to, reflect upon, and sometimes attempt to control primary thoughts” (p 95). This definition not only clarified what metacognition is, but it also pointed out that, just as there are several distinct primary cognitions, there are multiple “metacognitions,” each one correlating respectively with the primary cognition that is being reflected upon. For example, the ability to remember a childhood pet is a primary cognition (memory). Metacognitive memory (also known as metamemory), the ability to reflect on the pet and to be actively recalling and assessing details of the memory for accuracy, is the metacognition that corresponds to the particular cognition.

Two subparts of metacognition, metacognitive knowledge and metacognitive experience, were first introduced by Falvell (1979) in his description of metacognition. Over the years, metacognitive knowledge has become known as the reflection and assessment of personal knowledge as evidenced by Scannel and Grouzzet (2009) explanation that metacognitive knowledge refers to personal judgments about one’s level of knowledge, in which the accuracy of retrieved knowledge is monitored. This has also been referred to as “metacognitive confidence” by Petty, Brinol, Tormala, and Wegener (2007) and “metacognitive monitoring” by Nelson and Narens (date). An example of this metacognitive knowledge process would be thinking to oneself *I know that two plus two equals four*. It also comprises the awareness of limitations in one’s personal knowledge.
The second component of metacognition, originally identified by Flavell (1979), is metacognitive experience (ME). Metacognitive experiences generally precede metacognitive monitoring (metacognitive knowledge) and are defined as what a person is aware of and what she or he feels when coming across a task and processing the information related to it (Efklides, Salonen, & Vauras, 2005). A metacognitive experience requires the conscious awareness of the thinking that is taking place at any given moment. Efklides (2008) further explained that metacognitive experiences are part of a person’s subjective experience which can include familiarity or difficulty of a task. For example, if a student is taking a math class and is trying to solve a homework problem and catches himself or herself thinking, *This is a hard problem*, he or she is having a metacognitive experience.

Flavell (1979) admitted that there is a substantial amount of overlap between metacognitive knowledge and metacognitive experience. However, an important distinction between the two is that metacognitive knowledge is not necessarily a conscious experience, whereas a metacognitive experience requires the conscious awareness of a cognitive process as it is taking place. In testing situations, like the two plus two equal four example, the two types of metacognition are dependent; there is a metacognitive experience of metacognitive knowledge. But the two can exist independently as well. For example, a metacognitive experience that is separate from metacognitive knowledge would occur if during a long lecture a student realized, *I am having a really hard time paying attention right now.*

Nelson and Narens (1990) identified another component (sub-category) of metacognition called cognitive control, which is defined as the ability to make a
decision preceding the execution of a behavior. In essence, it is freedom of choice, deciding what to do in any given situation. A judgment made in the mind of the student to skip a question while taking his or her Graduate Record Exams would be an example of cognitive control (Kornell, 2009). Cognitive control allows an individual to make educated decisions about behavior based upon the self-knowledge gained from metacognitive knowledge and experience. Thus, to combine the three elements of metacognition identified above into an example, when a student is being tested, the student would first have the metacognitive experience: *This problem is hard*; then he or she would use metacognitive knowledge: *I do not know the answer to this question*; and finally he or she would exercise cognitive control: *I am going to skip this question and move on to the next*. These components become particularly important in the study of metacognition because during an experiment where subjects are tested they engage in all three steps whether on a conscious or unconscious level.

Just as theory of mind is represented by a breadth of terms in the literature, metacognition and its subparts are often labeled inconsistently. A specific metacognitive ability such as metacognitive knowledge is sometimes referred to simply as metacognition. Dunning, Johnson, and Ehrlinger, (2003) defined metacognition as the ability to assess a response as correct or incorrect and used the term synonymously with “performance evaluation” and “self evaluation.” This definition of metacognition suggests that Dunning et al. (2003) was looking at the subcomponent of metacognition: metacognitive knowledge (defined above). Similarly, Kelemen, Frost, and Weaver (2000) identified metacognitive knowledge by using the term “metacognitive accuracy.” Similarly, “Self-reflection” has been used
synonymously with metacognition and has been an important area of study as far as
the implications of metacognitive abilities are concerned.

The use of the actual terms metacognitive knowledge and metacognitive
experience identified by Flavell (1979) have remained consistent over time and
across cultures as evidenced by the study of metacognition in Taiwan students by
Zabrucky et al. (2009). Despite slight alterations in the technical definitions (Flavell
(1979) focused primarily on knowledge and beliefs of people, strategizing, and tasks),
the integrity of the terms, as originally presented, has not been compromised. This is
confirmed by Flavell’s (1979) proposed applications of metacognitive knowledge: “It
[metacognitive knowledge] can lead you to select, evaluate, revise, and abandon
cognitive tasks, goals and strategies in light of their relationships with one another
and with your own abilities” (Flavell, 1979, p. 908). Flavell reestablished that
metacognitive knowledge was a precursor to metacognitive control, and is important
in making decisions and changing behaviors adaptively.

