INDIVIDUAL DIFFERENCES IN THEORY OF MIND AND NARRATIVE IN EARLY ADULTHOOD

By

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To Jane

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LIST OF ABBREVIATIONS

AM	Autobiographical Memory
EF	Executive Functioning
FB	False Belief(s)
IC	Inhibitory Control
PPVT-4	Peabody Picture Vocabulary Test, Version 4
ToM	Theory of Mind

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Theory of Mind (ToM) can be understood as the uniquely human social cognitive ability to reason about the complex mental states of the self and of others. ToM has typically been studied as a skill that develops across early childhood. Current research is directed at further understanding the development and the processes ToM through the study of adults. Historically, social cognition in adulthood has been studied separately from child social cognition. This study attempted to bridge the gap between the child and adult literature on social cognition by exploring relationships among a variety of tasks used in both of these literatures. Specific aims of the present study were as follows: (1) to examine whether there is an underlying ToM factor comprised of Reading the Mind in the Eyes, hindsight bias, and curse of knowledge in adulthood; (2) to examine whether language and inhibitory control (IC) are related to ToM; (3) to examine the role of these factors for story quality; and (4) to test a mediation model of the indirect effect of language and IC on story quality through ToM.

Results indicated that the three factors included as indices of ToM did not correlate with one another. Regression analyses support the ongoing role of inhibitory control for ToM in everyday life, but did not provide strong evidence of the ongoing role

of language for adult ToM. ToM was found to be significantly related to the quality of socially shared stories, fictional and autobiographical in nature. Inhibitory control may have an indirect effect on story quality through ToM. Essentially, adults apply cognitive effort in inhibiting their own perspectives when communicating with others who have different perspectives.

Results are discussed in light of the most current theoretical viewpoints emerging in the growing literature describing ToM in adulthood as well as their implications in understanding classic views of child cognitive development, specifically Vygotsky's socio-cultural theory.

CHAPTER 1
INTRODUCTION

More than thirty years ago, Miller, Kessel, and Flavell (1970) brought to our attention the relative lack of research regarding children's social cognitive development. The ways and means by which children become adult-like in their ability to understand and participate in social situations has subsequently become one of the most fruitful areas of research in developmental psychology. Theory of Mind (ToM), as this type of social cognition is commonly referred to in developmental psychology, includes the uniquely human (Tomasello, 1998) ability to "share mindspace" with others (Tomasello and Carpenter, 2007), to take the perspective of others alongside our own, and to mentally represent the various mental states of the self and others. This special representational ability allows humans to see the mind as changeable, fallible, and unique to every individual; we are able to mentally represent mental representations. ToM includes the understanding that individual mental states are the starting point for individual behavior.

ToM is a sophisticated understanding of mental states where physical perception leads to knowledge, which leads to behavior. Baron-Cohen (2000) highlights two essential distinctions that individuals with ToM are able to make. First, the mental-physical distinction is the ability to distinguish between the mental world and the physical world. A person may think or believe in accordance or discordance with the true state of the physical world, and a person may think about something that does not exist in the physical world. Second, the self-other distinction is the ability to distinguish the physical and mental states of the self from those of others. A person's own thoughts are not visible or otherwise readily available to others, and others possess mental states

and thoughts that are hidden and different from one's own. These distinctions, commonplace for typical adults, are difficult for children, and to varying degrees in individuals with autism. Typically developing individuals may understand that these distinctions exist, but are able to employ this understanding in their behavior to varying degrees. For example, we may understand that there is a distinction between self and other, but nonetheless assume that we know what others are thinking, or that others share our viewpoints.

An important milestone in the development of a mature ToM is passing tests of false beliefs (FB) and representational change, for both the self and for other people. An understanding of FB includes the ability to understand that any person may hold a belief that is in contrast to reality (based on incorrect experiential information), and that this person will behave in accordance with this untrue information. Representational change refers to the ability to simultaneously represent the thoughts or beliefs one had prior to a specific experience, and the new thoughts or beliefs which resulted from that experience. This includes knowing that one currently has information not held before, and remembering that one's prior beliefs or thoughts were different, perhaps false. According to the abundance of research evidence accumulated over the past 30 years, children reach this level of social cognition around the age of 4.5 years (Wellman, Cross and Watson, 2001). Indeed, some researchers view the passing of FB tasks around the age of 4.5 years as "competence" in the area of ToM. However, theorists continue to debate whether this is a qualitative, discontinuous change or a more quantitative, continuous change (Wellman, Cross & Watson, 2001, provide an overview).

Specifically, is child performance on standard FB tasks equal to an all-or-nothing ToM competence, or indicative of the emergence of a nascent form of a highly individualized, and potentially continuously developing trait? That is, even though preschool-aged children pass basic FB tasks, does the ability to utilize, or incorporate into daily functioning, ToM skill continue to develop or differ across individuals? Individual differences in these skills have been relatively unexplored in typically developing populations, particularly in typically developing adults. The present paper takes the position that ToM is not an all-or-nothing, discontinuous phenomenon but varies between individuals and is subject to development not only through childhood but into adulthood as well. As will be discussed below, it is possible that an ultimate "competence" in employing one's ToM is tantamount to achieving ultimate competence in other skills, such as language or mathematics. Thus, individuals vary in terms of how competent they become at employing ToM skills.

The present research explores individual differences in social cognition, or ToM, in early adulthood. Additionally, this research is intended to bridge the gap that exists in the empirical literature between social psychology and developmental psychology in describing and understanding the processes of social cognition like ToM. Similar social cognitive skills have been viewed as being separate in these disciplines, though similarities in the processes of these skills are suggestive that they may suitably be viewed as one and the same. Finally, the current study explores other cognitive abilities that may be associated with the social cognitive abilities of primary interest, based on the literature describing ToM in childhood. Specifically, language, executive functioning, and autobiographical memory have been studied as factors related to ToM. Here, I will

explore the relationships between these factors and social cognition through a different lens. These relationships have not previously been explored in early adulthood, and these relationships have not previously been explored using the proposed methods of assessing social cognition, or ToM, discussed later.

CHAPTER 2
LITERATURE REVIEW

Theory of Mind in Childhood

Much attention has been paid to the child's achievement on the prototypical "litmus test" of ToM, a FB task, which is often operationalized using a change of locations task (commonly known as the Sally-Anne task, Baron-Cohen, Leslie, & Frith, 1985). In the traditional Sally-Anne change of locations task, the child is told a brief story in which one puppet (Sally) hides a toy, and then leaves the room. While the first puppet is away, another puppet (Anne) moves the toy to a location unknown to the first puppet. The child is asked to predict where the Sally will look for the toy upon returning to the room. Here, the child's own knowledge of the true location of the toy must be suppressed for the child to understand (and report to the experimenter) that Sally would look in the old location, where the toy no longer resides. The first puppet will act according to a FB. Before age 4.5 years, children will reliably and with great certainty report to the experimenter that the first puppet will look in the toy's new location, usually explaining "Because that's where it is!" to the experimenter. Around age 4.5, children become aware of the "trick" of the task, and can report to the experimenter that the puppet will look in the old location, "because she did not see the other puppet move the toy" or "she doesn't know where it really is." These children understand that seeing leads to knowing, and that an individual's personal knowledge will lead to their behaviors. This includes the ability to predict behavior that will lead to an undesired outcome, based on a lack of knowledge or a FB.

Another common method for assessing the child's ToM include tests of the appearance-reality distinction (Flavell, 1986). To determine if a child can distinguish

between two conflicting identities of one object, that is, the appearance and the reality of the object, children are often shown a piece of sponge painted to resemble a rock, and asked if the object is really a rock or a sponge, and asked if the object looks like a rock or looks like a sponge. In addition to these questions, the child is asked, “What did you think it was, when you first saw it?” to assess whether the child realizes that the first representation of the object, that it looks like a rock, had subsequently changed with experience to represent the object as really a sponge (representational change). Questions about FB can also be added to this type of task; the child can be asked what a naïve puppet will think the object is, having never seen or touched the object before (Gopnik & Astington, 1998). Each of these skills, appearance-reality distinction, representational change, and FB understanding require the ability to coordinate conflicting, or “dual” representations and have all traditionally been captured under the umbrella term of “Theory of Mind.”

Evidence that children pass these tasks between 4 and 5 years-of-age is well documented. However, the “How” and “Why” of children’s ToM ability remains the topic of debate. Some (Wellman, Cross & Watson, 2001) argue that the passing of standard FB tasks is evidence of a developmental discontinuity, or a genuine conceptual change. Wellman and colleagues argue that based on the preponderance of evidence, it is clear that prior to the average age of 4.5 years young children cannot reason about FBs and after this point children have achieved a ToM competence resembling that of the adult.

Passing FB tasks at this age may reflect a gradually emerging way of thinking about social interactions with roots in earlier skills. Newborn infants show a strong preference for human faces, and early in development engage in social smiling,

imitation of other humans and social referencing. Around 9-12 months, children who do not yet speak can nonetheless engage in a social exchange with others known as joint attention- the ability to interact with another person about an object in the external world. Joint attention can be viewed as a developmental precursor to later ToM achievements. Longitudinal studies (Charman, et al., 2000; Nelson, Adamson, & Bakeman, 2008) have indicated that joint attentional engagement with mothers predict children's later ToM. Joint attention brings together a several important social cognitions. First, the act of holding in mind a representation of an entity in the external world, and understanding that another person is capable of mentally representing the same entity clearly necessitates at least an implicit understanding of other minds. Second, the interaction which occurs provides a stage for the child to experience another person experiencing similar, as well as different ideas about the external word. The partner in a joint attentional episode may use a word unfamiliar to the child about the object, may manipulate the object in a new way, or may ask the child to manipulate the object. Tomasello discusses this uniquely human ability to share mindspace as perhaps the foundation of human society and responsible for the human ability to build upon prior knowledge (known as the ratchet effect, Tomasello, Kruger, & Ratner, 1993).

Recent studies have also shown children younger than age 4.5 engaging in reasoning that may be considered FB, or at least an implicit, earlier emerging form of FB reasoning than would be suggested by a genuine conceptual change account of ToM (Onishi & Baillargeon, 2005; Buttelman, Carpenter, & Tomasello, 2009). Onishi and Baillargeon (2005) found that 15-month-olds looked longer when a character looked for, and found, an object in a location that the character could not have known was

correct. Buttelman, Carpenter, and Tomasello (2009) found that 18-month-old children are capable of taking into account an adult's false-belief when attempting to help the adult find an object. These studies may indicate that younger children are capable of some nascent form of FB reasoning which leads to later, more explicit abilities like those evidenced by standard change of location tasks.

These studies of children younger than age 4.5 years suggest that FB may not emerge suddenly, but that it is a skill, like language, that is gradually strengthened and honed through time and social experience. Thus, the ability to entertain multiple representations of the same event is an element of ToM that develops.

There are other social cognitive skills that also reflect ToM understanding. In particular, emotion recognition (the ability to recognize and identify emotions in the self and others) is a skill which is often categorized under the heading of "Theory of Mind." This skill involves understanding and interpreting the internal mental states of others by "reading" external facial expressions, but does not require the understanding of conflicting or multiple representations as FB tasks do. Emotion recognition is often measured using the "Reading the Mind in the Eyes Task" (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Baron-Cohen et al., 2001), in which a participant chooses emotion words thought to best describe each of a series of photographs of the eyes region of the face. Performance on this task has been shown to improve from childhood to adulthood (Baron-Cohen et al., 1997). However, the relationship between emotion recognition and other ToM tasks is less clearly defined than, for example, the relationships among joint attention, FB, and representational change. Sabbagh and Seamans (2008) found that parents' performance on a test of emotion recognition

(namely, the Reading the Mind in the Eyes task, Baron-Cohen et al., 2001), was significantly related to their children's performance on tests of FB and appearance-reality, suggesting that whether through genetics or socialization, the two distinct skills are related. A study comparing high functioning autism (HFA) and control individuals found that only for control individuals was emotion recognition related to performance on advanced tests of ToM (Kaland et al., 2007). For HFA individuals, performance on the Reading the Mind in the Eyes task was not correlated with other ToM tasks. Despite this, theorists such as Baron-Cohen (2000) assert that emotion recognition is part of the constellation of skills and behaviors comprising ToM. Importantly, the findings of Baron-Cohen and colleagues (1997) provide evidence that a skill which falls under the heading of ToM is subject to development beyond childhood. However, no study to date has determined whether performance on the Reading the Mind in the Eyes task is related to performance on other ToM-based skills within the individual. This question will be addressed in the present study.

Theoretical Accounts of Early Theory of Mind Development

Across the period of infancy and early childhood, and before the emergence of an adult-like concept of ToM (including FB reasoning ability and mentalistic metarepresentation), social behaviors of the child can be viewed as the roots or foundations of this later achievement (Carpenter, Nagel & Tomasello, 1998; Charman et al., 2000). A number of theories exist which attempt to explain the origins and development of ToM. Each theory takes into account that some basic, or innate, human capability lays the groundwork for ToM, but strong differences exist in how these theories explain the development of ToM beyond that biological starting point. The following is an overview of the prevailing theories of ToM driving research in the field.

