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Theory of mind development and attentional processes in young school children.

Amy Gillies Wilson

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Running head: Theory of Mind and Attention

THEORY OF MIND DEVELOPMENT AND ATTENTIONAL PROCESSES IN YOUNG SCHOOL CHILDREN

Doctoral Dissertation

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LIST OF TABLES

TABLE OF CONTENTS

Abstract

The following study explored relations between theory of mind understanding, attention, language ability, and general intelligence. Scores on measures of auditory processing (Test of Auditory Reasoning and Processing Skills), language comprehension (Test of Auditory Comprehension of Language, Revised), matrix completion (Raven's Colored Progressive Matrices), false belief and recursive thinking understanding were obtained along with teacher ratings of children's self-regulation as measured by Attention and Hyperactivity subscales of the Conner's Rating Scale. Analysis of zero-order correlations revealed self-regulation to be negatively correlated with recursive thinking, while age, general intelligence, auditory processing, and language ability were positively correlated with theory of mind comprehension. Regression analyses revealed that language ability and auditory processing accounted for the most variance in performance on theory of mind measures. These results are discussed with respect to their application to social skills training with children who exhibit attention deficits.

Mind and mental events are complicated concepts that organize a large amount of stimuli in order to describe, explain, and predict behaviors that inherently entail the notion of complex causality. Having a theory of mind involves assessing relations between behavior and environmental stimuli, as well as being able to engage in counterfactual reasoning and role-taking.

Contemporary studies have identified several variables that are related to individual differences in theory of mind acquisition and understanding. Age, social skills, and language ability have all been shown to positively correlate with performance on theory of mind tasks (Astington & Jenkins, 1995; Hala, Chandler, & Fritz, 1991; Watson, Nixon, Wilson, & Capage, in press; Youngblade & Dunn, 1996). The present study will further this line of research by considering the role of attention to auditory cues in theory of mind acquisition. The timeliness of such a study is suggested by recent publications that have redefined Attention Deficit Hyperactivity Disorder (ADHD) in children by considering the relation between higher order processing and stimulus control. Barkley (1996b) has described ADHD as a disorder of behavioral self-regulation rather than one of understimulation, and hypothesized that many of the social problems experienced by children with ADHD are due to their difficulty in utilizing socially relevant stimuli to control their behavior. Because there has been little research of the link between behavior control and executive processes, the purpose of the present study was to investigate the relation between behavioral self-regulation, auditory processing, and theory of mind understanding. In the present study, self-regulation was defined as the ability to control one's behavior as measured by attention and hyperactivity, rather than a more cognitive definition of self-talk and metacognition. It was hypothesized that children with a decreased capacity for appropriate self-control would have a less well-developed theory of mind

understanding. In addition, children for whom auditory cues exert less effective control were expected to demonstrate deficits on theory of mind tasks, while children who were better able to process auditory stimuli would have a more sophisticated theory of mind.

Defining Attentional Processes

Attention as a concept has traditionally been very difficult to define. In fact, there is not currently a universally accepted definition of attention in the psychology literature (Barkley, 1996a). Most commonly, attention may be defined in terms of neurological pathways, cognitive information processing, or behavioral responses (Lyon & Krasnegor, 1996). However, the definition that incorporates concepts that appear to be most critical to theory of mind understanding is one that is derived from a behavior-analytic point of view. This theoretical perspective identifies attention as a "multi-component behavior" that is determined by the "establishment and maintenance of stimulus control and of observing features of the environment" (McIlvane, Dube, & Callahan, 1996). Such a behavioral definition does not distinguish between selective and sustained attention as is the case with other theories, but rather focuses on environmental antecedents and consequences which shape the behavior that is referred to as attending. In addition, it does not merely measure the quantity of stimulus control (e.g., time on task), but considers the quality of attending behavior (e.g., short term memory, encoding stimuli). It is also consistent with one of the most current theoretical perspectives that views disorders of attention as being the result of a "deficiency in response inhibition" which is grounded in an individual's inability to accurately and completely encode and process information from the environment (Barkley, 1994). This statement implies that ADHD is a disorder of self-control and the cross-temporal organization of behavior. It further highlights the role of executive functions that are influenced both by the environment and the individual

organism. Within the context of the current study, it is proposed that inattention to environmental cues may also result in a lack of access to important information about explaining, describing, and predicting causal events which are the basis for learning the concept of mind. In other words, children who demonstrate deficits in their ability to attend to the environment may not have encoded specific cues from the environment, and will have a limited amount of information from which to draw upon when attempting to understanding the thoughts and perspectives of others.

Theory of Mind: False Beliefs and Recursive Thinking

A central component of human social interaction is the ability to understand that individuals can have different perspectives on any given situation. In order to function successfully in social relationships, it has been suggested that children must attend to what others think, feel, and see, and be able to compare and contrast different perspectives, including their own, as they attempt to ascertain the intentions of those around them (Chandler, 1977; Shantz, 1983). In other words, an individual with a well-developed mentalistic theory of behavior is able to interpret intentional action as well as describe and predict the behavior of those in his or her environment (Chandler, Fritz, & Hala, 1989; Gopnik, 1993; Perner, Ruffman, & Leekam, 1994).

If they are to be able to predict the behavior of others, children must rely upon multiple sources of information. They must have a working knowledge about the past, present, and future environment and the actions of others in it. In addition, individuals must also attend to regularities in the behavior of themselves and others in order to be able to predict future actions. Tasks that assess a child's mentalistic theory of behavior have traditionally used the concept of false belief (Perner, 1991). Successful performance on a false belief task includes a demonstration of the understanding that thoughts may not match reality (Gopnik, 1993), and that

the knowledge states of another may not correspond with one's own. For example, Sarah is told that a bandaid box currently contains crayons instead of bandaids. She is then asked where her friend Mark would look if he cut his knee and needed a bandaid. If Sarah has developed an understanding of false beliefs, she will respond that Mark will look in the bandaid box, because boxes with pictures of bandaids on them usually contain bandaids and not crayons. If Sarah's understanding of false beliefs and her ability to consider and reason about the perspective of another is not yet well-developed, she will say that Mark will look elsewhere for a bandaid because the bandaid box contains crayons. She will answer the question based upon her perspective, not Mark's. It appears that this ability to problem solve and draw conclusions about behavior based upon false beliefs emerges in normal development during the preschool years around age 4 (Astington, 1991).

Once a child has an understanding of the basic representational aspects of thinking and believing, more complex capabilities become possible. One example of this is a child's ability to reason about embedded thoughts (Eliot, Lovell, Dayton, & McGrady, 1979; Oppenheimer, 1986; Veith, 1980), also known as recursive thinking or second order beliefs. Like false belief understanding, recursive thinking involves the ability to take the role of another person. However, these tasks require the additional capacity to utilize a mental model of two or more individuals' beliefs about each other (e.g., Tim thinks that Janet thinks that he thinks she is wearing the red hat). The understanding of second order beliefs further requires a child to reason about a belief that one individual has about another's thoughts or behavior.

