A NEO-PIAGETIAN APPROACH TO SOCIAL COGNITIVE DEVELOPMENT

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This study uses Case's neo-Piagetian theory (1991) of cognitive development as a conceptual framework to investigate social cognitive development from childhood through late adolescence. Method: Using a coding scheme based on the Case model of cognitive development to evaluate performance on a measure of social reasoning abilities (Movie Clips Task), we examined the relationship between age and levels of cognitive complexity (so-called dimensional and vectorial stages of cognitive complexity). We also examined the contributions of working memory, information processing speed, and verbal IQ on social reasoning complexity. Results: Consistent with Case's theory, adolescents (n = 25) had significantly higher percentages of vectorial responses than pre-adolescents (n = 21), indicative of a greater frequency of responses that are representative of the highest level of cognitive development. Also, in accordance with Case's theory (1992a), information processing speed and working memory were independently associated with Movie Clips task performance, although when entered simultaneously in a linear regression model, only information processing speed significantly predicted performance on the Movie Clips task. Last, partial support for criterion validity for the Movie Clips task was demonstrated by its significant correlation with performance on an alternative measure of social cognitive abilities. The findings support Case's cognitive developmental theory and suggest that social cognitive abilities develop through adolescence.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

Cognitive development has been a widely studied field for the past century. The ways that it has been studied, the methods that have been used, what aspects have been studied, and the theories that have driven the study have developed over the past 100 years. Several different philosophies, from empiricist to socio-historic to rationalist accounts have all driven and developed different (although sometimes similar) theories of how cognitive development actually takes place from the time of birth until death (Case, 1987, 1991, 1992). One particular and very famous view of children's cognitive development that emerged in the middle of the 20th century was Piaget's constructivist theory (Piaget, 1977). Although powerful and informative due to its testable theoretical framework and accumulating empirical support, it became increasingly apparent over the next decade that some modifications to this theory were essential if it was to be able to explain and account for the newly evolving data. Scholars and researchers who believed in the core concepts of Piaget's theory, but recognized some of its' theoretical flaws and outdated assumptions attempted to produce these modifications. These theorists are known as neo-Piagetians.

One particular neo-Piagetian theory was advanced in the 1980's by Dr. Robbie Case (1987), who proposed that the achievement of staged milestones in cognitive development did not proceed at a uniform pace across all content domains of knowledge as has been suggested by Piaget. Rather, Case argued, these developmental achievements derived from age-related increases in processing speed, processing capacity, and working memory capacity rather than an acquisition of a common underlying "logical structure". To the extent that development across domains was synchronous or temporally correlated, it was presumed that such synchrony was due to the system limits imposed by overall processing capacity and working memory (Case, 1982, 1987, 1991, 1995). Moreover, if processing capacity and working memory set constraints on children's level of thinking, this could have practical implications for children delayed in their development of cognitive skills. Improving their information processing and working memory capacities, or at least reducing their demands, could lead to better overall cognition (Case, 1999). Because of the lack of literature that examines social cognitive development through the adolescent years, it is this theory that I would like to use to explore children's and adolescents' cognitive development within a social domain.

The purpose of this study is to examine age-correlated changes in social cognitive development, as measured by performance of children between 5 and 19 years of age on a social reasoning task that calls for the interpretation of the thoughts, feelings, motives, and affective communications of others. More precisely, the study aims to use the developmental theory and stages specified by Case (1987, 1991) to test specific hypotheses regarding age-related changes in social-emotional reasoning and interpretation of behavior as they relate to: a) stage related qualitative changes in social understanding described by Case (1991); and b) age-related changes observed in information processing speed and working memory capacity among children between 5 and 19 years of age.

1.1 PHILOSOPHICAL FOUNDATIONS OF CASE'S NEO-PIAGETIAN THEORY

Case's neo-Piagetian theory has evolved primarily from the rationalist tradition of philosophy and psychology from which Piaget's constructivist theory emerged. Jean Piaget's constructivist theory of children's cognitive and intellectual development is arguably the most famous of child development theories. The foundation of this theory is based on the idea of a universal "logical structure" which is considered to be a set of logical operations or processes that are applied across different domains of human activity and cognitive concepts (Piaget, 1975). Piaget believed cognitive development was a very general process that consisted of a particular set of logical operations, depending on the stage or complexity of the child's thinking, that were applied to all content areas. Emanating from Baldwin's (1968) stage theory, Piaget believed that children progressed through four stages—each marked by qualitatively different styles of thinking. According to this theory, the first stage began with the sensorimotor stage (birth to two years old), then the preoperational stage (two to seven years old), followed by the concrete operational stage (7 to 11), and finally the formal operational stage (11 and older), with additional substages within each one of these major stages (Piaget, 1968). To help formulate and test his theory, he designed and administered many now famous cognitive tasks that were used to classify children's thinking into one of the four specified stages (Piaget, 1977).

From the formidable body of observational data he collected, Piaget concluded that each of the developmental stages is marked by more advanced and efficient logical structures than the preceding stage. In addition, what makes Piaget's theory diverge from the theoretical models of the behaviorist and information-processing theorists is that the Piagetian model places the child in the role of a proactive, actively integrative organism; at each stage of development, the child forms new, more advanced logical structures by differentiating, integrating, and thereby modifying the existing structures (Case, 1999).

A better and more in-depth understanding of Piaget's theory can be obtained by examining the criticism of some of his underlying assumptions. For instance, the fact that short-term training studies on Piagetian tasks revealed that children often had success on a particular task, but would be unsuccessful on tasks that were supposed to be "structurally related" gave way to skepticism (Case, 1992a; Gelman, 1969). In addition, individual differences in task acquisition were also problematic for Piaget's theory since development was supposed to be a formal and universal process in which very little cross-task or cross-child variation should exist. These two arguments derive from evidence that same aged children develop at different rates depending on the specific task, context, or domain that was being assessed (Case, 1991, 1992a).

Pascual-Leone (1969) also pointed out several other problems with Piaget's theory, namely that the mechanisms or ways in which stage transition takes place is unclear; there is an absence of any explanation for individual developmental differences, and the failure to acknowledge any individual difference factors such as affect or perception influencing the path of children's cognition (Case, 1992a).

Many researchers and scholars accepted most of Piaget's theory but could not ignore some of these glaring weaknesses that had to be explained if the theory was going to continue. It was these researchers that went on to be classified as neo-Piagetian theorists. They attempted to hold on to most of Piaget's core values while modifying or refining aspects of the theory that were not supported by or were contrary to empirical evidence or were too difficult to test empirically in the first place. Although the details of these emerging theories tended to sometimes differ, Case (1992a) points out that several core postulates of neo-Piagetian theory were retained from Piaget's theory. These postulates were: a) Children have cognitive structures which develop due in part to their active participation in the knowledge acquisition process (in contrast to the passive accumulation of knowledge); b) There is a universal sequence of structural levels or stages that all children pass through; c) The timing or age of the transition is considered to be universal; and d) Later structures are composed of the differentiation and integration of lower-level earlier achieved structures. Many neo-Piagetian theories have been proposed since the 1970's (Fischer, 1980; Pascual-Leone 1970; Yeates, Schults, and Selman, 1990; Selman, 1981), but it is Case's particular theory (Case, 1987, 1991, 1992a) that seems to explain cognitive development in a way that best addresses the criticisms from the rationalist and socio-historic tradition, while also addressing development through the adolescent and early adult years.

1.2 CASE'S NEO-PIAGETIAN THEORY OF CHILD DEVELOPMENT

This section will provide an overview of Case's neo-Piagetian theory (1991). Although building from Piaget's theory, this theory incorporated modifications in response to the problems and contradictions (discussed above) inherent in Piaget's constructivist theory. However, several core assumptions remain. One of the assumptions is that any conceptual understanding in any domain is actively constructed by the child. It is the child's active reflection on his or her current conceptual structure and thinking that enables him or her to progress in cognitive development. Through this reflection, children differentiate and coordinate their existing structures, and then consolidate this newly formed structure into a better and more complex coherent structure.

Another assumption is that children progress through a universal sequence of structural levels that begins with basic sensorimotor structures and advances to representational structures of increasing abstractness and complexity (Case, 1991). Also, Case's theory is comprised of four stages of development or structures of thinking, but development through these stages can differ depending on the particular domain.

According to Case, the stages occur at approximately the same ages as Piaget's stages, but are labeled somewhat differently. The first stage is the sensorimotor stage (0-2 years old), which is characterized by children processing sensory input and thinking in terms of the physical world and the physical impact one can have on his or her environment. Once a child can recognize the relationship between two action-reaction units, such as the fact that pushing on a door will open it, while pulling on a door will close it, he or she then progresses to the inter-relational stage (2-5 years old). It is the differentiation, coordination, and consolidation of these two action-reaction units that makes the child capable of what Case denotes as 'inter-relational' thinking. At the inter-relational stage, children are able to coordinate two qualitatively different relational structures, such that they now understand to open or close the door by both physical and verbal instruction. They can also understand the effects of adding a door stop to the door, in that the door opens and closes differently due to the presence or absence of the door stop.

