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Theory of Mind and Deception Ability

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Theory of Mind and Deception Detection

by

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Abstract

Social based strategies such as deception may require a theory of mind. Individuals with developmental disorders have deficits in deception that may be related to deficits in ToM. Individuals in the general population may have similar deficits. Participants were asked to rate the believability of videotaped actors. We found an inverse relationship between autistic and schizotypal tendencies and deception detection. Increased self-awareness scores were related to increased confidence when determining the believability of an actor. Results suggest deception detection is related to both self-awareness and Theory of mind.

Theory of Mind and Deception

Self-awareness can be defined as the ability to introspect or understand one's own thoughts and motives. To date, only humans and chimpanzees have been able to definitively pass the mirror test of self-awareness (SA). This test, developed by Gordon Gallup in 1970, has been used to identify self-conscious species. After exposure to a mirror, a mark is conspicuously placed on the forehead. If the mark is recognized then the organism most likely possesses self-awareness. This higher order cognition may be the fundamental building block for several socially based abilities (Gallup, 1998).

In humans, self-awareness can be broken down into two distinct components: public and private self-awareness. Public self-awareness is the ability to understand how others view you socially, while private self-awareness in the ability to understand one's own thoughts and motives (Fenigstein, Scheier, & Buss, 1975). Individual differences in self-awareness can result in distinctive differences in other abilities, such as theory of mind ability, which is the ability to take another person's mental state into account (Premack and Woodruff, 1978).

Lewis (1992) was able to demonstrate the relationship between self-awareness and mental state attribution by studying children as they develop these skills. The mirror test was used; it was given to children in the same fashion as the chimpanzees, with the exception of the anesthesia. The mark was placed on the child's head when the child is distracted or sleeping. Most children pass the mirror test by the age of 18 months, with

nearly all children passing the test by the time they reach two years of age. The ability to recognize one's own face is highly correlated with another developmental milestone, the development of embarrassment. Specifically, Lewis found that self-related emotions such as embarrassment usually develop simultaneously with SA, while emotions that are not self-related (such as fear) do not develop at this time. Lewis also noted that the ability to attribute mental states to others develops after the development of SA, around three years of age. However, because some children still fail certain, more advanced, ToM tasks, it is likely that the ability to understand false beliefs develops later in normally developing children (Frith, 2000).

Gallup (1998) also refers to this developmental milestone at around two years of age. Between the ages of one to two years old a child is unable to recognize him or herself in the mirror. Starting around the age of two, a child begins to develop social intelligence skills such as self-recognition, the use of personal pronouns, prosocial behavior, self-conscious play, perspective taking, and pretend play. These abilities eventually lead one to become aware of other people's experiences and intentions, and social strategies that require introspection begin to emerge (deception, sympathy, empathy, gratitude, grudging, and sorrow).

Social interaction often requires one to be able to predict or understand another person's thoughts and self-awareness is advantageous because it gives one insight into what another person may be thinking. The ability to use this insight has been termed theory of mind (Premack & Woodruff, 1979). Premack & Woodruff's experiment was the first to suggest that chimpanzees may have Theory of Mind (ToM). A fourteen year old chimpanzee was able to infer mental states from a human actor, in a variety of

troubling circumstances (e.g. shivering because of a malfunctioning heater), and predict the actor's response to the situation. To date, the chimpanzee is the only non-human species that has demonstrated the ability to use theory of mind.

There are many advantages that come with ToM ability. One such advantage is deception. The ability to attribute thoughts to another person may be necessary for the social based strategy of deception, which allows one to gain a competitive advantage over their opponent. Using theory of mind (ToM) one can make inferences about another person's thoughts by using one's own thoughts as a model. Inferences can be made about another person's thoughts and one can subsequently employ the proper deceptive technique to manipulate the person's thoughts (Gallup, 1998). Self-awareness seems to be critical if one is to employ ToM and use deception successfully. An individual's deception ability appears to be related to their level of self-awareness and theory of mind ability. Individuals with low theory of mind ability and low self-awareness seem to also have deficits in deception and deception detection ability. Similarly, individuals with high private self-awareness tend to be better at deceiving others (Johnson et al., 2005).

Autism is a pervasive developmental disorder (PDD) that is characterized by social deficits. It is also a unique case in which there are marked impairments in theory of mind ability and perhaps in self-consciousness as well. This would mean that an autistic individual has difficulty understanding both his own mind and the mind of others. Levels of introspection, in individuals with autism, correlate with theory of mind ability (Frith and Happe, 1999). High levels of introspection are found in individuals with superior theory of mind ability, while individuals with low theory of mind ability tend to have

little to no introspection. This suggests that impairments in SA are often accompanied by impairments in ToM.