A primary focus of metacognition research over the last few years has been
the ways in which metacognition correlates with and can enhance learning and
problem solving. Schraw (1998) described that while cognition was important in the
execution of a task, metacognition was essential to understand how the task was
performed. This idea has carried over to a body of research that has identified
metacognitive knowledge as essential for strategizing and the thought processes that
precede problem solving. Specifically, solving difficult math problems has been
shown to be positively correlated with metacognition (Artzt & Armour-Thomas 1992;
Carr and Biddlecomb, 1998). In addition, Davidson and Sternberg (1998, p 57)
identified metacognition as a “vital element” in strategizing and problem solving. In 1998, Hacker emphasized that “the ability to consciously and deliberately monitor and regulate one’s knowledge, processes, and cognitive and affective states” is an inherent part of metacognition (p. 11). These “processes” encompass topics such as learning (Jacobson, 1998), memory, language processing (Hanten, Levin, & Song, 1999), effective study habits, and object recognition (Strack & Forster, 1998). Even the desire and ability to communicate, justify, and explain our thoughts to others and ourselves are dependent on metacognition (Schraw, 2001).

**Testing Metacognition**

The experience of assessing personal knowledge is often brought into conscious awareness during testing situations. Testing creates the need to reflect and assess individual knowledge. With humans, speech capabilities have allowed the use of self-reporting measures to study metacognition. Some questions address “Feeling of Knowing”: “How well do you feel like you know the information you studied?”; “If you were to be tested over the material in what percentage range would you expect to score?” In other cases, instructions require that participants give a “Confidence Rating”: “Rate how confident you are, on a scale from one to ten, that you just answered the question correctly.” These methods are used to get people to reflect on their own knowledge and allow a comparison between confidence in performance and actual performance to be made; in other words, they test metacognition and primary cognition.
Uncertainty monitoring

Another method to test metacognition is known as “uncertainty monitoring.” This type of testing answers questions of metacognition, particularly metacognitive knowledge, by using the ability that humans have to self-report when they do or do not know (Smith, Shields and Washburn, 2003). Uncertainty monitoring allows a “safe” answer choice that can be selected when an individual does not know the answer to a question. This is often known as a third answer choice or an “opt out” response. Over 100 years ago, ground-breaking studies allowed humans the opportunity to respond “uncertain” when they felt that they were unsure, or unable to respond to tasks that required them to identify the presence or absence of a stimulus such as sound or no sound. The uncertain response has also been used in trials which asked participants to discern whether an object was lighter or heavier than the previous object that had been presented to them (Smith, Shields, Allendoerfer, & Washburn, 1998).

Instead of having participants rate their own certainty, or measure their confidence, some experiments look specifically at the behavior of the subjects by presenting a third response option which is available to the subjects. In 1997 Smith, Shields, Schull, and Washburn conducted an experiment that used uncertainty monitoring on a computer task. They had participants sit at a computer and try to identify the number of pixels presented on the screen, earning points for a correct answer and losing points for an incorrect answer. If the screen contained 2,950 pixels or more, it was to be categorized as “dense”; if there were any amount fewer than 2,950 pixels, it was to be categorized as “sparse.” The subjects were also presented
with the “star” answer option which they could select if they were unable to
categorize the screen as sparse or dense. Selecting this answer choice would skip the
difficult trial and move on to another trial without lowering the participants’ scores.
The “star” option presented in the pixilated trials of Smith et al. (1997) is an example
of a behavioral response that allows the subject to skip the particular trial at hand and
move on to a more simple trial. Any question in which an individual chooses the
“star” is a self-report of individual uncertainty, when the person does not maintain a
strong confidence in his or her knowledge in relation to the particular question being
asked. Washburn (2005) used the pixilated sparse/dense task (described above) and
concluded that providing an “escape” or “opt-out” option allows participants to avoid
making errors by allowing them to skip or “escape” from questions to which they do
not know the answer. In the same experiment, it was noted that people monitor their
level of confidence and respond adaptively (by escaping the trials which were
extremely difficult to differentiate between) to uncertainty, although, the chance to
escape is never utilized to the extent that it is needed. A subject should opt-out of a
trial when their performance for the given task is no better than chance. That is,
subjects guess when they should opt-out.

**Individual Differences**

From a gender standpoint, Washburn’s experiment in 2005 revealed that men
are less likely than women to use an uncertain response, a task that requires
metacognitive knowledge. During this particular experiment, men opted out 16% of
the time while women opted out 23% of the time even though there was no gender
difference in ability to distinguish between sparse and dense trials. In relationship to
gender, Lunderber, Fox, and Puncochar (1994) summarized age-related findings: from 6th grade through graduate level education women have been found to be less confident in their performance on tests than men. This pattern is seen not only when performance shows equivalent competency between the sexes, but also when women exhibit greater proficiency than their male counterparts. This evidence suggests that men may be less likely than women to admit (through their behavior) that they do not know. Differences in confidence that consider gender in relation to social-cognition were addressed specifically by Gavita (2005). In the study, the Mind Reading Beliefs Scale (MBS) (originally developed by Realo, 2003) was used as an instrument to assess gender differences in beliefs about mind reading abilities. Results of the MBS scale showed a tendency for men to be more confident in their abilities than women when it comes to the metacognitive knowledge (beliefs) of mind reading capabilities (Gavita, 2005).