As children progress through this stage, they become able to recognize and understand the relationship between two inter-relational units, instead of one. Another example of capabilities at this stage is that children can recognize the effects or outcome of having a heavy weight on one side of a balance beam and a light weight on the other side. Finally, the differentiation, coordination, and consolidation of these units enable the child to progress to the dimensional stage (6 to 11 years old). In this stage, children are able to coordinate their conceptual structures for dealing with causation. For example, with reference to the balance beam scenario (above), the child gains the ability to recognize and anticipate the outcome of having different weights on two sides of the fulcrum of the balance beam. Thus, in the process of learning to recognize and cognitively manipulate two relationship structures, the child is able to consolidate the inter-relationship functions and in so doing, another more complex logical structure emerges, in this case, the understanding of the physics of balance and the impact of gravity on objects that have different weights.

Moreover, children begin to understand weight in terms of quantity instead of its physical appearance (Case, 1991). This ability can be observed by the child's ability to focus on the actual value or number of weights on each side of the balance beam, instead of simply arriving at conclusions based on which side "looks" heavier. By the end of the dimensional stage, children can further understand the relationship between two such dimensions, such as the relationship between number and weight, in this case the number of weights on each side of a balance beam, and the distance of weights placed on each side of the balance beam. Once again, when the differentiation, coordination, and consolidation of two or more dimensions are achieved, the child is in the final, i.e., the 'vectorial,' stage. Within this general stage, the adolescent progresses to a second sub-stage of vectorial operations, in which s/he learns to coordinate two dimensional structures, e.g., the type of dimensional structure used for the weight-distance effect on the balance beam, and another dimensional structure such as the concepts of fractions and ratios (Case, 1991). Finally, in the third sub-stage of vectorial operations, the child is able to understand abstract systems in which there are no concrete referents to a problem. For example, in the balance beam task, this ability is reflected by the ability to convert two ratios of weight or distance to two new ratios that share a common denominator. In this example, the child has compared two new abstract terms to draw a conclusion as to which side of the balance beam will go down. Throughout all of these specified stages, development proceeds through a recursive process in which transitions between one stage and the next that occur in the first stage occur in all of the proceeding stages, they are just composed of more complex units and therefore increase working memory demands (Case, 1991).

As previously mentioned, there have been modifications and additions to Piaget's theory. Of primary importance is the assumption that cognitive development in any domain is not the result of improving logical structures, but the result of improving conceptual structures in that particular domain. Also important is the premise that the rate of change across different domains is similar due to system-wide changes in cognitive processing capacity and working memory (Case, 1985; Fischer, 1980; Pascual-Leone, 1970). Case's original intent in forming his theory can be seen from this description: that cognitive development can be considered both domain-general and domain-specific at the same time. It is domain-general because of the underlying biological or maturational effect on processing capacity and working memory capacity, which Pascual-Leone called 'M-power' (1970). However, as both Pascual-Leone and Case argue, development itself is domain-specific for the following reasons. The first one is that cross-cultural studies show that societies where there is no appreciation or instruction given to a certain domain of knowledge will usually show retarded development in that domain. Fiati (1987) showed that in a culture where there is no importance or instruction given to numerical cognition, these people's development in this domain never progressed passed the level usually achieved by age six in western cultures. Their spatial and social cognition, on the other hand, showed the typical progression that would be expected of people in western cultures. Other theorists have produced these results and conclusions (Vygotsky, 1962). Another accepted postulate is that a child's experience and affective investment within a particular domain or area of content will affect that child's development within that domain (Case, 1991).

1.3 THE CONCEPTUAL SOCIAL STRUCTURE

This section will provide a description of the application of Case's theory to the social domain. As mentioned above, the theory states that individual conceptual structures can exist not only in the domains of numbers, or physical properties (such as weight, volume, etc.), but in the social and spatial domains (McKeough, 1991; Dennis, 1991), as well as others. In addition, this theory describes developmental processes through late adolescence and into early adulthood, which is of primary relevance when considering the lack of literature explaining social cognitive development throughout these years.

The only exceptions to this lack of literature that the author is aware of is the literature that looks at facial emotion recognition abilities and the maturation of neurological pathways believed to be used in social cognitive processes (Choudhury, Blakemore, & Charman, 2006 ; Herba & Phillips, 2004). These exceptions have shown that adolescents and young adults, as compared to young children and pre-adolescents, have faster response times in facial emotion recognition tasks and first person and third person perspective taking tasks. These faster response times are believed to be attributed to the processes of synaptogenesis and synaptic pruning, which occur in the prefrontal cortex for the last time at the beginning of adolescence, and the mylenization of the brain regions that are used in these social cognitive processes. Synaptogenesis occurs when the brain produces an abundance of synapses that will exceed adult levels of synapses per unit volume of brain tissue. This leads to an increased ability for the brain to make additional connections. Synaptic pruning then follows this synaptogenesis, typically continuing through adolescence. This synaptic pruning eliminates synapses that are underused or inefficient, leading to the strengthening of frequently used connections and the elimination of infrequently used connections (Blackemore & Choudhury, 2006). These maturational processes, in combination with increased mylenization, which insulates neurons leading to increases in the speed of transmission of electrical impulses from neuron to neuron, are believed to be large contributing factors to the faster response times of adolescents and adults on facial recognition tasks.

Studies have also shown that adults are better than children and adolescents at detecting subtle differences in emotional facial expressions. For example, Thomas, DeBellis, Graham, & Labar (2007), tested children, adolescents, and adults on tasks that presented six facial expressions on three sets of continuums. The three continuums consisted of facial expressions that would gradually progress from neutral to anger facial expressions, neutral to fear facial expressions, and fear to anger facial expressions. The results showed both linear and quadratic improvements with age in detecting the more subtle differences between the emotional facial expressions.

There have been several studies that have applied Case's theoretical framework to the explanation of the development of different aspects of social cognition. For example, Bruchkowsky (1991) applied it to investigation of children's empathic cognitive abilities; McKeough (1991) applied it to the analysis of children's construction of narratives; Griffin (1991) applied it to the investigation of children's interpersonal intelligence, and Marini and Case (1994) applied it to investigations of inferential thinking about personality traits. What emerges from a review of these studies and review of more recent empirical research on theory of mind abilities (such as false-belief understanding [Wimmer & Perner, 1983; Wellman, Cross, & Watson, 2001; Frye, Zelazo, & Palfai, 1995] and appearance-reality understanding [Flavell, Flavell, & Green, 1983]), is evidence that a major shift in performance occurs between the ages of four and six. At four years of age, children have clearly developed a TOM and are able to hold in mind and coordinate two beliefs or internal states simultaneously. For example, most four year olds are able to understand false-belief tasks because they are able to hold in mind both an actual state of affairs, as well as the inaccurate state of affairs that an ignorant character might believe in (Davis & Pratt, 1995; Gordon & Olson, 1998; Keenan, 1998). This is approximately the age at which Case believes that children are emerging from the inter-relational stage into the dimensional stage.

Another example of how recent findings on social cognition lend support to Case's theory comes from the work on social perspective-taking in early childhood. A transition occurs from simple recognition of the independence of internal mental states in others to the ability to coordinate the representations of multiple internal states that often involve more than one person. For example, at the end of what Case describes as the inter-relational stage (approximately at the age of five), children understand that people have internal mental states (Perner & Lang, 1999), and that these internal states-- whether they are beliefs, desires, or intentions--can influence emotional reactions in a familiar context (Bruchkowski, 1991). At the same time, children are acquiring the ability to predict what will happen next in a social script- based on a series of scenes or actions (McKeough, 1991). However, it is not until the age of six that they are able to coordinate these two structures into one coherent structure in which they can explain any event in a script or scene based on the events or actions preceding it, and on the basis of the beliefs, emotions, or desires of the characters regarding future events.