Modularity. According to the modularity viewpoint (Baron-Cohen, 2000), all of the achievements leading up to the ability to pass FB (and indeed, beyond into social interactions in general) are connected within an innate Theory of Mind Module (ToMM). Thus, face preferences, joint attention, and the physical-mental distinction are specialized brain-based skills. Notably, the ToMM is proposed to be involved specifically with the metarepresentation on mentalistic concepts, and is separate from other, non-mentalistic representational abilities. This view is intricately linked to the ToM hypothesis of autism. In autism, individuals have deficits that appear to be isolated within this ToMM. These deficits include difficulties with the pragmatics of language and with communication in general, difficulty with the appearance-reality distinction, lack of pretend play, difficulties with imagination, and inability to interpret facial expressions, to name a few.

According to Baron-Cohen's (2000) theory of autism, autism involves a specific deficit in ToM. Theory of Mind, in Baron-Cohen's view, is an organized set of behaviors and cognitions that hinge on a fundamental distinction- the mental physical distinction- which is difficult or impossible for individuals with autism. To illustrate, individuals with autism have difficulty distinguishing between a person who is holding a cupcake and a person who is only thinking about a cupcake in determining who can actually eat the cupcake. Behaviors and skills that are impacted by the mental-physical distinction include the understanding that seeing is knowing, the ability to distinguish mental state verbs from other verbs, the tendency to pay attention to mental states, comprehension of issues of the mind such as false belief (FB) and representational change, pretend play, real-life social skills, pragmatic speech, understanding the link between mental

states and emotions, and the ability to interpret the eyes mentalistically. If this range of skills is founded on one underlying concept of mental-physical distinction, we might expect that tasks which assess these skills would be interrelated within an individual. That is, a person's ability to read mental states in the eyes would be related to their ability to use FB reasoning.

Social constructivist. According to the social-constructivist viewpoint (Carpendale & Lewis, 2004; Fernyhough,2008), more advanced ToM abilities are built upon earlier, related, achievements as described above. Carpendale and Lewis (2004) cite the "construction of social understanding through social interaction". Thus the ability to socially interact using the skills of infancy leads to the construction of more advanced social understanding. Specifically, Carpendale and Lewis propose the "epistemic triangle" which is in essence a way of describing how joint attention is the cornerstone of the development of all social understanding. Here, the child, adult, and external world (such as a concrete object) all reciprocally interact. The child's understanding of reality is grounded in the external world, and the two converging perspectives of the child and adult reflect upon the world/object. This leads the child to mentally represent the physical-mental distinction, as well as the self-other distinction. To this, Fernyhough (2008) adds the critical aspect of child language as mediating the advancement from earlier (less advanced) and later (more advanced) ToM abilities. When children internalize social dialogues they are able to engage in dialogic thinking. This is evidenced by self-regulatory speech (which itself becomes internalized with development). This dialogic thinking is critical to the development of the mind which is

not only representational of duality in general, but which represents perspectives of the self and other.

Shared intentionality and cultural learning. Tomasello and colleagues (Tomasello, Kruger & Ratner, 1993) claim that human beings are evolutionarily endowed with the uniquely human skill of shared intentionality, and draw many conclusions from comparative psychology. It is shared intentionality- or the innate desire to share mindspace with others- that takes skills of the social world and transforms them into uniquely human skills of ToM. The infant enters the world with the desire to share attention with others. The chimpanzee is able to follow the gaze of another, but only the human child is able to engage in joint attention about an external object. The chimp communicates to make requests or manipulate another, but only the human communicates with the intent to cooperate. Social skills of the chimpanzee are raised to another level in humans because humans understand the minds of others. Indeed, under the rubric of cultural learning, ToM is conceptualized as “person concept”. What develops is the child’s concept of persons. Early in life, the child’s person concept is that of an “intentional agent”- here the person has internal states, and behaviors result from perceptions and desire. The child who engages in joint attention and learns the vocabulary of the language understands the person as intentional, and can engage in imitative learning. Next, the child begins to see the person as a mental agent. Behaviors are seen as the result of more complex mental states such as thoughts and beliefs. This child can benefit from instructed learning and internalize the perspective of other persons. Adults have the desire to pass on cultural information and the child is now able to understand and benefit from this cultural transmission of knowledge. This child can

pass FB, because of the perception of the person as a mental agent. Finally, children come to see individuals as reflective agents. Not only does the person have representational thoughts and beliefs, but the person has their own, subjective inner world. That inner world can come to affect the external world, and minds can influence other minds. Here, cooperative learning becomes possible. Existing knowledge is built upon further, and minds converge.

Theory-theory. According to this view (Gopnik & Wellman, 1991), the child's ToM is just that: an organized, rule-governed set of statements intended to describe, predict, explain, and interpret behavior. These authors view the child's theory as equivalent to any scientific theory. ToM is seen as based on evidence collected from experience and organized by the child. The child's ToM changes with the acquisition of new evidence thus undergoes paradigm shifts. Specifically, 3-year-old children have a desire-psychology theory of human behavior. They understand others as being driven to behave by the internal state of desire, but this desire is non-representational. A person desires an apple because they perceive and apple, and because the apple is real and available. The mind is an exact copy of the real world. Thus, according to this child's theory, the person behaves based on a mental state, but this is a rudimentary and non-representational theory. The child's theory changes with experience and under the weight of an abundance of evidence. The 4-year-old child is able to develop a belief-desire psychology. This new theory is representational, and based on a working knowledge that the mind is not simply a copy of the external world, but is representational. This conceptualization of ToM development is largely based on the ability to pass false-belief tasks.

The theoretical perspectives described above represent a summary of the more prominent perspectives on the development of ToM in childhood. These perspectives vary in the precise mechanism by which children are able to express and utilize their ToM abilities, but all incorporate certain evidence from the empirical literature in one way or another. Specifically, each perspective takes into account the role of some innate, brain-based, or distinctly human characteristic, and further, takes into account the relative roles of other related cognitive functions. Language and executive functioning (specifically inhibitory control) for the development of ToM are discussed below. The various theories previously reviewed incorporate the precise roles of language and executive functioning differently in childhood. The present study takes the position that language and executive functioning can be incorporated into these perspectives when considering ToM in adulthood as well. That is, the present study does not intend to test a specific theory, but rather examines the roles of language and executive functioning in adult ToM.

Cognitive Contributors to Theory of Mind

Executive functioning. Executive functioning (EF) abilities, including self-regulation, planning and inhibitory control (IC, among other related skills associated with the development of the frontal lobes) have been shown to play a role in the development of ToM. Considerable research has shown links between of ToM and EF skill in young children (Perner, Lang & Kloo, 2002; also see Perner and Lang, 2000, for a review). Carlson, Moses and Breton (2002) describe the specific role played by IC and working memory in children's performance on FB tasks. IC is defined as the ability to inhibit a prepotent response in favor of a desired response, block interfering information, or refrain from impulsive behaviors. In the case of the classic "Stroop" task, IC is

required as the participant must inhibit a prepotent response of reading a color name in favor of the desired response of naming the conflicting color of ink the word is printed in. FB tasks, in this view, require the participant to inhibit a response that is in accordance with reality (where the object really is) in favor of the desired response (where the character in the story falsely believes the object to be).

Carlson, Moses, and Breton (2002) describe two accounts of the possible role that IC might play in the development of ToM. First, IC may play a role in the actual emergence of FB understanding. Here, a child's EF ability must be adequately developed to allow for the suppression of more salient states of reality in favor of less tangible mental representations when reasoning about the world. EF may be necessary for competence in dual representation. Dual representation refers to the ability to hold two conflicting aspects of one situation in mind simultaneously, and is viewed as essential in distinguishing mental states from the physical reality of a situation. EF thus provides the child with the cognitive tools to represent mental versus physical simultaneously, or true and false simultaneously. Thus, ToM skills are not present until sufficient EF has developed. Alternatively, EF development may play the role of allowing for the expression of an already present ToM understanding. Before children are able to correctly answer target questions on FB tasks, that is, when they provide an answer that is consistent with reality rather than with a FB, some researchers have noted that the child unwittingly will look in the direction of the "correct" answer (the FB, Clements & Perner, 1994). These researchers have called this phenomenon "the pull of the real", in which the child cannot suppress a verbal response that is concordant with reality even though a latent understanding exists that there is an alternative answer

discordant with reality. Thus, when the child's ability to inhibit the response that is consistent with reality is sufficiently developed, he or she can finally provide a verbal response that elucidates the child's already present knowledge. IC simply allows the child to show what he or she already knows.

Supporters of the important role of EF do not exclude the importance of other factors in the development of ToM, either emergence accounts or expression accounts, specifically the role of language in the development of ToM. Indeed, some theorists contend that EF belies both language and FB, and is the essential factor in ToM development.

Language. In addition to EF, special attention has been paid to the influence of language as a correlate, and most specifically as a predictor of the development of FB understanding. A metaanalysis of the extant literature on the relationship between language and FB by Milligan, Astington, and Dack (2007) provides a concise illustration that both general language and specific syntactic abilities are associated with performance on FB tasks. Why this relationship exists is a matter of debate for theorists.

Astington and Jenkins (1999) propose that language is an important cognitive tool of representation. Specifically, syntax, the aspect of language concerned with logical and rule-based word order, is viewed as critical for FB. This position of linguistic determinism holds that syntax is a necessary scaffold in the mind which holds and supports the representations required for a child to comprehend, remember, process, and understand FB tasks. This also applies to the real world, in that syntax is a cognitive tool that allows children to organize events in mind, and keep track of sequences of social situations. Some theorists argue for a strong position of linguistic

determinism that specifies the syntactic structure of embedded complements as the central linguistic ability that determines FB ability in the individual (de Villiers & de Villiers, 2000).

Ruffman and colleagues (Ruffman, Slade, Rowlandson, Rumsey, & Garnham, 2003; Slade & Ruffman, 2005) argue for the importance of general language (semantic and syntax) for FB. Ruffman and colleagues support the notion that language and FB are bi-directionally related. That is, language contributes to the understanding of ToM (and the ability to pass FB) but that having a ToM also contributes to the development of language. The two are social skills that interact across development, and the relationship between the two is not necessarily deterministic. Ruffman claims that language likely plays the role of allowing implicit understandings of FB to be made explicit- both internally, in the sense that the child is able to think about and reflect upon issues of FB and conflicting representations, and externally, in the sense that the child can express their ToM competence. An important aspect of the position of Ruffman and colleagues is the role of social interaction. Thus, this research group places emphasis on naturalistic conversations between mothers and their children, and the types of linguistic interactions that take place.

Nelson (2005) proposes a social constructivist view of the role of language in the development of ToM, referred to as the “Community of Minds” – encompassing one-on-one interactions with individuals as well as the ability to interact in and understand a world of social situations across time and cultures. Language plays the role of bringing the child into this community of minds. Mental states are, by definition, hidden.

Language is the way that mental states are revealed to others. By talking to children, we reveal that others have internal states that are unique, variable, and interpretive.

Special populations provide further insight into the intricate relationship between language and ToM. Individuals with autism show difficulties with the representational aspect of language, particularly the pragmatics of language (Baron-Cohen, 2000). Alongside ToM deficits, individuals with autism have difficulty tailoring their speech to the listener, staying on topic, and employing social norms of conversational manners, turn-taking, and appropriateness (Colle & Baron-Cohen, 2008). Children with specific language impairment (SLI) show a similar correspondence between language and ToM difficulties (Farrar et al., 2009).

Role of Theory of Mind in Childhood

When considering the development of ToM in children, much empirical research is devoted to understanding what factors *lead to* the development of this complex set of social cognitive skills, such as language and EF discussed above. Another perspective on the development of ToM concerns what develops *as a result of* ToM. Research has uncovered the role of ToM in children's behavior, such as the level of imaginary or fantasy ideation a child is capable of (Taylor & Carlson, 1997), peer acceptance (Slaughter, Dennis & Pritchard, 2002), memory suggestibility (Welch-Ross, 1999), and even acting ability in early adolescence (Goldstein, Wu & Winner, 2009). Of particular interest is the role of ToM in autobiographical memory development.

