2014-06-27

Theory of Mind Reasoning and its Relationship to Executive and Social Functioning in 10-Year-Olds

Cassetta, Briana

UNIVERSITY OF CALGARY

Theory of Mind Reasoning and its Relationship to Executive and Social Functioning in 10-Year-Olds

by

Briana Cassetta

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
DEGREE OF MASTER OF SCIENCE

GRADUATE PROGRAM IN CLINICAL PSYCHOLOGY

CALGARY, ALBERTA

JUNE, 2014

Abstract

Theory of mind (ToM) is the ability to make inferences about mental states, though little research has examined ToM development in middle childhood. Recent studies have distinguished inferencing about beliefs (cognitive ToM) and emotions (affective ToM). ToM has also been associated with executive and social functioning. The current study examined advanced cognitive and affective ToM in 10-year-olds (N = 56) using false-belief and irony tasks. In addition, working memory, inhibition, and set-shifting abilities were assessed, along with empathy and bullying/victimization. Results show that cognitive ToM is more advanced than affective ToM in this age group. While cognitive false-belief was positively associated with inhibition and set-shifting, irony comprehension was negatively associated with these executive functions. Finally, affective false-belief was associated with less instances of bullying. Taken together, cognitive and affective ToM may develop at different rates and be differentially related to functioning.

Acknowledgements

I would first like to thank my family and friends for their unwavering support and encouragement while I completed my MSc degree. I would also like to thank my supervisor, Dr. Vina M. Goghari, as well as Dr. Penny M. Pexman for helping to guide me through the entire process and providing regular help, suggestions, and support in conducting this research. I also thank all the honours students and research assistants who helped with running the study. Finally, I thank my cohort for reminding me to enjoy every moment along the way.

Table of Contents

List of Tables

List of Figures and Illustrations

CHAPTER 1: INTRODUCTION

Theory of Mind (ToM) refers to the ability of an individual to attribute mental states, such as beliefs, intentions, and emotions, to the self and to other individuals. The ability to understand the beliefs and intentions of others is critical for being able to predict and explain human behaviours, which are vital components of day-to-day social interactions (Brothers, 1990). While it is well established that humans have the innate potential to develop a ToM, it is less clear how ToM abilities mature across typical development, and how advancements in ToM reasoning are related to other aspects of functioning (e.g., neurocognitive and social functioning) during different developmental periods.

The vast majority of research to date has focused on the initial period of ToM development, with most studies looking at ToM reasoning in children under the age of five and comparatively little research investigating ToM abilities in older children (e.g., Miller, 2009; Samson & Apperly, 2010). In fact, out of 33 studies published in 2006-2007 that investigated ToM abilities in typically developing samples, only nine included children over the age of five (Miller, 2009). Given the widespread popularity of basic belief reasoning tasks, which are typically passed by young children, and the lack of empirical research on older children, it has commonly been assumed that ToM development ends some time around early school age.

To date, studies on young children indicate that basic ToM reasoning, and particularly the ability to reason about another individual's beliefs, tends to develop around the age of three or four (e.g., Wellman, Cross, & Watson, 2001). By this age, children are reliably able to reason about false beliefs – beliefs about the world that contradict reality – which is an important initial step in the understanding of mental states (Wellman et al., 2001). Notably, it has been shown that females typically show more advanced ToM reasoning than males in these younger age groups

(e.g., Calero, Salles, Semelman, & Sigman, 2013). However, there are reasons to believe that ToM abilities continue to develop into late childhood and beyond. First, brain regions that have been implicated in ToM reasoning, including medial prefrontal and temporal-parietal regions, continue to develop throughout middle childhood and even into early adulthood (e.g., Blakemore, den Ouden, Choudhury, & Frith, 2007; Giedd et al., 1999). Moreover, recent studies have suggested that ToM continues to develop throughout childhood and adolescence (e.g., Devine & Hughes, 2012; Dumontheil, Apperly, & Blakemore, 2010). More specifically, ToM abilities appear to become more multi-dimensional and more abstract throughout development (Steinberg, 2005). Finally, late childhood is associated with a variety of social changes, including a decline in parental attachment and an increase in peer influence (Nickerson & Nagle, 2005), the evolution of peer groups or "cliques," and an increase in contexts for peer interaction such as instant messaging and online networks (Gifford-Smith & Brownell, 2003), which may interact with a child's ability to implement his or her ToM skills. Together, these findings emphasize the need for further research on the development and utilization of ToM reasoning in older children.

Recent advancements in the methodology used to assess ToM skills have led to a growing interest in exploring ToM across the lifespan, with researchers beginning to use measures of reaction time and error rate with older populations, including healthy adolescents and adults, in order to differentiate between individuals with more or less sophisticated ToM abilities (Samson & Apperly, 2010). For example, in one study that required participants to use a director's perspective to follow directions and only move items that the director himself could see, it was found that ToM reasoning (as measured by perspective taking) continued to develop throughout late childhood and adolescence (Dumontheil et al., 2010). Similarly, another study

found that full understanding and incorporation of the intentions of others in social interactions continues to increase from middle childhood to late adolescence, as context understanding appears to show a linear development across this age range (Güroğlu, van den Bos, & Crone, 2009). Finally, one study identified ToM development across middle childhood, as 8- to 13-year-old children showed advancements with age in explaining a character's behaviours after viewing a silent film (Devine & Hughes, 2012). Thus, ToM development does not appear to end during early childhood, as was once widely believed.