Other social cognitive changes during this same age range are occurring as well. For example, around the age of five or six children begin to go beyond simple understanding that people have internal mental states, but that their particular mental states or perspectives may be different from those of others. They also begin to describe events in relation to people's mental states, not by simply describing people's actions (Selman, 1990, 1981). According to Case (1991), these new abilities (in this case, the ability to discriminate between the mental states of two or more individuals) emerge as a result of increasing information-processing and working memory capabilities. Enhanced information processing and working memory capabilities enable the child to apprehend, hold in mind, and coordinate, two or more lower-level structures (in this case, the perception of the internal states of two or more individuals) into one higher-level structure (as, for example, the relationship between the inner states of two individuals). A good example of this type of combinatorial capability in the sphere of social perception or social perspective-taking is the ability to engage in what Theory-of-Mind researchers describe as second-order perspective-taking—the ability of a child to conceive of how one individual perceives the mental state of another individual. From the perspective of Case, this second-order perspective-taking represents the ability to combine higher-level conceptual units and thus mark the beginning of the dimensional stage. As children further progress through this dimensional stage, they become able to take into consideration two or more mental states within the same individual and then to integrate these distinctive and sometimes apparently conflicting states into a coherent explanation or interpretation of a person's behavior. For example, the child who observes evidence of another child's pleasure while playing with a puppy can also recognize and acknowledge the same person's dissatisfaction (and evident loss of temper) with the puppy when the puppy is discovered chewing on their prized new leather shoes. While the child observer recognizes that the child observed can experience both pleasure and distress or anger in relating to the puppy, the child recognizes that these emotions vary with the circumstances or context. That is, inferences regarding the mental state of the child being observed are conditional upon the specific circumstances or context rather than constant across all situations or contexts.

According to Case, the last qualitative shift in cognitive development takes place around eleven years of age. At this juncture, adolescents begin to be able to coordinate two compound units (what Case refers to as 'bi-dimensional' units or structures) into one coherent abstract structure. The achievement of this ability marks the beginning of the vectorial stage. Vectorial-stage cognition can entail the ability to consider two traits based on two previous episodes. Note that the ability to assign a personality trait to someone requires abstract reasoning since the trait is a result of previous episodes that are being held on-line. The ability to consider several possible reactions is also an abstract thought since neither of the reactions have actually been seen. It is the integration and coordination of these two abstract bidimensional units that characterize vectorial thinking.

The beginning of this stage can be seen in an example presented by Marini and Case (1994) using a task that calls for inferences regarding personality traits. For example, an adolescent or adult can make inferences regarding the intelligence of a child, and such inferences are presumed to involve the integration of at least two key characteristics or informational units—that is, the chronologic age of the child and data or information regarding their competence on an observable task. In this example, intelligence represents one bi-dimensional unit that is based on information about both the age and the performance of the child. Thus, conceptualization and application of the concept of the trait of intelligence involves the apprehension and coordination of two units or 'dimensions' of inter-individual variance (age and performance skills) instead of one alone. In other words, the observer must consider two features in order to assign a complex trait (such as level of intelligence) to someone. Likewise, a child or adolescent who could identify a personality trait based on the previous episode or scene (more generally, based on multiple observations of a particular individual under different conditions or circumstances) would be said to be apprehending two or more units of information (dimensions) in order to recognize a personality trait—as opposed to a situation-specific response or behavior, i.e. behavior that is determined by a specific circumstance or situation rather than a characteristic or trait that is intrinsic to the character. Thus, the adolescent would be demonstrating the ability to coordinate compound units of behavior ('if-then' here and 'if-then' there and 'if-then' in many other circumstances) with the inference that such behavior represents an underlying trait or characteristic that is common to all circumstances. This is a simple example of an interpersonal inference or interpretation of behavior at the vectorial stage of development.

An example of a yet more complex type of vectorial stage cognitive processing involves the combination of two or more complex bi-dimensional units. Consider the following: Given: 1) that a personality trait is itself a type of a bi-dimensional unit (as discussed above) based on the ascertainment or inference of a trait from observations of the observed individual under changing conditions; and 2) that the adolescent is now faced with a new set of contrasting circumstances in which the observed character must operate (and the adolescent must recognize as having a significant potential impact on the behavior of the observed character), then how does the adolescent predict that the individual will respond under circumstances that would presumably conflict with or prevent the expression of that personality trait or characteristic? In other words, in this complex type of vectorial stage person perception, the adolescent faced with a familiar character—i.e. someone with a recognized predilection or personality trait--will need to apprehend and take into account both the complex trait and the complex or unusual circumstances that could operate to prevent or otherwise modify the expectable behavior of the character. For example, when individual A is known for their consideration of the needs of others is faced with another person (individual B) in danger of physical injury, the expectation would be that individual A would respond to the call for help by providing assistance and rescue to individual B. However, when faced with a personal obstacle to providing such help—as for example, the fact that the two persons are in the process of robbing a bank and the police are on the brink of catching up with both A and B,--it may be that individual A would depart from the typical and most expectable course of action for individual A and, in this circumstance, run from the scene to avoid arrest by the police.

It should also be stated that according to Case's theory, advancement through substages within a stage or from one major stage to another (as from dimensional to vectorial) depends heavily on increasing working memory and information processing capacities. In a study by Pascual-Leone (1970), it was shown that a child's cognitive structure, as measured by Piaget's tasks and cognitive stages, was highly correlated with working memory capacity. Each stage required a certain working memory capacity to complete the tasks of that stage. What is hypothesized, but still unknown, is if these standard working memory requirements are also needed in a social cognitive domain. Studies that have looked at the relationship between theory of mind abilities and working memory abilities have showed strong associations. After controlling for age and language ability, performance on working memory tasks predicted performance on false belief tasks and appearance reality tasks for three, four, and five year-olds (Davis & Pratt, 1995; Gordon & Olson, 1998; Keenan, 1998).

Many studies have shown different trajectories in children's development of working memory abilities; however, what has been consistently shown is an increase in ability with age for both information processing and working memory (Fry & Hale, 2000; Luciana & Nelson, 2002; Brocki & Bohlin, 2004; Luciana, Conklin, Hooper, & Yarger, 2005;). In fact, some studies have shown working memory to continue to develop up to the age of 19 (Keage, et al., 2008; Luna, Garver, Urban, Lazar, & Sweeney, 2004). If this is the case, and information-processing capacity and working memory abilities do set an upper boundary on children's social cognitive abilities, then it may be possible to apply this to children showing social cognitive deficits. By improving their information-processing and working memory capabilities (or alternatively, by reducing the demands on these functions), children's social cognitive abilities should also improve (Case, 1999).

In applying this developmental model to the investigation of the development of social cognition, children ranging in age from 5 to 19 will perform a "Movie Clips task" that calls for inferences regarding the internal states, possible consequences of and motives for interpersonal behavior. The use of this task is of particular relevance given that other more popular social cognitive tasks, such as perspective taking and Theory of Mind tasks, show ceiling effects by around age ten (Wimmer & Perner, 1987). It is the purpose of this study to determine whether evidence of a qualitative shift in social cognitive competence is manifest around eleven years of age (in the comparison of children age ten and younger to children and adolescents ages eleven and older). This qualitative shift will be shown by the older children's verbal responses to an observational task ('Movie Clips') in which the behaviors of several characters across several different episodes are viewed, followed by questioning from the experimenter to the participants to request inferences regarding the thoughts, feelings, motives or changes in feeling state.

This shift in ability should be evidenced by adolescents eleven years old and older being able to hold in mind two or more internal states of two or more characters and integrating these four or more internal states into an explanation of the specific actions depicted in a scene. This ability could also be demonstrated in another way, which would be by acknowledging two or more mental states of one character and relating them to two or more actions or possible actions, so that one integrated explanation consisting of multiple internal states and multiple actions or possible actions explain events depicted in the scene. Examples of these higher level responses (vectorial responses), as well as lower level responses (dimensional responses), can be seen in Table 1.

The younger age group consisting of 5- to 10-year-olds should show a higher percentage of dimensional stage thinking as compared with the older-age group (11 to 19 years of age), while the older children (11- to 19-year-olds) should show a higher percentage of vectorial stage thinking as compared with the younger-age group. In addition, the frequency of higher-level cognitive inferences regarding the interpersonal behavior and internal states of characters in a social situation (as measured using the Movie Clips task) should be positively correlated with scores on working memory and information-processing performance tasks.

Also, child and adolescent performance on the “Movie Clips Task” is hypothesized to be positively correlated with performance on the Penn Emotion Recognition Task (PERT96) since they are both considered to tap emotion recognition abilities. Because previous studies have shown the development of facial emotion recognition abilities to continue into adulthood, comparing performance on this task to performance on the “Movie Clips Task” will serve as a criterion validity check for the “Movie Clips Task”.

Study Aim 1: To investigate whether social reasoning skills, as reflected on a laboratory behavioral observation measure of social reasoning (the 'Movie Clips Task') with children and adolescents (ages 5 to 19), will show an age-correlated shift from a less efficient and less complex mode of social reasoning ("dimensional stage") to a more efficient and more complex mode of social reasoning ("vectorial stage") as proposed by Case (1991).

Study Aim 2a: To determine whether age differences emerge in social reasoning skills that are consistent with Case's (1991) neo-Piagetian theory of cognitive development. Specifically, it is hypothesized that children and adolescents in the pubertal and post-pubertal age range (ages 11 to 19), should be in the vectorial stage of cognitive development, and, therefore, should show a higher percentage of social reasoning responses that reflect vectorial-stage thinking than children ages 5 to 10.

Study Aim 2b: A corollary hypothesis to Study Aim 2a is that children ages 5 to 10 should show a higher percentage of dimensional-stage responses than children and adolescents in the older age range.