Many of the basic premises just described in regard to theory of mind understanding are also similar to the social information processing theory developed by Kenneth Dodge. For well over a decade, Dodge and his colleagues have studied the relation between social cognition and

aggressive behavior (Dodge, 1980, 1989; Dodge & Frame, 1982). Stemming from this work, Dodge has identified three cognitive skills which are highly correlated with levels of aggressive behavior in children: a) perspective taking, b) empathy, and c) problem solving ability (Dodge, 1986). In 1993, Dodge used these principles to develop a social information-processing model of aggression. In this model, he describes the four steps that are essential for adaptive social behavior: 1) interpreting cues, 2) generating responses to the cues, 3) choosing a response, and 4) acting and evaluating the responses. A key component to Dodge's model is a child's ability to attend to social stimuli. If a child is unable to attend to stimuli in his environment, he or she will be unable to accurately interpret the cues necessary for positive interactions. The child must rely upon attention to previous experiences, which may also be incomplete, to guide his or her behavior. Because of this lack of knowledge, this child would also have difficulty generating and choosing appropriate responses as well as evaluating his or her behavior. Inattention may also affect response generation and implementation because both of these tasks require continued learning and attention to stimuli in the environment. Because of the similarities between Dodge's social information processing and theory of mind, attentional processes might be expected to be a key component to understanding metacognitive concepts.

Why Study Attention and Theory of Mind?

Research on theory of mind presupposes that understanding the intentions and thoughts of others at any level is a complex process that involves three steps: 1) attending to behavior and the impact that the environment has on behavior, 2) taking into account past events, and 3) making predictions about future events (Perner, Ruffman, & Leekam, 1994). First, an individual must encode information about the behavior of individuals and observe how their behavior affects others in the environment and vice versa. Second, he or she must be able to

remember and access information about past behavior and environmental events. Third, a child must be able to incorporate all of this information into predictions about future behavior. Deficits in any one of these steps may result in faulty assumptions about another person's behavior, which could lead to negative social interactions. For example, if a child is unable to attend appropriately during a conversation, he or she may miss information that is vital to further positive interactions. While talking with classmates before school, this child may miss hearing that his best friend won an important game over the weekend. Not knowing this information, the child would fail to congratulate his friend who may then view him as being inconsiderate and become angry. There is great potential for such a situation to initiate a series of events which could lead to the social rejection of this child. Investigations of the relation between social information processing and popularity in children with ADHD have shown that children with attention problems are often overlooked by peers, a subtle form of rejection (Barkley, 1990). In fact, studies have found that children with attention problems may be at risk for rejection during initial social interactions (Erhardt & Hinshaw, 1994; Hubbard & Newcomb, 1991).

Present Study

As previously stated, the goal of the present study was to assess the relation between theory of mind understanding and the attentional mechanisms of auditory stimulus control and self-regulation. Because attention is defined by the quality of stimulus control and not just the quantity (percent of time on task), the Test of Auditory Reasoning and Processing Skills (TARPS) was chosen as the primary measure of auditory processing and attention in this study. The TARPS assesses the ability to comprehend and reason about information that is presented auditorily by requiring a child to accurately perceive auditory stimuli and cognitively manipulate it in such a way as to draw conclusions and make inferences about it. The TARPS is appropriate

for the age group being examined and is relatively quick to administer. The Conner's Teacher Rating Scale was used as a measure of self-regulation and was completed by teachers who rated each child's classroom behavior. For purposes of the present study, the Hyperactivity and Attention subscales of the Conner's were used for analysis. It was expected that scores on the TARPS and Conner's subscales would be correlated with theory of mind understanding. That is, children who were more attentive to auditory cues in their environment and exhibited higher levels of self-control would have a more advanced theory of mind.

Theory of mind understanding was measured in the present study by two false belief tasks and two tasks that assess the ability to reason about another person's embedded thoughts. Even though false belief and recursive thinking understanding both require a child to utilize a mental model to interpret another's beliefs, their exact relation to one another is unclear as they have never been evaluated in the same study. While false belief tasks have been most commonly used with younger children (preschool) and recursive thinking tasks with older subjects, the incorporation of both measures into one study allowed for the inclusion of a broad age range and may provide some information about the developmental progression of theory of mind understanding. Because false belief understanding is acquired by age four, it was expected that all children would do well on the most simple theory of mind tasks (false belief), while older children would do better than younger children on the more complex tasks (recursive thinking).

Because verbal aptitude has been shown to be related to theory of mind understanding (Astington & Jenkins, 1995; Watson, et. al., in press), a measure of language ability, the Test for Auditory Comprehension of Language, Revised (TACL-R) and a test of general intelligence, Raven's Progressive Colored Matrices, were included for comparison purposes.

Method

Participants

Sixty-three children (32 females, 31 males) were recruited from kindergarten, first, second, and third grade classes at an elementary school in Morgantown, WV. Seventeen children (9 females, 8 males) were in kindergarten, fifteen (4 females, 11 males) were in first grade, sixteen (11 females, 5 males) were in second grade, and fifteen (8 females, 7 males) were in the third grade. The children's ages ranged from 65 months to 119 months with a mean of 88.79 months. The elementary school used in the present study was comprised of predominantly white, middle class families. The student population was 8-10 percent minority with around 40 percent of the student body receiving free or reduced lunch. Of the students included in the present study, 5 percent of them were African American and about 20 percent received free or reduced lunch. Approximately 10 percent of the subjects in the present study had participated in previous theory of mind studies which utilized false belief tasks, when they were in preschool.

Procedure

Permission to conduct this study was obtained from the West Virginia University Institutional Review Board before subject recruitment was initiated. Permission to recruit subjects was also obtained from the principal of the elementary school, as well as the Monongalia County Board of Education. A letter was sent to all kindergarten, first, second, and third grade teachers briefly describing the study and asking for their cooperation. In addition, letters were sent home with all children in grades K-3 that explained the study and asked for parental permission to participate in the project. Only those children with signed permission forms were tested. From over 400 letters sent home, 63 families returned permission forms. Consequently, every child who had a signed permission form was included in the study.

Data collection consisted of each child separately completing several tasks over a period of two or three approximately thirty-minute sessions. Classroom teachers were also asked to complete the Conner's Teacher Rating Scale for each child. Testing took place during school hours in a small conference room in the school library to allow for maximum privacy. Two undergraduate and two graduate students majoring in Psychology were trained in task administration and conducted all testing along with the primary investigator. Each experimenter was trained in administration of all tasks. However, in order to minimize experimenter effects, one undergraduate student administered the false belief tasks (Chocolate and Bandaid) and second order belief task (Town) to all of the children. These three tasks were always administered in the same session and in the same order from most simple to most complex (Chocolate, Bandaid, Town). The remaining three research assistants administered the TARPS, TACL-R, Raven's, and Thought Bubble task. Whenever possible, these four tasks were administered together in random order, resulting in two test sessions. However, because data was collected during school hours, time constraints and scheduling frequently determined the length of time available for data collection, and more than two sessions were sometimes necessary.

Measure of Auditory Processing and Attention

Test of Auditory Reasoning and Processing Skills. The Test of Auditory Reasoning and Processing Skills (TARPS), was administered to all children. This task measures the quality of an individual's auditory thinking and reasoning by assessing his or her ability to draw conclusions, make inferences, and think logically about what is auditorily perceived (Gardner, 1992). The TARPS also assesses how well a child can pick out key words in a question or statement that is presented to them auditorily. This task is normed for children ages 5 to 13 and

took approximately 10-15 minutes to administer. The internal consistency of the TARPS was examined using Chronbach's alpha which yielded reliability coefficients ranging from .79 to .89 across the age groups (Gardner, 1992). The validity of the TARPS has been established via content and item analysis. Scores on the TARPS have also been shown to be highly correlated with scores on Similarities (r = .58) and Vocabulary (r = .62) subtests of the WISC-III, but were not significantly correlated (r = .34) with a matrix analogy task (Gardner, 1992).