Cognitive vs. Affective ToM

A more recent distinction in the ToM literature has focused on separating cognitive and affective components of ToM (e.g., Kalbe et al., 2010). In particular, cognitive ToM reasoning involves making inferences about beliefs and motivations, whereas affective ToM involves making inferences about emotions (Shamay-Tsoory & Aharon-Peretz, 2007). Evidence for this distinction comes from studies that suggest specific impairments in cognitive or affective ToM in various patient populations, including individuals with selective brain damage (Shamay-Tsoory, Tomer, Berger, Goldsher, & Aharon-Peretz, 2005) and schizophrenia patients (Shamay-Tsoory et al., 2007). Further evidence comes from studies that suggest that cognitive and affective domains of ToM may have different neural correlates (Shamay-Toory & Aharon-Peretz, 2007). Taken together, these results suggest that cognitive and affective ToM may have different developmental trajectories and may be associated with different types of social behaviours.

Very little research has studied the distinction between cognitive and affective ToM processing in healthy populations, with some research groups looking at healthy adults (Corradi-Dell'Acqua, Hofstetter, & Vuilleumier, 2013; Duval, Piolino, Bejanin, Eustache, & Desgranges, 2011; Hooker, Verosky, Germine, Knight, & D'Esposito, 2008; Kalbe et al., 2007; Sebastian et

al., 2012; Wang & Su, 2012) and two research groups looking at adolescents (Sebastian et al., 2012; Vetter, Altgassen, Phillips, Mahy, & Kliegel, 2013a). These studies have found different psychophysiological correlates of cognitive and affective ToM (Kalbe et al., 2007), variations in the neural correlates specific to cognitive vs. affective ToM reasoning (Sebastian et al., 2012), and a greater decline in cognitive ToM than affective ToM related to aging effects (Wang & Su, 2012). To date, very few research groups have directly compared the development of cognitive and affective ToM components in typically developing children in the same study. Results to date have suggested small, non-significant advancements in cognitive ToM over affective ToM in 9- and 10-year olds (Lonigro, Laghi, Baioco, & Baumgartner, 2014; Sutton, Smith, & Swettenham, 1999). However, there is additional indirect evidence that cognitive ToM development precedes affective ToM development, as children can typically pass second-order false-belief tasks (cognitive ToM) by the age of six or seven (Perner & Wimmer, 1985), while tasks that require second-order understanding of what a person feels, such as recognition of a social faux pas (affective ToM) typically develop later, between the ages of nine and eleven (Baron-Cohen, O'Riordan, Stone, Jones, & Plaisted, 1999). Given the evidence in support of differing developmental paths of cognitive and affective ToM, coupled with the possibility of these two domains of ToM having different relationships to social functioning, more research is needed on the healthy development of cognitive and affective ToM reasoning in children.

Assessment of ToM abilities

ToM is not a unitary process but rather involves a number of complex processes. One common distinction separates different orders of reasoning, with higher order levels of understanding generally developing with age. Several different paradigms have been used to assess ToM abilities in various populations, with one of the most frequently used tasks being the

false-belief task (Wellman et al., 2001). Recognizing a false-belief is one way of assessing different orders of ToM reasoning, as first-order false-belief requires attributing a character's false-belief about real world events, and second-order false-belief requires an understanding of what someone thinks about another person's thoughts. While children begin to pass first-order false-belief tests around the age of three or four, and second-order false-belief tests around the age of five or six, research has shown that there is considerable instability in the understanding of false-beliefs in 5-year-olds, particularly when asked to reason about personal volition as opposed to physical objects (Brune & Brune-Cohrs, 2006).

Other types of tasks require the interpretation of indirect or non-literal speech, including comprehension of irony or sarcasm, which requires the use of pragmatic information to understand the intended meaning (Monetta, Grindrod, & Pell, 2009). While basic irony comprehension tends to develop around the age of five or six, a greater understanding and appreciation of irony continues to develop through childhood and adolescence (Pexman, 2008).

ToM & Executive Functioning (EF)

Executive functions (EFs) are a heterogeneous set of skills that regulate and control both thought and action (Carlson, Moses, & Breton, 2002). Though the exact number of EF components remains debatable, three frequently postulated and distinct, yet overlapping, components are generally examined in the literature: working memory, response inhibition, and set-shifting (Miyake et al., 2000). This three-component model has also been utilized in research on middle childhood and has shown promising value (e.g., Huizinga, Dolan & van der Molen, 2006). However, recent research has shown that EF performance may qualitatively change across development, as 5-year-old children utilized semantic cues, while 10-year-old children and adults utilized perceptual cues to detect task switches (Chevalier, Huber, Wiebe, & Espy, 2013).

Advances in EF are believed to be strongly related to ToM development (Perner & Lang, 1999; Carlson & Moses, 2001). For example, EF and ToM begin to develop around the same age in children, with both skills improving markedly in children at preschool age (Carlson et al., 2002). Additionally, both EF and ToM seem to have common neural correlates, with both skills largely associated with activity in the prefrontal cortex (PFC) in adults (e.g., Sabbagh & Taylor, 2000; Welsh, Pennington, & Groisser, 1991). Finally, both EF and ToM skills are impaired in various clinical populations, including in individuals with autism and schizophrenia (Ozonoff & McEvoy, 1994; Pickup, 2008), which further suggests that these abilities are cognitively related.