Study Aim 2c: Consistent with this model, this study will test the hypothesis that within the adolescent group, the prevalence of vectorial responses will increase with age. Also consistent with this model, this study will test the hypothesis that within the pre-adolescent group, the prevalence of dimensional thinking should increase with age.

Study Aim 3: To evaluate the relationship between age-related changes in basic cognitive capacities and categorical shifts in children's social reasoning. Since processing speed and working memory are believed to set the upper limits of children's cognitive capabilities, it is hypothesized that processing speed and working memory will be correlated with the complexity of children's conceptual social structure or stage of thinking, as reflected in scores on an observational measure of social reasoning responses to interpersonal interactions.

Study Aim 4: To evaluate the criterion validity of the "Movie Clips Task" by examining the relationship between age-related performance on this task with age-related performance on the Penn Emotion Recognition Task, which is an accepted measure of facial emotion recognition abilities (Kohler, et al., 2004).

2.0 METHOD

2.1 PARTICIPANTS

Participants were recruited by flyers distributed to local public schools, summer camps and churches in the Pittsburgh area, local physician's offices, local public organizations (public libraries and recreation centers), and from referrals of healthy control children and adolescents from a high-risk research program. All recruitment procedures were conducted in accordance with research procedures approved by the Institutional Review Board of the University of Pittsburgh. All of the participants spoke English as their first language. All children have been observed and interviewed using the Structured Clinical Interview for DSM-IV Diagnosis (SCID-IV), with a collateral SCID interview with the parent to determine the presence/absence of Axis-I psychiatric disorders in first-degree relatives as well as freedom from psychotic or mood disorders in the child/adolescent. These interviews were conducted by a Licensed Clinical Psychologist to ensure that there is no history of Axis I psychotic or mood disorder in the child or the first degree relatives. All participants were free of any medical or neurological disorders.

For the purposes of this study, children and adolescents were separated into two age groups, based on the age ranges in Case's stage model of cognitive development. The child and pre-adolescent group consisted of twenty-one (n = 21) 5- to 10- year-olds and the adolescent group consisted of twenty-three (*n* = 25) 11- to 19-year-olds. Recruitment was intended to generate an equivalent number of males and females within each age group.

Before participating, a research assistant (trained to administer informed consent procedures and approved for such by the IRB) presented the written informed consent form to potential subjects, who were then asked to read the form and were invited to ask questions of the research assistant. For subjects 5-13 years old, informed consent was obtained from the parent or legal guardian. For subjects ages 14 to 17, informed consent was obtained from both the adolescent and his or her parent or legal guardian. For subjects 18 to 19 years old, informed consent was obtained from the subject. Commensurate with the time required to complete the full battery of tests for the parent study, all subjects were offered participant payment by check. All children and adolescents received a $60.00 check for their participation; for each child or adolescent, the parent who participated received a $30.00 check for their participation in the study.

2.2 PROCEDURES

An initial diagnostic (SCID) interview was conducted by an experienced clinical psychologist with the potential subject and a similar interview was conducted with the parent of the participating subject to ascertain the presence of any DSM-IV Axis I psychopathology in the prospective subject or their first degree relatives. Subjects who met criteria for study participation took part in approximately 6 to 8 hours of assessments, including a battery of neurocognitive and social cognition tasks, administered over one to three sessions. Frequent breaks were taken during testing and multiple sessions were used to minimize potential fatigue and to maximize motivation to perform on the part of the participants.

With the exception of the videotape coding data for this project, a majority of the primary data has been collected by an existing research lab over the last seven years. As of August 2007, primary data have been collected on 27 children and adolescents between the ages of 5 and 19. To complete the data collection and to achieve the proposed cell sample sizes of at least 20 per age group or cell, 19 children and adolescents were recruited to participate in the study. All coding data was collected over the fall of 2007 and the spring of 2008 using the coding scheme developed by the primary investigator and another research assistant. Data analysis for this study and preliminary data analyses and data reduction of the secondary (videotape coding) data was conducted by the primary investigator. All secondary data was collected with the assistance of trained research assistants who conducted all coding.

2.3 MEASURES

For this study, three neuropsychological tests were selected from a larger battery of neuropsychological and information processing tasks administered as part of a larger study. A description of each of these selected tasks are as follows:

2.3.1 Digit Span Task

This test is part of The Wechsler Memory Scale-Third Edition (Wechsler, 1997). The first part of this task (forward digit span) is a measure of short-term memory span. In this task, the test administrator reads a string of numbers one time and then the participant has to repeat this string of numbers back in the same order. The numbers are presented at a pace of one digit per second. For example, if the tester presents four digits, and the participant replies correctly with the same numbers in precisely the same order, then the examiner increases the next digit span to five digits. Each digit span, regardless of performance, is presented twice, with each correctly repeated presentation giving a score of one. Once a participant fails two times on the same digit span, the task is over. Because the largest digit span tested is seven, a perfect score is 14. The same procedure is then used for the backward digit span, a measure of working memory in which the subject is asked to recall the numbers presented but to repeat them in the reverse order. Because backward digit span involves more of a memory 'load' requiring recall and internal manipulation of the number series, it is considered to be a more sensitive test of working memory than is forward digit span, which is why this was the only digit span measure used in the analysis.

2.3.2 Trails Task

There are two versions of this task, however, for the purposes of this study, only the first part is of relevance. This part is referred to as Trails A and requires participants to connect in order numbered dots ranging from 1 to 25 on a sheet of paper. The subject is first given a practice trial that consists of eight dots to ensure that the subject understands the task. If the subject makes a mistake by connecting two dots that are not in the correct order, the task administrator stops the subject, records the error, and guides the subject back to the point right before the location of the error. A timer or stop watch is used to record the total time taken to finish the task. The total time taken to perform the task is the final score with higher response times indicating slower information processing speeds and lower response times indicating faster information processing speeds. This task is used in The Halstead-Reitan Neuropsychological Test Battery (1985) and is a measure of information processing speed. A one-year retest reliability of 0.64 (Snow et al., 1988) and an alternate form reliability of 0.89 (Charter & Adkins, 1987) has demonstrated adequate reliability. For control subjects ranging from 8 – 60 years of age, the normative range is 8 – 86 seconds to complete the task (Spreen & Strauss, 1991.)

In addition to the neuropsychological tasks administered, two social cognition tasks were used in this study. A description is as follows:

2.3.3 Movie Clips Task

The Movie Clips Task is a new assessment, created in the Family and Psychosocial Studies Research Lab at Western Psychiatric Institute and Clinic (WPIC), which measures an individual's social perspective-taking, social situation understanding, inferential thinking, and affect recognition abilities. The assessment consists of six videotaped scenes from the movie Toy Story in which a series of questions are asked of the participant immediately following each scene. Examples of the types of questions asked can be seen in Table 1. Five scoring categories are used to evaluate performance in each of the five domains on the Movie Clips Task: Affective Change (AC), the ability to recognize shifts in mood states; Cognitive Inference (CI), the ability to make inferences in regard to what a character is thinking; Empathic Cognition (EC), the ability to make inferences in regard to the emotion or feeling state of a character ; Motives (M), the ability to make inferences regarding a character's intentions, or motives for actions or spoken words; and Personal Empathic Cognition (PEC), the ability to relate to the characters on a personal level by making emotional responses to the social context (based on self-report response to question regarding personal emotional response to the scene). Scores for each item range from 0 (failing to acknowledge or provide an inference regarding the targeted domain, e.g. emotion, internal state, or actions in the scene) to 8 (integrating or relating multiple internal states of at least two characters, or integrating or relating multiple internal states of one character and understanding the effects of those states on his or her actions.) Scores for each of the five domains are computed by summing item scores to generate five subscales.

To assess the participant's overall performance on the Movie Clips Task, a 'Total Score' is computed by summing the scores across all 25 questions. For this project, a newly modified coding system has been designed to reflect stages of cognitive development described by Case (1987). Scores ranging from 0 to 3 were coded as pre-dimensional, scores ranging from 4 to 6 were coded as dimensional, and scores ranging from 7 to 8 were coded as vectorial. Frequency counts for total number of dimensional and total number of vectorial scores were calculated, as well as the corresponding percentages. In addition, to assess whether each participant was capable of a vectorial response, each subject was coded as either having the ability or not having the ability based on the presence or absence of at least one vectorial response (0 = *no vectorial response*, 1 = *one or more vectorial responses*). To obtain adequate reliability using this coding system, training was conducted by two experienced and trained coders in collaboration with the principal investigator of this project. An assessment of inter-rater reliability was conducted using a set of fourteen training tapes for coder 1 and coder 2, a set of ten training tapes for coder 1 and coder 3, and a set of six training tapes for coder 2 and coder 3, to achieve an estimate of inter-rater reliability based on the agreement among the three coders. Achievement of greater than or equal to 0.70 (intra-class correlation coefficient) on the set of training tapes enabled each coder to proceed with a final set of 10 tapes, which were independently coded. To provide an additional assessment of inter-rater reliability, Cohen's kappa coefficients (1960) were calculated to ensure adequate reliability among each pair of coders on vectorial response capability. For rater 1 and rater 2, $\kappa = 0.67$ and percent agreement of 87.5% demonstrated adequate to good inter-rater reliability for these two coders on this measure. For rater 1 and rater 3, $\kappa = 0.55$ and percent agreement of 80.0% demonstrated adequate inter-rater reliability for these two coders on this measure. Coders were blind to the specific hypotheses and ages of the participants.