Baron-Cohen, Leslie, and Frith (1985), postulate that deficits common in autism, such as abnormalities in social development, communication development, and pretend play, are a result of an inability to mind read. A false belief test, known as the Sally-Anne task, was developed by Baron-Cohen, Leslie, & Frith to assess the autistic child's theory of mind ability. The task requires one to make inferences about a person's beliefs based on an illustrated scenario depicting two characters, Sally and Anne. The task involves Sally (a doll) putting her marble in a covered basket and then leaving the room; Anne (another doll) comes into the room and moves Sally's marble to a box sitting next to the basket. Sally comes back into the room.

Twenty autistic children and controls (14 children with MR and 27 typically developing children) were asked a question about Sally's beliefs (i.e. Where will Sally look for the ball?). The children with autism answered the question based on their own beliefs rather than the character's beliefs. That is, they did not understand that other people may have beliefs and desires different from their own, and that these beliefs cause them to behave in a certain way (intentionality). Most of the control children were able to answer correctly; based on the character's beliefs rather than their own.

Baron-Cohen, Leslie, and Frith (1986) were able to replicate these results in a follow up study using different methodology. A picture sequencing task was presented to twenty-one children with autism, fifteen children with Down's syndrome, and twenty-seven typically developing children. The children were asked to arrange pictures into a correct sequence and were then asked to narrate. There were three categories of picture

sequences: mechanical, behavioral, and intentional. Only one category required the use of mental state attribution, the intentional category.

The children with autism accelerated at the mechanical picture sequencing; they performed significantly better than the typically developing children. However, their performance on the picture sequencing task, that involved mental state attribution, was significantly worse than the typically developing children. The fact that the children with autism were able to correctly sequence the behavioral pictures but not intentional pictures suggests that their poor performance was due to a theory of mind deficit rather than an inability to understand sequencing. The narrative data is consistent with this conclusion; the children with autism rarely used language to refer to mental states but were able to use language to describe behavior.

Although testing for an understanding of false beliefs is an adequate way of measuring theory of mind, there are other abilities that require mental state attribution, which should also be tested. Leslie and Frith (1988) employed a limited knowledge condition, in addition to a false belief condition, to further test theory of mind ability in children with autism. The task was set up so that the child could see two tally counters being hidden. The first counter was in the presence of a second experimenter, while the second counter was hidden in the absence of the second experimenter. The child was then tested to make sure that they could remember where both counters were hidden, and the second experimenter's presence/absence during the hiding process was brought to the child's attention. The child was then asked to predict where the experimenter would look when he came back into the room.

The results of this study support the idea that children with autism have a limited ability to understand what another person believes. Children with autism, with a MA of over seven years, had poor performance on both the limited knowledge and the false belief tasks. Their performance was at 36% taking both tasks into account; a failure on one task was predictive of a failure on the other task. Since twelve children with specific language impairment outperformed the eighteen children with autism, deficits in language can be ruled out as a cause of failure. Deficits in the concept of seeing/not seeing can also be ruled out as the cause of failure, since all children passed this test prior to the experiment. The most logical explanation for failure to produce a correct response is an inability to use meta-representation.

Similar results were found in a study conducted by Perner, Frith, Leslie, and Leekam (1989). The task involved showing children a box of Smarties and asking them "What do you think is in here?" After the child replied "Smarties", the experimenter then opened the box to reveal it contents, a pencil. The child is then asked two follow up questions pertaining to the child's knowledge and beliefs. The first question the child was asked is "what is in here?". The second question the child was asked was "When I first asked you, what did you say was in here?" The child was then told that there was another child coming in and that he/she was going to be asked the same question about the Smarties box. The child is then asked to predict what the next child will say is in the box.

Twenty -three children with autism performed significantly worse on the Smarties task than did the linguistically impaired controls (two girls and ten boys). The autistic children had the same response pattern as the autistic children in the previously mentioned experiments (Perner et al. 1989; Baron-Cohen et al. 1985, 1986; Leslie and

Frith 1988); their response reflected their own knowledge rather than the knowledge of another child. Only four of the twenty-three children with autism were able to answer the prediction question correctly, whereas only one linguistically impaired child did not answer correctly. This indicates that linguistic ability is not the cause of failure to predict another child's response. These results are supportive of the growing literature that indicates a deficit in theory of mind ability in children with autism.

Autism is not the only PDD group that shows diminished ToM capacity. An examination of ToM ability in children with schizophrenia revealed that, significant deficits in theory of mind ability do exist, even though they may not be as pronounced as the deficits seen in autism. In a study examining these deficits, children with schizophrenia were matched to typical children and children with autism for mental age, verbal mental age, and performance mental age. They were given a deception task, a false belief task, and a fact and value belief task. The researchers found that the children with schizophrenia had difficulty understanding false beliefs, which suggests that they have only a limited understanding of other people's intentions (Pilowsky, Yirmiya, Arbelle, Mozes, 2000).