Autobiographical Memory (AM) can be simply described as a remembered event that occurred in a person's past. AM sharing is an important social skill likely to be linked with other social cognitive abilities. Theoretically, AM and ToM can be linked in several important ways. First, AM and ToM both require that an individual entertain

multiple representations of a single event. AM requires that the individual understand that the event is situated in the past as well as in memory. Further, when sharing AMs, individuals must entertain their own representation of the event as well as the listener's representation of the event (Welch-Ross, 1997). For ToM, individuals must represent their own and others' mental states in the same way. Second, AM and ToM require an understanding of the origins of knowledge (see Welch-Ross, 1995, for a review). To relate an AM to another person, one must understand that having experienced the event personally endows the individual with privileged knowledge, and individuals *not* present are *not* likely to share that knowledge. Thus, in sharing an account of the experience the storyteller must take into account the listener's knowledge. Finally, both AM and ToM require that an individual have an understanding of the important causal links between events in time. For ToM, this includes that seeing leads to knowing, for example, and not the other way around. For AM, this includes that one event led to the next, or that the past led to the future. Story structure, or the idea that a coherent narrative includes important links between pieces of information, is knowledge that develops around the same time as children pass traditional FB tests. In addition, individuals with autism have trouble understanding and employing narrative story structure and also have trouble with ToM tasks. Adler and colleagues found a direct relationship between ToM (as measured by the Reading the Mind in the Eyes task) and AM in individuals with high functioning autism (Adler, Nadler, Aviatar & Shamay-Tsoory, 2010).

As we have seen, ToM is linked both theoretically and practically to AM. Welch-Rosss (1997) directly tested the connection between ToM and AM in normally

developing children. To do so, Welch-Ross (1997) focused on the role of the adult in scaffolding AM reminiscence with children. When conversing with their children about AMs, mothers may adopt different styles of interaction. Research evidence has shown that children of “elaborative” mothers (Reese & Fivush, 1993), characterized by sharing extended amounts of information and rich detail, asking open ended questions, and including evaluative content, experience several advantages over children whose mothers do not use this style of conversation. These advantages include improved story structure understanding, more elaborate AMs, and enhanced self-understanding (Reese, Haden & Fivush, 1993; also see Reese, 2002, for a review). Welch-Ross (1997) showed that children’s ToM ability (measured using tests of both FB and representational change) was correlated with the child’s skill at conversing about AMs. Critically, mothers’ elaborative style of memory talk was correlated with children’s ToM performance. Thus, ToM of the child both contributes to the child’s AM, and mother’s style of conversation contributes to ToM.

The findings of Welch-Ross (1997) are suggestive that parental elaborative style may contribute to ToM development. However, a question that has been relatively unexplored in the literature concerns the individual characteristics that mothers employing this elaborative style may possess. It is possible that mothers with superior understanding of the world of mental states, or ToM, are able to discuss memories with their children in this way because they understand differing perspectives to a greater degree than non-elaborative mothers (Welch-Ross, 1997). Sabbagh and Seamans (2008) found an association between parents’ ToM task performance and their children’s’ ToM. However, the mechanism by which this “intergenerational transmission”

of ToM occurs is underexplored. Determining if a link exists between adult ToM and storytelling style is an important step in uncovering how ToM may be transmitted from parent to child. It is important to note that the direction of relationship between ToM and autobiographical memory may be bidirectional. Whereas some view ToM as a precursor to autobiographical memory (Welch-Ross, 1995), others note that autobiographical memory deficits may lead to increasing ToM deficits in clinical populations (Corcoran & Frith, 2003).

That an understanding of story structure is relevant to telling a coherent narrative is not limited to the case of AMs. Tompkins and Farrar (2010) found that wordless storybooks afforded more opportunities for elaborations between mothers and their children than simple AM sharing, thus the wordless storybook paradigm is employed in this study. Narrating a fictional story from a book clearly utilizes the ability to link episodes in time and causality. Good story telling also entails taking the perspective of the listener in terms of what needs to be shared, or told, in order to relate a good story. Wordless storybook narratives by individuals with autism have been found to be lacking in objective measures of story structure (Colle & Baron-Cohen, 2008), tend to include many more off-topic utterances, unnecessary or unrelated information, and evidence a general lack of understanding of the perspective of the listener. Their stories may be viewed as similar to the stories of children who have not yet learned the “rules” of telling a good story, who also happen to be younger than the average age of passing FB tests.

In their key paper depicting the development of autobiographical memory, Nelson and Fivush (2004) provide a comprehensive account of the role that language plays in the emergence of AM in children. Notably, these authors discuss the importance of

language in allowing the young child to organize information in mind for the purpose of coherence of memory as well as the ability to recall events from memory. In addition, Nelson and Fivush cite the social nature of language as playing a role in allowing the child to mentally represent personal experiences as separate from fictional events or the experiences of others. A study by Haden, Ornstein, Eckerman, and Didow (2001) showed that very young children, with even very limited verbal recall of an event, largely remembered and verbalized information that was spoken and discussed by their mothers during the event. Thus, experiencing an event that is spoken about in a social situation plays a role in what and how much a young child can recall. Language also is inextricably linked to narrative beyond that narratives require language at a basic level. Skilled language allows for coherent, interesting, evaluative, and meaningful narration of remembered events.

AM storytelling, language and ToM have been shown to be related in a number of ways. The representational abilities that are part and parcel to ToM may help children develop AM and storytelling skills, and storytelling interactions may lead children to understanding the processes of the mind. Further, having an understanding of minds contributes to the quality of the story told. In these ways, ToM skill is linked to the ability to tell a good story, whether autobiographical or fictional.

Thus, it well established that FB understanding becomes evident in childhood, around 4- or 5-years of age. Further, both language and EF contribute to its development, and may contribute to the development of children's autobiographical memory. Of interest in the current research is how ToM develops beyond childhood and whether there are meaningful individual differences in adult ToM. If so, are these

differences linked to EF and language, the same as they are in childhood? Finally, is adult ToM similarly related to autobiographical memory?

Theory of Mind Beyond Childhood

Research is beginning to highlight the differences between children and adults in their social cognitive abilities but, more surprisingly their many similarities. Whereas we can be sure that the adult is quite savvier at parties and in job interviews to the nuances of social interaction than a 4.5 year old child, a wealth of evidence suggests that humans of all ages make some mistakes in their social cognition. Children and adults alike are surprisingly apt to attribute their own, however private, knowledge to others. Equally so, children and adults are likely to assume that others share personal likes, dislikes and viewpoints, and to ascribe these to others especially strongly when even the most trivial of similarities are told to them to exist. In general, adult social cognition and perspective taking has been viewed through a different theoretical lens than has ToM in children, despite apparent similarities. There exists a large amount of evidence in the social psychology literature that adults commit a variety of errors and are prone to certain biases in social situations which closely resemble the errors that young children make prior to age 4.5, with some important differences. These biases are founded in the same skills that underlie ToM, but are operationalized differently. Whereas tests of ToM for young children are relatively simple for adults, the tasks that have been used in social psychology to elucidate these biases are more nuanced, and can reveal more subtly that adults so not simply employ their ToM skills in an all-or-nothing way. In fact, some research (Apperly, Riggs, Simpson, Chiavarino & Samson, 2006) provides evidence that correctly answering basic questions about FB does not happen automatically for adults, but requires extra time or cognitive effort when compared to

questions not involving FB. Four specific biases, the curse of knowledge, hindsight bias, the false consensus effect, and visual perspective taking are discussed next.

As we have seen, theorists claim that ToM develops in childhood either continuously or discontinuously, culminating in “competence” by the age of 4 to 5 years. Others (Birch & Bloom, 2007; Dumonthiel, Apperly, & Blakemore, 2009) take an altogether different view of ToM development. They suggest that children’s inability to pass FB tasks prior to age 4.5 years reflects a cognitive bias that exists across the lifespan, but to different degrees. Birch and Bloom refer to this bias as “the curse of knowledge.” According to their perspective, children fail tests of FB because they lack the ability to suppress their current knowledge when inferring the knowledge of another (naïve) person. The evidence of Birch and Bloom suggests that adults are likely to make this very mistake, but in a more discreet manner. That is, rather than unequivocally stating that a character will look in the “new” location in a change of locations task, adults who know the true location of a displaced object are surprisingly more likely than those who do not know the true location to assign a higher search probability to the true location than other possible new locations. This, despite the fact that both groups are told that the character has no knowledge of the new location. For Birch and Bloom, adults and children who hold privileged knowledge are “cursed” by this knowledge, and thereby have a mistaken impression that their knowledge is shared by others.

In addition to the curse of knowledge, adults are found to have a strong propensity to commit a hindsight bias (Pohl & Hell, 1996). Easily understood as the tendency to believe we “knew it all along,” adults who are armed with knowledge “after the fact” tend to attribute that knowledge to naïve others or to the naïve former self. In

1975, Fischhoff found that participants were likely to claim that they could have predicted the outcome of certain historical events and that others would be likely to have correctly predicted the outcome of those events (also, Fischhoff & Beyth, 1975). These findings have been replicated in a variety of ways. For example, if two groups of adults are asked to guess the true height of the Eiffel Tower, they will provide a wide range of responses. Later, when asked to recall those guesses the group that is told the correct answer prior to recollection will “recall” having been more accurate than the group not given the correct answer. Individuals will even recall having been “more correct” after being told the correct answer despite being explicitly warned against committing this bias (Pohl & Hell, 1996). Thus, adults are not perfect when considering their own representational changes, nor are they perfect when taking into account the possibility of another person having a FB (Birch & Bloom, 2007). The belief, and the behavior of a naïve other person is judged based on the adult’s privileged knowledge.

Both of these mistakes are highly similar to the mistakes made by young children who do not pass traditional representational change and FB tasks. Bernstein, Atance, Loftus, and Meltzoff (2004) demonstrated that adults and children are prone to making this mistake using visual tasks. When armed with the knowledge of what an ambiguous picture really is, individuals report seeing the object sooner as the picture resolution is made clearer than those who are not told what the picture really is. Interestingly, in two studies these researchers found two different pictures of the developmental trajectory of child to adult visual hindsight bias. In one study, visual hindsight bias was greater for children than for adults, suggesting a developmental decline in hindsight bias. In another study, children and adults were equally likely to commit visual hindsight bias.

Thus, despite being much better at traditional FB and representational change tasks, adults may not be much better than children when the same skills are required of them in a different type of task.

Another bias, or social error, reliably committed by adults is the false consensus effect. The false consensus effect occurs when adults expect that others share their beliefs, or that their personal preferences are common to the population as a whole. Early work by Ross, Greene and House (1977) showed that regardless of actual commonality, individuals are likely to consider their own personal preferences or choices in a variety of situations as “common” to the general public. Wolfson (2000) showed that college students attributed their own level of drug use as common to the general public as well. Considering that ToM competence includes the conscious awareness that minds differ, it stands to reason that ToM competence should, ideally, prevent this error.

That ToM may not be a discontinuous achievement of early childhood, but may in fact be a skill that continues to develop across adolescence and adulthood is highlighted in a study by Dumontheil, Apperly, and Blakemore (2010), who studied visual perspective taking. These researchers showed that the ability to take into consideration the viewpoint of another person increased across five age groups ranging from approximately age 7 through 27. The viewpoint in question was a literal viewpoint. Participants were able to see certain objects on a set of shelves that were occluded from the view of a confederate “director”. Other objects were visible to both parties. The director asked the participant to move certain objects around the set of shelves. When directed to “move the smallest truck,” participants were required to take into

consideration that the smallest truck visible to the participant may be occluded from the view of, therefore unknown to the director. The tendency to move objects that were invisible to the director decreased (but did not disappear) across age groups.

Even the propensity to stereotype based upon outward appearances flies in the face of the notion that adults with ToM require sensory knowledge of an event before assuming knowledge of the outcome. We often assume the contents of a person's mind or character based on the minimal information of type of clothing or color of skin. Further, adults are by no means perfect when it comes to effectively taking the perspective of others. Epley, Morewedge, and Keysar (2004) found that an adult's initial reaction to directions given by another person are often egocentric, but adults simply correct for this egocentrism more quickly than do children.

As we have seen, adults commit several errors that appear to reveal anomalies of the adult's ToM competence. The primary purpose of present study, then, is to explore whether the processes of ToM in early adulthood reflect those of the development of ToM in early childhood. This includes multiple related questions. First, this study will determine whether multiple social cognitive biases are interrelated. No study has attempted to draw a parallel between social cognitive biases of adulthood and ToM.

Following this, the present study is intended to show individual differences in these biases. The expectation that individuals will vary meaningfully in the degree to which they fall prey to social cognitive biases is rooted in the perspective that ToM is not an all-or-nothing change that happens at age 4.5 years, but rather is a gradually developing skill affected by a wide range of experiences across the lifespan.

Meaningful individual differences in ToM are expected to be associated with individual differences in other skills conceptually related to the development of ToM. Specifically, language and EF have been shown to be important factors contributing to the child's ToM. Only limited research has examined similar relations in adulthood. Botting and Conti-Ramsden (2008) found that language skill in adolescents was associated with functional social outcomes such as friendships and social engagements, and that adolescents with a history of SLI were at particular risk for reduced social functioning. This study suggests that language may remain an important social tool beyond early childhood as ToM is emerging.