2.3.4 Penn Emotion Recognition Task (PERT96)

This is a computerized task that tests emotion recognition abilities (Kohler, Turner, Gur, & Gur, 2004). Faces displaying Happiness, Anger, Fear, Disgust, Sadness, and Neutral emotions are presented on the computer screen one at a time, and the participant is required, without time limit, to click on the appropriate emotional label that he or she believes is being expressed by the present face. There are 48 female and 48 male faces presented, for a total of 96 facial presentations. Half of the emotions displayed are of mild intensity, while the other half are of extreme intensity. Age and race are balanced for each emotional condition by gender. The total amount of correctly indentified emotional expressions is the final score with higher scores indicating a higher frequency of the correct identification of the emotional expressions displayed, thus indicating more efficient facial recognition abilities. The validity of the detectibility of the six emotions has been demonstrated (Gur, et al., 2002). Seven faces were rated by 45 healthy raters and an additional eight faces were rated by 62 healthy raters. These ratings demonstrated that all expressions were detected correctly at levels far above chance. The percentage of correctly identified expressions ranged from 45 percent (fear expression) to 95 percent (happy expression). The procedure for generating these stimuli has also been previously described (Kohler, et al., 2002).

2.3.5 Peabody Picture Vocabulary Test (PPVT-III)

The PPVT (Dunn & Dunn, 1997) is a verbal test of intelligence that is notable for being more culture-fair than many other intelligence tests. It is administered to provide a verbal IQ estimate. Reliability statistics have been calculated across 25 different age groups with 100 participants in each group. The median age alternate-forms reliability coefficient for the PPVT-III was 0.94. The median age alpha reliability coefficient was 0.95 and split-half reliability coefficient was 0.94 demonstrating good internal consistency (Dunn & Dunn, 1997). Satisfactory to good criterion validity of the PPVT-III was demonstrated by testing 41 children ages 7 years 11 months through 14 years 4 months on both the PPVT-III and the Wechsler Intelligence Scale for Children-Third Edition (WISC-III; Wechsler, 1991). The corrected correlations between the standard scores ranged from 0.82 to 0.92 with slightly higher correlations with the Verbal IQ scores than with Performance IQ and Full Scale IQ scores (Dunn & Dunn, 1997).

3.0 RESULTS

3.1 DESCRIPTIVE STATISTICS

Descriptive statistics for the three age groups are presented in Table 2. The IQ range of each group was within the normal or above normal range, with the exception of one participant within the pre-adolescent group who had a PPVT standard score of 78. As shown in Table 2, there were no significant race or sex differences across the two age groups.

3.2 MOVIE CLIPS TASK RELIABILITY

To analyze the reliability of the Movie Clips task, several reliability tests were conducted. To analyze the inter-rater reliability of the overall total score of the Movie Clips task, a fixed set Shrout-Fleiss intra-class correlation coefficient (ICC) reliability test was performed. Of the 30 transcripts available for reliability assessment, the performances of fourteen participants were coded by both rater 1 and rater 2, the performances of ten participants were coded by both rater 1 and rater 3, and the performances of six participants were coded by both rater 2 and rater 3 for an overall fixed set Shrout-Fleiss intra-class correlation coefficient (ICC) of 0.71. To analyze the inter-rater reliability of coding whether or not participants were capable of at least one vectorial response, percent agreements and Cohen's kappa coefficients (1960) were calculated. Cohen's kappa coefficients were used, as opposed to only percent agreements, because a Cohen's kappa calculation partials out the percent of agreement that would occur by chance alone. For rater 1 and rater 2, $\kappa = 0.67$ and percent agreement of 87.5% demonstrated adequate to good inter-rater reliability for these two coders on this measure. For rater 1 and rater 3, $\kappa = 0.55$ and percent agreement of 80.0% demonstrated adequate inter-rater reliability for these two coders on this measure.

3.2.1 Study Aim 1: To Test Hypothesis that Mean Score of Performance on the Movie Clips Task is Positively Correlated with Age

An analysis using a Pearson's correlation coefficient indicated a significant positive linear relationship between age and mean score of performance on the Movie Clips task, $r = 0.06$, $p < 0.001$. A scatter plot that demonstrates this relationship can be found in Figure 1. Descriptive statistics demonstrating the adolescents' superior mean score of performance on the Movie Clips task can be found in Table 3.

3.2.2 Study Aim 2a: To Test Hypothesis that Adolescents More Often than Pre-Adolescents Perform Vectorial Responses

An analysis using a chi-square goodness of fit test indicated a significant ordinal relationship across the two age groups (pre-adolescent and adolescent) in terms of the frequency of persons within each age group that demonstrated the capability to perform one or more vectorial responses (0 = *did not perform at least one vectorial response*, 1 = *performed at least one vectorial response*), χ^2 (1, N = 46) = 12.02, $p = 0.001$, when gamma = 0.82, $p < 0.001$.

Descriptive statistics for the age groups can be found in Table 2. Descriptive statistics for vectorial response capability can be found in Table 3.

The percentages of vectorial responses were calculated for each age group to determine if the adolescent group was more often performing vectorial responses than the pre-adolescent group. An analysis using an independent samples *t* test indicated that the adolescent group had a significantly higher percentage of vectorial responses than the pre-adolescent group, t (31.44) = - 3.80, p = 0.001. Descriptive statistics for percentage of vectorial responses on the Movie Clips task can be found in Table 3. A scatter plot demonstrated a cubic relationship between percentage of vectorial responses and age, as presented in Figure 2.

3.2.3 Study Aim 2b: To Test Hypothesis that Pre-Adolescents show Higher Percentage of Dimensional Responses than Adolescents

An analysis using an independent sample *t* test indicated that the adolescent group performed significantly more dimensional responses than the pre-adolescent group, t (28.69) = -2.71, p = 0.01. Descriptive statistics for the age groups can be found in Table 2. Descriptive statistics for the percentage of dimensional responses on the Movie Clips task are presented in Table 3. A scatter plot demonstrated a cubic relationship between percentage of dimensional responses and age, as presented in Figure 3.

3.2.4 Study Aim 2c: Test Hypothesis that within Each Age Group, Performance on Movie Clips Task is Positively Correlated with Age

An analysis using a Pearson correlation coefficient indicated that, within the adolescent age group, there was no significant positive linear relationship between age and percentage of vectorial responses on the Movie Clips task, $r = -0.00$, $p = 0.99$. In addition, an analysis using a Pearson correlation coefficient indicated that, within the pre-adolescent age group, there was a significant positive linear relationship between age and percentage of dimensional responses on the Movie Clips task, $r = 0.70$, $p < 0.001$. Descriptive statistics for the percentage of vectorial responses and percentage of dimensional responses on the Movie Clips task are presented in Table 3.

3.2.5 Study Aim 3: To Test Hypothesis that Information Processing Speed and Working Memory are Correlated with Performance on Movie Clips Task

An analysis using a Pearson's correlation coefficient indicated a significant positive linear relationship between working memory and mean score of performance on the Movie Clips task, $r = 0.46$, $p = 0.001$. A second analysis using a Pearson's correlation coefficient indicated a significant negative linear relationship between information processing speed and mean score of performance on the Movie Clips task $r = -0.55$, $p < 0.001$. A third analysis using a Pearson's correlation coefficient indicated no significant linear relationship between verbal IQ and mean score of performance on the Movie Clips task, $r = 0.12$, $p = 0.43$. Next, a simultaneous linear regression model indicated that working memory, information processing speed, and verbal IQ explained 37.0% of the variance in the mean score of performance on the Movie Clips task.

However, as presented in Table 5, only information processing speed was a significant predictor of Movie Clip task performance. For every unit increase in information processing speed there was a 0.47 standard deviation unit decrease in Movie Clip task performance. Working memory may not have significantly predicted Movie Clip task performance because it was significantly correlated with information processing speed, as shown in Table 5. This multicollinearity may have masked the independent contribution of working memory on Movie Clip task performance and may suggest that a more appropriate regression model should only include one of these two inter-correlated variables. Descriptive statistics for the three predictor variables are presented in Table 4. The linear regression statistics and coefficients are presented in Table 6.