Similar to research on ToM development, research on the link between ToM and EF has largely focused on young children, with many studies finding a correlation between ToM abilities and EFs in typically developing young children. For example, Carlson and Moses (2001) found that ToM performance – as measured on two false-belief tasks, a deceptive pointing task, and an appearance-reality task – in 3- and 4-year-old children was strongly related to inhibitory control, such as performance on the day/night task. Another research group found a significant relationship between false-belief reasoning and a measure of set-shifting (i.e., card sorting) in 3- to 5-year-old children (Cole & Mitchell, 2000). Several studies have also found a relationship between false-belief reasoning and working memory in children aged five and under (e.g., Davis & Pratt, 1995; Gordon & Olson, 1998; Hughes, 1998). Additionally, research has shown a strong relationship between false-belief reasoning and a dual combination of working memory and inhibitory control (e.g., Carlson et al., 2002; Hala, Hug, & Henderson, 2003).

Overall, the relationship between ToM and EF in young children appears to be strongest for working memory and inhibitory control aspects of EF, with mental flexibility (i.e., set-shifting) also showing a moderate association with ToM reasoning (Moses, Carlson, & Sabbagh,

2005). Importantly, several studies have found that the correlation between EFs and ToM remains significant even after controlling for the effects of verbal abilities, which suggests that the relationship between EFs and ToM is not simply mediated by their individual significant correlations with verbal ability (e.g., Carlson & Moses, 2001; Carlson et al., 2002; Hala et al., 2003; Hughes, 1998). However, a recent shift in the literature has focused on identifying explanations for the association between ToM and EFs that is seen in childhood. While the theory of *emergence* suggests that EFs are only necessary for initial development of ToM reasoning, the theory of *expression* suggests that EFs play a key role in ToM during actual task performance and, thus, are necessary for ToM maintenance throughout development. Both accounts have been supported by research with young children, with emergence accounts being supported by longitudinal studies that find early EF abilities predict later ToM reasoning (e.g., Carlson, Mandell, & Williams, 2004), and expression accounts being supported by studies that manipulate the EF demands within a ToM task (e.g., Carlson, Moses, & Hix, 1998).

In an attempt to further clarify this debate, recent studies have focused on the relationship between EFs and ToM in healthy adults. Some studies have found a similar association between EFs and ToM in adults that is typically seen in young children (e.g., Bull, Phillips, & Conway, 2007; Saltzman, Strauss, Hunter, & Archibald, 2000). However, other research groups have found results in adults that do not correspond with the developmental literature. For example, a recent study found no relationship between ToM and inhibitory control in young adults (Ahmed & Miller, 2011). These authors explained their results by suggesting that inhibition may be more critical for the development of ToM and less important in individuals with a developed ToM (Ahmed & Miller, 2011). Similarly, other researchers have suggested that EFs, or at least certain domains of EF, are more necessary for ToM development than ToM maintenance (Apperly,

Samson, & Humphreys, 2009). Moreover, one recent study found that, while ToM abilities do not develop considerably past early childhood, the interaction between ToM and EF continues to develop into adolescence and early adulthood (Dumontheil et al., 2010). Taken together, there is reason to believe that the association between ToM and EF is not constant across the lifespan, but rather is a dynamic relationship that changes with development. However, more research is needed to provide further support for this hypothesis.

Recent research has also postulated that there may be a different relationship between cognitive ToM and EFs than there is between affective ToM and EFs. For example, in one study looking at these abilities in adults, cognitive ToM reasoning was significantly associated with EFs (i.e., shifting, updating, and inhibition), but affective ToM reasoning was only moderately correlated with EFs (Duval et al., 2011). Similarly, in another study, inhibitory control was correlated with cognitive ToM but not affective ToM in adults (Wang & Su, 2012). To date, there is limited research comparing cognitive and affective ToM components separately with EFs in children.

ToM & Social Functioning

ToM has been associated with a variety of prosocial human behaviours, including consoling others and the ability to cooperate within a group (Miller, 2009). For example, the perspective-taking abilities of young children have been found to be associated with their ratings of showing concern to others and engaging in helpful behaviours and, consequently, the child's overall popularity within their peer group (Deković & Gerris, 1994). Specifically, ToM has been related to empathy, or the ability to infer and share in the emotional experiences of other individuals (Vollm et al., 2006). Empathy is also theorized to be a multi-dimensional and integrative construct, with some researchers distinguishing between cognitive and affective

aspects of empathy (e.g., Shamay-Tsoory, Tomer, Goldsher, Berger, & Aharon-Peretz, 2004). While cognitive empathy involves a cognitive understanding of another individual's emotional perspective, affective empathy also includes the sharing of those emotions (Shamay-Tsoory et al., 2004). Recent research has shown that adults who utilize affective information to infer the emotional experiences of others (i.e., affective ToM) tend to experience greater levels of empathy towards other individuals (Hooker et al., 2008). Similarly, another research group identified a significant relationship between empathy and affective ToM, but not empathy and cognitive ToM in adults (Shamay-Tsoory & Aharon-Peretz, 2007).