Measure of Self-Regulation

Conner's Teacher Rating Scale - Revised. Teachers completed a measure of children's behavior that included subscales of attention, conduct problems, and hyperactivity. The revised Conner's Teacher Rating Scale (CTRS-R) includes 28 questions which provide information about children's classroom behavior. Edelbrock, Greenbaum, & Conover (1985) demonstrated that one-week test-retest reliability for the total scale score on the CTRS-R was .96 and ranged from .88 (Inattentive-Passive) to .95 (Conduct Disorder, Hyperactivity) for individual factors. Previous versions of the CTRS were found to have adequate test-retest reliability at one month, .72 to .92 (Conners, 1973) and one year, .35 to .57 (Trites, Blouin, Ferguson, & Lynch, 1981). Edelbrock et al. (1985) also found adequate criterion-related validity, including convergent and discriminant validity, for the CTRS-R. While the validity of the CTRS-R has not been assessed nearly as extensively, a large amount of additional data on the validity of the original CTRS also exists (Barkley, 1987; Klee & Garfinkle, 1983; Trites & Laprade, 1983). For the purpose of the present study, raw scores were only tabulated for the attention and hyperactivity subscales of the CTRS-R as it was hypothesized that these specific self-regulatory factors might be most crucial to theory of mind understanding.

Measure of General Intelligence

Raven's Colored Progressive Matrices. Raven's Progressive Matrices measures problem solving ability and general intelligence by asking the child to match designs into matrices (Raven, Raven, & Court, 1995). The matrices come in three different forms, Standard Progressive Matrices, Advanced Progressive Matrices (APM), and Colored Progressive Matrices (CPM). For this study, we used Raven's Colored Progressive Matrices which is normed, and most appropriate, for children ages 5-11 and has been shown to have a test-retest reliability of approximately .90 across all age groups. The colored matrix problems were presented to the children in book form. This task took approximately 15 minutes to administer.

Measure of Language Development

Test for Auditory Comprehension of Language, Revised (TACL-R). The TACL-R assesses receptive language functioning in children between the ages of 3 years, 0 months and 9 years, 11 months (Carrow-Woolfolk, 1985). The TACL-R is divided into three 40-item subtests: (a) Word Classes and Relations (assesses knowledge of vocabulary), (b) Grammatical Morphemes (assesses knowledge of grammar), and (c) Elaborated Sentences (assesses comprehension of complex sentences). The TACL-R was standardized on a diverse sample of 1,003 children and found to be highly reliable as a measure of receptive language functioning in children. Test-retest reliability ranged from .89 to .91 for the subtests, and was .95 for the total test. Additionally, the TACL-R has satisfactory concurrent and content validity (Sattler, 1992). The TACL-R was administered to each child according to the procedures presented in the TACL-R Examiner's Manual (1985). During each subtest item, the experimenter presented the child with a series of three pictures and a verbal prompt, such as a word, phrase, or sentence and then asked the child to point to the picture that corresponded with the prompt. The total raw

score for this task was used as a measure of language ability in subsequent analyses.

Measures of Theory of Mind

False Belief Tasks The two false belief tasks used in this study were adapted from previous research (Astington & Gopnik, 1988; Bartsch & Wellman, 1989; Lalonde & Chandler, 1995; Lewis & Osborne, 1990; Wimmer & Perner, 1983). However, as the present study is one of the first to look at individual differences in theory of mind understanding, the specific versions of the tasks used in this study have not been standardized.

Chocolate Task. For the first false belief task, a child was shown two dolls, Max and his mom. The experimenter told a story about Max and his mom returning home from a shopping trip with some chocolate. The experimenter told the child that mother put the chocolate in the blue drawer of a small, pink cupboard. The experimenter then put a Hershey's kiss into the blue drawer. As the story continues, Max leaves the room and during his absence, his mother moves the chocolate from the blue drawer to the green drawer in the cupboard. The experimenter then moved the candy to the green drawer. Later in the story, Max returns to the kitchen to look for the candy. The child was then asked a series of two questions to measure comprehension of the story: "Where did the chocolate used to be?" and "Where is the candy right now?" A second set of questions were asked to assess the child's false belief knowledge. The first question was "Where will Max think the chocolate is when he comes back?" If the child responded "the blue drawer," then he or she correctly predicted the doll's thoughts, demonstrating an understanding that others can have incorrect beliefs, and was given one point. The child was then asked, "Where will Max first look for the candy?" If he or she again responded "the blue drawer," an understanding of false belief was demonstrated and one point was recorded (see Appendix A). This task took approximately 5 to 10 minutes to administer.

Bandaid Box. For the second task, each child was presented with a bandaid box and asked, "Do you know what is in here?" The child was then shown that a car was inside of the box. Next, he or she was asked, "What did you think was inside this box?" If the child's response indicated that he or she thought there were bandaids in the box, the child recognized that he or she can have beliefs which are untrue, and two points were recorded for a correct answer. If the child's response was that the box contained bandaids, he or she was asked, "What did you think was inside this box before I opened it?" If he or she answered correctly ("bandaids") then one point was recorded. A zero was recorded if the child failed to demonstrate false belief under-standing (continued answering that he or she thought there was a car in the bandaid box originally).

In the second phase of this task, the child was presented with a crayon box and shown that it contained bandaids. A doll named Pam was then introduced and the child was told that she had cut her finger and needed a bandaid. The experimenter then asked the child, "Where will she look for bandaids?" If the child answered "the bandaid box," one point was recorded for correct false belief understanding. If the child's reply was "the crayon box," zero points were recorded and the child was asked the following questions: "Will she find bandaids there? What will she find there?"

In the final phase of this task, the child was introduced to a doll named Bill who had a cut. The experimenter then showed Bill looking in the bandaid box and asked the child "Why is he looking in there?" Two points were recorded if the child's reply included a statement about Bill thinking that the box contained bandaids. One point was recorded for responses that described the box, but did not make reference to Bill's thoughts (see Appendix B). This task also took approximately 5 to 10 minutes to administer.

Total possible scores ranged from 0 to 5 on the bandaid box task and from 0 to 2 on the chocolate task. Even though the range of possible scores is rather narrow, previous research has found that preschool children show reliable individual differences in their performance on these tasks (e.g., Astington, 1991; Watson, et. al., in press).

Recursive Thinking and Second Order Belief Tasks Two higher order thinking tasks were included which measured a child's ability to understand embedded thoughts or second order beliefs. Once again, because this was one of the first studies to use these tasks with the present population, there was no information available about the reliability and validity of the measures.

Town Task. The first task was adapted from a study by Perner and Wimmer (1985) and utilized a three dimensional representation of a town and a narrative structure to examine children's understanding of second order beliefs. The first part of the task consisted of the original story used by Perner and Wimmer (1985). In this phase, a child was told a story about Mary and John who are playing in the park when they see an ice cream man. Mary does not have any money with her, but the ice cream man tells her that she can get her money and come back later. The child was then told that Mary goes home and John is in the park alone when he sees the ice cream man leaving in his van. He asks the man where he is going and he tells John that he is going to the church to sell his ice cream. In the third scene, the child was told that as he was on his way to the church, the ice cream passes by Mary's house. She sees him through the window and runs outside to find out where he is going. The ice cream man tells her that he is going to the church. In the final scene, the child was told that John went to Mary's house and was told that she had gone to get an ice cream cone. Following the story each child was asked a test question, "Where does John think Mary has gone?" a justification question, "Why does he think she has gone to the _____?" and three control questions, "Does Mary know that the ice-cream

van is at the church? Does John know that the ice cream man has talked to Mary? Where did Mary go for her ice cream?" In order to pass this task and receive 3 points, a child had to respond correctly to both the test and justification questions. A correct response to the test question was one that reflected that John thinks that Mary went to the park. A justification question was included to ensure that the child used second order reasoning rather than random guessing to answer the test question. A correct justification response had to use second order belief deduction and contain: nesting of epistemic states (e.g., because he doesn't know that she already knows where the van is), information nested within a belief (e.g., because he doesn't know that she had talked to the ice cream man), or refer to the initial location of the ice cream van (e.g., because she said she would go to the park to get ice cream in the afternoon). The three control questions were used to ensure that the child understood the story and no points were given for correct answers. During the telling of the story, the experimenter moved Lego people representing John, Mary, and the ice cream man. Children were allowed to touch and move the figures as they answered the questions (see Appendix C).