However, for the most part research evidence for the role of language for adult ToM is lacking. Apperly, Samson, and Humphreys (2009) outline evidence that in the case of brain injury, ToM skill is found to remain intact if language areas of the brain are damaged after ToM has "developed" in childhood. Thus, adult brain injury patients are able to pass modified versions of standard FB tasks despite deficits in language skill. Apperly and colleagues propose that language is an important tool supporting the emergence of ToM, but that once ToM is in place, language may no longer be necessary to employ ToM skill. In contrast, Newton and de Villiers (2007) showed that verbal interference, but not non-verbal interference, had the effect of reducing adult accuracy on simple non-verbal FB tasks. These researchers suggest that the impact of verbal interference is indicative of the continued importance of language for ToM and FB reasoning in adulthood. Dungan and Saxe (2012) however, showed that the most likely cause for this reduction in adult accuracy on FB tasks was due to increased demands of working memory and EF. Thus, using the interference paradigm has not

provided conclusive evidence regarding the role of language for adult FB. To date no study has directly examined the relationship between ToM and language in early adulthood.

It is possible that language skill remains associated with ToM throughout life. Three theoretical viewpoints provide a basis for this assertion. First, the findings of Botting and Conti-Ramsden (2008) that adolescents with a history of SLI experience continued social deficits support the continued role of language for ToM beyond early childhood. An individual experiencing early difficulties interacting with others through language may carry those difficulties in both language and social skill into adolescence and adulthood. However, this evidence is not a direct test of whether language remains an important predictor of social skill (in general) or ToM (specifically) throughout development.

Second, Fernyhough (2008) proposes a Vygotskian account of the role of language for ToM, in which language based interactions, or dialogues, are central to developing a ToM. In Fernyhough's view, simply engaging in dialogue is the mechanism by which children come to understand and internalize the mental states of others, and even of the self. The dialogic thinking framework describes how the experience of dialogues highlights the alternating and often conflicting representations held within different minds (that is, the different participants in the dialogue). Multiple aspects of minds and of situations are brought to the child's attention through dialogue, and with time and experience these dialogues become internalized as a general way of thinking. For the present purposes, this dialogic thinking framework is extended to encompass the continuing dialogues that a person engages in beyond early childhood, and more

(and higher quality) social and linguistic interaction may be related to continued improvement in ToM skill as well as use.

Third, the strong linguistic determinism perspective tested by Newton and de Villiers (2007) holds that language is crucial for thought, specifically language is critical for thinking about FB. Thus, without language the child cannot think about FB, and the same applies in adulthood.

If language and ToM are found to be related in early adulthood this would provide further support for a continuity account of ToM development, as opposed to the genuine conceptual change account. The proposition is, in essence, that factors and experiences which lead to the enhancement of ToM understanding in children continue to be effective in enhancing related ToM skills throughout development. Adults who have been consistently engaged in high quality language-based interactions, in this view, would be more likely to have honed ToM skill; they would have a better understanding of the minds of others, and be more skilled at social cognition in general. Here, language serves as a constant support of ToM use and development. If language is not found to be relevant to performance on ToM tasks for adults, this would be suggestive that language is a tool which supports the initial emergence of ToM, but which ceases to be necessary once the foundations of ToM are established.

EF may also play an important role in adult TOM. Recent research (Apperly, Samson & Humphreys, 2009) has questioned whether EF is important simply for emergence of ToM in childhood, or whether EF remains integral to ToM reasoning throughout development.

Apperly et al. (2009) investigated the role of EF for adult performance on ToM tasks in their analysis of the existing literature, and found that performance on ToM tasks was affected by EF ability in cases of adults with brain injury as well as in normally developing adults. Samson, Apperly, Kathirgamanathan and Humphreys (2005) showed that a brain injury patient with impaired EF performed significantly below chance on standard FB tasks used with 4-year-old children. Qureshi, Apperly and Samson, (2007) found a relationship between EF and performance on a visual perspective taking task in which normally developing participants were required to “think like” another person. In this case, higher EF was associated with fewer errors in perspective taking. In addition, the increased time it sometimes takes adults to answer questions involving FB as compared to non-FB questions (Apperly, Riggs, Simpson, Chiavarino, & Samson, 2006) hints at the executive processing involved in reasoning about FB. These findings are suggestive that EF plays a role in ToM beyond childhood. However, the role of EF in measures of adult social cognitive biases is relatively unexplored. Also unexplored in early adulthood is the role of language in the use of ToM. The present study considers the roles of both language and EF for performance on measures of ToM in adulthood.

In addition, ToM has been shown to play a role in behaviors considered to be more of an outcome, or a result of ToM, such as effectiveness of communication with others. Apperly and colleagues (2010) showed that adult participants were limited in their ability to use or apply their ToM skill in communicating with others, resulting in egocentric errors in interpretation. Keysar, Lin and Barr (2003) and Apperly et al. (2010) showed that adults have difficulty applying their ToM understanding using a creative grid paradigm described earlier. In this paradigm, participants are instructed to move

objects around a shadow-box type grid as instructed by a “director” who is seated at the opposite side of the grid (Apperly et al., 2010 used a computer-based, cartoon version of the original live-action task). Participants are clearly instructed to take into account that the director’s view of some objects is occluded- that there are some objects that ONLY the participant can see. The director has no knowledge of and will not make reference to the items that the director cannot see. However, when considering the discrepancy between what the director and participant see, some directions are ambiguous. For example, the grid may contain three different sized trucks, all three of which are visible to the participant, but only two (the medium and large) are visible to the director. The director may tell the participant to move “the smallest truck.” From the participant’s perspective the smallest truck is not visible to the director, thus the medium sized truck must be this smallest truck that the director refers to. Adults consistently show limitations in their ability to interpret instructions like “move the smallest truck” in that they frequently will respond egocentrically, by moving the smallest truck. If the participant had actively taken the director’s perspective, the participant would have moved the medium truck. Switching from one’s own perspective to the perspective of a naïve other person is not automatic, consistent, or reliably done by participants on this task.

In the present study, the role of adult use of ToM in communication is explored in the circumstance of autobiographical memory and fictional storytelling in a social context. The present study will explore the role of ToM and social cognition, language, and EF in AM as well as fictional storytelling in early adulthood.

Study Aims

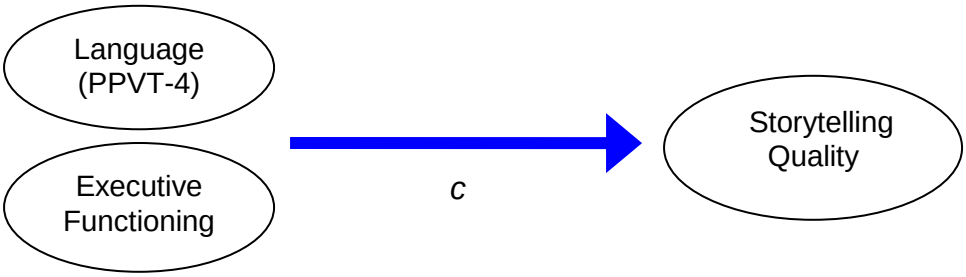
This study explores ToM in Early Adulthood and its relationship to language, EF and narrative. The first specific aim of the proposed study is to determine if individual differences in measures of ToM, as typically used in the developmental psychology literature (emotion recognition and FB), are associated with individual differences in hindsight bias, as typically studied in the social psychology literature. It is expected that performance on emotion recognition and FB tasks will be related to one another and will be related to performance on the hindsight bias measure, comprising an overall TOM factor made up of emotion recognition, curse of knowledge and hindsight bias.

The second specific aim of the proposed study is to determine if individual differences in these various measures of adult ToM are associated with individual differences in language ability and IC. It is expected that individual differences in language and IC will be associated with individual differences in performance on ToM tasks in adults.

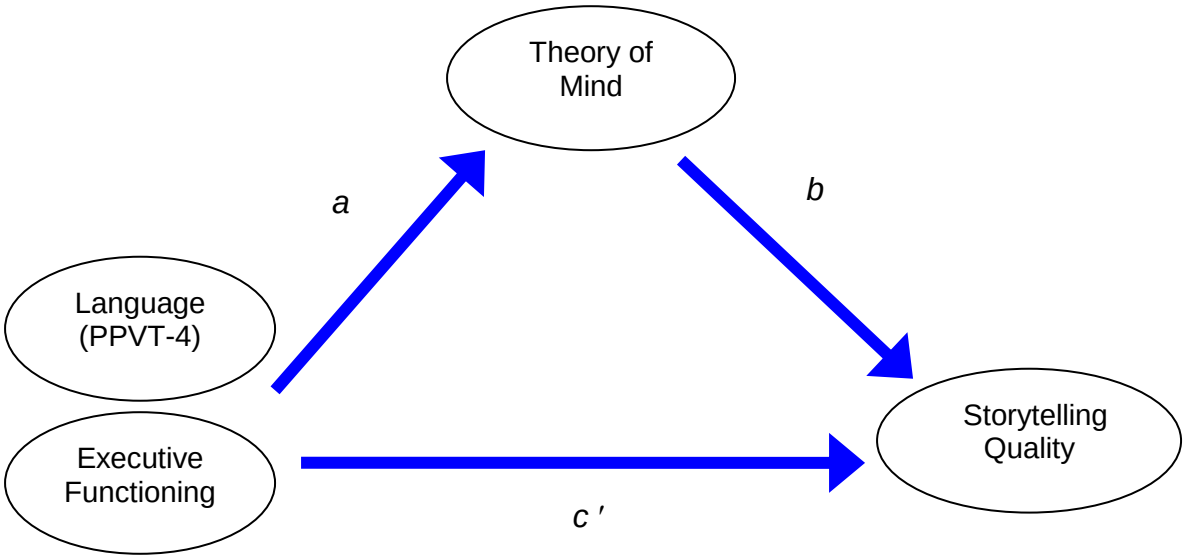
The third specific aim of the proposed study is to determine if individual differences in measures of ToM, language and IC are associated with individual differences in storytelling ability, including the quality of socially-shared narratives of AMs and a fictional story. It is expected that individual differences in adult ToM will be associated with individual differences in story quality. Although conceptualized as an "outcome" of ToM skill, it is important to note that in a single time-point study, the direction of influence of ToM on storytelling cannot be specified.

Finally, an overarching fourth specific aim is to elucidate a possible pathway from language and EF (specifically IC) to AM quality mediated by ToM. In other words, language and IC have an indirect effect on storytelling quality through ToM (Figure 2-1).

Based in the theoretical perspectives described here, and included as a comprehensive model incorporating the previous specific aims of the study, an overarching model of the interconnections among language, EF (IC), ToM and storytelling is proposed. As seen in Figure 2-1(A) the basic cognitive skills of language and EF (IC) are expected to be associated with an individual's ability to tell a high quality story. Figure 2-1(B) illustrates the proposition that language and EF (IC) may be found to affect storytelling indirectly, through their influence on ToM in the individual. Thus, language and EF (IC) will impact storytelling not simply because they are basic cognitive tools that are used when engaging in storytelling, but because these skills are necessary for ToM, and the use of ToM is essential in communicating a good story to another person.



A.



B.

Figure 2-1. Mediation model showing an indirect effect of language and executive functioning through Theory of Mind.

CHAPTER 3
METHODS

Participants

The age range chosen for the present study represents early adulthood, ranging from 18-25 years of age. This age range was chosen because it is easily accessible in a university setting, represents relative diversity of individuals, and is a period of ongoing development across a variety of developmental domains. Individuals in early adulthood, especially those in college, have been studied because they are experiencing continued brain development, social development, emotional development, and cognitive development. Adults in this age range experience a wide range of life changes, face a wide range of choices, and have ample opportunity for development through social interactions with peers and other individuals. Additionally, this developmental period is an ideal time to collect autobiographical memories as the life story has been found to "emerge" in adolescence (Habermas & Bluck, 2000) and telling stories of the events of one's life becomes an everyday occurrence.

Participants were recruited through the Psychology Participant Pool at the Ohio State University. Specifically, participants attended a satellite campus of the Ohio State University, which promotes open-enrollment and samples from this campus include a variety of non-traditional and diverse university students. Students who completed the study were given course credit commensurate with university guidelines. Although the intended age range for "early adulthood" was 18-25 years, participation was not restricted based on age, and upon examination of the final sample, the age range represented was 18-35.5 years. All individuals in this extended age range were university students, and examination of the data showed no outliers on any measure

within this age range. Individuals between the ages of 18-35.5 were included in analyses as this allowed for a larger sample while not otherwise changing the characteristics of the sample. Individuals over the age of 35.5 years were excluded from analyses, as these represented outliers not consistent with the remainder of the sample. A total of 104 students were tested. Students over the age of 35.5 years were excluded from analyses resulting in a final sample of 96 students. Participant age ranged from 18.5 years to 35.2 years (M = 21.29 years, SD = 3.41 years) and included 59 freshmen, 19 sophomores, 4 juniors, 9 seniors and 5 post graduates. The sample included 49 males and 47 females (no gender differences were found on any measure), and was largely Caucasian (83 Caucasian, 6 African American, 3 Asian, 2 Hispanic, and 2 multi-racial).

Procedure

Participants were tested in the Psychology Building by graduate and undergraduate student researchers. During each session, participants were given a paper-and-pen packet, after which they were interviewed by a researcher. Interviews were audio recorded.