To date, very little research has compared the relationship between ToM and empathy across different developmental periods. Importantly, empathy has been shown to continue developing past childhood (e.g., Dadds et al., 2008). Moreover, age-related changes in the neuronal correlates of empathy have been identified from childhood to early adulthood (Greimel et al., 2010). Thus, the association between ToM and empathy in childhood requires further elaboration, given the current evidence of both empathy and ToM development across development, coupled with the likely relationship between empathy and ToM. This information would lead to a better understanding of the mechanisms and development of prosocial behaviour in children, which may lead to interventions targeting deficits in prosocial behaviour.

Recent research has also begun to look at the relationship between ToM and bullying. Although limited, current studies suggest that individuals who are victims of bullying tend to show relative deficits in ToM skills (Gini, 2006; Sutton et al., 1999). In contrast, research on ToM skills in individuals who do the bullying has been mixed. For example, some studies have found that bullies have relatively superior ToM abilities (Gini, 2006; Sutton et al., 1999), whereas others have found relatively inferior ToM skills in this group (Monks, Smith, &

Swettenham, 2005). Importantly, a recent longitudinal study of children aged 5 to 12 years found that poor ToM skills predicted later involvement in bullying, including participating in bullying, becoming a victim, and a combination of both bullying and victimization (Shakoor et al., 2012). Given the identified negative implications of bullying on both social functioning and mental health (e.g., Arsenault, Bowes, & Shakoor, 2010; Smith, Polenik, Nakasita, & Jones, 2012), the relationship between ToM and bullying/victimization in middle childhood requires further examination.

Current Objectives & Hypotheses

Given the lack of research on ToM development in middle childhood, the current study aimed to examine ToM reasoning, including any gender differences, in 10-year-olds. More specifically, the distinction between cognitive and affective ToM was explored in 10-year-olds. It was hypothesized that 10-year-old children would be more accurate in their comprehension of cognitive second-order false-belief and irony comprehension than in the respective affective domains and that females would show more advanced ToM reasoning than males.

The second aim of the current study was to identify the relationship between ToM abilities and specific domains of EF. It was hypothesized that all three domains of EF would be positively associated with ToM abilities in 10-year-olds. However, given the lack of previous studies on the relationship between ToM and EF in older children, coupled with recent findings that this relationship may vary across development, no hypothesis was made about which domain(s) of EF would be most significantly associated with ToM in this age group, so this was exploratory in nature. Finally, it was hypothesized that EF would be more strongly related to cognitive ToM reasoning than affective ToM reasoning.

The third aim of the current study was to identify the relationship between ToM and

social functioning (i.e., empathy and bullying) in 10-year-old children. It was hypothesized that both empathy and bullying/victimization would be significantly related to affective ToM reasoning. In particular, it was hypothesized that more developed second-order false-belief reasoning and irony comprehension abilities in the affective domain would be associated with greater empathy. However, the expected direction of the relationship between affective ToM reasoning and bullying/victimization is less clear and was, thus, exploratory in nature.

CHAPTER 2: METHODS

Participants

Fifty-six 10-year-olds (33 females, 23 males) were recruited through the Ch.I.L.D. participant database at the University of Calgary, where families are recruited for participation at health clinics, baby fairs, and family events in the city of Calgary. Criteria for inclusion included: 1) no history of psychiatric or neurodevelopmental disorder (as confirmed by parent report), 2) English as a first language, 3) IQ above 70, and 4) no language or pragmatic impairments. The vast majority of participants were born in Canada (94.6%) and were predominantly born to Caucasian mothers (89.3%) and fathers (83.9%). The average annual family income was $128,760 (*SD* = $68,788), and mothers had an average of 15.46 years of education (*SD* = 1.85 years), while fathers had an average of 15.29 years of education (*SD* = 2.11).

Intelligence and Language Measures

The Vocabulary subtest of the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV; Wechsler, 2003) was used to estimate the IQ of all participants. Vocabulary has been shown to have the highest correlation with the Full Scale IQ of the WISC-IV, with a correlation coefficient of $r = 0.79$ (Sattler, 2008). The Children's Communication Checklist - 2 (CCC-2; Bishop, 2006) was used to screen for children with language and pragmatic impairments. The

CCC-2 is a 70-item parent-report questionnaire that assesses speech, syntax, semantics, coherence, initiation, scripted language, context, nonverbal communication, social relations, and interests for children aged 4 to 17. Responses are given on a 4-point Likert scale. No exclusions had to be made for an IQ below 70 (falling below the 2nd percentile) or for language impairments (falling below the 2nd percentile on the general communication composite).

Cognitive and Affective ToM Measures

Second-order false-belief task. This task was adapted from Shamay-Tsoory & Aharon-Peretz (2007) in order to be more engaging and appropriate for children (see Appendix A). Each story was shown in a PowerPoint presentation with an accompanying illustration and pre-recorded narration so that the children were able to read along with the narrator. This task was comprised of six stories, with three stories assessing cognitive second-order false-belief reasoning and three stories assessing affective second-order false-belief reasoning. Both types of stories involved an interaction between two people, with cognitive stories requiring an interpretation of beliefs about actions, and affective stories requiring an interpretation of beliefs about feelings. At the end of all stories, one character had a belief about another character that was divergent from reality. The stories ranged in length from 71 to 89 words, with a mean length of 83 words. Following each story, one question was posed that required an understanding of what one character was thinking that another character thought about what he or she is doing (cognitive ToM), or an understanding of what one character was thinking that another character thought about his or her feelings (affective ToM). A second question was posed following each story to assess basic story comprehension, and acted as a manipulation check (i.e., control). Children were given two possible response options to each question, and were awarded 1 point for a correct answer and 0 points for an incorrect answer. Thus, each participant was given a

cognitive false-belief score out of 3, an affective false-belief score out of 3, a cognitive control score out of 3, and an affective control score out of 3.