The relationship between the trends in sex differences which revealed that men use the uncertainty responses less often than women and that men score lower than women on the Reading the Mind in the Eyes test (see methods section) leads to the hypothesis that men are not only generally worse at reading emotion in the expression of others, but are also more likely to overestimate their accuracy/ability than women are (Gavita, 2005). These results emphasized a key relationship with metacognition: the less knowledgeable a person is in any given area, the less accurate he or she is in judging personal competence. Kruger and Dunning (1999) highlighted this effect by showing that among those least skilled in problem solving, perceptions of performance declined after subsequent training in the domain: as competence
increased, these perceivers seemed to show a growing awareness of their limited skills. In conjunction, Ames (2004) noted that the participants who were the most ineffective mind readers greatly overestimated their ability. Several authors (Davis & Kraus, 1997; Ickes, 1993; Realo et al., 2003) have found that not only does competence in general seem to be negatively correlated with accurate metacognitive knowledge, but specific to empathic abilities, confidence was also shown to be a poor predictor of actual success on theory of mind tasks. Realo (2003) expanded on the findings by saying that metacognitive abilities may best be explained and predicted in terms of personality traits which seem most likely to account for the variability when the difference in competence levels is controlled for.

**Metacognition and Theory of Mind**

Metacognition and theory of mind connect through a series of events. First, an individual (the observer) gathers sensory information from another person’s facial expression. Theory of mind allows that data to be internalized and translated into a meaningful message: *The face of that person is expressing a particular emotion (emotion X), one that reflects his or her state of mind.* Then, the metacognitive process then takes over, and the person contemplates the accuracy of his or her conclusion that emotion X is being expressed: *Is it really emotion X and not emotion Y or Z? Am I confident enough in my assessment of his or her emotion to act?* This metacognitive process is often largely subconscious; most of the time it is not
necessary to bring the decision into conscious awareness because humans perform this type of task daily. Regular practice reading emotional cues has made it almost second nature; it is a “gut feeling.” Ultimately, the assessment (result of metacognitive processes) leads to action or inaction in response to an emotional expression during any number of social situations encountered and as a result contributes to the enhancement or degradation of personal relationships.

During social interactions, like the one described above, theory of mind and metacognition work together in such a way that it can be difficult to distinguish one concept from the other. Consequently the topics are sometimes misrepresented, being grouped together as if they are the same. The strongest evidence to support that theory of mind and metacognition are distinct and separate entities comes from neurological and developmental research. Baron-Cohen (1997) concluded that developmentally, theory of mind is acquired independently of other cognitive abilities, such as metacognitive knowledge, and it originates in a pre-established course of development. Additional support from Baron-Cohen (1997) stated that this ability can be strengthened separately from other forms of cognition. If ToM were not a distinct ability, it would be strengthened simultaneously with other cognitive functions. Neurological evidence to support the differentiation between Theory of mind and metacognition has been found by Saxe et al. (2006) who conducted functional Magnetic Resonance Imaging (fMRI) studies which illustrated that while there are overlapping brain regions active during self reflection and theory of mind tasks, there are also unique and non-overlapping areas of the brain active during each task respectively. Finally, Baron-Cohen (1997) highlighted, that there are cases when
theory of mind may be impaired while other forms of cognition remain unaffected, as is the case with people who are diagnosed with autism. The reverse relationship, when theory of mind remains unaffected in the event of general cognitive impairment, has yet to be studied sufficiently (Dimaggio, 2008).

Relationships between theory of mind and metacognition have been identified and suggest that certain components of metacognition may serve as important precursors to theory of mind abilities. Lane and Schwartz (1987) observed that as the level of self-reflectivity and awareness increases, the more likely it is that a person will be able to distinguish his or her own emotional state from that of another. More recently, Dimaggio (2008) acknowledged that groups with strong self-reflective capabilities (a component of metacognition) performed better on identifying emotions from vocal and facial expressions than a group with limited self-reflective abilities. These preliminary findings have led to the hypothesis that in disorders such as Narcissistic Personality Disorder and Schizophrenia, where there is often decreased empathy for others, developing a deeper understanding of one’s own mental states should precede trying to strengthen theory of mind abilities (Dimaggio 2008). This is important because studies have shown that people often project their own moods such as happiness or sadness on the ambiguous faces of others (Niedenthal 2000), making them less accurate in identifying emotion in the facial expressions of others. Increased self-awareness could improve theory of mind abilities by decreasing the likelihood that a person would project their own feelings onto another person. With less self projection, it would be easier to accurately identify an emotion another
person was expressing, especially if the emotion of the other is opposite or different from what the observer is currently experiencing.

While theory of mind and metacognitive knowledge are not equivalent there may be ways in which the two abilities strengthen each other. Studies that consider theory of mind and metacognition suggest relatedness but do not necessarily lead to the conclusion that one will be an accurate predictor of the other. Ickes et al. (1990) studied the relationship between empathic accuracy or ToM and a self-reporting measure of mind reading abilities. In the study, a male and a female participant were introduced and their interaction was voice and video recorded. After the interaction, each participant was asked to infer the thoughts and feelings of the other person at specific points of the conversation where identifiable thoughts or feelings had been experienced (as noted by the subject experiencing the feelings). The participants were then asked to fill out a number of self-reporting measures; one in particular designed by Ickes (1988) focused on confidence of empathic accuracy. The results of the experiment revealed an unexpected negative correlation between the ability to accurately infer the thoughts and feelings of a stranger and the self-reported beliefs of empathic abilities. This study provides further evidence that as competence increases, confidence decreases (or becomes more realistic). The study proved that at the very least, the measure developed by Ickes in 1988 to evaluate a person's perception of his or her empathic abilities (the one used in the 1990 study) was not an accurate predictor of actual performance. The notion that self-predicted or self-evaluated performance is a poor predictor of actual mind reading abilities has been accepted throughout the psychological community largely based on Ickes' experiment (1988).
The current study seeks to test the idea that people tend to overestimate their theory of mind abilities. Very little research has actually tested the relationship between metacognitive knowledge and theory of mind abilities, although many assumptions have been drawn based on the study of each of these topics separately. A behavior-based measurement such as uncertainty monitoring, needs to be used to address awareness of ability as opposed to a self-report measure. In conjunction with uncertainty monitoring, a well-established theory of mind test, Reading the Mind in the Eyes, which presents emotions in a particularly challenging format, will be used. The task is challenging because it provides limited visual information, solely picture clips of the eye region, in which subjects are asked to ascertain the emotion being expressed. Under non-experimental conditions, humans are provided with an entire face conveying emotion, not just the eye region. Because this task is unfamiliar, it is proposed that subjects will be unaware of their abilities to accurately match the eye pictures with the appropriate emotion being expressed. Thus, it is hypothesized that the subjects know more than they think they know when it comes to Reading the Mind in the Eyes.