3.2.6 Study Aim 4: Test Hypothesis that Performance on Movie Clips Task is Positively Correlated with Performance on PERT96

An analysis using a Pearson's correlation coefficient indicated a significant positive linear relationship between the mean score of performance on the Movie Clips task and performance on the PERT96, $r = 0.58$, $p < 0.001$. Descriptive statistics demonstrating performance improvements through adolescents on the PERT96 are presented in Table 4. Descriptive statistics demonstrating performance improvements through adolescents on the Movie Clips task are presented in Table 3.

4.0 DISCUSSION

As hypothesized, our findings did indicate a strong relationship between age and social reasoning complexity. Across the pre-adolescent and adolescent age groups, age was significantly associated with cognitive complexity ratings. As expected, adolescents were significantly more capable of performing at least one or more vectorial responses than pre-adolescents, thus demonstrating a higher prevalence and competence of vectorial-stage thinking. Adolescents also demonstrated this greater prevalence of vectorial-stage thinking by having a higher proportion of vectorial responses than pre-adolescents on the Movie Clips task. Also, in accordance with Case's theory (1992a), working memory and information processing speed were each independently correlated with Movie Clips task performance. As hypothesized, information processing speed and working memory were both strongly associated with each other and with the dependent measure (complexity ratings on the Movie Clips task). When information processing speed and working memory, as well as verbal IQ, were included in a linear regression predicting performance on the Movie Clips task (total complexity rating score), only information processing speed significantly predicted performance on the Movie Clips task. It is likely that the non-significant contribution of working memory to variance in Movie Clip task performance was due to the variance in the dependent variable that was common to the two predictors in the equation.

In addition, the significant relationship between performance on the PERT96 and performance on the Movie Clips task indicates that the Movie Clips task, as intended, is measuring at least some subset of social cognitive abilities.

4.1 SOCIAL COGNITION DEVELOPMENT

The analyses support the hypothesis that social cognitive abilities develop from early childhood through the adolescent years. Adolescents consistently outperformed pre-adolescents on all Movie Clips task measures. The adolescents average scores, percentage of vectorial responses, percentage of dimensional responses, and vectorial response capability scores were all superior to those of the pre-adolescent subjects. These findings are consistent with Case's cognitive developmental theory (1991) and offer support for the hypothesis that social cognitive developmental improvements are continuing through adolescence.

These findings also suggest that the adolescents may have developed, or are in the process of developing, a qualitatively more advanced cognitive structure for dealing with social understanding, or as Case would call it, a central social structure (1991). These findings indicated that adolescents demonstrated that they are capable of holding in mind multiple internal states (emotions, motives, or desires) of a character or of more than one character, and they are capable of relating these internal states to the actions performed or discussed by the characters. It is this ability that is characterized as vectorial thinking. Pre-adolescents, on the other hand, were rarely ever able to do this. Pre-adolescents did demonstrate that they were capable of dimensional thinking, which consists of: a) the ability to understand that characters may be feeling multiple internal states simultaneously; b) the ability to understand that multiple internal states can result from a single action or event; c) the ability to understand that multiple actions or events can result in a character experiencing a single internal state; and d) the ability to understand that two characters can experience a different emotional reaction in response to the same action or event.

Although the differences between these two levels of responses may at first seem minimal, a more qualitative review of these differing performances indicates not just a quantitative, but also a qualitative improvement. Adolescents, significantly more often than pre-adolescents, were able to combine two dimensional level thoughts. For example, as pre-adolescents were certainly capable of understanding that a character's internal state(s) could result from a particular event, adolescents were often capable of understanding that this internal state could change as the result of additional actions or events. Therefore, adolescents were able to hold mind that one particular action or event elicited or resulted from a character's internal state, and that an additional action or event elicited or resulted from an alternative internal state. Adolescents were also significantly more often able to hold in mind the multiple internal reactions or feelings that a character had in response to a series of events or actions, while at the same time considering the multiple internal states or feelings a second character had to a series of events or actions. It is this ability of combining two dimensional thoughts into one coherent and more complex thought that indicates a qualitative advancement of adolescents' central social structure.

In order for adolescents to hold in mind two dimensional units simultaneously and consequently to perform at the vectorial level, Case's developmental theory suggests that adolescents' working memory and information processing speed must have matured enough to meet this demand (Case, 1992). It is apparent in the example above that vectorial stage thinking requires more units of information to be held on-line simultaneously, thus increasing working memory and information processing speed demands. As expected, working memory and information processing speed were both independently significantly correlated with performance on the Movie Clips task. However, in our linear regression analysis, only information processing speed, not working memory or verbal IQ, predicted performance on the Movie Clips task. It is possible that this is due to the significant inter-correlation between information processing speed and working memory. This significant inter-correlation indicates that there is probably variance in the dependent variable that is shared by information processing speed and working memory. Although this may appear problematic for this theory, it is actually in agreement. Case believes that working memory is dependent on information processing speed (1991) because the quicker one can process information, the less amount of time one has to hold in mind additional information. Therefore, since both functions were highly independently correlated with social reasoning complexity, as well as highly correlated with each other, they may best be thought of as serving a joint function contributing to Movie Clips task performance.

If working memory and information processing speed are considered to serve a joint function, then these findings are in line with the studies that have shown working memory to predict young children's performance on Theory of Mind (ToM) tasks (Davis & Pratt, 1995; Gordon & Olson, 1998; Keenan, 1998). Also, because information processing speed and working memory were independently correlated with social reasoning abilities, because information processing speed significantly predicted social reasoning complexity, and because information processing speed and working memory are believed to improve through adolescents (Keage, Clark, Hermens, Williams, Kohn, Clarke, Lamb, Crewther, & Gordon, 2008; Luna, Garver, Urban, Lazar, & Sweeney, 2004), the hypothesis that at least some social cognitive abilities continue to develop through adolescents is supported.

An additional finding, pertaining strictly to the pre-adolescent group, supports Case's theory (1991) and should not be overlooked. Within the pre-adolescent group, the percentage of dimensional responses was significantly associated with age. This indicates that throughout this age period the occurrence of dimensional thinking is increasing. This finding was expected because, according to the theory, this is precisely the age that children should be progressing through the dimensional stage, thus becoming increasingly competent of dimensional thinking.

4.2 THE MOVIE CLIPS TASK

The Movie Clips task, although a measure only in its infancy of development, did show adequate to good inter-rater reliability across three coders. It also demonstrated good criterion validity due to its high significant correlation with performance on the PERT96. Although the PERT96 does not require multiple internal states to be held on-line, nor does it require inferences about internal states based off of the actions of characters, it does measure the ability to recognize and label different emotional states based off of facial expressions. According to Case (1992a), both tasks should be similar enough to tap the same central social structure. Within this theoretical framework, the PERT96 should serve as an appropriate task to use to test the criterion validity of the Movie Clips task. The next step for establishing this Movie Clips task as an accepted measure of social cognitive abilities would be to see if these same reliability statistics could be replicated. Also, testing whether performance on this task is correlated with performance on

Theory of Mind tasks, or other established social cognition measures, might further demonstrate the criterion validity of this task.

It should be mentioned that the questions used on this task were initially created to serve the purposes of a previous and slightly different version of this task. It is possible that wording and presenting the questions specifically tailored towards Case's cognitive developmental theory may lead to different results.

4.3 STUDY LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

There are several limitations to this study that may have affected the results that were found. For instance, as seen Table 2, the sample sizes for reach age group ranged from only 21 to 25. This prevented small or medium sized effects from being detected. Larger sample sizes would also allow more variables to be controlled for in regression analyses. Future studies that control for parental education levels, SES, as well as additional working memory measures that measure different types of working memory (e.g. working memory using emotional stimuli, visual working memory, verbal working memory) may lead to a better and more accurate understanding of social cognitive development. Because the current sample only consisted of whites and African Americans, it would be imperative for future studies to obtain a more racially representative sample to improve generalizability.

Because the Movie Clips task is a new task and is not yet a well accepted measure of social cognitive abilities, it may have been more desirable to use an already validated measure to test this study's hypotheses. Unfortunately, the author is unaware of any social cognitive measure that is sensitive to the developmental changes that may take place from early childhood through late adolescents. In addition, the Movie Clips task asks participants to make inferences based on movie scenes, and not real life events. Therefore, the additional dramatic effects that are inherent in all motion pictures may lead to misinterpretations of participants' true social cognitive abilities that are demonstrated in real life settings.

5.0 CONCLUSION

This study has several implications for better understanding social cognitive development, and therefore, can help us better understand and address social cognitive deficits. This study has taken one of the first steps to understanding social cognitive development across a large age span that extends from childhood into late adolescence. These findings support the possibility that social cognitive abilities continue to develop at least through late adolescents. Also, as Case believed, this study supports the hypothesis that social cognition relies heavily on working memory and information processing abilities (1991). This suggests that children and adolescents who display social cognitive difficulties or delays may have deficits with more basic cognitive functions. Improving these basic cognitive functions (working memory and information processing speed), or reducing their demands, may lead to better social cognition in children and adolescents who otherwise show deficits.