Irony comprehension task. This task was adapted from Whalen & Pexman (2010) in order to incorporate both cognitive and affective irony components (see Appendix B). Each child was presented with nine brief illustrated stories that were shown on a computer screen. The stories involved the following topics: making a sandcastle, flying a kite, playing with a puppy, going to the zoo, going camping, playing hockey, going to the movies, making a pizza, and riding on the bumper cars at the fair. The stories had a mean length of 59 words, and ranged in length from 50 to 64 words. Each short story consisted of three illustrated pictures that were shown in a PowerPoint presentation and accompanied by pre-recorded narration. Stories from both experiments of the original study, including ironic compliments and ironic criticisms as well as their literal counterparts, were used in order to obtain a wide range of responses. For vignettes utilizing ironic or literal compliments, the story outcomes were positive, and those vignettes incorporating ironic or literal criticisms had negative story outcomes.

At the end of each story, one of the characters made either an ironic or a literal comment about the story outcome, using appropriate intonational cues. For stories in the compliments conditions, the ironic and literal remarks were all complimentary of the event outcome, and the ironic statements were all counterfactual in form. For stories in the criticisms conditions, the ironic and literal remarks were all critical of the event outcomes, and the ironic statements were all counterfactual in form. In addition, the tone of voice for all ironic remarks was mocking and insincere, and the tone for literal statements was blunt and factual. Each participant watched the nine stories in a pre-determined random order, with each child viewing three stories that ended in an ironic criticism, three ending in an ironic compliment, two ending in a literal criticism, and

one story ending in a literal compliment. The story endings were not counter-balanced, but instead were the same for each participant, as all nine stories had been validated in the previous study and had been more or less equated in difficulty (Whalen & Pexman, 2010). The specific stories in each condition were chosen randomly.

Following the presentation of each story, each child was asked two comprehension questions to assess their understanding of the second-order belief intent (cognitive ToM) and second-order emotion intent (affective ToM) of the character in each story. Thus, the first question assessed second-order cognitive ToM reasoning by evaluating comprehension of what the speaker intends the listener to think about what he or she believes. The second question assessed second-order affective ToM reasoning by evaluating comprehension of what the speaker intends the listener to think about how he or she is really feeling.

For both ironic and literal compliments, the correct interpretation of both second-order belief and affective intent was a positive evaluation. For both ironic and literal criticisms, the correct interpretation of both second-order belief and affective intent was a negative evaluation. With a total of six irony stories, each cognitive and affective irony comprehension score was out of 6 possible points each. Similarly, each participant received a score for literal remark accuracy (i.e., understanding of speaker belief and affective intent in literal statements, with a maximum score of 2 for each story). With a total of three stories ending in literal statements, the literal comprehension score was out of 6 possible points total (3 each for cognitive and affective literal comprehension). All responses were scored through group consensus, requiring the agreement of four researchers who worked on the study. For each question, participants were given 1 point for demonstrating full comprehension of the ironic or literal intent, 0.5 points for partial comprehension (e.g., having the correct valence, but using a cognitive or affective word

incorrectly), and 0 points for demonstrating no comprehension of the statement.

EF Measures

Working memory. The Digit Span subtest of the Wechsler Intelligence Scale for Children - IV (WISC-IV; Wechsler, 2003) was used to assess working memory abilities. In this task, the child was first required to repeat verbally-presented digits in the same order that they were presented (digits forward), and then in reverse order (digits backwards).

Inhibitory control. The Color-Word Interference Test (CWIT) from the Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001) was used as a measure of inhibitory control. The third condition of this test was administered, as it measures response inhibition and requires participants to name the colour of the ink in which the words are printed while inhibiting the more salient response of reading the word.

Set-shifting. The 64-card computer version of the Wisconsin Card Sorting Task (WCST; Heaton, Chelune, Talley, Kay, & Curtiss, 1993) was used to measure set-shifting abilities. In this task, participants were asked to sort a deck of cards according to various stimuli dimensions (colour, number, and form) with the sorting principle changing without warning over time.

Social Functioning Measures

Empathy questionnaires. Bryant's 22-item Index of Empathy for Children and Adolescents (Bryant, 1982), one of the most widely used self-report measures of empathy for children, was administered to all participants. Children were asked to either agree or disagree with a series of statements tapping attributes including emotional expressivity and attitudes, sympathy, and empathy.

The Empathy Quotient - Child (EQ-C; Auyeung et al., 2009) was completed by the parent of each participant. The questionnaire consists of 27 items that assess both the child's

thought and behavioural characteristics related to aspects of empathy. The parent indicated how much the statement described their child by responding on a 4-point Likert scale.