Selective impairments in ToM ability have also been found in schizophrenic adults (Mazza, De Risio, Surian, Roncone, Casacchia, 2001). Thirty-five subjects were given four ToM stories, which were read by the experimenter and accompanied by cartoon pictures. Two of the stories tested first order belief, while the other two stories tested second order belief. The schizophrenic group performed significantly worse than the normal controls on all four of the ToM tasks. However, there were differences in ability among the different schizophrenia sub-groups, with the psychomotor group

performing worse than the disorganized and the reality distortion group on three out of four of the stories.

In schizophrenic individuals, it is likely that ToM ability will vary with the heterogeneity of the disorder. According to Frith (1992) there are some positive symptoms that are more likely to be associated with ToM ability. These positive symptoms, such as paranoid delusions, may result from the inability to understand another person's intentions. Corcoran, Mercer, and Frith's (1995) study provides more evidence for this argument. Participants were fifty-five schizophrenic patients, fourteen psychiatric controls, and thirty normal controls. Schizophrenics were divided into six subgroups (negative symptoms, paranoid with positive features, incoherent, passivity, undifferentiated, and those in remission). The participants were given a social inference task in which they had to identify the real intentions behind indirect speech utterances. The utterances served as a hint to the real intentions of the character in the story.

Results of this study indicate that schizophrenics, as a whole, performed worse than both control groups on the hinting task. When the schizophrenic group was divided into subgroups it was found that there were two groups that performed worse than the others. The two groups were schizophrenic patients with negative features and patients with paranoid delusions and related positive features. Frith (1992) also concludes that ToM ability is associated with positive symptoms in paranoid schizophrenics. This may indicate that deficits theory of mind ability may be more impaired in paranoid schizophrenics with positive features. These results may explain the variability of schizophrenic patient's performance in the literature.

Further evidence for ToM deficits in schizophrenia come from neuroimaging data. Schizophrenics may have abnormal brain functioning that may be associated with the deficits in theory of mind. The deficit can be seen in a PET study involving seven schizophrenic patients (Brunet, Sarfati, Hardy-Bayle, & Decety, 2003). The patients were given three different types of stories during PET scan. Only one type of story required the attribution of intentions (AI) and the other two did not (physical causality with human subjects and physical causality with objects). As expected, the schizophrenic group performed significantly worse than the eight healthy controls on the attribution of intention task. The PET scan revealed that the brain activity during the task differed between the groups. During the AI condition the healthy controls had activity in the right prefrontal cortex but the schizophrenic patients did not. It may be that the important ToM areas of the brain fail to become active in schizophrenic patients.

Another study that examined mental state attribution in the schizophrenic brain also found under activation in the prefrontal cortex (Russell, Rubia, Bullmore, Soni, Suckling, Brammer, et al., 2000). Participants performed the mind in the eyes task. The task involved looking at eyes and deciding which emotion the person is feeling. Five schizophrenic patients had very poor performance on the task when compared to seven healthy controls; the MRI revealed that the schizophrenics had less activation in the left inferior frontal gyrus.

In a review of the literature, Vogeley, Kurthen, Falkai, and Maier (1999) suggest that the prefrontal cortex (PFC) and its association areas are disrupted in schizophrenia. They also suggest that it is the PFC that is involved in consciousness, the self-model, and theory of mind, and that dysfunction of the PFC, may cause impairment in these areas.

There have been several studies that have results supportive of this view. A similar hypothesis can be found in the case of autism. There are several review papers that point to the PFC dysfunction as the cause of disruption in both the self model and theory of mind ability (Frith, 1992; Bradshaw and Shepard, 2000; Shalom, 2000; Frith and Frith, 2000). Some key studies involving autism and the PFC, mentioned in these reviews, will be discussed.

In a PET study, five individuals with Asperger's syndrome were found to have less activation than six normal controls in the medial prefrontal region of the brain during a theory of mind task (Happe, Ehlers, Fletcher, Frith, Johannson, Gillberg et al., 1996). The task involved reading stories and answering questions that either required understanding mental states or did not require mental state knowledge. Both the Asperger's group and the control group answered both types of questions correctly. However, the Asperger's group used a different part of the frontal cortex than did the controls. The results are quite interesting, even when individuals on the autism spectrum are able to answer questions pertaining to mental states they do not use the same brain regions that is noted in the literature (medial prefrontal cortex).

A study using fMRI also found that individuals with autism access different areas of the brain than do controls during a mental state attribution task (Baron-Cohen, Ring, Wheelwright, Bullmore, Brammer, Simmons, et al., 1999). The study consisted of six participants diagnosed with either autism or Asperger's syndrome and twelve matched controls. The participants were given a theory of mind task in which they had to determine the emotion being expressed in pictures of eyes (similar to the mind in the eyes task). The controls outperformed both clinical groups. It was found that the autism group

did not show as much activation as the controls in the frontal region of the brain and showed less activation in the MPC (although not statistically significant). Further, the amygdala was activated in the controls but not at all active in the individuals with autism. Consistent with Happe et al. (1996) these results provide evidence for abnormal processing of mental state attribution in individuals with autism.