Participants participated in two sessions. Session 1 lasted one hour and included an Adult Theory of Mind battery (including hindsight bias- Day 1, curse of knowledge and Reading the Mind in the Eyes), self-relevant autobiographical memory, two cue-word elicited autobiographical memories, and language assessment (PPVT-4). Day 1 also included a personal information sheet to gather information about age, gender, race/ethnicity, SAT/ACT scores, and socio-economic status. Session 2 occured one week after session 1 and lasted 30 minutes. Session 2 included hindsight bias follow-up, the Stroop Color Word test and storybook narrative.

Measures

Social Cognition

The Reading the Mind in the Eyes Task, Revised Version (Baron-Cohen, et al., 2001). This paper and pencil test consists of 36 photos of the eye-region of the faces of a variety of human actors and actresses. Participants are required to choose the word, out of 4 answer choices (one correct, three carefully chosen foils), that best describes the mental state expressed in the eyes. Participants are provided with a glossary of the mental state terms included in the test for reference. Participants were not timed, but generally this task took about 10 minutes to complete.

This revised version of the “Eyes Task” was developed specifically for use as an indicator of subtle individual differences in ability to detect, or “tune into”, mental states as expressed through the eyes. The previous version (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997) of the Eyes Task resulted in near-ceiling level performance for normally developing adults, and served to distinguish normally developing adults from those on the autism spectrum. In order to serve as an individual difference measure for normally developing adults, the revised version includes more items (previously there were 25), four answer choices rather than the previous two, and answer choices which require a nuanced understanding of the mental state presented, as opposed to a forced choice between 2 opposites as in the original version.

Participant scores can range from 0-36. Mean scores for the general populations in the report of this task were 26.2 (SD=3.6) and for student populations the mean score was 28.0 (SD=3.5). This task has been used previously with normally developing adults (Kemmis, Hall, Kingston & Morgan, 2007) and special populations including High Functioning autism (Kaland et al., 2008).

Curse of knowledge task. Participants are presented with one paper-based scenario based on the series of experimental versions of a hidden displacement task developed by Birch and Bloom (2007). This scenario resembles the classic Sally-Anne change of locations task typically used to test children's FB competence, but is modified for use with adults (Figure 3-1). Essentially, this is a FB task with responses in the form of a predicted probability of a character's choice of where to search for a hidden object. Participants read "This is Vicki. She finishes playing her violin and puts it in the blue container. Then she goes outside to play" paired with an illustration of 4 similarly shaped but different colored containers. Next, participants read "While Vicki is outside playing, her sister Denise moves the violin to the red container. Then, Denise rearranges the containers in the room until the room looks like the picture below" paired with an illustration of the same containers in a different configuration. Finally, participants read the target prompt, "When Vicki returns, she wants to play her violin. She first looks for the violin in the blue container where she left it. What are the chances that Vicki will first look for her violin in each of the remaining containers? Write your answers in percentages in the spaces provided under each container. Your responses should total 100%." This task takes less than 5 minutes to complete.

In order to score this assessment, it is important to take into consideration what a "correct" or unbiased score would be under an "unbiased" circumstance. One would expect a participant not cursed with the knowledge of the true location to assign equal probability to each of the three remaining containers (pilot testing suggests that many, though not all, non-cursed participants do this). Thus, individual curse of knowledge scores were calculated by subtracting 33.33 from the probability assigned to the red

container, resulting in a raw score range of 0-66.66, with 66.66 indicating the highest level of “curse of knowledge”.

The scenario used is a modification of the method used by Birch and Bloom (2007) and is structured to be as sensitive as possible in detecting whether an individual is “cursed” by their own private knowledge when predicting the behavior of a naïve other person. The participant is told that the violin is hidden in the red container without the knowledge of the character who will search for the violin (Vicki). Thus, Vicki has no reason to search the red container preferentially over the other containers. By telling the participant that Vicki first searches in the blue/original container we eliminate the possibility that all participants will assign 100% probability to this container (perform at ceiling for standard FB). In addition, we are maximizing our ability to determine each individual’s ability to set aside their own knowledge, as the red container can potentially be assigned anywhere from 0-100% probability for being the first search location. Ideally, an individual who sets aside their privileged knowledge of the true location would assign equal probability to each of the remaining containers (that is, 33.33%), applying their understanding that Vicki is naïve to the true location of the violin.

Pilot testing of this task has indicated that when individuals are told the true location of the violin, as a group they assign a higher probability to the red container than to the other containers when compared to a control group (in which participants are not told the true location of the violin). In addition, pilot data indicates that those who are told the true location of the violin assign a first search probability ranging from 0-100% to the red container, with some participants assigning equal probability to each container. This suggests that the proposed procedure will elucidate individual

differences in ability to set aside privileged knowledge when predicting the behavior of another person. This specific task has not been used previously as an indicator of individual differences in ToM for adults. Reliability was not calculated for this measure because of the nature of the responses being a division of 100% probability and a limit of 3 responses.

Hindsight bias. A battery of 50 questions addressing “uncommon” knowledge is administered on day 1 of testing using a paper and pencil format. According to previous work, (i.e., Pohl & Hell, 1996) the questions are Almanac-based questions of facts of which the average person would have no specific knowledge, each with a numerical answer. An example question might be, “What is the height of the Eiffel Tower, in feet?” Participants were asked to write their answer (or estimate) in the space provided. On Day 2 of testing (one week later) participants were presented with the same list of questions. For 25 of the 50 questions, participants were asked to recall the answer they gave on Day 1 of testing after being told the correct answer. For the remaining 25 questions, participants were asked to recall the answer they gave on Day 1 of testing without being told the correct answer.

Hindsight bias scores were calculated using the procedure of Pohl and Hell (1996). For each question, a bias score was calculated in the following way: $B = (E - R) / (E – S)$, where B = bias, E = original estimated response, R = the recalled response, and S = the solution, or actual answer to the question. Using this formula, 5 types of score are possible, indicating (1) that the remembered response was the same as the original estimated response ($B = 0$), (2) that the recalled response moved farther away from the solution ($B < 0$), (3) that the recalled response moved beyond the solution (B

> 1), (4) that the recalled response moved toward the solution (0 < B < 1), or (5) that participants recalled their original response as the same as the solution (B = 1). Notably, Pohl and Hell (1996) found this fifth type of response only 3 times out of 900. For each participant, frequency of the four types of bias scores were calculated separately for the "Biased" (where the participant is told the solution prior to recall) and "Unbiased" (where the participant is told the solution after recall) lists of questions. Of particular interest here is the number of scores indicating a drift toward the correct response (i.e., 0 < B < 2). The difference between frequencies of drift toward the solution for each list will indicate overall bias for each participant. Scores on this measure can range from -25 to 25. A score of 25 would indicate complete hindsight bias, in which all 25 responses in the biased condition drifted toward the correct answer while no response in the unbiased condition drifted toward the correct answer.

General Cognitive Abilities

Language. Participants completed the Peabody Picture Vocabulary Test, Version 4 (PPVT-4, Dunn & Dunn, 2007). This standardized language assessment was developed for use with participants aged 2 years 6 months to over 90 years, and is often used as a measure of general language ability or verbal intelligence. This test was chosen because it is commonly used in studying language development, is prevalent in the literature examining the relationship between language and ToM, and because it is standardized for the widest age range of all language measures, making it useful for comparing across studies and applying to a diverse sample of adults. To administer this test, the researcher states the target word for each item and participants must choose the correct illustration (out of four choices) that matches the target word. Target words

become increasingly difficult and administration of the task is ended when 6 of 8 consecutive words are answered incorrectly.

Participants were also asked to report their SAT and ACT scores for verbal sections of the test. However, due to a response rate of less than 40%, this information was excluded from analyses.

Executive functioning/Inhibitory control. Participants completed the Stroop Color Word Test (SCWT), (Victoria Version, Spreen & Strauss, 1998). In this task, participants' responses to 3 separate test cards were timed individually. The first card consists of 6 rows of 4 dots, colored red, green, blue, and yellow in varying order. Participants are required to name the color of the dots as quickly as possible. The second card consists of 6 rows of 4 words (when, hard, over, and) printed in red, green, blue and yellow ink (word color and order varies across rows). Participants are required to name the color of the ink for each word as quickly as possible. The third card consists of 6 rows of 4 color-words, each printed in a conflicting color ink ("green" printed in blue ink, for example). Participants are required to name the color of the ink for each color-word as quickly as possible. Mean time (in seconds) to complete the first (color reading) and second (ink color naming) cards will be subtracted from the time required to complete the third (IC) card. The resulting score is considered to be an indicator of individual differences in IC, as a participant who answers the third card more quickly (or more similarly to the first two cards) is better able to inhibit the more automatic responses of color-word reading in favor of the secondary response of ink color naming. The third card maximizes this IC demand by presenting color words in mismatched colored ink.

Autobiographical Memory and Story Narratives

Participants were interviewed to elicit three AM narratives and one narrative about a wordless story book. Time to complete these narratives varied among individuals.

Autobiographical Memory. For the first autobiographical memory narrative, participants were asked to relate to the interviewer a memory of an event, occurring within the previous 6 months, which highlights the idea of “Who Am I?” The interviewer prompted the participant by telling them that often we tell stories to give another person insight into our own sense of who we are, or we remember these events privately to reflect on this sense of “self.” Participants were given time to think about the prompt, and then asked to relate the memory to the best of their ability to the interviewer.

For the remaining two autobiographical memory narratives, participants were shown a list of “cue” words commonly used in the elicitation of autobiographical memories (car, water, play, fear, animal). Participants were then asked to remember events from their lives which were cued to memory by individual words from the list. Participants were then asked to choose a word and to narrate a memory related to the cue word chosen to the best of their ability so that the interviewer understood. This procedure was repeated with a different cue word. The interviewer was instructed to act as an active and interested listener without speaking, responding or asking questions.

Wordless Story Book Narrative. Participants were provided with a wordless story book, “Breakfast for Jack,” and asked to peruse the drawings in the book to get a sense of the story line. Once satisfied with their understanding of the story, participants were asked to narrate the story aloud, keeping in mind that the narrative would be intended for child around the age of 4 who has not seen the book or heard the story

before, but who will be able to look at the pictures while listening to the recorded narrative.

This story was chosen for its potentially engaging storyline, colorful illustrations, as well as its potential for participants to include information regarding mental state, emotional, and perceptual details.

Narrative Quality Ratings. Narratives were audio recorded, then rated for overall story quality using Baron and Bluck's (2011) Perceived Story Quality Index (PSQI). This six question scale asks a lay rater to indicate how entertaining, emotional, memorable, original, rich in imagery, and engaging a narrative is using a 5 point likert-type scale. Ratings for each individual scale were averaged to represent an overall story rating ranging from 1-5. Baron and Bluck showed that individual raters tend to rate the same story similarly, reducing the need for a large number of ratings of quality for each individual narrative. Thus, each AM narrative, as well as each wordless storybook narrative, was rated using this scale by 3 independent coders and the average rating of these three was used in analyses. Internal validity of the scale was determined using Cronbach's Alpha, with results reflecting those of the original report of the PSQI. Cronbach's Alpha for the 6 items on the PSQI was .96, indicating a high level of internal validity.

Additionally, when considering the average score across three different AM narratives and the storybook narrative for each participant, Cronbach's Alpha was .7 or higher for each individual item of the PSQI. However, when Cronbach's Alpha for the overall average of all AM narratives and the storybook narrative was examined, it was shown that Alpha was higher when the storybook narrative was not included in the

overall average. Therefore, the overall story quality average as well as AM and storybook narratives were examined in separate analyses in order to determine if relationships among language, IC, ToM and narrative were different depending on whether the story was autobiographical or fictional.

Three narrative scores were used in analyses. Average rating for all AM narratives (AM only), average storybook rating (Storybook Only), and an overall story quality average which included both AM and storybook ratings.