Bullying questionnaire. A shortened version of the Revised Olweus Bully/Victim Questionnaire (Solberg & Olweus, 2003) was used to assess bully/victim problems, including exposure to and participation in physical, verbal, racial, or indirect forms of bullying and harassment. This measure consisted of 16 self-report questions from the original questionnaire that were rated on a 5-point Likert scale.

Procedure

A parent provided written informed consent and children provided written informed assent prior to the child's participation in the study. Tasks were administered by trained research assistants and were delivered in a pre-determined, semi-randomized order. The two ToM tasks were always administered first, with the order randomized for each child. Next, the three EF tasks were administered in a randomized order. Finally, Bryant's Index of Empathy, the Bullying Questionnaire, and the Vocabulary subtest of the WISC-IV were consistently administered last, in that order. All participants received a small prize for their time and participation.

Statistical Analysis

Data quality. Participants who received less than 50% (i.e., a score below 3) on the false-belief control questions had their data from this task excluded from statistical analysis (n = 5, 3 females and 2 males). Additionally, outliers were detected using a decision criterion of .05, sample size estimate of 50, and a Bonferroni correction, which suggests considering data points with an absolute z-value greater than 3.29 as being outliers (Cousineau & Chartier, 2010). One negative outlier was found on the inhibition score of the CWIT (z = -4.26), two positive outliers were found on the bullying questionnaire (z = 3.49), and one positive outlier on the victimization

questionnaire (z = 4.34), and these points were all removed from statistical analysis. Notably, analyses with and without the outliers removed showed similar results.

The skewness and kurtosis of all measures were also examined, using accepted criteria for medium-sized samples, which suggests that the sample is non-normal if the absolute z-score for either skewness or kurtosis exceeds 3.29 (corresponding to an alpha-level of .05) (Kim, 2013). Following removal of the outliers reported above, scores on literal stories from the irony comprehension task (skewness = -1.37, *SE* = .33; kurtosis = .53, *SE* = .64), as well as control questions from the false-belief task (skewness = -1.37, *SD* = .32; skewness = .29, *SE* = .63) were significantly negatively skewed, indicating more large values, as expected. In addition, ratings on the Olweus questionnaire indicated significant positive skewness and kurtosis for both bullying scores (skewness = 1.87, *SE* = .32; kurtosis = 3.47, *SE* = .63) and victimization scores (skewness = 1.46, *SE* = .33; kurtosis = 2.44, *SE* = .64), indicating more small values and a more acute peak. No other measures showed indications of non-normal distributions.

Cognitive vs. affective ToM. To examine the validity and consistency of the ToM tasks, a series of correlation analyses were conducted between the respective cognitive and affective ToM conditions in the two ToM tasks (i.e., false-belief and irony comprehension scores). Next, for the false-belief task, a 2 condition (cognitive ToM, affective ToM) repeated measures analysis of variance (ANOVA) with gender as a between-subjects factor was conducted. Similarly, for the irony task, a 3 condition (cognitive ToM, affective ToM, literal) repeated measures ANOVA was conducted with gender as a between-subjects factor. To look more specifically at the effect of story type in the irony task, a 2 condition (cognitive ToM, affective ToM) by 2 story type (criticisms, compliments) repeated measures ANOVA was also conducted. Follow-up tests were completed as necessary. Bonferroni-corrected alpha levels were used to

maintain a family-wise error rate of .05 for all follow-up tests, and Greenhouse-Geisser corrections were reported for all repeated measures ANOVAs, where appropriate.

ToM and verbal IQ, language. Given that socioeconomic status (SES) has been associated with neurocognitive functioning (e.g., Hackman & Farah, 2009), Pearson's 2-tailed partial correlations, controlling for SES (measured by estimated annual family income), were computed to identify the relationship between verbal IQ and language abilities, and both cognitive and affective ToM.

ToM and EF. Pearson's 2-tailed partial correlations, controlling for verbal IQ and SES, were computed to identify the relationship between the three EF measures and cognitive and affective ToM.

ToM and social functioning. Pearson's 2-tailed partial correlations, controlling for IQ and SES, were computed to identify the relationship between empathy and each of cognitive and affective ToM, and between bullying/victimization and each of cognitive and affective ToM.

CHAPTER 3: RESULTS

Cognitive vs. Affective ToM

Descriptive statistics can be seen in Table 3.1.

Table 3.1: Descriptive Statistics for All Tasks and Measures

	N	Mean (S.D.)	Minimum	Maximum
Cognitive Irony - Criticisms (out of 3)	54	1.75 (1.11)	0	3
Cognitive Irony - Compliments (out of 3)	54	1.32 (1.27)	0	3
Affective Irony - Criticisms (out of 3)	54	1.86 (1.03)	0	3
Affective Irony - Compliments (out of 3)	54	.89 (.86)	0	3
Cognitive Literal Questions on Irony Task (out of 3)	54	2.69 (.49)	1.5	3
Affective Literal Questions on Irony Task (out of 3)	54	2.55 (.46)	1.5	3
Cognitive False-Belief (out of 3)	51	2.49 (.78)	0	3
Affective False-Belief (out of 3)	51	2.25 (.85)	0	3
Cognitive Control Questions on False-Belief Task (out of 3)	51	2.84 (.37)	2	3
Affective Control Questions on False-Belief Task (out of 3)	51	2.63 (.69)	1	3
Digit Span Scaled Score (Working Memory)	56	9.32 (2.64)	4	17
CWIT Inhibition Scaled Score (Response Inhibition)	55	11.16 (1.83)	7	14
WCST Total Errors T-Score (Set-Shifting)	56	56.55 (10.21)	33	78
Bryant's Index of Empathy (max = 22)	56	15.18 (2.91)	10	21
Empathy Quotient - Child (max = 54)	56	39.20 (9.07)	16	52
Bullying Others (max = 40)	54	8.64 (1.11)	8	13
Victimization (max = 40)	55	11.57 (3.90)	8	26
Vocabulary Scaled Score	56	12.68 (2.31)	6	18
CCC-2 General Communication Composite Score	56	104.57 (12.69)	67	124

Note. CWIT = Color-Word Interference Test; WCST = Wisconsin Card Sorting Task; CCC-2 = Children's Communication Checklist - 2.