In the second part of the task, several variables were manipulated to fully examine the extent of second order belief understanding (i.e., disappearance of object, memory aid, prompt). The manipulations chosen were based upon the findings of Perner and Wimmer (1985) and most closely reflected the abilities expected of children in the age group being studied. If a child passed the original town story, he or she was told a similar story which was made more difficult by the inclusion of a disappearance component. In this version, the van broke down on the way to the second location and was put in the shop, out of sight, and never arrived at its destination. Children receiving this story had to use second order reasoning to correctly answer the questions as they could not base them on the actual location of the van. This particular storyline was

included because Perner and Wimmer (1985) found it to be more difficult and to assess a more complex understanding of second order beliefs appropriate for the older age group in the present study. The test, justification, and control questions were the same as in the original story. An additional point was given and a total score of 4 was recorded for the entire task if the child also got the test and justification questions correct for this story.

If the child failed the original town task, he or she was told a second story which contained an inference prompt (Where does Mike think Sally will go when she wants to play on the swings?) before the final scene of the story was read (see Appendix D). If the child still failed to answer the test or justification question correctly, a memory aid (Remember, Mike doesn't know that Sally talked to the ice cream man) was used before questioning continued. These particular versions of the town story were used because Perner and Wimmer (1985) found them to be easier for young children. A total score of 2 was recorded if a child passed the prompt section of this task, 1 point was scored if the child failed the prompt section but passed the task with a memory aid, and a score of 0 was recorded if the child failed either the justification or test question in this story. A range of 0 to 4 total points were possible for the entire task which took about 10 to 15 minutes to administer.

Thought Bubble Task. The second recursive thinking task utilized thought bubbles to capture the child's ability to reason about embedded thoughts. Miller, Kessel, and Flavell (1970) determined that children's understanding of recursive, or embedded, thinking emerges during middle childhood. They further argued that this understanding develops sequentially across four types of thinking: a) thinking about people as social objects; b) thinking about actions between people; c) thinking about thinking and d) thinking about thinking about thinking. Contiguity involves an individual thinking about himself or others (e.g., the boy is thinking of himself and

the girl). Action thoughts involve one individual talking to another (e.g., the boy is thinking that the girl is talking to her father). One-loop recursion involves thinking about another person's thought processes (e.g., the boy is thinking that the girl is thinking of her father). Finally, two-loop recursion involves more in-depth perceptions of another person's thought processes (e.g., the boy is thinking that the girl is thinking of the father thinking of the mother). In their study, children were shown cartoon drawings that included thought bubbles and asked to interpret their contents. Results indicated a positive correlation between age and the ability to understand embedded thoughts at these four levels, thus supporting the hypothesis that knowledge of recursive thinking develops in sequential stages that are related to chronological age. Veith (1980) supported Miller, Kessel, and Flavell's findings in a study which found that fifth graders were significantly superior to third graders in thinking about a social nonrecursive act, thinking about thinking, and thinking about thinking about thinking. These developmental data suggest the possibility of individual differences in performance on this task that would tap into the sophistication of a mentalistic theory of behavior.

One criticism of Miller, Kessel, and Flavell's (1970) study of recursive thinking was that it required an advanced level of verbal production. Oppenheimer (1985) addressed this issue by changing Miller, et al.'s paradigm slightly. Instead of asking children to describe a picture, he presented them with a set of picture cards and asked them to point to a specific one (e.g., "show me the picture of the boy thinking that the girl is thinking about him"). This procedure resulted in kindergartners evidencing the possession of contiguity thinking and the onset of action thinking and one-loop recursive thinking. Third graders in this study demonstrated early signs of an understanding of two-loop recursive thinking. These findings place the onset of understanding one-loop and two-loop recursive thinking two years earlier than those suggested by

Miller, et al. and will be used as a model for the recursive thinking tasks in the present study.

For our study, each child was pretested, and trained if necessary, to insure that he or she could relate the concepts of thinking and talking to pictoral representations (i.e., thought clouds) and could identify each of the four characters (boy, girl, mother, father) on the cards. The child was then presented with cartoon pictures of a boy with thought clouds depicting the 4 types of thinking previously mentioned, contiguity, action, one-loop, and two-loop. An array of eighteen cards were presented and the child was asked to point to a specific one (e.g., "show me the picture of the boy thinking of the girl talking to the father"). Stimuli were presented in a certain order (contiguity, action, one-loop, two-loop) which was identical for each child (see Appendix E). Responses were scored as a 1 if correct and a 0 if incorrect, for a total of 18 possible points. This task took approximately 10 minutes to complete.

Results

Following specific hypotheses outlined in the introduction, several different sets of analyses were conducted. First, descriptive information about the independent (Age, Attention, Hyperactivity, Raven's, TACL-R, TARPS) and dependent variables (Bandaid, Chocolate, Thought Bubble, Town tasks) was obtained. Second, relations among variables were explored through zero-order correlations. Lastly, prediction of performance on the three theory of mind tasks was considered. Preliminary analyses were also conducted for boys and girls separately and no patterns for gender differences were found. Therefore, all future analyses were collapsed across gender.

Descriptive Analyses

Table 1 shows the mean, standard deviation, and range for each of the variables in the present study. These data were examined for their distributions and for any univariate outliers.

All variables met acceptable criteria for inclusion in further analysis except for the Chocolate task. The distribution of scores on this task was highly skewed in a positive direction due to the fact that all but one child reached ceiling levels. The Chocolate task data was therefore excluded from further analysis. As expected, scores on the Bandaid task also approached ceiling levels, however, this variable was retained in further analysis because it was significantly correlated with the remaining theory of mind tasks (thought bubble and town).

Relatedness of Thought Bubble Subtasks

Next, the intercorrelations between subscales of the Thought Bubble task were examined. Table 2 shows that the Action, Contiguity, One-loop, and Two-loop subscale scores were all positively and significantly correlated with one another. Therefore, the scores were totaled and their sum was used in subsequent analyses.

Relatedness and Difficulty of Theory of Mind Tasks

The relations between the three theory of mind tasks were then examined to determine if these measures could be combined into a single Theory of Mind Factor (see Table 3). All three measures were found to be positively and significantly correlated, and an exploratory factor analysis yielded one factor composed of Bandaid (.68), Thought Bubble (.74), and Town (.71), henceforth referred to as the "Theory of Mind" scale. However, because of the fairly low correlation coefficients between the three tasks (.22 to .29), each was also analyzed separately with respect to their relation to the independent variables.

In order to determine the relative difficulty of the three theory of mind measures, scores on the Bandaid, Town, and Thought Bubble tasks were converted to percentage correct and then their degree of difficulty compared. T-tests revealed that children performed significantly better on the Bandaid task (mean = .76) than the Thought Bubble (mean = .57) (t=5.93, p<.001) and

Town (mean = .54) (t=4.65, p<.001) tasks. However, the two Recursive Thinking tasks did not differ significantly in their degree of difficulty (t=.55, p<.29).