There is research that suggests that SA, ToM, and deception can all be localized to the frontal brain regions, with a possible right hemisphere advantage. Damages to these brain regions tend to cause deficits in the ability to understand second order beliefs and deception, much like the deficits seen in autism and schizophrenia. Several of these studies will be discussed in detail.

Self-awareness and theory of mind may share activation in the right prefrontal cortex (Vogeley, Bussfield, Newman, Herrmann, Happe, et al., 2001). To investigate this possibility researchers recruited eight right handed male volunteers to participate in an fMRI study. The participants were given a collection of short stories to read and answer questions about. There were five conditions: stories involving only the self, stories involving only another person, stories involving the self and another person, and two control conditions (i.e. unlinked sentences and physical stories).

The stories that involved thinking about the 'self only' produced significant activity in the anterior cingulate and the superior frontal cortex, while stories that involved 'other only' thought produced activity in the right-tempo-parietal junction. These areas were found to be the unique neural mechanisms for self and ToM, respectively. However, stories that involved self and other thought produced activity in

the right prefrontal cortex suggesting a common neural mechanism for both self and ToM.

In a similar study, investigating the neural correlates of self-awareness and ToM, Platek, Keenan, Gallup, and Mohamed (2004) found comparable results in an fMRI study. Five right handed subjects were shown pictures of their own face, a familiar famous face, and images from the mind in the eyes task, which assesses ability to see emotion in a person's eyes. They were instructed to think about who the picture was of during the face conditions and were asked to think about the mental state of the person in the image during the mind in the eyes task.

Results of this study support the idea that there may be a common neural mechanism for SA and ToM. Right hemisphere activation was found for both SA and ToM and there was significant overlap between the areas of activation during the mental state attribution task and the self face task. This overlap was found in the right superior and middle frontal gyri. The study is consistent with Vogeley et al. (2001) in that in supports a common neural mechanism for both the attribution of mental states and the processing of self related information and stimuli.

There is a vast amount of research that found that deficits in ToM and self-awareness are often followed by an inability to use and detect deception. Stuss, Gallup, and Alexander (2001) found that damage to the right prefrontal cortex impairs a person's ability to draw inferences about what another person is thinking, which leads to impaired deception detection ability. The researchers examined theory of mind and deception ability in patients with frontal and non-frontal lesions. The participants were divided into

five distinct groups: patients with bifrontal, right frontal, left frontal, left non-frontal, and right non-frontal lesions.

Participants were given two tasks, an inference task and a deception-detection task. For both tasks something was hidden under one of three cups, and the participant had to choose the correct cup. Before the experiment, the participants were given a chance to wear glasses that the assistant would later be wearing. There were two pairs of glasses, one had opaque lenses and the other had clear lenses. The experimenter hid the ball, behind a closed curtain, while the assistant was watching. The participant was then told to choose the cup the ball was under with the help of the assistant. During the inference condition an assistant was given either the opaque or clear glasses, the participant knew which pair. If the assistant was wearing the clear glasses he always provided the participant with the correct answer. If the assistant was wearing the opaque glasses he always provided the participant with the wrong answer. During the deception-detection the glasses were not used. Participants were asked to identify which cup a quarter was hidden under. If the participant pointed to the correct cup they could keep the quarter. Assistants knew where the quarter was and 'helped' the participants choose cups. Assistants always deceived the participant by pointing to the wrong cup.

Stuss et al. (2001) found differences between the patient groups on two of the tasks. All of the participants passed the baseline task and inference condition. However, participants with right frontal and bifrontal damage did not perform well on a second inference condition, transfer inference. The transfer inference condition was identical to the inference condition, with one exception. Instead of wearing glasses, the assistant either sat next to the participant, who could not see where the ball was hidden, or next to

the experimenter, who hid the ball. Participants with bifrontal damage also had poor deception task performance. Patients with bifrontal damage were also likely to have medial frontal damage, which may have contributed to their inference and deception deficits. Overall, the results indicate that bilateral frontal, and possibly right frontal patients, are unable to incorporate another person's deception into their plans. This is consistent with Vogeley et al. 2001 and Platek et al. 2004 who suggest a right frontal dominance in SA and ToM ability.