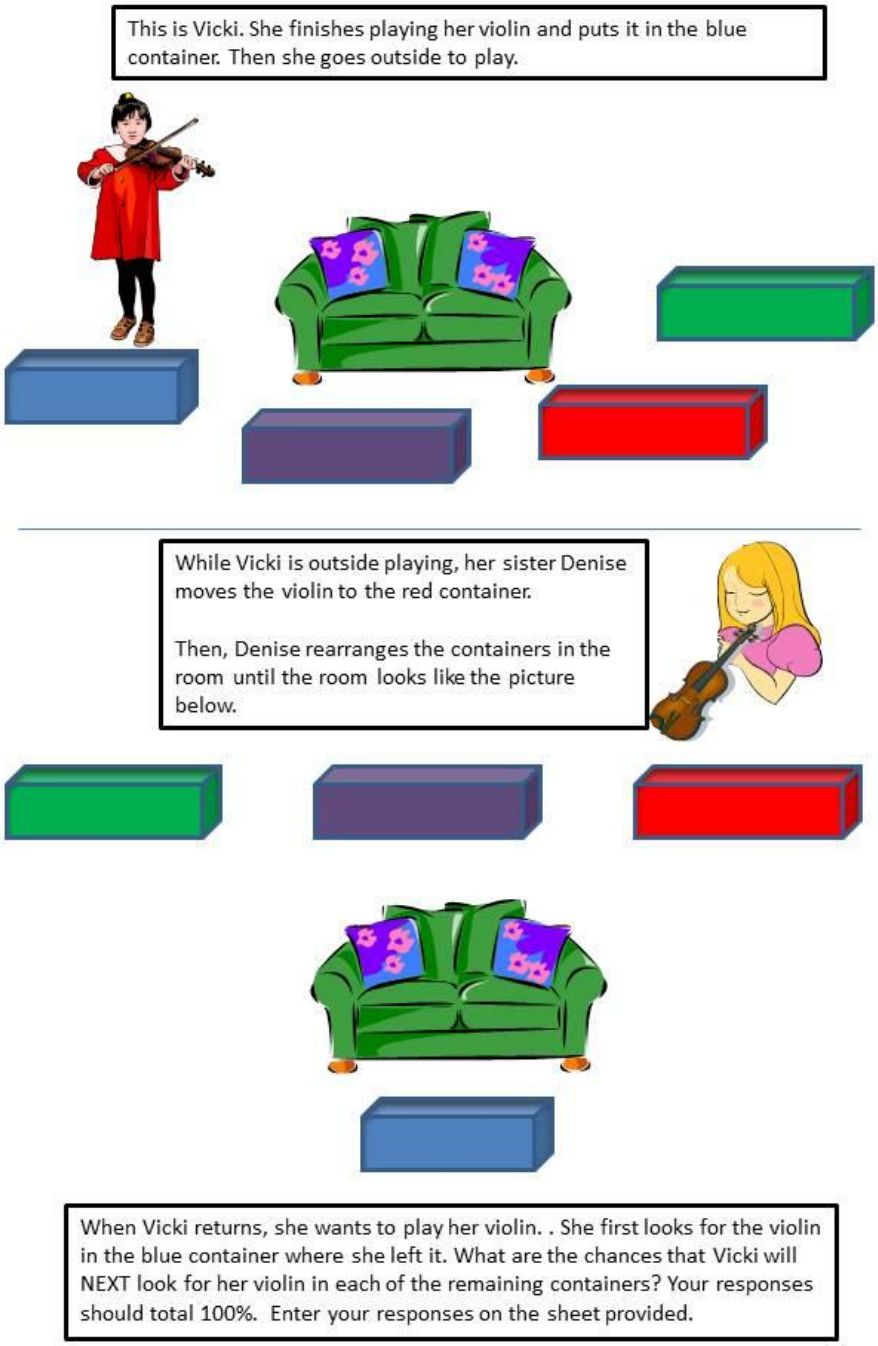


Figure 3-1. Curse of knowledge task stimulus.

CHAPTER 4
RESULTS

Descriptive results

Descriptive results are displayed in Table 4-1 for each of the measures of interest. All missing data was handled using listwise deletion, as the missing data was considered to be missing completely at random, and loss of power was not found to be an issue using listwise deletion in this study. Age was correlated with raw scores on the PPVT-4 in preliminary analyses, so it was deemed appropriate to use standardized scores (consistent with the intended use of the test) in analyses, thus controlling for age in analyses involving the PPVT-4. The mean standard score on the PPVT-4 for this sample (M = 96.74) was close to the population mean, and performance on this test was normally distributed.

Also of note, maximum ratings of story quality for the storybook and for AMs remained below 4, out of a maximum of 5 as a rating of a very good story, with means just below average. Raters consistently found that the stories told in this study were average or below average.

Performance on the Reading the Mind in the Eyes task was as expected, with a mean score of 24.74 items correct out of 36 (SD = 4.19, range 15-33 correct). All participants performed better than chance and there were no ceiling effects, indicating that the test was understood by participants but posed a challenge and highlighted individual differences in emotion recognition effectively. Performance on the remaining two proposed ToM measures (curse of knowledge and hindsight bias) was slightly different than expected based on prior work. Responses on the curse of knowledge task were not normally distributed. More than half of the responses on this task fell in the

“correct” range of 34-30%, indicating that most participants were not biased by the knowledge of the true location of the object in the scenario. Only one participant assigned 100% probability to the red container, indicating being fully cursed by the knowledge of the true location, and only five participants assigned a probability higher than 50% to the red container. Two participants assigned 0% probability to the red container.

For the hindsight bias measure, a mean score of 1.13 indicates that participants, overall, were subject to hindsight bias, but only slightly. That is, their responses drifted closer to the correct answer when the correct answer was given to them roughly one item more frequently than when the correct answer was not given. Hindsight bias scores were normally distributed around this mean. Many participants’ (n = 33) responses drifted closer to the correct answer more frequently when the correct answer was *not* given or drifted closer to the correct answer equally in the two conditions (n = 13) resulting in 39.7% of the sample failing to show hindsight bias.

Study Aim 1

The first aim of the present study was to examine associations among a variety of ToM measures in early adulthood, namely the Reading the Mind in the Eyes task, FB probability or “curse of knowledge” task, and hindsight bias. First, these relationships were explored using simple correlations (Table 4-2). No relationships were found to exist among the Reading the Mind in the Eyes task, curse of knowledge task, or hindsight bias. Thus, the confirmatory factor analysis planned to show a unitary underlying “Theory of Mind” factor was deemed unnecessary.

The Eyes task henceforth will be used as the standard measure of ToM for analyses. This is based on the fact that it is the most established, most frequently used

measure in the ToM literature, whereas the curse of knowledge task and the hindsight bias task have not previously been used as individual difference measures. Attempting this application of these measures was intended to extend the study of individual differences in ToM in adulthood through the addition of tasks used in the adult social cognition literature. However, because the Eyes task was the only of the proposed ToM measures to be correlated with more than one other measure of theoretical or practical interest (described below), the Eyes task was selected to operationalize ToM in adulthood.

Study Aim 2

The second aim of the present study was to reveal relationships among ToM, language, and IC. These relationships were first explored using simple correlations, shown in Table 4-2. Notably, age was not found to be correlated (Table 4-2) with any of the proposed measures of ToM, indicating that age did not suffice in explaining individual differences in performance on these measures. Higher scores on the Eyes task were found to be significantly associated with higher language scores (PPVT-4) ($r(94) = .20$). In contrast, language was not found to be related to either of the remaining proposed ToM measures (curse of knowledge or hindsight bias). IC, as measured by the traditional Stroop task was found to be related to both the Reading the Mind in the Eyes task ($r(82) = -.32$, $p = .004$) and the curse of knowledge task ($r(82)= .25$, $p = .023$). Quicker response times on the incongruent (test) card of the Stroop task were associated with higher scores on the Eyes task and lower likelihood of being cursed by the knowledge of the true location of the object in predicting the behavior of an individual with a false belief.

To explore the relative contributions of language (PPVT-4) and inhibitory control (Stroop) for ToM, a regression model using the forced entry method was conducted. Only the Stroop task significantly predicted performance on the Reading the Mind in the Eyes task β = -.26, $t(79) = -2.65$, $p < .05$, and explained a significant proportion of variance in Reading the Mind in the Eyes scores, $R^2 = .13$, $F(2, 79) = 5.74$, $p < .01$, however the effect was small.

Because of the non-normal distribution of scores on the curse of knowledge task, responses were recoded to indicate whether the participants were not cursed (assigned a probablitiy of 30-34% to the red container, n = 45), cursed in favor of the red container (assigned a probability higher than 34%, n = 30) or cursed against the red container (assigned a probability less than 30%, n = 21). A one-way ANOVA comparing these three groups on all other measures was not significant. The groups did not differ in performance on language or IC. Similarly, when the two “cursed” groups were combined and compared to the “non-cursed” group, an independent samples t-test indicated no difference on any measure between groups. Thus, it is difficult to interpret the small but significant correlation found between the curse of knowledge task and the Stroop task mentioned above.

Study Aim 3

The third aim of the present study was to explore the relative roles of ToM, language and IC for story quality reflected in the PSQI scores for AM and storybook narratives. These relationships were first explored using simple correlations (Table 4-2). Higher scores on the Eyes task were found to be related to higher story quality when considering storybook narratives ($r(83) = .36$, $p < .01$) and the Overall (combined

storybook and AM) story quality rating (r(82) = .38, p < .01). Higher scores on the PPVT-4 were found to be related to story quality for AM stories only (r(94) = .23, p , .05). No other measure was significantly correlated with story quality.

Multiple regression analyses are displayed in Table 4-3. Separate multiple regression models (using the forced entry method) with each of the three narrative scores used as the outcome variable (AM Only, Storybook Only, and Overall Story Quality) were examined with the Eyes task, the PPVT-4, and the Stroop as predictors. Regression models predicted a significant portion of the variance in Storybook Quality $F(3,80) = 3.766$, $p = .014$, and Overall Story Quality, $F(3,81) = 3.671$, $p = .016$. The model predicting AM quality alone was not significant. Upon examination of individual predictors within the regression models, for both Storybook only and Overall Story Quality only the Eyes task was a significant predictor of variance in story quality ($\beta = .32$, $R^2 = .12$, and $\beta = .31$, $R^2 = .13$ respectively).

Study Aim 4

The fourth aim of the study was to show an indirect effect of language and IC on storytelling quality through ToM as measured by the Eyes task, using a mediation model (Figure 2-1). Hayes (2009) argued for the use of a bootstrapping method of testing for mediation as opposed to using Baron and Kenny's (1986) steps or the Sobel test, as the bootstrap resampling method allows for nonnormal distributions and tests for mediation using a 95% confidence interval. Results are summarized in Table 4. First, when Overall Story Quality (OSQ) was entered as the dependent variable (DV), the omnibus test of the indirect effect indicated that the model supported an indirect pathway from the IVs (language and IC) through the mediator (ToM) to the DV (story quality). Examination of the individual IVs indicated that IC, but not language, was responsible

for the significance of the model. However, the effect was very small. That is, the 95% confidence interval of the indirect effect of the Stroop through the Eyes task on story quality did not include zero, suggesting the presence of an indirect effect, indirect effect = .01, R^2 = .13, adjusted R^2 = .1, 95% CI [-.0137, -.0013]. In order to determine relative effect size for the model, more work is needed in this area. Standardized coefficients were not calculated, as the creators of the method employed do not recommend the interpretation of standardized coefficients. Thus, the relative size of this effect is not clear. The pattern of results was the same when Storybook Only ratings were entered as DV. When Autobiographical Memory Only ratings were entered as DV, no indirect effect was found.

Table 4-1. Descriptive information for key measures.

Measure (possible score/metric)	N	Mean	SD	Minimum	Maximum
Age (years)	96	21.29	3.41	18.47	35.16
PPVT-4 (standard)	94	96.74	11.65	75	130
Eyes (0 – 36)	96	24.74	4.19	15	33
FB Curse (-.33 - .67)	96	-.02	.14	-.33	.67
Hindsight Bias (-25 – 25)	78	1.13	2.89	-8.0	7.0
Stroop (seconds)	81	10.28	4.63	3.0	25.5
AM Only (1 -5)	94	2.55	.35	1.86	3.47
Storybook Only (1– 5)	83	2.06	.50	1.13	3.50
Overall Story Quality (1- 5)	82	2.30	.36	1.56	3.27

Table 4-2. Pearson's correlations for age, emotion recognition (Eyes), curse of knowledge (Curse), hindsight bias (HB), language (PPVT-4^) and inhibitory control (Stroop) and story quality.

	Age-in years	Eyes	Curse	HB	PPVT-4	Stroop
Eyes (ER)	.05					
Curse	.17	-.09				
HB	.07	-.17	-.05			
PPVT-4	-.02	.18	.04	.09		
Stroop	.07	**-.31	*.25	.07	-.16	
AM Quality	.02	.20	-.08	-.03	*.23	-.14
Storybook Quality	.20	**.36	-.09	.02	.09	-.18
Overall Story Quality	.11	**.38	-.19	.01	.06	-.19

^PPVT-4 scores are standardized * $p < .05$, two-tailed, ** $p < .01$, two-tailed

Table 4-3. Multiple regression analyses of the effects of emotion recognition (Eyes), inhibitory control (Stroop), and language (PPVT-4) on story quality.

	AM only			Storybook only^			Overall Story Quality^		
Variable	B	SE B	β	B	SE B	β	B	SE B	β
Constant	1.753	.39		1.072	.61		1.341	.41	
Eyes	.01	.01	.17	.04	.01	**.32	.03	.01	**.31
Stroop	-.002	.01	-.03	-.01	.01	-.07	-.01	.01	-.06
PPVT-4	.01	.003	.17	-.001	.01	.01	.003	.003	.09
R^2		.08			.12			.13	

^model predicted a significant proportion of variance in the DV; *p < .05. **p<.01

Table 4-4. Summary of mediation results for Language (PPVT-4) and Inhibitory Control (Stroop) mediated by Emotion Recognition (Eyes) on story quality using bootstrapping method (5000 bootstrap resamples). OSQ=Overall Story Quality, SB=Storybook only, AM= Autobiographical memory only.