Intercorrelations among Independent Variables

The next step in analysis involved determining relations between the independent variables. Correlations were computed between age, raw scores on the Attention and Hyperactivity subscales of the Conner's, raw scores on the Raven's, raw scores on the TACL-R, and raw scores on the TARPS (see Table 4). Age was positively and significantly correlated at the $p < .01$ level with Raven's, TACL-R, and TARPS scores. The five remaining independent variables were also found to be positively and significantly correlated with one another at the $p < .01$ level.

Correlations between Theory of Mind Measures and Independent Variables

After separately determining the intercorrelation among theory of mind tasks and independent variables, zero-order correlations were conducted between the independent variables (Age, Attention, Hyperactivity, Raven's, TACL-R, and TARPS) and theory of mind understanding (Bandaid, Thought Bubble, Town, Theory of Mind scale) (see Table 5). This analysis revealed that Attention and Hyperactivity were negatively and significantly correlated with performance on the Thought Bubble task (r = -.40 and -.29 respectively) and Theory of Mind scale (r = -.28 and -.29). Age and scores on the Raven's were positively and significantly correlated with the Thought Bubble task (r = .44 and .60), Theory of Mind scale (r = .49 and .52), and Town task (r = .51 and .40). Scores on the TACL-R and TARPS were found to be positively and significantly correlated with all four measures. The TACL-R scores were more highly correlated with the Thought Bubble task (r = .75) and Theory of Mind scale (r = .70) than the Town (r = .45) and Bandaid tasks (r = .27). A similar pattern was true for TARPS

performance which was most highly correlated with the Theory of Mind scale (r = .65), followed by the Thought Bubble (r = .58), Town (r = .52), and Bandaid tasks (r = .27).

Regression Analyses

Because the three theory of mind tasks and the Theory of Mind scale were significantly correlated with several intercorrelated independent variables, regression analyses were conducted to examine which variables accounted for the most variance. Four single-step multiple regressions were conducted which included age and each significantly correlated independent variable in order to predict scores on the 1) Bandaid Box task, 2) Thought Bubble task, 3) Town task, and 4) Theory of Mind scale.

Table 6 shows the results of the four multiple regressions. For the Bandaid task, age, TACL-R and TARPS raw scores were entered as one step. As the table indicates, age, language ability and auditory processing accounted for only 8 percent of the variance in performance on this task $F(2,60) = 2.53$, p = n.s. None of the betas for the predictors were significant.

For the Thought Bubble task, age, Attention, Hyperactivity, Raven's, TACL-R, and TARPS scores were entered as one block. Results of the multiple regression revealed that even though all six variables were significantly correlated with performance on this task, only the TACL-R accounted for a significant amount of unique variance. Overall, these variables accounted for 61 percent of the variance, $F(6,56) = 14.45$, $p < .0001$, in Thought Bubble performance.

Age, Raven's, TACL-R, and TARPS scores were entered as one block in the multiple regression for the Town task. Betas for age and TARPS were found to be significant, and together with TACL-R and Raven's scores they accounted for 33 percent of the variance in performance $F(4,58) = 7.25$, $p < .0001$.

A pattern similar to the Thought Bubble task was found with the Theory of Mind scale. Once again, age, Attention, Hyperactivity, Raven's, TACL-R, and TARPS scores were entered as one block in the regression. The beta for the TACL-R was the only one which was significant, and the six variables together accounted for 52 percent of the variance on performance on the Theory of Mind scale, $F(6,56) = 10.24$, $p < .0001$.

Discussion

The purpose of the present study was to investigate the relation between theory of mind understanding and the attentional processes of self-control and auditory processing. An additional contribution of this study was that it explored multiple measures of theory of mind understanding in elementary school children.

Several significant findings emerged from the data. First, the data showed that children performed at ceiling on what had been posited as the easier theory of mind tasks and that age was significantly correlated with performance on the more complex theory of mind measures. These findings support the hypothesis that older children would be better at the higher order thinking tasks and are particularly interesting since the study used a somewhat older age range than is seen in more traditional theory of mind studies. These results seem to indicate that continued understanding of more complex concepts related to "mind" follows a developmental pattern similar to that of initial theory of mind acquisition.

A second goal of the study was to examine the relatedness of traditional theory of mind tasks and those that measure reasoning about another's embedded thoughts. Even with the scores on the easier tasks having a somewhat more restricted range, analyses confirmed the hypothesis that these processes are positively and significantly related. Comparisons also revealed that there was a significant difference in the degree of difficulty among simple false belief and recursive

thinking tasks, with the latter being more difficult. The inclusion of multiple theory of mind measures in a single study is a major contribution to the exploration of individual differences in this area as it provides new information about the developmental progression of specific types of thinking that are an integral part of theory of mind acquisition.

Past studies have found that language ability was related to performance on theory of mind tasks. This finding was replicated in the present study. Zero-order correlations revealed that language ability as measured by the TACL-R was positively and significantly related to performance on all theory of mind tasks. In fact, the present study found that language ability was a better predictor of theory of mind understanding than was general intelligence.

There was also support for the relation between auditory processing, self-regulation, and theory of mind understanding. Teacher ratings on the Attention and Hyperactivity subscales of the CTRS were found to be negatively and significantly correlated with performance on the Thought Bubble task, while TARPS scores were positively and significantly correlated with all three theory of mind measures at the zero-order correlation level. However, the unique contribution of both verbal ability and auditory processing to theory of mind understanding was confirmed by multiple regressions which revealed that language ability explained the most variance in performance on the Thought Bubble task while age and auditory processing accounted for a significant amount of variance in Town task performance. These findings indicate that specific executive processes may be essential for successful performance on different theory of mind tasks. It seems that auditory processing skills and attention to auditory stimuli are more essential for tasks which require reasoning about a series of events (Town), while language ability is more related to performance on tasks which require one to disentangle embedded concepts (Thought Bubbles). It also appears that self-control (inattention,

hyperactivity) and general intelligence are not significant predictors of theory of mind performance.

In light of the present findings, there are several directions that future research in this area could take. First, given the extensive interrelatedness of the independent measures, it would be beneficial to examine other skills that are not correlated with verbal ability or theory of mind understanding. The high degree of correlation between the independent measures is somewhat logical given the fact other measures (e.g., WISC-III) have found that general intelligence is highly correlated with verbal ability. However, in order to better identify those skills above and beyond language ability which may impact theory of mind understanding, measures which are not correlated with verbal aptitude (e.g., WISC-III performance subscales; processing speed) should be considered.

The high correlation between language ability and the auditory processing measure is also a concern. One way to address this problem would be to use a more direct, nonverbal measure of auditory attention that was less highly correlated with verbal ability. This may be addressed by using measures such as subtests of the Test of Auditory Processing Skills (TAPS) which includes a digit memory scale similar to the Digit Span subtest of the WISC-III. The use of a more direct measure of auditory attention, such as an auditory Continuous Performance Task might also aid in teasing apart the specific higher-order processes other than language production which are related to theory of mind understanding.

There also needs to be some consideration of the stimuli and methodology used with the false belief and recursive thinking tasks. Currently there is not a set of standardized instruments which can be used to measure theory of mind. Because of this, it is uncertain whether or not characteristics of the stimuli might have had an impact on children's performance on these tasks.

One way to address this question would be to administer the false belief and town tasks auditorily. This might allow the question of the impact of auditory attention and stimulus control to be addressed more directly by removing factors such as familiarity, visual attention, and novelty. The specific skills being tapped by the various theory of mind tasks is also unclear. The present study begins to address this issue by including several different measures in one study, however, their exact relationship to one another warrants further investigation.