Another study, which also tested participants with damage to the right hemisphere found similar results. Patients with brain damage were tested to see if they were capable of understanding first and second order beliefs. If a person can accurately describe another person's beliefs about the world, they are capable of understanding first order beliefs. A second order belief requires a person to be able to understand one person's belief about another person's belief. The authors concluded that right hemisphere damage may impair one's ability to understand second order beliefs, which may be necessary in order to understand lies (Winner, Brownell, Happe, Blum, & Pincus, 1998). Participants were thirteen stroke patients with right hemisphere damage and twenty controls. Patients were given short stories, which either ended with the main character making an ironic joke or telling a lie to conceal a sneaky act, such as stealing money. The participant knows that the second character in the story has witnessed the sneaky act (joke stories) or has not witnessed the sneaky act (lie stories). When the story ended with an ironic joke, the main character was attempting to cover up his wrongful act with a joke in order to make light of an embarrassing situation. When the story ended in a lie, the main character was not aware that the listener knew the truth, so the speaker expected that the listener

would believe what was said. The task tested the participant's ability to distinguish lies from jokes.

Consistent with Stuss et al. (2001), right hemisphere brain damaged (RHD) patients were more impaired at understanding second order belief questions when compared to the control group (Winner et al., 1998). The RHD patients also had more difficulty with first order belief questions, although not statistically significant. RHD patients were also impaired in their ability to distinguish lies from jokes. The RHD patient's inability to understand second order beliefs and failure to distinguish lies from jokes were highly correlated (r =. 71). The authors conclude that right hemisphere damage may impair one's ability to understand second order beliefs, which may be necessary in order to differentiate lies from jokes.

It is not surprising that deception relies on the cognitive mechanisms of self-awareness and theory of mind since understanding one's own mind, and the mind of another person, is crucial if one is to create a believable lie. There is evidence that deception relies on the same neural systems as ToM and SA. The major area that is found to be active during these tasks is the prefrontal cortex.

In an fMRI study, it was found that the PFC is predominately involved in deception. Activity was found in the bilateral ventrolateral prefrontal and medial premotor cortices when lying (Spence, Farrow, Herford, Wilkinson, Zeng, & Woodruff, 2001). There were thirty participants in this study; however, only ten males were examined in the fMRI scanner. Participants were asked to fill out a questionnaire that assessed the activities that they engaged in that day. The task required the participants to both tell the truth and lie about the activities that they did before arriving at the

experiment (e.g. brushed teeth). The questions were presented to participants in an auditory and visual mode in the fMRI scanner.

Another fMRI study sought to examine the neural correlates during different types of lies (Ganis, Kosslyn, Stose, Thompson, and Yurgelun-Todd, 2003). Results indicate that different brain activity is present for different types of lies, however, there are brain regions that are consistently employed for deception purposes. The deception conditions (memorized and spontaneous lies) produced more activation in the prefrontal cortex when compared to the truth condition. Participants were three males and seven females. The lies were either memorized lies or spontaneous lies. Memorized lies were lies that were constructed and rehearsed minutes earlier, while spontaneous lies were not previously constructed and rehearsed. The participants answered questions about their memorable experiences; they were asked to answer in one of three ways: truthfully, with a spontaneous lie, with a memorized lie. All three lie types produced activation of the prefrontal cortex.

A guilty knowledge paradigm is often used to create a true to life deception scenario in the laboratory. A participant is asked to "steal an item" or is told exclusive information. They are then asked to either lie or tell the truth about the item that they stole or the information that they know. Langleben et al. (2002) used fMRI to examine the correlates of deception in eighteen participants. A guilty knowledge paradigm was used. A picture of a playing card was presented to the participants. The task required that the participants either lie or tell the truth about the card that they had in their possession (e.g. Do you have the ace of spades?). The participants lied and told the truth an equal

number of times. A twenty-dollar reward was given to the participant if they were able to conceal the identity of their card from the computer.

The researchers found that the anterior cingulate and the superior frontal gyrus as significant brain regions associated with deception during the guilty knowledge task. The superior frontal gyrus was also more active during the deception response, when compared to the truth response. This area (the superior frontal gyrus) has also been found to be active during theory of mind tasks and a self and famous face identification task (Platek et al. 2004).

Support for the idea, that SA, theory of mind, and the ability to deceive are related, comes from several different areas of research. These areas of research include development, comparative, and abnormal psychology. Self-awareness and theory of mind may be necessary in order to understand and manipulate the thoughts of another person. Only organisms that possess self-awareness (i.e. humans and chimpanzees) demonstrate that they are capable of employing intentional deception (Byrne & Whiten, 1998). The same is true for children; self-awareness and ToM ability typically precede the ability to deceive. Only children with Self-awareness and at least some ToM ability seem to understand and be capable of employing deception (Gallup, 1998; Lewis, 1992). In addition, individuals with PDD often have deficits in both ToM and deception (Baron-Cohen et al. 1985, 1986; Brunet et al., 2003; Corcoran et al., 1995; Frith; 1992; Frith and Happe,; Mazza et al., 20011999; Perner et al., 1989; Pilowsky et al., 2000). These results have also been demonstrated in participants with brain damage (Stuss et al., 2001; Winner et al, 1998); that is, deficits in Self-awareness and ToM are associated with decreased deception ability. This remarkable relationship between ToM, self-awareness,

and deception may be the result of a shared neural circuit, most likely in the prefrontal cortex (Ganis et al., 2003; Langleben et al., 2002; Platek et al., 2004; Stuss et al., 2001; Vogeley et al., 2001).