Scores from the cognitive ToM questions (r = -.05, p = .73) and affective ToM questions (r = -.23, p = .12) were not significantly correlated between the irony and false belief tasks (see Table 3.2). Given the lack of correlation between the two ToM tasks, the scores were not collapsed across tasks to create a global cognitive ToM and affective ToM score. Rather, all analyses were conducted on each ToM task separately.

On the false-belief task, a 2 condition (cognitive ToM, affective ToM) by 2 gender (males, females) repeated measures ANOVA demonstrated a main effect of type of judgment

($F(1, 49) = 8.45$, $p = .005$), with cognitive scores ($M = 2.50$, $SD = .78$) being significantly higher than affective ToM scores ($M = 2.22$, $SD = .85$). No significant main effect of gender was found ($F(1, 49) = .49$, $p = .49$). However, there was a significant gender by type of judgment interaction ($F(1, 49) = 4.81$, $p = .03$) (see Figure 3.1A).

To follow up on the significant interaction, the effect of type of judgment was examined for each gender separately. For males, cognitive false-belief scores ($M = 2.52$, $SD = .81$) were significantly higher than affective false-belief scores ($M = 2.05$, $SD = .87$) ($F(1, 20) = 13.16$, $p = .002$). However, there was no significant difference between cognitive ($M = 2.47$, $SD = .78$) and affective ($M = 2.40$, $SD = .81$) scores for females ($F(1, 29) = .28$, $p = .60$). Notably, no significant differences were found between males and females on either cognitive false-belief ($F(1, 49) = .06$, $p = .80$) or affective false-belief ($F(1, 49) = 2.20$, $p = .14$).

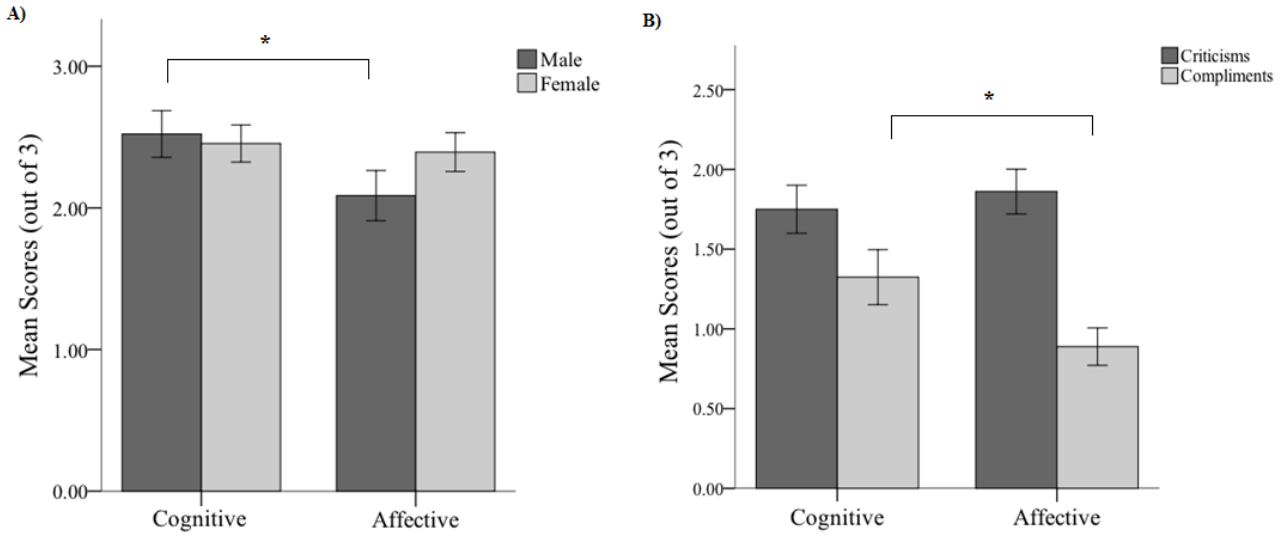
To examine the irony task, a 3 condition (cognitive ToM, affective ToM, literal) by 2 gender (males, females) repeated measures ANOVA demonstrated a main effect of type of judgment ($F(1.39, 72.24) = 59.61$, $p < .001$), with literal scores being significantly higher than both cognitive ($p < .001$) and affective ($p < .001$) ToM scores, and cognitive ToM scores being significantly higher than affective ToM scores ($p = .04$). No significant main effect of gender was found ($F(1, 52) = .002$, $p = .97$) and there was no significant gender by type of judgment interaction ($F(1.39, 72.24) = 1.23$, $p = .29$).