Previous studies have found that the understanding of embedded thoughts occurs in a developmental progression (Miller, et.al., 1970; Oppenheimer, 1986). However, that was not the case in the present study. Exploratory comparisons of the percentage correct for action, contiguity, one-loop, and two-loop thinking revealed minimal differences in degree of difficulty. Some of the reasons for this may have been due to the fact that the experimenters repeated the stimulus stems upon a child's request or when there was a delay in the child responding. More standardized procedures for administration of this measure should be considered in the future.

A study such as this one is important not only for its empirical findings, but also for its possible implications for clinical populations. The present study found that children with a decreased capacity for processing auditory stimuli, whether in the clinical range or not, have a less well-developed theory of mind. This means that these children have a compromised ability to obtain complete and accurate information about the thoughts and behavior of others in their environment, often resulting in inappropriate social behavior (Cunningham & Siegel, 1987; Landau & Milich, 1988). Children who demonstrate deficits in self-regulation frequently report difficulty attending to the speech of others, as in the case of lectures, conversations, or verbal directions (Hooks, Milich, & Lorch, 1994; Phelan, 1993). A study by Pearson, Lane, and Swanson (1991) suggests that the ineffectiveness with which ADHD children orient to auditory

stimuli may underlie this difficulty. The study further states that the inability of these children to attend to more complex stimuli is very similar to that of young children.

There are currently several behaviorally-based programs that teach children with self-control problems the basic skills necessary to get along with others in their environment (Abikoff & Gittleman, 1984; Barkley, 1990). Most of these programs report at least some short-term success in teaching children with acting out problems appropriate social skills (Barkley, 1991). However, when these children are faced with "real life" situations, especially those dealing with conflict, their ability to access these skills appears to decline (Abikoff, 1991; Barkley, 1990) and they revert to more immature behavior (e.g., hitting). It seems that children with disorders of attention are capable of learning to attend to and respond appropriately to environmental cues in a sterile setting, but they have difficulty generalizing stimulus control to novel situations. This may be particularly true when attention disordered children are under increased amounts of stress and distraction. However, even after taking stimulant medication or participating in social skills training, many of these children continue to have difficulty in their relationships with others. One reason for this may be that the core of their social deficits is not acting out behavior, but the way they see the world around them. A lack of attention to environmental stimuli may result in an inability to access information critical to the development of a concept of mind (Dodge, 1993; Wheeler & Carlson, 1994). In light of this information, social skills training programs may want to target improvement of social cognitive skills and theory of mind understanding that appear to be critical for successfully interacting with others.

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Table 1

Mean, Standard Deviation, and Range for All Variables

	MEAN	STANDARD DEVIATION	RANGE
AGE	88.79	14.40	65.00 - 119.00
ATTENTION	1.00	1.33	.00 - 4.00
BANDAID	3.78	.77	2.00 - 5.00
CHOCOLATE	1.97	.18	1.00 - 2.00
HYPERACTIVITY	7.19	8.64	.00 - 35.00
RAVENS	22.35	6.59	8.00 - 35.00
TACL	101.79	12.10	66.00 - 120.00
TARPS	37.87	21.21	3.00 - 79.00
THEORY OF MIND	.00	1.00	-2.66 - 2.18
THOUGHT BUBBLES	10.25	4.30	2.00 - 18.00
TOWN	2.17	1.45	.00 - 4.00

Table 2

Intercorrelation Between Thought Bubble Task Subscales

	1	2	3	4
1. ACTION				
2. CONTIGUITY	.25*			
3. ONELOOP	.48**	.49**		
4. TWOLOOP	.35**	.47**	.56**	

* $p < .05$. ** $p < .01$.

Table 3

Intercorrelations Between Theory of Mind Measures

	1	2	3
1. BANDAID			
2. THOUGHT BUBBLES	.26*		
3. TOWN	.22*	.29**	

* $p < .05$. ** $p < .01$.

Table 4

Intercorrelations Between Independent Variables

	1	2	3	4	5	6
1. AGE						
2. ATTENTION	.06					
3. HYPERACTIVITY	-.11	.70**				
4. RAVENS	.57**	-.47**	-.38**			
5. TACL-R	.62**	-.39**	-.43**	.70**		
6. TARPS	.59**	-.43**	-.43**	.66**	.77**	

* $p < .05$. ** $p < .01$.

Table 5

Zero Order Correlations Between Theory of Mind Measures and Independent Variables

	BANDAID	THOUGHT BUBBLES	TOWN	THEORY OF MIND
AGE	.09	.44**	.51**	.49**
ATTENTION	-.14	-.40**	-.05	-.28*
HYPERACTIVITY	-.18	-.29**	-.14	-.29**
RAVENS	.08	.60**	.40**	.52**
TACL	.27*	.75**	.45**	.70**
TARPS	.27*	.58**	.52**	.65**

* $p < .05$. ** $p < .01$.

Table 6

Regression Analyses Predicting Performance on Theory of Mind Tasks

	Bandaid			Thought Bubble			Town			Theory of Mind		
	B	Beta	sr^2	B	Beta	sr^2	B	Beta	sr^2	B	Beta	sr^2
Age	.01	-.16	.01	-.01	-.02	.00	.03	.33**	.04	.00	.06	.00
Attention				-.71	-.23	.02				-.03	.04	.00
Hyperactivity				.10	.20	.02				.01	.06	.00
Raven's				.06	.10	.00	.00	.01	.00	-.00	-.02	.00
TACL-R	.02	.27	.03	.25	.70**	.15	-.00	-.02	.00	.04	.50**	.04
TARPS	.00	.13	.01	.00	.01	.00	.02	.33**	.03	.01	.25	.01
R^2		.09			.61			.33			.52	
Adjusted R^2		.05			.57			.29			.47	
R		.30			.78**			.58**			.72**	

** $p < .01$

Appendix A

Chocolate Task

CHOCOLATE TASK

EXP: Mother returns from her shopping trip. She bought chocolate for a cake. Max may help her put away the things. He asks her: "Where should I put the chocolate?" "In the blue drawer," says mother. Max puts the chocolate in the blue drawer. Max remembers exactly where he put the chocolate so he could come back and get some later. He loves chocolate. Then he leaves for the playground. Mother starts to prepare the cake and takes the chocolate out of the blue drawer. She grates a bit of it into the dough and then she does NOT put it back into the blue drawer, she puts it into the green drawer. Now she realizes that she forgot to buy eggs. So she goes to her neighbor for some eggs. Here comes Max back from the playground, hungry, and he wants to get some chocolate. He still remembers where he had put he chocolate.

EXP: Where did the chocolate used to be?

CHILD:

EXP: Where is the candy right now?

CHILD:

EXP: Where will Max think the chocolate is when he comes back?

CHILD:

EXP: Where will Max first look for the candy?

CHILD:

Scoring: 1 point is given for the correct answer to question number 3 (blue drawer) and 1 point is given for the correct answer to question number 4 (blue drawer) for a total of 2 possible points

Appendix B

Bandaid Box Task

BANDAID BOX TASK

EXP: Do you know what is in here? **(Show child Bandaid box)**

CHILD:

EXP: Let's look. **(Open Bandaid box)**
Hey, there's a car in here! Imagine that, a bandaid box with a car inside. **(Close box)**
What did you think was inside this box?

CHILD:

EXP: **(If child misses previous question)** What did you think was inside this box before I opened it?