Methods

Subjects

Seventy-three Carroll College Developmental Psychology students were tested for this experiment. There were fifteen males and fifty-eight females ranging in age from
eighteen to twenty-two. The subject pool represented a variety of majors from undecided to History and Theology, although the class was comprised predominately of Nursing students (44). All thirty-six participants were tested using a within-subject repeated measure design in which each of the thirty-six individuals was tested on two conditions.

**Instruments**

S. Baron–Cohen and colleagues (2001) developed the *Reading the Mind in the Eyes* test to be a visual task which could accurately assess advanced first-order (attribution of emotional state) theory of mind abilities. The revised *Reading the Mind in the Eyes* task was designed to be a more sensitive measurement of identifying individual differences in theory of mind abilities than the original test developed by Baron-Cohen in 1997. The first test was much less difficult than the current model and ceiling effects, where a majority of people (without autism) achieved similar high scores, prevented it from effectively identifying individual differences and subtle impairments among groups of adults with a normal intelligence level (Baron-Cohen, Wheelwright, Jill, Raste, & Plumb, 2001). While taking the *RMET*, individuals seek to correctly identify the emotion being expressed by a stranger based on a picture of the eye region alone. The test is comprised of thirty-six picture clips which show a pair of eyes. Each set of eyes is accompanied by four words, each describing a particular emotion. One of the four word choices identifies the correct emotion of the eyes. The answer choices represent complex emotions, for example, “aghast,” “irritated,” and “affectionate,” rather than basic emotions such as “happy,” “sad,” or
"mad." The correct answer is termed the "target" word, and the other three are incorrect, called "foil" words. See Figure 1 for an example.

**Procedure**

A Power Point was constructed to deliver the RMET to a large group of people simultaneously. Each slide was composed of a picture of eyes, three accompanying foil words, and one target word. There were thirty-seven slides in all, thirty-six pictures that were counted as part of the test and one example slide to explain instructions to participants. In a lecture hall at Carroll College in Helena, MT. Participants were assembled for their regular Developmental Psychology Lecture. All thirty-six participants were given two answer sheets; answer sheet one was used to test the first condition and answer sheet two was used to test the second condition (see Appendix A for first answer sheet and B for the second). The two answer sheets were stapled together and were matched with a number. Participants were immediately instructed not to turn to the second page of the answer sheet and were monitored by experimenters. The experimenter then briefly explained that the participants had the opportunity to participate in a research experiment that would test their ability to read emotional expressions in the eyes of strangers. The participants were clearly informed that participation was optional, that they could quit at anytime throughout the experiment, and that they would remain anonymous throughout the entire study. No students declined participation in the study. Before the *RMET* began, participants were asked to identify gender and academic major on answer sheet. An example of a test question (not to be used in the actual test) was displayed on the screen at the front of the room in order to familiarize subjects with the test format.
The students were informed that subsequent slides would each be displayed for fifteen seconds. With thirty-six slides (example slide not included in actual test), the test took approximately eight minutes for each condition (two conditions) with about five minutes of explanation and set-up prior to each condition.

**Condition one: choice task.**

Answer sheet one, for the first exposure to the RMET, was supplied for the choice task of the experiment. This task allowed the students to use uncertainty monitoring, to respond uncertain, by writing “Blank” for any answer they did not know. This is the opt-out response. Instructions asked the students to write the emotion that each pair of eyes was expressing on their answer sheet on the line provided which was numbered corresponding to the number on the slide (all numbers in order, 1-36). They were allowed to only select emotion labels from the four words that were presented with each pair of eyes. For each set of eyes in which the students were uncertain about the emotion being expressed, they were asked to write “Blank” on the line for that picture (*identified as blank(s) hereafter*). While the example slide was still being displayed, students were verbally read the instructions which emphasized “A blank answer DOES NOT count as a wrong answer” and then asked to read the instructions on their answer sheets again themselves. See Appendix A for a copy of the answer sheet and instructions presented to the students during this condition. After the test was complete, the top answer sheet was then handed in to the experimenter.
Condition two: force task.

Answer sheet two, for the second exposure to the *Reading the Mind in the Eyes*, was the force task of the experiment. The instructions were delivered in the same manner as they had been in the Choice Task, but a new set of instructions displayed on answer sheet two, was read aloud. The forced task did not allow the participants to opt out of any questions on the *RMET*. The instructions from the experimenter and on the answer sheet clearly stated “You MUST NOT leave any answers blank” (see Appendix B for a copy of the answer sheet and instructions presented to the students during testing). After the power point ended, the second answer sheets were collected and the participants were debriefed on theory of mind and metacognition.