APPENDIX

TABLES AND FIGURES

Table 1. Example of Questions Asked on Scene Two of the "Movie Clips Task" and Responses Representative of the Dimensional and Vectorial Stages.

Type of Question	Question	Dimensional Response	Vectorial Response	Explanation
Cognitive Inference	How does Woody act towards Buzz in this scene?	Woody acts like he's jealous because he is complaining.	Woody acts jealous and worried because he is complaining and tells everyone that Buzz isn't a real superhero.	"jealous" - **1st internal state** "worried" - **2nd internal state** "complaining" - **1st action** "tells everyone that Buzz isn't… - 2nd action**

Table 2. T-tests / Chi-Square for Demographic Characteristics by Age Group

Demographic Variable	5-10 year-olds (n = 21)	11-19 year-olds (n = 25)	df	t / χ^2	p
Age					
$\bar{X}$ (SD)	71.4 (1.59)	14.56 (2.43)	44	-11.97	0.001
Min	5	11			
Max	10	19			
Sex			(1, N = 46)	0.57	0.45
% Male	43	32			
% Female	57	68			
Race			(1, N = 46)	0.45	0.50
% White (Caucasian)	71	80			
% African American	29	20			

table continues

Demographic Variable	5-10 year-olds (*n* = 21)	11-19 year-olds (*n* = 25)	*df*	t / χ^2	*p*
IQ					
$\bar{X}$ (*SD*)	109.24 (12.48)	113.48 (13.90)	44	-1.08	0.29
Min	78	90			
Max	134	143			
Highest Level Of Parent Education[a]					
Mother $\bar{X}$ (SD)	5.59 (1.42)[b]	5.32 (1.12)	(1, *N* = 42)	0.48	0.49
Father $\bar{X}$ (SD)	5.29 (1.31)[b]	5.64 (1.15)	(1, *N* = 42)	0.82	0.37

[a]Highest level of Parent Education (0 = information not available, 1 = less than 7th grade, 2 = junior high school [7th, 8th or 9th grade], 3 = partial high school [10th or 11th grade], 4 = completed high school or trade school or other non-academic training requiring high-school completion for admission, 5 = attended college but did not receive four year academic degree, 6 = completed college, received four year academic degree, 7 = completed post-graduate training). [b] *n* = 17.

Table 3. Dependent Variables by Age Group.

Dependent Variable	5-10 year-olds (*n = 21)*	11-19 year-olds (*n* = 25)
Average Score (Movie Clips)[a]		
$\bar{X}$ (*SD*)	2.91 (0.69)	3.76 (0.59)
Min	1.44	2.88
Max	3.96	4.92
% of Dimensional Responses		
$\bar{X}$ (*SD*)	37.62 (16.05)	48.12 (8.25)
Min	12	28
Max	60	60
% of Vectorial Responses		
$\bar{X}$ (*SD*)	1.90 (3.92)	10.60 (10.61)
Min	0	0
Max	16	36
Vectorial Response Capability		
% Yes	29	80
% No	71	20

[a] Range of Average Movie Clips Score is 0 – 8.

Table 4. Independent Variables by Age Group.

Independent Variable	5 – 10 year olds (n = 21)	11 -19 year olds (n = 21)	*df*	t / χ^2	*p*
Information Processing Speed					
$\bar{X}$ (*SD*)	78.86 (66.18)	27.12 (8.49)	20.55	3.57	0.002
Min	25	14			
Max	263	55			
Working Memory Span					
$\bar{X}$ (*SD*)	4.05 (1.40)	8.32 (2.17)	41.37	-8.05	0.001
Min	2	4			
Max	8	13			
PERT96 Correct Responses					
$\bar{X}$ (*SD*)	56.63 (11.58) [a]	66.55 (5.65) [b]	25.24	-3.40	0.002
Min	34	54			
Max	72	75			

[a] n = 19. [b] n = 21.

Table 5. Correlations Matrix of Independent and Dependent Variables (N = 46).

Variable	1	2	3	4	5	6	7	8[a]	9[b]	10[b]	11	12	13
1. Movie Clips Average Score	-												
2. % of Vectorial Responses	0.77**	-											
3. % of Dimensional Responses	0.73**	0.26	-										
4. Vectorial Response Capability	0.69**	0.90**	0.36*	-									
5. Information Processing Speed	-0.55**	-0.22	-0.57**	-0.37*	-								
6. Working Memory	0.46**	0.32*	0.41**	0.36*	-0.54*	-							
7. IQ	0.12	0.25	-0.10	0.12	0.16	0.03	-						
8. PERT96[a]	0.58**	0.35*	0.49*	0.40*	-0.63*	0.34*	0.26	-					

*$p < 0.05$. **$p < 0.01$. ***$p < 0.001$. [a]$n = 40$. [b]$n = 17$.

table continues

Variable	1	2	3	4	5	6	7	8[a]	9[b]	10[b]	11	12	13
9. Highest Level of Mother's Education	-0.12	0.01	-0.11	0.05	0.08	-0.07	0.39**	0.23	-				
10. Highest Level of Father's Education	0.26	0.29	0.13	0.19	-0.23	0.07	0.53**	0.44**	0.39**	-			
11. Sex	0.04	-0.11	0.08	-0.04	-0.24	0.08	-0.07	0.28	-0.03	0.18	-		
12. Race	0.04	-0.11	-0.08	0.08	0.16	-0.06	-0.39**	-0.13	-0.01	-0.51**	0.11	-	
13. Age Group	0.52**	0.55**	0.32*	0.52**	-0.74**	0.78**	0.14	0.47**	-0.09	0.13	0.11	-0.10	-

*p < 0.05. **p < 0.01. ***p < 0.001. [a]n = 40. [b]n = 17.

Table 6. Summary of Linear Regression Analysis for Variables Predicting Average Movie Clips Score for Pre-Adolescents and Adolescents(N = 46).

Independent Variable	*B*	*SE B*	β
Information Processing Speed	-0.007	0.002	-0.469*
Working Memory Span	0.053	0.039	0.200
Verbal IQ	0.011	0.007	0.185

*$p < 0.07$

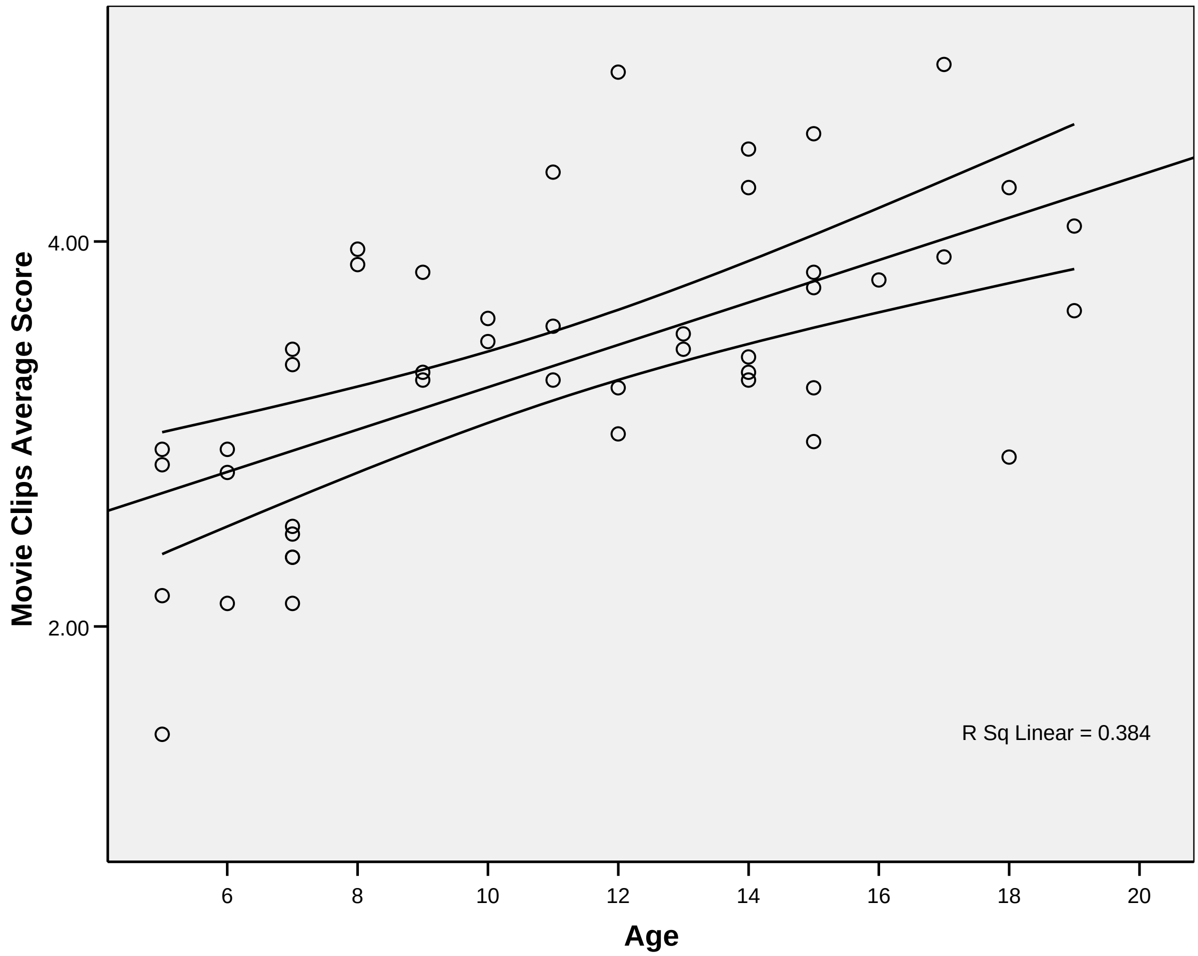

Figure 1. Mean score of performance on Movie Clips Task as a function of age.