DV	Mediator	IV	Direct Effect (SE)	Indirect Effect (SE)	95% CI for Indirect Effect		Model R^2
					LL	UL	
OSQ	Eyes		.03 (.01)				
		PPVT-4	.00 (.00)	.00 (.00)	-.0004	.0046	
		Stroop	-.00 (.01)	.01 (.00)	-.0137	-.0013	
		Omnibus		.00 (.00)	.0003	.0095	*.13
SB	Eyes		.04 (.01)				
		PPVT-4	.00 (.00)	.00 (.00)	-.0007	.0072	
		Stroop	-.01 (.01)	.01 (.00)	-.0216	-.0029	
		Omnibus		.00 (.00)	.0004	.0143	*.14
AM	Eyes		.01 (.01)				
		PPVT-4	.00 (.00)	.00 (.00)	-.0005	.0027	
		Stroop	-.00 (.01)	-.00 (.00)	-.0091	.0009	
		Omnibus		.00 (.00)	-.0006	.0057	.07

*p = .01

CHAPTER 5
DISCUSSION

The study described was intended to explore social cognition in early adulthood, with a focus on ToM, it's predictors and it's outcomes. Specifically, this study was intended to bridge a gap between child ToM research in the developmental psychology literature and adult social cognition research in the social psychology literature. These results add to the growing literature describing adult ToM. The findings of this study will be discussed by each of the four primary study aims in turn, followed by a discussion of the overall theoretical implications for the development of ToM.

Study Aim 1

The first aim of the present study was to examine associations among a variety of ToM measures in early adulthood, namely the Reading the Mind in the Eyes task, FB probability or "curse of knowledge" task, and hindsight bias. These tasks were chosen because they represent the beginning of the bridge between traditional children's tasks assessing ToM and tasks used in adult social cognition literature. Of primary interest is whether ToM in adulthood represents a unitary construct and whether there are meaningful individual differences in ToM performance.

The Reading the Mind in the Eyes task used in this study is the adult version of a child version of the same task used to assess emotion recognition (Baron-Cohen, Wheelwright, Scahill, Lawson & Spong, 2001). The curse of knowledge task is a nuanced version of the traditional FB change of locations task designed to tap into more subtle errors in adult FB reasoning (Birch & Bloom, 2007). The participant is required to predict the probability that a naïve character will search for a secretly displaced object in a location known to the participant to be the correct location of the object. The "curse"

referred to is simply the knowledge of the true location of the object, and the fact that adults do not perform at ceiling on this task suggests that the ability to reconcile conflicting representations (reality and a FB) is imperfect in adults.

The hindsight bias task, because it highlights the individual's tendency to think they knew the correct answer all along, parallels children's representational change tasks. For example, if a young child is shown that a crayon box contains ribbon, the child is likely to claim they always thought the box contained ribbon. Similarly, if an adult is told that the Eiffel Tower is 986 feet tall, the adult is highly likely to claim their guess of the height would have been very similar to 986 feet.

Because these tasks fit into the scheme of child ToM research, which shows consistent correlations between these types of tasks, and because well-respected and well-researched theories of ToM and autism (Baron-Cohen, 2000) propose that these skills are based on an underlying and unitary ToM trait, results of the present research were expected to show interrelations among individual performance on these adult tasks. This expectation was not met in this study, as the three ToM measures were not correlated. This result was unexpected, as multiple tasks measuring different aspects of ToM (such as FB and representational change) are often found to be correlated in the child ToM literature (i.e., Gopnik & Astington, 1988). There are multiple explanations for why these tasks were not related in the current study. First, these results may indicate that the measures of ToM do not represent a unitary construct, and are not organized as such within the individual. This evidence may be construed as an indication that ToM, as conceptualized in many prominent theories of ToM is not truly a unitary cognitive construct, but more of a constellation of skills that share common skills, such

as thinking about mental states, the self-other distinction, the physical-mental distinction, and meta-representation, but which are not based on a common biological or cognitive underpinning. It is important to recognize that ToM in adulthood is less widely studied, and more evidence of a disconnect between different “ToM” skills should be replicated in order to further apply the finding that multiple ToM skills did not represent an underlying ToM construct. However, in light of the present findings, it is important to realize that ToM as discussed in the present paper from this point forward is operationalized using only the Reading the Mind in the Eyes task, an emotion recognition task that does not require the coordination of multiple conflicting representations. Thus, some may view this as not a true or complete representation of ToM. However, as the Reading the Mind in the Eyes task has previously been used as a measure of ToM (i.e.,Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997), I consider it appropriate to use this task as an indicator of some form of ToM for the present study.

A point worth considering is that the individual differences expressed through the hindsight bias and curse of knowledge tasks were not meaningful as a result of methodological difficulties or sample issues. Further, though the measures of ToM used in this study were not interrelated, it may be that a different selection of ToM tasks for adults may show a different pattern of results.

An interesting distinction has recently received attention in the ToM literature delineating two separate types of ToM reasoning: affective ToM and cognitive ToM (Leopold et al., 2012). Affective ToM includes the ability to understand, interpret, and empathize with the affective or emotional mental states of others. Cognitive ToM includes the ability to reason about epistemic mental states such as beliefs and

knowledge. Evidence from brain injury patients (Leopold et al., 2012) suggests that these two types of ToM are grounded in different regions of the brain. As a specific example of this, Leopold and colleagues showed that damage to the ventromedial prefrontal cortex and bilateral ventromedial prefrontal cortex was associated with significantly impaired affective but not cognitive ToM ability. Results of the present study may be viewed as supporting this brain evidence, as the affective Reading the Mind in the Eyes test was not associated with the cognitive curse of knowledge and hindsight bias tests.

Some methodological considerations, or limitations, may also provide an explanation of the finding that the ToM measures did not represent an underlying construct. Specifically, the ToM methods used in the present study, with the exception of the Reading the Mind in the Eyes task, have not previously been used to assess individual differences in ToM reasoning ability. Thus, the use of measures not well-established or supported in the existing literature makes strong conclusions about the implications of a lack of association among these measures difficult. These measures were used in the present study as an exploratory tool, and this use was always considered a bit of a gamble in terms of what the findings might be. Further research and development of individual difference measures would be ideal in moving toward a stronger methodology for studying curse of knowledge and hindsight bias as adult correlates of FB and representational change.

It is possible that the curse of knowledge and hindsight bias measures employed are not valid measures of ToM, but there may be other explanations for individual performance on ToM measures observed in this study. First, the underwhelming

evidence of both curse of knowledge and hindsight bias in this sample may be an important addition to the hindsight bias and curse of knowledge literature as the robust findings of bias previously reported for these tasks was not replicated here. Next, factors such as attention, motivation to perform, and time to respond were not measured in this study. Questions arise during test administration using a participant pool (in which students are required to participate in research, or alternatively write a paper, for course credit) about the possibility that these factors will affect outcomes. Thus, whether the participant is motivated to apply their full cognitive resources to the measures, or whether they are simply filling in blanks as quickly as possible may be a way of determining whether scores on these measures are reliable. For the hindsight bias measure, even though response times were not measured, it was clear during task administration that individual differences existed in attention, motivation, and time to respond both to the Day 1 and Day 2 lists of uncommon knowledge. During the curse of knowledge task, participants may have merely skimmed to the end of the vignette and reasoned that there was an equal probability that the character would look in the three containers without processing the information that was needed to produce a “curse” in their reasoning (that the object was really in the red container). In contrast, participants appeared to enjoy and relate with the Reading the Mind in the Eyes task, potentially leading to more reliable responses on this measure.

Future research may add an “explanation” question to the basic response of entering numbers indicating probability on the curse of knowledge task to delve deeper into the cognitions behind participants’ responses. Additionally, more attention-grabbing methods of administering these tasks may be employed. For example, a video vignette

may be more likely to transmit the essential information to all participants. Other methods for assessing adult reasoning about FBs may be added to this type of study as well. Apperly (2006) recorded time to respond to basic FB questions. This method may be useful in exploring individual differences in FB skill in future research.

Study Aim 2

The second aim of the present study was to reveal relationships among ToM, as measured using the Reading the Mind in the Eyes task, language, and IC. The expectation that individual differences in language, as measured by the PPVT-4, would be associated with individual differences ToM was supported when considering simple correlations with the Reading the Mind in the Eyes task. However, the effect of language for this task was eliminated when examined within a regression model including the IC task (Stroop). Despite the fact that the Stroop and the PPVT-4 were not correlated, it seems that an association between language and the Eyes task is explained by IC in this sample.

This finding is inconsistent with a large amount of research evidence from the literature regarding the child's development of ToM demonstrating a strong and consistent relationship with language (i.e., Milligan, Astington & Dack, 2007). It is possible that, in adulthood, language takes on a different role in the development or use of ToM. The findings are consistent with research evidence from the childhood literature showing the importance of IC for ToM skill (i.e., Carlson, Moses & Breton, 2002). Further, the fact that the best indicator of ToM in this study is an emotion recognition task, not a task that requires reasoning about conflicting representations, may explain why language is not a good predictor of this form of ToM. Some may argue that emotion

recognition is a separate skill, not entirely representative of ToM as a whole. Further research should address the role of language in both affective and cognitive ToM.

Apperly, Samson and Humphreys (2009) provide a clear explanation of the processes involved in the development of ToM in childhood, adults' ToM reasoning, and the different roles of language and EF. They explain that language is an essential tool in the initial construction of ToM in childhood, but once ToM is constructed, language ability is no longer associated with the support and use of ToM in adulthood. Applying Nelson's (2005) concept of the "community of minds," it stands to reason that language interactions in childhood do indeed play a role in escorting the child into the understanding of other minds. Through language, children are able to access the contents of the minds of others, understand that perspectives differ, and realize that the contents of the mind are not visible and must be revealed through language. The findings presented here, supported by the work of Apperly and colleagues, suggest that once the child is escorted into the community of minds through language, language has done its part and is no longer necessary for reasoning about ToM. However, measures of the indirect effect of language, using a cognitive interference paradigm during administration of FB tasks suggest that there may be some role of language (Newton & de Villiers, 2007). Newton and deVilliers showed that requiring adult participants to engage in a language-based interference task reduced accuracy on a non-verbal test of FB, more so than when using an interference task that did not require language (for an argument to the contrary, see Dungan & Saxe, 2012).

In contrast, EF (specifically, IC) appears to be a skill inherently involved in ToM reasoning itself, and not simply a tool for the initial construction of ToM. Children's

improving ability to inhibit prepotent responses, avoid the pull of the real, and suppress an egocentric perspective is clearly linked to their ability to perform on FB tasks (Carlson, Moses & Breton, 2002). Findings from the current study support the necessary role of IC for ToM reasoning, as opposed to the weaker claim that IC may be important simply for the initial emergence of ToM. Further, these findings suggest that IC is critical for the expression of ToM skills that exist within the individual. Even adults must actively engage in IC to suppress their own perspective in order to take the perspective of another.

In the current study, better IC was associated with better performance on the Reading the Mind in the Eyes task. This finding is particularly strong evidence for the essential and ongoing role of IC for ToM throughout development. This emotion recognition task does not require inhibition of a prepotent response, or suppression of one's own perspective in favor of the perspective of another, or indeed reasoning about conflicting representations. The association found may suggest that IC is critical to the development of the emotion recognition skill itself, and not only for performance on a specific test of ToM skill which overtly requires IC. Thus, processing, understanding, and relating to the information conveyed through the facial expressions of others may require the individual to inhibit automatic responses. These automatic responses may be based on preconceived notions about what a person should feel at a particular moment or perhaps the individual's own current mental state. Employing higher level IC over time and across development may enhance emotion recognition, thereby enhancing a ToM skill.

Zelazo and Carlson (2012) describe an emerging way of differentiating EF skills based on motivational significance, using the terms “hot” and “cold” EF. Hot EF refers to EF under emotional or highly motivated circumstances. Cold EF refers to EF that is less affective and more cognitive. Interestingly, the Stroop task used in the current study would generally fall under the heading of a “cold” or cognitive EF task, but was found to be associated with the more emotional ToM task used, the Reading the Mind in the Eyes task. It is possible that even stronger effects of EF for ToM may be found if a more affective, “hot” EF task is incorporated into a similar study. A Stroop-like task which requires inhibition of the actual emotion expressed on a face in favor of a response of the opposite emotion, called an Emotion Face Stroop task may be used for this purpose (Avram, Baltes, Miclea & Miu, 2010).