Results

Participants Used in Data Analysis

Of the 73 participants tested on conditions one and two, 43 (58.9%) expressed uncertainty by writing “Blank” for one or more questions on the *Reading the Mind in the Eyes* test. These 43 participants will be the focus of the data analysis since they represent the independent variable being considered in this study: number of questions left blank during choice trial, which represents what the participants thought that they did not know. The dependent variable (number of blanks correct on forced trial) can only be considered in terms of the hypothesis if there were blanks on
the choice trial. If the participants think they know everything, then there is no way to draw a conclusion that they know more than they think they know.

**Uncertainty Monitoring and Gender**

When broken down by gender, 35 out of 58 females, 60.34% (M = .603, SD = .516), and 8 out of 15 males, 53.33% (M = .533, SD = .4933), expressed uncertainty on at least one of the test items. A z test for two sample means was used to analyze the data and no significant difference between males’ and females’ tendency to respond “uncertain” was found, z (N = 73) = .485, p > .313.

**Frequency of Uncertain Responses by Gender**

Gender was also considered in terms of the frequency of responses. A one-tailed, two sample t test was used to analyze the number of uncertain responses between females (M = 4.57, SD = 3.38) and males (M = 2.5, SD = 1.92). A significant difference was found between the number of uncertain responses the males use in relationship to the females, t (41) = 1.66, p = .052.

**Number of Blanks Incorrect**

To discover if the participants used the uncertain response effectively and skipped questions on the choice that they really didn’t know (answered incorrect on the forced), a paired two sample t test was used. A significant difference between number of blanks (M = 4.53, SD = 3.19) and number of blanks incorrect (M = 1.67, SD = 1.58) was found, t (42) = 7.61, p < 9.87E-10.

**Better Than Chance**

On the forced trial, participants correctly answered 63.07% of the questions that they had left blank on the choice trial (M = .63, SD = .336). Despite a very large
standard deviation, a one-tailed t-test revealed that the data were significant, \( t(42) = 7.42, p < 6.38691 \times 10^{-9} \), and the alternative hypothesis was accepted. The true value was tested using a confidence interval \( \text{CI}_{.95} = 53.03\%, 73.11\% \).

**Ineffective Use of “Blank” Response**

A paired two-sample t-test was used to analyze if participants effectively opted out of the questions that their performance showed they did not know on the choice trial. Statistically significant differences were found between the number of questions participants answered on the choice trial (\( M = 31.46, \ SD = 3.19 \)) and the number of those questions that were answered correctly (\( M = 25.53, \ SD = 4.30 \)), \( t(42) = 9.51, p < 2.38 \times 10^{-12} \).

**Discussion**

**Gender Results**

Previous findings of gender differences in uncertainty monitoring suggested that a similar gender difference, where more men than women expressed uncertainty, would be seen. The first gender analysis was the only one to include the entire sample, 73 participants. Because not all participants expressed uncertainty, it provided a unique and unpredicted opportunity to analyze if there was a sex difference in willingness to express uncertainty to at least one of the questions. The data analysis assigned a “1” to anyone who responded blank to at least once and a “0” to anyone who did not express any uncertainty (left no questions blank). This coding
system allowed for an average number to be found which could be converted to the percent of males or females respectively who expressed some uncertainty. The null hypothesis states that the averaged codes of females who showed uncertainty (equivalent to the percent of females uncertain) will be greater than or equal to the averaged codes of males who showed uncertainty (equivalent to the percent of males uncertain). \( H_0: \mu_{\text{females uncertain}} \geq \mu_{\text{males uncertain}} \). The alternative hypothesis stated that there would be a greater percentage of females who responded uncertain than the percentage of males. \( H_a: \mu_{\text{females uncertain}} < \mu_{\text{males uncertain}} \). The data analysis revealed that in this experiment there was no significant difference between the percents of males and females to express at least some uncertainty (1 or more questions blank) and therefore failed to reject the null. Females appeared to be indistinguishable from males in their willingness to opt out of trials on the Reading the Mind in the Eyes test.

The number of uncertain responses as a function of gender was also considered in the data analysis. As previously discussed, Washburn (2005) suggested that men use the uncertain response less often than women and therefore the alternative hypothesis represented the expectation that the average number of uncertain responses would be lower for males than for females. \( H_a: \mu_{\text{males}} < \mu_{\text{females}} \). The null hypothesis, that males would respond blank at an equal rate or more than females \( H_0: \mu_{\text{males}} \geq \mu_{\text{females}} \) was rejected, as the data analysis showed that men did indeed use the blank responses less frequently than females.
Know More Than They Think They Know