The present study examines ToM ability and its relationship to deception detection in the general population. Since ToM ability is diminished in individuals with autism and schizophrenia, individuals in the general population who have autistic and schizotypal tendencies should also have diminished ToM ability. In addition, deficits in ToM ability should cause individuals to be inferior at deception detection. Therefore, individuals with increased autistic tendencies should exhibit decreased deception ability. A number of scales will be used to assess these relationships in the general population.

Autistic and schizophrenic tendencies can be seen in individuals who are not diagnosed with these disorders. Baron-Cohen (2003) developed a questionnaire, the Autism Quotient, to assess autistic tendencies in normal individuals. In addition, the empathy questionnaire (EQ) and the mind in the eyes (MIE) test were developed to assess ToM ability in the general population. The EQ is a written questionnaire, while the MIE requires the participant to determine a person's emotion by looking at a person's eyes. Similarly, Raine (1991) developed a questionnaire to assess schizotypal personality traits in the general population.

Method

Participants

Participants were 49 Montclair State University undergraduate students. All participants were recruited from a subject pool derived from undergraduate classes. In addition, twelve people (six males, six females) were recruited from the general

population to serve as actors. The actors were recruited from outside of Montclair State University to avoid familiarity with the participants. None of the actors were professional, and all reported only a minimum of acting experience (e.g., school play).

Participants were asked to sign a consent form before they participated in the experiment. All participants were treated according to the ethical guidelines of the American Psychological Association.

Materials

Each actor prepared three video segments, according to a script provided by the researchers. Each of the segments lasted approximately 30-45 seconds. The actors were filmed from the shoulders up under bright lighting conditions. Each actor was given a few minutes to practice their script until they felt comfortable and natural in their presentation.

The actors were asked to introduce themselves and to give biographical information for all three segments. Biographical information included: age, height, weight, current residency, occupation, salary, occupation aspiration for 10 years from now, number of days a weeks spent at the gym, does/does not want family, and desired number of children. Each actor prepared a video clip for all three of the conditions: faking bad, faking good, and truth. In both the faking bad and faking good conditions, the actors were asked to exaggerate their biographical information according to gender differences in deception (Dimoulas et al., 1997). Faking good was defined as presenting biographical information that a person of the opposite sex would be expected to desire. For example, a female 'faking good' would decrease her desired number of children in order to suggest she is not interested in a committed relationship, while a male would

increase his desired number of children to indicate that he is willing to make an exclusive paternal investment in one female. The faking bad condition is the reverse of the faking good condition; for example, males would decrease their desirability by decreasing the number of children they would like to have. In the truth condition, participants provided accurate information. Three videos were prepared for this experiment. Each actor appeared only once in a video. Each video consisted of 12 actors, six males and six females. Each videotape consisted of two males and two females in each of the three conditions (fake bad, fake good, truth).

Procedure

A series of classrooms were used for testing, each classroom contained a 25-inch monitor and a VCR. Participants were asked to complete a series of questionnaires before viewing the video segments. All participants completed these surveys within 20 minutes. The first questionnaire consisted of questions regarding basic demographics. Next, participants were given the Schizotypal Personality Questionnaire (SPQ)—full version (Raine, 1991) and the Self-Consciousness Scale (SCS: Fenigstein et al. 1971). The SPQ was developed to assess schizotypal personality disorder, using DSM-III-VR criteria, in a normal population. The SCS evaluates one's self-awareness, using two subscales. The private subscale evaluates one's awareness of their feelings, thoughts, and motives, while the public subscale evaluates one's ability to understand how other people view them socially.

In addition to the SPQ and SCS, participants were given a number of theory of mind tasks. The MIE task required that the participant read another person's emotion by observing their eyes (Baron-Cohen, 2003). Two other questionnaires were given to the

participants, the Empathy Quotient (EQ) and the Autism Quotient (AQ) (Baron-Cohen, 2003). The EQ was designed to measure empathy in the general population and the AQ was designed to assess autistic tendencies in the general population (for scoring see Baron-Cohen, 2003).

For the video portion of the experiment, the principal investigator played the 12 segments from only one of the videotapes. There were 15-second pauses between each of the segments (actors). During this pause each participant answered two questions. First, they indicated if they believed the actor was being truthful or deceitful. Second, using a 5-point Likert scale, they were asked to indicate how confident they were in their responses from 1 (*Not at all confident*) to 5 (*Very confident*). The videos were only played once. Following the completion of the video portion of the experiment, the participants were debriefed.