CHILD:

EXP: **(Show crayon box)** Let's see what is inside here.
Look, there are bandaids in this box. **(Open box, then close it)**
Here is Pam. Pam has a cut and she needs a bandaid. She wasn't here when we found out what was in the boxes. Where will she look for bandaids?

CHILD:

EXP: Ok, will she find bandaids there?

CHILD:

EXP: What will she find there?

CHILD:

EXP: Look, here is Bill. Bill also has a cut and he needs a bandaid. Why is he looking in there? **(Show Bill looking in Bandaid box)**

CHILD:

EXP: **(Ask if child misses previous question)** What does Bill think?

CHILD:

EXP: Are there bandaids there really?

CHILD:

Appendix C

Initial Town Task

INITIAL FALSE BELIEF ICE CREAM STORY

This is a story about John and Mary who live in this village. This morning John and Mary are together in the park. In the park there is also an ice-cream man in his van.

Episode 1

Mary would like to buy an ice cream cone but she left her money at home. So she is very sad. "Don't be sad," says the ice-cream man, "you can fetch your money and buy some ice cream later. I'll be here in the park all afternoon." "Oh good," says Mary, "I'll be back in the afternoon to buy some ice cream. I'll make sure I won't forget my money then."

Episode 2

So Mary goes home. She lives in this house. She goes inside the house. Now John is on his own in the park. To his surprise he sees the ice cream man leaving the park in his van. "Where are you going?" asks John. The ice cream man says, "I'm going to drive my van to the church. There is no one in the park to buy ice cream, so perhaps I can sell some outside the church."

Episode 3

The ice cream man drives over to the church. On his way he passes Mary's house. Mary is looking out the window and spots the van. "Where are you going?" she asks. "I'm going to the church. I'll be able to sell more ice cream there," answers the man. "It's a good thing that I saw you," says Mary. Now John doesn't know that Mary talked to the ice cream man. He doesn't know that!

Episode 4

Now John has to go home. After lunch he is doing his homework. He can't do one of the tasks. So he goes over to Mary's house to ask for help. Mary's mother answers the door. "Is Mary in?" asks John. "Oh," says Mary's mother, "She just left. She said she was going to get an ice cream cone."

Test Question

So John runs to look for Mary. Where does he think she has gone?

Justification Question

Why does he think she has gone to the _____?

Scoring: If both answers are correct then the child receives 3 POINTS, continue with disappear story: If either or both answers are incorrect, then the child receives 0 POINTS, continue with memory aid/prompt story.

Control Questions

1. Does Mary know that the ice cream van is at the church?
2. Does John know that the ice cream man has talked to Mary?
3. Where did Mary go for her ice cream?

Appendix D

Disappear or Memory/Prompt Town Task

DISAPPEAR FALSE BELIEF STORY
(Used if child passes original false belief story)

This is a story about Sally and Mike who live in this village. This morning Mike and sally are together at the playground. At the playground there is also a workman in his van.

Episode 1

Sally would like to play on the monkey bars but she is wearing her school clothes. So she is very sad. "Don't be sad," says the workman, "you can go home, put on your play clothes, and come back and play later. I'll be here in the park all afternoon." "Oh good," says Sally, "I'll be back in the afternoon to play. I'll make sure that I am wearing my play clothes then."

Episode 2

So Sally goes home. She lives in this house. She goes inside the house. Now Mike is on his own at the playground. To his surprise he sees the workman leaving with the monkey bars in his van. "Where are you going?" asks Mike. The workman says, "I'm going to drive my van to the school. There is no one at the playground playing on the monkey bars, so perhaps more kids will play if they are at the school."

Episode 3

The workman drives over to the school. On his way he passes Sally's house. Sally is looking out of the window and spots the van. "Where are you going?" she asks. "I'm going to the school. More kids will play on the monkey bars there," answers the workman. "It's a good thing I saw you," says Sally. Now Mike doesn't know that Sally talked to the workman. He doesn't know that! What did the workman tell Sally?

Episode 4

The workman continues. Suddenly the van loses a wheel. The workman can't go to the school but has to go to the next garage (van disappears inside garage behind school). There the van should be repaired but that takes a full day. The workman goes home, he will pick up his van the next morning.

Now Mike is home. After lunch he is doing his homework. He can't do one of the tasks. So he goes over to Sally's house to ask for help. Sally's mother answers the door. "Is Sally in?" asks Mike. "Oh," says Sally's mother, "She just left. She said she was going to play on the monkey bars."

Test Question: So Mike runs to look for Sally. Where does he think she has gone?

Justification Question: Why does he think she has gone to the _____?

Scoring: If both correct, child receives 1 POINT; if either or both incorrect, child receives 0 POINTS

Control Questions

1. Does Sally know that the van was going to the school?
2. Does Mike know that he workman talked to Sally?
3. Where did Sally go to play?

MEMORY AID/INFERENCE PROMPT FALSE BELIEF STORY
(Used if child fails original false belief story)

This is a story about Sally and Mike who live in this village. This morning Mike and sally are together at the playground. At the playground there is also a workman in his van.

Episode 1

Sally would like to play on the monkey bars but she is wearing her school clothes. So she is very sad. "Don't be sad," says the workman, "you can go home, put on your play clothes, and come back and play later. I'll be here in the park all afternoon." "Oh good," says Sally, "I'll be back in the afternoon to play. I'll make sure that I am wearing my play clothes then."

Episode 2

So Sally goes home. She lives in this house. She goes inside the house. Now Mike is on his own at the playground. To his surprise he sees the workman leaving with the monkey bars in his van. "Where are you going?" asks Mike. The workman says, "I'm going to drive my van to the school. There is no one at the playground playing on the monkey bars, so perhaps more kids will play if they are at the school."

Episode 3

The workman drives over to the school. On his way he passes Sally's house. Sally is looking out of the window and spots the van. "Where are you going?" she asks. "I'm going to the school. More kids will play on the monkey bars there," answers the workman. "It's a good thing I saw you," says Sally. Now Mike doesn't know that Sally talked to the workman. He doesn't know that!

Prompt: Where does Mike think Sally will go when she wants to play on the monkey bars?

Episode 4

Now Mike is home. After lunch he is doing his homework. He can't do one of the tasks. So he goes over to Sally's house to ask for help. Sally's mother answers the door. "Is Sally in?" asks Mike. "Oh," says Sally's mother, "She just left. She said she was going to play on the monkey bars."

Test Question: So Mike runs to look for Sally. Where does he think she has gone?

Justification Question: Why does he think she has gone to the _____?

Scoring: If both correct, child receives 2 POINTS; if either or both incorrect, continue with MEMORY AID

MEMORY AID: Remember, Mike doesn't know that Sally talked to the workman. He doesn't know that!!!!!

Test Question: Where does he think she has gone?

Justification Question: Why does he think she has gone to the _____?

Scoring: If both correct, child receives 1 POINT; if either or both are incorrect, child receives 0 POINTS

Control Questions

1. Does Sally know that the van was going to the school?
2. Does Mike know that he workman talked to Sally?
3. Where did Sally go to play?