In order to find out if the participants knew more about the emotional expressions of the strangers pictured in the *Reading the Mind in the Eyes* test than they thought that they knew (also known as under-confidence) both the relationship between answers on the choice trial and the forced trial were analyzed. The questions left blank on the choice trial were the participants' behavioral expression of uncertainty (what they did not think they knew). Correct answers on the force trial were a measurement of what the participants' actually knew. The forced trial eliminated the participants' ability to behaviorally express uncertainty, because they had to answer the question whether or not they thought they knew the correct answer. To answer the question of knowing more than the participants thought they knew, the analysis of the forced trial was particularly focused on the questions that had been left blank on the choice trial. Questions previously left blank on choice were then looked at on the choice trial to see if the participant answered them correctly when forced. The null hypothesis, $H_0: \mu_{\text{blanks}} = \mu_{\text{blanks incorrect}}$, was that the number of blanks on the choice trial would be equivalent to the number of those questions that were answered incorrectly on the second trial, called "blanks incorrect" hereafter. An example of the null hypothesis in action would be if a participant had left three questions blank on the choice trial and then when forced to answer those questions on the forced trial, answered all three of those questions incorrectly. This would suggest that the participants were opting out effectively, and that their metacognitive knowledge of what they knew vs. what they did not know was accurate. The alternative hypothesis, $H_a: \mu_{\text{blanks}} > \mu_{\text{blanks incorrect}}$ the main hypothesis for this study,
states that the number of blanks left on the choice trial would be greater than the number of those questions answered incorrectly on the forced trial. The alternative hypothesis would suggest that participants left questions blank they did not need to leave blank because their performance on the force trial revealed that the correct answer was known. Participant number 54 from the current study provides an example of data which illustrates the alternative hypothesis. Participant 54 was a female, who left 8 questions blank on the choice trial, and then on the forced trial she correctly answered 6 of those 8 questions. Therefore, her number of blanks incorrect would be 2 (8 blanks – 6 correct) and therefore, number of blanks, $8 > \text{blanks incorrect}$, 2.

As in the example of participant 54, the trend seen throughout the study was that participants left significantly more questions blank on the choice than they answered incorrectly (of those questions initially left blank) on the forced trial. The data analysis allowed a rejection of the null hypothesis, supporting that the participants knew more than they thought they knew. In other words, their actual knowledge about the emotional states of other people being ascertained from picture clips of eyes, their theory of mind, exceeds their metacognitive awareness of this ability.

**Better Than Chance**

To support the main hypothesis of the current study, a second hypothesis that compared results to chance was needed. On the forced trial, any participant could merely guess on the questions he or she had previously left blank and chance would dictate that 25% of those questions would be answered correctly. To verify that
participants really knew more than they thought they knew and not that they merely guessed correctly on questions they left blank on the choice trial, the data analysis compared the percent of the questions that had been left blank on the choice that were correct on the forced trial to chance, 25%. The alternative hypothesis stated that participants would answer significantly more than 25% of questions that they had opted out of correct on the forced trial: $H_a: \mu > 25%$. The null hypothesis stated that the percent of previously skipped questions answered correctly on the forced trial would not be statistically distinguishable from chance, $H_0: \mu \leq 25\%$. The data analysis revealed that students did significantly better than chance with a p value far below .001. A test to determine the confidence interval reported with 95% confidence that the true percentage of questions known but left blank on choice is approximately 63% plus or minus 10%. Even if the true percentage was 53%, that number is more than twice the likelihood of chance, further emphasizing the significance of the results that participants knew significantly more than what they thought they knew.

When applied to metacognition and theory of mind, these results suggest that the participants' metacognitive abilities were not accurate in assessing what information they knew vs. what information they did not know. Performance indicated that the participants metacognitive monitoring vastly underestimated their actual theory of mind abilities on the trials where they had expressed uncertainty. These results are important because they suggest that the participants possess theory of mind abilities that they are largely unaware of and are not effective at implementing.
Ineffective Use of The “Blank” Response

A final component to be analyzed is if participants used the opportunity to leave questions blank as often as they should. In other words, how well were they able to identify questions to which they did not know the answer? If the participants were good at identifying the questions they did not know the answer to, then they would leave all of those questions that they did not know blank on the choice trial, and therefore they would not incorrectly answer any questions on the choice trial. This data analysis was conducted to see (despite participants knowing more than they think they know on the questions they opted out of) it is possible that they know less than they think they know as well. The choice trial, because participants had the option to leave any question that they did not know the answer to blank, answering any given question was a self-report that the participants believed they knew the correct answer to that question. The null hypothesis for this analysis, $H_0: \mu_{\text{answered}} = \mu_{\text{correct}}$, states that the number of questions answered on the choice trial would be equivalent to the number of questions answered correctly on the choice trial. In other words, everything the participants thought they knew (and therefore answered) on the choice trial, they actually knew and therefore answered correctly.

The alternative hypothesis, $H_a: \mu_{\text{answered}} > \mu_{\text{correct}}$, stated that the number of questions answered on the choice trial would be greater than the number of correct answers on the choice trial. This would mean that the participants did not use the opportunity to leave questions blank as often as they should because they answered questions their performance showed they did not know. Results showed that indeed participants did not opt out as much as they should. These results are representing
only the data of the 43 participants who left blanks on the choice trial. Thirty of the
73 participants originally tested in the study did not opt out at all, which further
supports that the participants did not opt out as effectively as they should (since not
one of the participants scored 100% on the RMET).

Results of the current study revealed that people have poor metacognitive
knowledge of their theory of mind skills, supporting the findings of Ickes (1990;
1993). However, this study expands upon the conclusions made by Ickes (1990) by
showing that participants seem to lie simultaneously on separate ends of the
spectrum: they know more than they think they know and at the same time less than
they think they know. Participants opted out of trials on which their performance
demonstrated accuracy (that they knew), but they also failed to opt out of a number of
trials in which their performance suggested that they did not know. The trend of
under-confidence, where participants opt out of trials in which their abilities are
sufficient, seen in the study, has not been identified in the literature. In fact,
Washburn (2005) commented that people rarely escape trials in which their
performance testifies to their abilities to respond correctly. The novel results in this
study may very likely be attributed to the difficulty of the Reading the Mind in the
Eyes test and testify to the complexities of reading emotion in the expressions of
strangers, a task identified by Gavita (2005) as one of the most difficult cognitive
tasks. Difficulty appears in the literature to be directly correlated with accurate use of
the opt out response. Smith (2003) summarized findings from developmental
literature which recognized that with increasing task difficulty there is a
corresponding decrease in ability to use the uncertain response effectively.
On the other hand, overconfidence, participants knowing less than they think they know, is well documented as people often respond in a way that greatly overestimates their individual abilities (Dunning et al., 2003; Washburn, 2005; Alicke, 1985; Dunning, Meyerowitz, & Holzberg, 1989; Taylor & Brown, 1988).