SPQ Scoring

Answers to questions on the SPQ were given numerical values. A yes response (indicating more schizotypal characteristics) was assigned a numerical value of 1, while a no response received a numerical value of 2. Numerical Values for all questions were added to obtain a total SPQ score for each participant. Scores ranged from 74 (lowest possible score) to 148 (highest possible score).

Results

First, the correlation within the ToM variables (MIE, AQ, and EQ) was examined. It was found that the AQ correlated with the MIE ($r(47)= -.51$, $p<.001$) and EQ ($r(47)= -.33$, $p<.001$) scales. The nature of the correlation confirmed the hypothesis that ToM abilities would decrease as autistic tendencies increased. Interestingly, there was no

correlation between the MIE and EQ ($r(47)= .01$, $p>.05$). This finding may imply that cognitive and emotional ToM abilities vary independently.

Next, the SA variables were examined. It was found that the SCS private correlated with the SCS public ($r(46)= .55$, $p<.001$) and the SPQ scales ($r(46)= .32$, $p<.03$). These data replicate previous findings that the SCS private scale measures SA (Fenigstein, Scheier, Buss, 1975). There was no correlation, however, between the SPQ and the SCS public scale ($r(47)= .14$, $p>.05$).

In terms of the ToM and SA variables, it was found that there was a significant correlation between the SPQ and the MIE ($r(47)= .29$, $p<.05$) and the SPQ and the EQ scales ($r(47)= .34$, $p<.02$). The nature of the relationship was such that an increase in SA (as measured by the SPQ) resulted in an increase in TOM(as measured by the MIE and EQ). There were no other correlations between any SA and ToM variables. Because there were no adjustments for multiple comparisons, these relationships were considered marginally significant.

Each of the ToM variables (MIE, EQ, and AQ) were averaged together to generate a ToM composite score (ToMc), with a reverse scoring for the AQ. The same was done for the SA, resulting in a Sac. The Sac consisted of a combined score for the SPQ and the Self-Consciousness Scale. It was found that these composite scores significantly correlated with each other ($r(47)=.39$, $p<.006$) indicating that increased SA is related to increased TOM. In other words, the more self-aware one becomes the better they are at "mind reading".

Deception detection was examined using three different measures. The first was accuracy, which was simply a measure of correct/incorrect percentage. The second

measure was confidence, which was the indication of how confident the participants were in their response. The final measure was a combination of the (accuracy and confidence). This average was computed by assigning incorrect answers a score of 0 and correct answers a score of 1 to measure accuracy. For each point of confidence, the score was moved towards the extreme 1. Correct answers, with low confidence, were given .5, while incorrect answers, with low confidence, were given a -.5. The adjusted average gave the highest total score (4.5) to a correct responder with high confidence. The lowest possible total score was given to an incorrect responder with high confidence (-4.5). Therefore, the midpoint was hypothetical 0.

The average accuracy was 55.1% (SD=13.2%). Employing a single-df t-test, it was found that accuracy was significantly greater than chance ($t(48)=2.72$, $p<.009$). The average confidence rating was 3.42 (SD=.51). This was significantly greater than the midpoint (2.5) indicating the participants were above average confidence in terms of their response ($t(48)=3.42$, $p<.001$). The average adjusted score was .32 (SD=.88) which was significantly above the midpoint ($t(48)=2.53$, $p<.02$). To test the relationship between accuracy and confidence, a median split was performed on accuracy scores, and divided the groups in high and low accuracy groups. It was found that there was no significant difference in confidence between the high accuracy (M=3.40, SD= 45) and the low accuracy groups (M=3.44, SD=.58; ($t(47)=.32$, $p>.05$).

To test the hypothesis that SA and ToM might be related to deception detection, the relation between the 3 deception detection variables and the ToM and SA variables was examined. In terms of the ToMc and SAc scales, the only significant correlation was

between the SAc and confidence ($r(47)=.3$, $p<.04$). The nature of this relationship indicated that increased self-awareness was related to increased confidence in response.

Next, the individual ToM and SA scales as they related to deception detection were examined. There was a correlation between the SPQ and confidence ($r(47)=.31$, $p<.03$), indicating that it was the SPQ driving the SAc confidence correlation. In terms of TOM, it was found that the AQ was significantly correlated with deception detection. First, there was a significant correlation between AQ and accuracy ($r(47)= -.30$, $p<.04$). There was also a significant correlation between the AQ and the adjusted average ($r(47)=.37$, $p<.008$). Both correlations indicated that increased autistic tendencies decreased deception detection performance.

Discussion

This study confirmed a number of predictions regarding ToM, self-awareness, and deception detection. High self-awareness involves increased consciousness of one's feelings, thoughts, attitudes, motives and behavioral tendencies. Theory of mind is the ability to understand what another person may be thinking by using our own thoughts as a model (Premack and Woodruff, 1978). Gallup (1982) maintained that self-awareness and ToM are related in that self-awareness must precede ToM. The ability to deceive may be made possible by the presence of ToM, since one must be able to understand another's thoughts in order to manipulate them (Keenan, 2003).