Appendix E

Thought Bubble Task

THOUGHT BUBBLE PROMPTS

Contiguity:

1	**The boy is thinking of the girl**
2	**The boy is thinking of himself**
3	**The boy is thinking of the girl and father**
4	**The boy is thinking of himself and the girl**
5	**The boy is thinking of the girl, father, and mother**
6	**The boy is thinking of himself, the girl, and father**

Action:

7	**The boy is thinking that the girl is talking to father**
8	**The boy is thinking that he is talking to the girl**
9	**The boy is thinking that the girl is talking to him**

One-loop Recursion:

10	**The boy is thinking that the girl is thinking of father**
11	**The boy is thinking that he is thinking of the girl**
12	**The boy is thinking that the girl is thinking of him**
13	**The boy is thinking that the girl is thinking of herself**
14	**The boy is thinking that he is thinking of himself**

Two-loop Recursion:

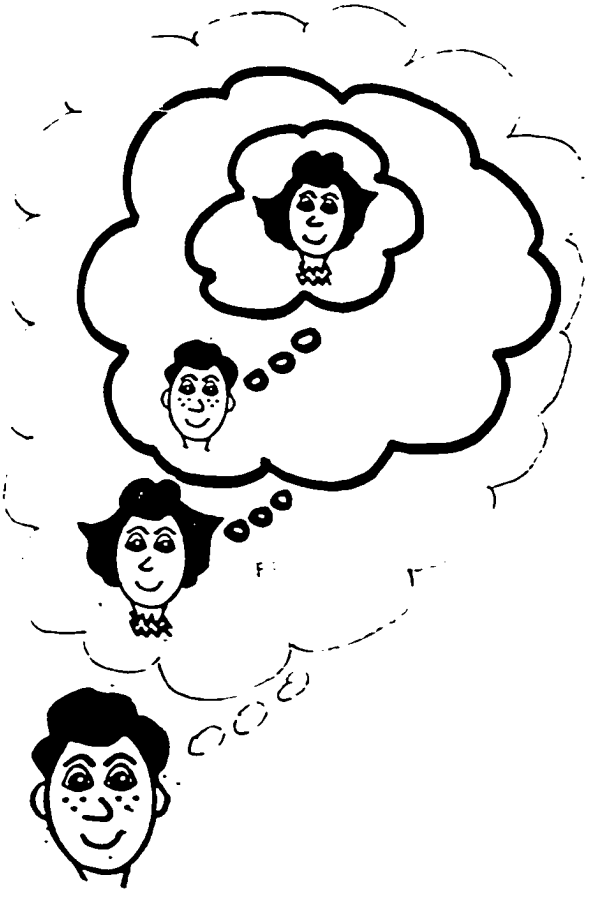
15	**The boy is thinking that the girl is thinking of the father thinking of mother**
16	**The boy is thinking that he is thinking of the girl thinking of herself**
17	**The boy is thinking that the girls is thinking of him thinking of her**
18	**The boy is thinking that he is thinking of himself thinking of himself**

THOUGHT BUBBLE PICTURES

CONTIGUITY

ACTION

ONE-LOOP RECURSION



TWO-LOOP RECURSION

THEORY OF MIND DEVELOPMENT AND ATTENTIONAL PROCESSES

IN YOUNG SCHOOL CHILDREN

By Amy G. Wilson

A DISSERTATION

Submitted to
West Virginia University
in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy

APPROVAL OF EXAMINING COMMITTEE

Stanley H. Cohen, Ph.D.

Rayne S. Dennison, Ph.D.

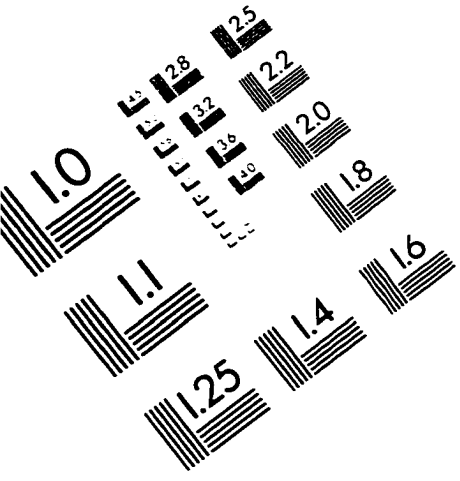
Cheryl B. McNeil, Ph.D.

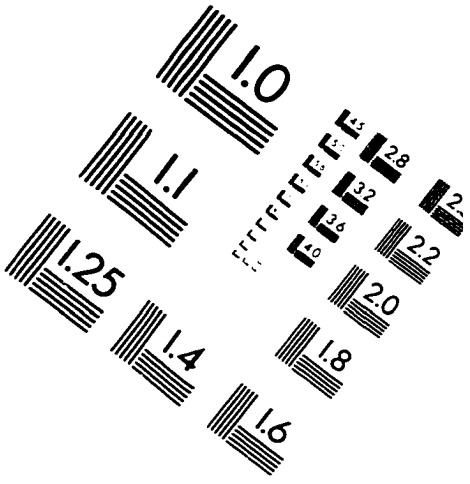
Michael T. Yura, Ph.D.

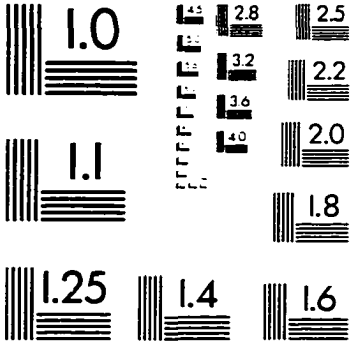
5/11/99
Date

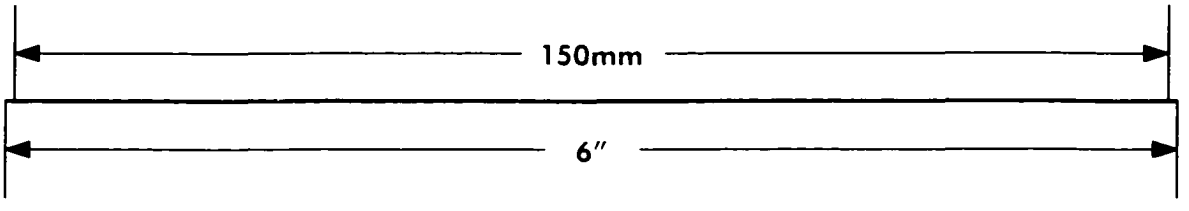
Anne C. Watson, Ph.D., Chair

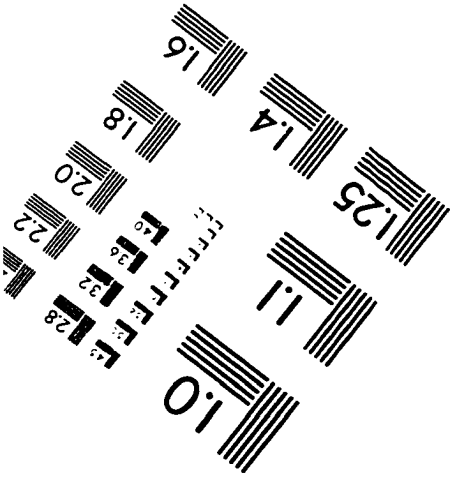
IMAGE EVALUATION TEST TARGET (QA-3)

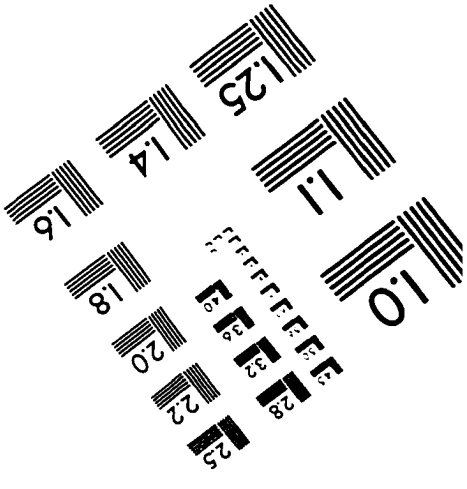












APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989