Ickes (1990) proposed that people seldom provide verbal explanations to correct conclusions that are drawn about an emotional experience they are having. For example, if a person is extremely upset with their performance on a test and this emotion causes them to be quieter than is usual for that person, the behavior may be labeled by peers as “tired” or “angry”. The person being mislabeled is not likely to correct them (especially if they are strangers or acquaintances) to explain that they are really sad. It is not common practice to walk around outwardly labeling the emotions of the strangers that are encountered on a daily basis. Even in the rare event that an individual outwardly identified the presumed emotion of a another person, whether to be polite, or for the sake of saving time and breath, the person who’s emotion is being labeled is unlikely to correct the labeler. In other words, when dealing with strangers, corrective feedback about true emotions and feelings is very seldom offered. This lack of feedback prevents learning from occurring, and the same mislabeling of emotion is likely to reoccur in encounters that follow.

The results of the study failed to support a gender difference in overall likelihood to respond blank. This, in large part, could be the result of a disproportionate sample size of men and women. However, the unequal sample sizes did not compromise the other gender analysis that was done, which showed that men used the uncertain response less frequently than women. Precautionary measures
should be taken in future studies by incorporating an equal number of males and females.

Since the gender analyses were the only tests in the study that looked at two groups instead of matched pairs, they highlighted that personality variables could be confounding the two-group analysis. Personality is starting to become a focus in metacognition research in hopes of explaining the variations that are seen in metacognitive knowledge. Factors such as need for achievement, the big five personality traits: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (Bidferano & Yun Dai, 2007), self-esteem (Davis & Kraus, 1997), narcissism (Ames et al., 2004), and other trait inventories should be included in future assessments of metacognitive knowledge.

One of the main weaknesses of the study was the lack of a motivator. Since the participants remained anonymous throughout the study, there was little motivation or reason for them to do their best on the Reading the Mind in the Eyes test. Often during uncertainty monitoring tasks, participants are losing points in a game for a wrong answer; with animals other types of aversive stimuli are presented such as a shock or a loud undesirable tone. Smith (2003) pointed out that the smaller the penalty, the less of a need to escape or opt out of trials. A future study which uses an effective penalty, a reason (with high enough stakes) that participants do not want to get the answer wrong, or a positive motivator for doing well, such as extra credit points or money, may strengthen the trend that was seen in this study, that participants opt out even when their performance on those trials is high.
Future Research

The statistically significant trend of under-confidence found in the study reveals an opportunity for a new focus in the study of metacognition. Understanding personality traits and other factors that may influence a participant to skip a question he or she knows the answer to is an intriguing reason to continue studying differences in metacognitive knowledge. This study raises the question of why: "Why are participants unaware of their abilities to read and understand others?" Perhaps the answer lies in a lack of education or understanding that could be remedied through classes that enhance the awareness of Emotional Intelligence and individual abilities.

In the real world, being under-confident in theory of mind abilities could potentially be more harmful than being overconfident because of metacognitive control, the ability to plan and make decisions to act. If a person is over-confident they are likely to act on that feeling of confidence and their actions or assumptions could be corrected if they were incorrect. On the other hand, if a person is under-confident they are unlikely to act and thus, potentially leaving alone a situation that could benefit from some action or attention. For example, if the uncertainty causes a police officer to second-guess his assessment of the look of fear in a young girl’s eyes as she talks to an older man, and thus his uncertainty keeps him from approaching her to address the situation, the repercussions could be traumatic. Without accurate awareness, a potentially romantic relationship could go unexplored if the look of desire goes unrecognized between two friends. Regardless of the situation, there is no denying the importance of being able to read social cues through the facial expressions of others. If research can shed light onto the characteristics, traits, and other factors that
contribute to under-confidence, as well as to over-confidence, then there is the potential to strengthen both theory of mind and the metacognitive awareness of the ability. Optimal social interactions are most likely to be experienced when both theory of mind and metacognitive awareness work together effectively. Theory of mind is an ability, just like the ability to solve a math problem. Metacognition allows us to monitor that ability. If, for example, a student does not have strong abilities to solve a calculus problem that is written on a white board in the front of his or her classroom, then he or she uses metacognitive knowledge to decide to raise his or her hand when the teacher asks if anyone has any questions about how to solve the problem. The ability to monitor knowledge helps people adapt to situations and learn how to better address them in the future. In a similar manner, metacognition can serve as a check-and-balance system to make up for what theory of mind abilities lack: asking questions when theory of mind abilities are insufficient and acting properly when they suffice.
References


Table 1

Uncertainty Expressed By Gender

<table>
<thead>
<tr>
<th>Uncertainty Expressed By Gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td># that expressed uncertainty</td>
<td>8</td>
<td>35</td>
<td>43</td>
</tr>
<tr>
<td>Total number surveyed</td>
<td>15</td>
<td>58</td>
<td>73</td>
</tr>
<tr>
<td>Percent Expressing Uncertainty</td>
<td>53.33%</td>
<td>60.34%</td>
<td>58.90%</td>
</tr>
</tbody>
</table>