Current neuropsychological evidence supports the finding that EF (IC) continues to play a role in ToM in adulthood as well. Development of EF regions of the brain in childhood contribute to the child’s ability to reason about ToM, and continue to be critical in ToM reasoning in adulthood. In their cross-sectional study of children and adults, Apperly, Warren, Andrews, Grant and Todd (2011) showed that across age groups, FB reasoning took longer and required more cognitive effort than did reasoning about true beliefs. Processing ToM information clearly requires effort and is not automatic, even for adults. There are many reasons for this supported by research (Apperly, Samson & Humphreys, 2009 provide a review). Briefly, reasoning about mental states sometimes requires inhibiting a known reality to understand the behavior of one with an inexperienced mind. Often a person must inhibit their own knowledge, their own opinion, and their own experience in order to understand the knowledge,

opinion and experience of others. Adults are capable of these things, but require cognitive effort in the employment of these behaviors. The cognitive effort involved seems to be located largely in the areas of the brain associated with EF. Importantly, research is ongoing attempting to determine specific areas of the brain devoted to ToM itself (Apperly, Samson, Chiavarino, Bickerton, & Humphreys, 2007).

The present finding that IC, and not language, is associated with emotion recognition performance in adulthood is congruent with findings from brain injury patients who experience intact ToM reasoning ability despite damage to language areas of the brain, and impaired ToM associated with damage to EF areas of the brain (Apperly, Samson, Carroll, Hussain & Humphreys, 2006; Apperly, Samson & Humphreys, 2009). No previous study has directly examined individual language ability in participants without brain injury and its association with ToM in adulthood (see Newton & de Villiers, 2007, for an indirect examination of language and ToM.) . The findings presented here dovetail nicely with the findings of Apperly and colleagues demonstrating this lack of association.

Apperly and colleagues (2006) describe a detailed case study of a patient with compromised general language, general grammar, and specific grammatical structures closely scrutinized in the ToM literature as being significant for ToM reasoning (embedded complements). This patient was able to perform accurately on first-and second-order FB tasks. Further, brain injury patients with damage to regions of the brain associated with EF and IC show significant decreases in ToM reasoning ability. Apperly and colleagues (2005) describe a case study of a patient with damage to the right frontal and temporal lobe as a result of a stroke. This patient was unable to inhibit his

own perspective when confronted with FB tasks and when asked to make judgments about the desires, perceptions, and emotions of other people when he had his own perspective on the same situation. That is, he was unable to inhibit his own personal judgments when considering the perspectives of others. Studies of participants without brain injury have revealed a similar association between IC and ToM (Apperly, Samson & Humphreys, 2009).

Beyond this explanation, other conclusions may be considered when reviewing the findings of the present study. First, it is important to recognize that language was measured using only one indicator of ability, the PPVT-4. This test is widely used and highly reliable, however drawing conclusions about the lack of importance of language for ToM in adulthood should be done with caution. The PPVT-4 is highly correlated with IQ, and assesses receptive vocabulary. To achieve this in adults, the items on the PPVT-4 represent words used with low frequency in speech, conversation, and even in printed text. Advanced academic study and high general intelligence are more likely to be predictors of performance on the PPVT-4 for adults than amount and quality of social interaction, for example. Thus, the notion that high quality social interactions through language may contribute to better ToM ability in adults is not necessarily addressed when language is measured using the PPVT-4. Similarly, it could be that it is not language, per se, that plays a role in enhancing adult ToM, but ongoing participation in social interaction in general. More research in this area is needed. Assessing multiple aspects of language, and obtaining objective measurements of amount and quality of social interaction may elucidate the role of language and speak to the social construction of ToM in adulthood.

In the present study, ToM was operationalized mainly using the Reading the Mind in the Eyes task, a test of emotion recognition. Although other measures were used in this study, intending to provide information about a variety of different ToM reasoning skills, it is unclear why the curse of knowledge and hindsight bias tasks were not found to be associated with language, as measured by the PPVT-4. This may be due to the potential limitations of these tasks discussed earlier. An examination of other indices of ToM reasoning ability is also called for when trying to answer questions about the role of language for ToM in adulthood. Other methods used for assessing ToM in adulthood include the grid paradigm developed by Keysar, Lin and Barr (2003), the Faux Pas test (Stone, Baron-Cohen & Knight, 1998), and the Strange Stories task (Happe, 1994) among others. A study utilizing a variety of ToM tests, representing both affective and cognitive ToM, and their associations with language ability and IC in typically developing adults is needed.

Study Aim 3

The third aim of the present study was to explore the relative roles of ToM as measured by the Reading the Mind in the Eyes task, language and IC for story quality. Previous research on autobiographical and fictional storytelling led to the expectation that language would be a predictor of story quality, as storytelling is essentially an exercise in language use. Importantly, previous research has also shown that ToM is related to autobiographical memory and in story quality in general (i.e., Kleinknecht & Beike, 2004). As discussed earlier, ToM was expected to allow the storyteller to take the perspective of the listener. By taking the listener's perspective, and suppressing one's own perspective, a storyteller is able to provide the most relevant and appropriate information which the listener needs to follow and understand the story.

A good story, as perceived by the listener, will necessarily require that the speaker communicate effectively. Effective communication is dependent upon the speaker's ability to take the perspective of the listener (Miller, 2006; Byom & Turkstra, 2012). This is the essence of ToM. Take the example of the role of imagery in telling a story. The presence of imagery in a story is an indicator of a good story (Baron & Bluck, 2011), and is one of the six indices of story quality assessed in the PSQI. To summon an image to the mind of the listener using only words to tell a story, the speaker must fundamentally understand that it is possible to manipulate or exercise influence over the mind of the listener. The listener's mind can be affected by that which the listener perceives, and the speaker is required to reveal his or her own inner thoughts in order to affect the listener in this way.

Results of this study support the role of ToM, at least as measured by an emotion recognition task, in story quality with higher scores on the Reading the Mind in the Eyes task predicting better perceived story quality, but did not support the role of language or of IC (included because of its high level of interconnectedness with ToM, language, and social cognition in general). The present results are in concordance with the finding that individuals with autism have difficulty telling objectively high-quality stories, and that in these clinical populations, higher scores on the Reading the Mind in the Eyes task are associated with higher story quality (Colle & Baron-Cohen, 2008).

That emotion recognition, as measured by the Reading the Mind in the Eyes task, is associated with story quality in the present study may have been partially influenced by the procedure used for eliciting narratives from participants. Here, we used a social sharing paradigm in which participants told their stories to an

experimenter, face-to-face. Despite the fact that experimenters were instructed not to interject verbally or ask questions, no instructions were given to control for the facial expressions of the experimenter, as instructing experimenters to hold a steady, impassive expression may have created a potentially uncomfortable environment not conducive to participant storytelling (based on typical response to the still-face paradigm, Mesman, van IJzendoorn & Bakermans-Kranenburg, 2009). Not all participants told their stories to the same experimenter, but experimenters shared certain key characteristics, including a specific interest in autobiographical memory story sharing research. Experimenters are likely to have shown interest, and responded to participant stories as they were being shared using facial expressions. Those participants more skilled at reading facial expressions may have been more likely to add information when a quizzical look was observed, elaborated on a point when an interested expression was observed, and so forth. Different results may be found if stories are elicited without an experimenter present, either using a written narrative paradigm or solitary verbal narration in front of a video camera or tape recorder, for example.

That language as measured by the PPVT-4 was not associated with story quality in this study may, again, be the result of the type of language assessed by the PPVT-4. Knowledge of low-frequency vocabulary words may not be the best indicator of the type of language skill that might be needed to tell a good story. Grammatical skill, as well as pragmatic language and knowledge of story structure might be language indices more likely to show relationships with story quality. Further, it may be useful to consider that the stories told in this study were overwhelmingly rated as low to average in quality.

Clearly, no participant in the study was telling stories to rival the imagery, entertainment, emotion, or originality of Mark Twain. It is possible that personal investment in participation in the study was lacking, and even those participants capable of telling a high quality story through the use of advanced language skill did not choose to do so.

Study Aim 4

The fourth aim of the study was to show an indirect effect of language and IC on storytelling quality through ToM as measured by the Eyes task, using a mediation model (Figure 2-1). Results of the mediation analysis were not straightforward. The results suggest an indirect effect of IC on story quality through the Eyes task, but the effect size was very small (based on Cohen's conceptualization of effect sizes, more research in the area of adult ToM and storytelling is needed to truly understand the size of the effect found). Thus, it is possible that IC affects storytelling quality through its established role in ToM, but strong conclusions about the implications of this finding cannot be made. If this result is interpreted as reflecting a true effect, it may be explained by revisiting the role of IC in ToM and the role of ToM in storytelling. This constellation of factors tells an interesting story. Employing ToM, as we have seen, requires cognitive effort, apparently in the form of IC. IC may have an indirect effect on story quality because the storyteller must use executive cognitive resources to inhibit his or her own perspective, knowledge, and experience with the event told in the story in order to communicate effectively with the listener. That is, IC is needed to utilize the ToM necessary for good communication with a listener and ultimately good storytelling. This is especially interesting considering that ToM is operationalized using an emotion recognition task, not a more cognitive FB or representational change task, yet the effect was still present.

However, because this effect was small and only a partial one, more information is needed to make confident conclusions.

That language did not emerge as having an indirect effect on story quality through ToM (emotion recognition) can be understood in light of the findings discussed earlier. Language itself was correlated with AM story quality when examining simple correlations. However, that ToM does not explain this relationship can be expected, as we have seen that a good amount of evidence shows that language in adulthood is not a predictor of ToM use or understanding. Thus, language plays a small role in storytelling because stories are essentially made up of language, but IC is the primary cognitive factor (measured here) which underlies the use of ToM in adulthood.

Implications and Conclusion

The present study focused on individual differences in ToM in early adulthood and its relationships with language, IC, and storytelling ability. Results did not support a unitary ToM construct that spanned FB, representational change, and emotion recognition in the developmental and social psychology literatures. However, the present findings concerning the role of ToM, as measured using an emotion recognition task, in good communication may promote further explorations of the role of ToM in psycho-therapy or counseling, teaching, parent-child conversations, and parent-child storytelling. In addition, the role of IC in these domains may be considered to be of equal interest. Effective communication of ideas appears to be related not only to a person's ability to take the perspective of the listener, but also to the ability to inhibit an egocentric focus on his or her own knowledge or perspective.

The findings presented here also add to a growing literature that speaks to the issue of the continuity of development of ToM across the lifespan. Evidence from

infancy, through childhood and adolescence and extending into adulthood supports a gradually emerging ToM ability that does not seem to reach a state of “completion” or ultimate competence. The ability to use and apply ToM reasoning in social situations and in social reasoning continues to change and vary across individuals even after the typical child gains a new ability to reason about conflicting representations in the preschool years. The ability to reason about conflicting representations, to understand the representational nature of the mind, and specifically to pass traditional FB tasks is acquired fairly uniformly by typically developing individuals. However, applying that reasoning continues to be subject to change, individual differences, and development driven by brain maturation, continued social interaction, or possibly improvements in language, intelligence, and a host of other experiences not yet discovered. Results presented here support the importance of IC in the application of ToM to communication with others in adulthood. The ways and means by which adults become proficient at applying their uniquely human ToM skill is currently a fascinating and fruitful topic of research.

At the most basic level, the utilization of ToM for communication may be applied to Vygotsky’s (1986) socio-cultural theory, specifically when considering the role of the “more skillful” social partner in elevating the child to a new and more advanced level of cognitive functioning. While simply being in the presence of a more skilled peer or adult may play a role in the cognitive development of the child, active scaffolding may suitably be viewed as being impacted by the use of ToM skills. An adult attempting to scaffold or teach will necessarily have to take into consideration the mental state of the child. By definition, scaffolding requires consideration of the child’s current level of cognitive

functioning or knowledge, and creating a zone of proximal development within which the child is capable of achieving success in new knowledge and cognitive skill. That Vygotsky's theory is social in nature may suggest that the processes involved in development are founded in the human ability to understand and utilize the concepts of ToM.

In conclusion, the present research adds to a rapidly expanding field exploring ToM in adulthood. These explorations are elucidating the need to view ToM as more than just a skill that emerges in childhood, but as one that must be used and applied to everyday functioning. This use is effortful, is by no means applied perfectly, automatically, or at a ceiling level by children older than age 5 or even by adults, can come in many different forms, and can be impacted by a variety of other cognitive processes or skills (Samson & Apperly, 2010).

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BIOGRAPHICAL SKETCH

Mary Ellen McKay, called Molly, received a Bachelor of Science degree in psychology from the University of Florida in May 2000. Molly worked in a variety of applied psychological fields, including counseling inpatient child and adolescent psychiatric clients and helping young people in an early delinquency intervention program. Following these experiences, Molly returned to graduate school in 2002 to pursue an academic career in developmental psychology. During her tenure in the developmental psychology program at the University of Florida, Molly devoted her time to teaching, research, and gaining experience in applied educational and intervention settings. Molly received her Master of Science degree in 2009. Molly worked in the Florida Museum of Natural History's Center for Informal Science Education implementing a grant-funded science and literacy curriculum, and worked for Nemours Jacksonville in research and evaluation of an early literacy intervention program. This variety of educational and vocational experiences was invaluable to Molly's well rounded understanding of the field of developmental psychology. Molly received her Ph.D from the University of Florida in the summer of 2013.