Schizophrenics and individuals with Autism tend to have poor self awareness, which is often accompanied by a theory of mind deficit (Baron-Cohen et al., 1985; 1986; Perner et al., 1989). Research with these clinical groups is supportive of a relationship between SA and ToM. Research also indicates that there may be related deficits in

deception. Oswald and Ollendick (1989) found the deception ability is impaired in adolescents with autism when compared to mentally retarded (MR) adolescents. These results were reproduced by Baron-Cohen (1992) using normal and MR controls with mental ages that were lower than the autism group. The same results were also obtained in a study that tested sabotage ability in children with autism, MR, and normal controls (Sodian & Frith, 1992). Autistic children were unable to use intentional deception to prevent another person from getting a piece of candy.

Research indicates that children with autism are developmentally similar to normally developing children at three years of age (Russell, Mauthener, Sharpe, & Tidswell, 1991). They are not able to achieve successful deception, which typically develops around four years of age. Children with autism had poor performance on a deception task while children with MR were able to incorporate deception into their plans. Since deception scores could be predicted by a child's score on a false belief task, it is likely that the lack of deception ability is due to poor theory of mind ability.

It was predicted that there would be a relationship between self-awareness, ToM, and deception detection ability in the general population. Results of the study indicate that such a relationship does exist. First, it was found that increased autistic tendencies, which are associated with deficits in ToM, resulted in inferior deception detection. These data are consistent with reports on individuals with pervasive developmental disabilities. The same inverse relationship was found between autism and deception.

It was also predicted that individuals with schizotypal personality traits would have diminished ToM and deception ability. A relationship between schizotypal personality traits and deception was found. Low SPQ scores, which indicate high self-

awareness, were correlated with high response confidence during the deception task. This also means that individuals, who were high in schizotypal personality traits, and low in self awareness, were not very confident in their answers. It is likely that this lack of confidence reflects some difficulty that is being experienced, by those high in schizotypal personality traits, while engaging in a deception detection task. This would be consistent with the literature that suggests that schizophrenics may have trouble understanding ToM related tasks and using and understanding deception (Pilowsky et al., 2000; Brunet et al., 2003).

The results of this study are supportive of the literature that suggests a common neural mechanism for SA, ToM, and deception. Individuals with autism (Happe et al., 1996; Baron-Cohen et al., 1999) and schizophrenia (Brunet et al. 2003; Russell et al., 2000) may have underactivation of the PFC that may result in deficits in SA, ToM, and deception. Different brain areas were activated in the PDD groups when compared to controls. Although this hypothesis was not directly tested in this study, the relationship between ToM, SA, and deception detection in the normal population may also suggest a common neural system. It was found that SA correlated with ToM ability, and that together they were predictive of deception detection ability. It would be interesting to see if the normal individuals high in autistic tendencies had neural activation that is similar to the activation found in individuals with autism and schizophrenia.

In addition, it was found that increased self-awareness was related to increased confidence in response when judging believability of the actors. However, increased confidence was not associated with increased accuracy. Being aware of one's own thoughts may lead a person to believe that they have superior mind reading ability when

in reality they may not. Since being confident in an incorrect assumption is the worst case scenario when deciding if a person is deceitful, those with high self-awareness may be at a disadvantage when it comes to deception detection. This is interesting considering the opposite may be true for individuals engaging in a deceptive act. In a previous study, it was found that individuals with high private self-awareness tend to be better at deceiving others (Johnson et al., 2005). This may challenge assumptions (e.g., Keenan, Falk, & Gallup, 2003) that deception and deception detection are nearly identical cognitively. It was found that this may not be the case and that different cognitive abilities predict deception and deception detection.

Future research should experimentally manipulate variables, as the current study is correlational. Further, future studies should employ neuroimaging to test the claim that there is in fact a common neural substrate for these higher-order abilities. Future studies should also examine males. Because of recruiting difficulties, only females were tested in the current experiment. It would also be beneficial if other types of deception detection were examined. In this study, actors on video tapes were used. It might be interesting to use face-to-face deceptive encounters.

Another suggestion for future research would be to further examine the relationship between SA, ToM, and Empathy. Since empathy is related to theory of mind ability (Baron-Cohen, 2003) it was expected the EQ would be correlated with deception ability, but this was not the case. There was no correlation between the Empathy Quotient (EQ) and deception detection or the EQ and MIE ToM variable. This finding may imply that cognitive and emotional ToM abilities vary independently.

In summary, this study found that increased autistic tendencies, which are associated with deficits in ToM, resulted in inferior deception detection ability. It was also found that increased self-awareness is related to increased confidence in response when rating believability of actors. The results of this study indicate that ToM ability may be directly related to one's ability to detect deception. However, further research needs to be done to examine the nebulous relationship between these variables.

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