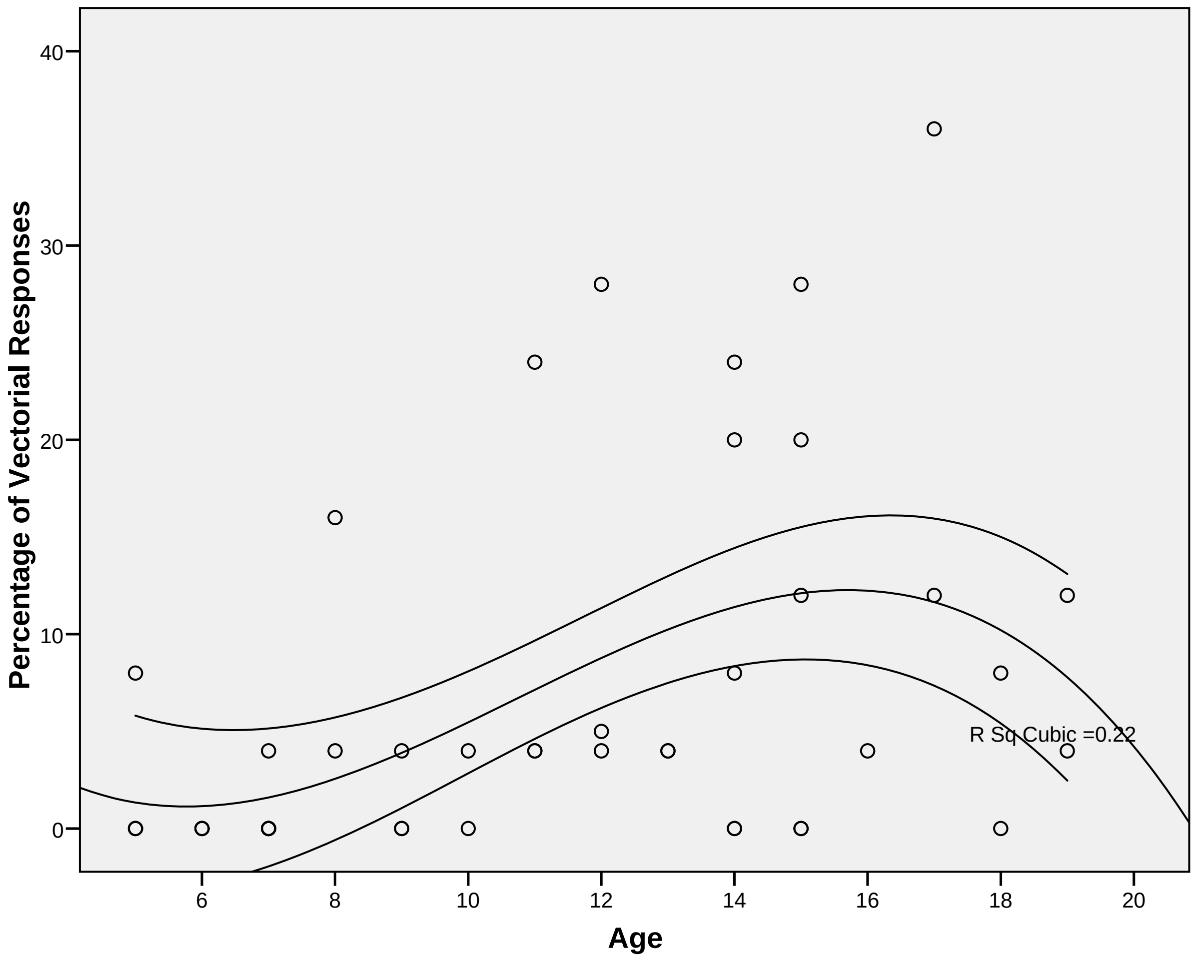

Figure 2. Percentage of vectorial responses performed on Movie Clips Task as a function of age.

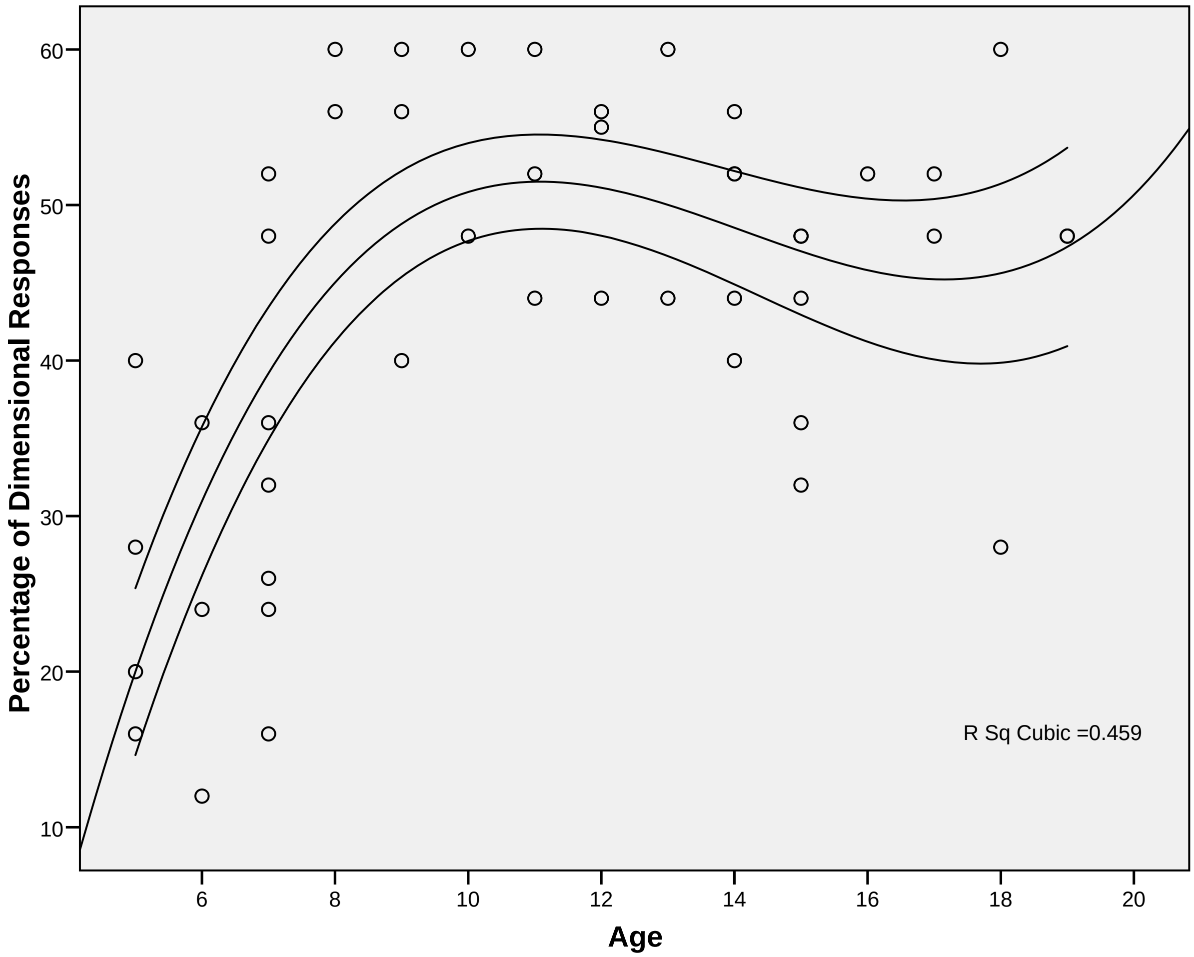

Figure 3. Percentage of dimensional responses performed on Movie Clips Task as a function of age.

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