*Note:* There was no significant difference between the number of males and the number of females who used the blank answer response. Percent of males and females who expressed uncertainty were calculated by dividing the number of people (respective to the gender being calculated) who wrote blank for at least one question on the *Reading the Mind in the Eyes* test by the total number of people of that specific gender that were tested.
Table 2

*Frequency of Blanks by Gender*

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td># of participants observed</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>Average Number of Blanks</td>
<td>3.5</td>
<td>4.571428571</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>2.386719207</td>
<td>3.380617019</td>
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</tbody>
</table>

*Note:* Data considered the 43 participants who expressed uncertainty by writing “Blank” for at least one question on the choice trial of the *Reading the Mind in the Eyes* test. There was a significant difference found between the frequency that males and females used the “Blank” answer response. Females used the “Blank” response more frequently than males.
Table 3

**Blanks Correct on Forced**

<table>
<thead>
<tr>
<th></th>
<th>Blanks</th>
<th>Number of Blanks Correct on Forced</th>
<th>Percent of Blanks Correct on Forced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>4.534884</td>
<td>2.860465116</td>
<td>61.12%</td>
</tr>
<tr>
<td>St. Dev</td>
<td>3.194853</td>
<td>2.464813287</td>
<td>33.6%</td>
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<tr>
<td>Chance</td>
<td>-</td>
<td>-</td>
<td>25%</td>
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*Note:* The data considered the 43 participants who expressed uncertainty by writing “Blank” for at least one question on the choice trial of the *Reading the Mind in the Eyes* test. The average number of blanks was calculated by taking the sum of the number of blank responses from each participant and divided by 43. Male and Female data was not separated in this calculation. “Number of Blanks Correct on Forced” refers to the number of questions that participants answered correctly on the forced trial that they had written “Blank” for on the choice trial. This number represents the extent to which participants knew more than they thought they knew. The “Chance” percent expresses that out of the 4 answer choices given with each picture clip of eyes, if participants were merely guessing, it would be expected that they would get 25% of the questions right on the force trial that they had left blank on the choice trial. There was a statistically significant difference between the “Percent of “Blanks” Correct on Forced” and what would have been expected due to chance.
Table 4

*Answered vs. Correct on Choice*

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<tr>
<th></th>
<th>Correct on choice</th>
<th>Answered on Choice</th>
<th>Percent of Correct Answers on Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>25.53488372</td>
<td>31.46511628</td>
<td>81%</td>
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<tr>
<td>St. Dev</td>
<td>4.300325775</td>
<td>3.194853281</td>
<td>12%</td>
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*Note:* The data considered the 43 participants who expressed uncertainty by writing “Blank” for at least one question on the choice trial of the *Reading the Mind in the Eyes* test. If participants were metacognitively monitoring their theory of mind abilities with 100% accuracy, they would have only answered the questions on the choice trial that they actually knew and therefore got correct. If this was the case, the “Percent of Correct Answers on Choice” would have been 100%, meaning that every question answered was answered correctly. The data shows 81% average percent correct when forced which illustrates that participants answered questions on the choice trial that they actually did not know. Data analysis revealed statistically significant results that participants did not opt-out as much as they should and therefore *knew less than they thought that they knew*. 
Figure Caption

*Figure 1.* An example of a question from the *Reading the Mind in the Eyes* test. The figure displays the exact same format as the test, with 3 foil words and 1 target word flanking the picture. The target word for the following example is playful.
playful

comforting

irritated

bored
Figure Caption

*Figure 2.* The graph charts the number of questions left “Blank” on the choice trial, represented by a dashed line, for all of the 43 participants who had written “Blank” for at least one of the questions on the choice trial. The number of those questions left “Blank” on the choice trial that were correct on the forced trial are represented by the solid line. Finally, to visually compare the number of questions participants answered correctly on forced compared to chance, the dotted line on the bottom shows out of the number of questions left “Blank” for each participant, how many questions would be expected to be answered correctly as a result of chance, 25%.
What They Didn't Think They Knew Vs. What They Knew

![Graph showing the number of blanks on a forced choice test compared to the expected number due to chance across participants.](image-url)
Appendix A

Participant #1

Please indicate your gender: Male    Female

Please indicate your major: ____________

Instructions: For the eyes that appear on the screen in front of you please indicate out of the 4 choices given what emotion best describes the actor’s facial expression. It is important that you answer all of the questions, DO NOT leave any questions “Blank.” The point of this experiment is to get as few questions wrong as possible, so do your best. Thank you and good luck!

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14 __________________________ 32 __________________________
15 __________________________ 33 __________________________
16 __________________________ 34 __________________________
17 __________________________ 35 __________________________
18 __________________________ 36 __________________________
Appendix B

Participant # 1

Please indicate your gender: Male   Female

Instructions: For the eyes that appear on the screen in front of you please indicate out of the 4 choices given what emotion best describes the actor’s facial expression. It is important that you answer only the questions that you know. For the questions in which you are unsure or do not know write “Blank” on the line for that question. The point of this experiment is to get as few questions wrong as possible. A “Blank” answer DOES NOT count as a wrong answer. You are allowed to leave as many questions “Blank” as you want. Thank you and good luck

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