More specifically, a 2 condition (cognitive ToM, affective ToM) by 2 story type (criticisms, compliments) repeated measures ANOVA examining the irony task across all participants showed a main effect of type of judgment ($F(1, 53) = 4.23$, $p = .04$), with cognitive scores ($M = 1.54$, $SE = .14$) being significantly higher than affective scores ($M = 1.38$, $SE = .11$). A significant main effect of story type was also found ($F(1, 53) = 29.11$, $p < .001$), with ironic

criticism scores (M = 1.81, SE = .14) being significantly higher than ironic compliment scores (M = 1.11, SE = .14). Importantly, a significant type of judgment by story type interaction was found ($F(1, 53) = 4.03$, $p < .001$) (see Figure 3.1B). Follow-up repeated measures ANOVAs examining this interaction found no significant effect of type of judgment for ironic criticism stories ($F(1, 53) = 1.08$, $p = .30$). However, a significant main effect of type of judgment was found for ironic compliment stories ($F(1, 53) = 17.47$, $p < .001$), with cognitive scores (M = 1.32, SD = .17) being significantly higher than affective scores (M = .89, SD = .12) on ironic compliment stories. However, given the strong correlations between the ironic criticism and ironic compliment stories on both cognitive questions ($r = .52$, $p < .001$) and affective questions ($r = .47$, $p < .001$), the scores were collapsed across story type for all correlation analyses below.

In summary, scores on the irony and second-order false-belief tasks were not significantly correlated and, thus, were examined separately. On the second-order false-belief task, males scored significantly higher on cognitive than affective questions, but females did not have a significant difference in scores based on condition. On the irony task, no gender effects were found, though a significant interaction between story type (i.e., compliments, criticisms) and condition (i.e., cognitive, affective) was found. Notably, cognitive irony scores were significantly higher than affective irony scores, as predicted.

Figure 3.1: Cognitive vs. Affective ToM Scores



Mean number of correct responses for cognitive ToM and affective ToM questions. Part (A) shows mean scores for two types of judgment (cognitive, affective) and two genders (male, female) on the false-belief task. Part (B) shows mean scores for two types of judgment (cognitive, affective) and two story types (criticisms, compliments) on the irony task. Error bars represent ± 1 standard error. Asterisks denote statistically significant differences (* $p < .05$).

ToM and Verbal IQ, Language

All partial and bivariate correlations can be seen in Table 3.2. Notably, partial and bivariate correlations showed similar results. Partial correlations showed that both cognitive (r = .38, p = .02) and affective (r = .31, p = .04) scores on the false-belief task had significant positive relationships with verbal IQ, as measured by the Vocabulary subtest of the WISC-IV. Both cognitive (r = .23, p = .14) and affective (r = .19, p = .22) scores on the false-belief task had non-significant associations with general communication abilities. In contrast, neither cognitive scores on the irony task (r = -.09, p = .57) nor affective scores on the irony task (r = -.07, p = .64) were associated with verbal IQ. Similarly, neither cognitive (r = -.05, p = .75) nor affective (r = -.05, p = .76) scores on the irony task were associated with general communication.

In summary, both cognitive and affective second-order false-belief were significantly

positively related to verbal IQ and had positive, non-significant relationships with general communication abilities, though not at a Bonferroni-corrected alpha-level of .01. Neither cognitive nor affective irony comprehension was associated with verbal IQ or general communication abilities.

ToM and EF

Partial and bivariate correlations can be seen in Table 3.2. Notably, partial and bivariate correlations showed similar results. Pearson's 2-tailed partial correlations indicated a significant negative relationship between response inhibition scores on the CWIT and both cognitive ToM scores on the irony task (r = -.33, p = .04) and affective ToM scores on the irony task (r = -.40, p = .01). Similarly, there was a significant negative partial correlation between set-shifting abilities (i.e., correct responses on the WCST) and both cognitive ToM scores (r = -.43, p = .003) and affective ToM scores (r = -.37, p = .01) on the irony task. In contrast, no relationship was found between working memory abilities (i.e., digit span scores) and either cognitive ToM scores (r = -.05, p = .75) or affective ToM scores (r = .07, p = .65) on the irony task.

Pearson's 2-tailed partial correlations indicated positive, non-significant relationships between response inhibition and cognitive scores on the false-belief task (r = .10, p = .50), and between set-shifting abilities and cognitive scores on the false-belief task (r = .22, p = .15). A non-significant negative relationship was found between working memory scores and cognitive ToM scores on the false-belief task (r = -.19, p = .19). In contrast, no relationship was found between affective ToM scores on the false-belief task and any of response inhibition (r = .05, p = .74), set-shifting (r = .01, p = .95), or working memory (r = .03, p = .86).

In summary, both cognitive and affective irony comprehension were negatively associated with response inhibition and set-shifting abilities, but not associated with working

memory. Notably, the negative relationship between cognitive irony comprehension and set-shifting abilities maintains significance at a Bonferroni-corrected alpha-level of .008. Positive correlations were found between cognitive second-order false-belief reasoning and both response inhibition and set-shifting, while a negative correlation was found between cognitive false-belief reasoning and working memory, though none met significance. No associations were found between affective second-order false-belief reasoning and any EFs.

Table 3.2: Correlations Between Cognitive and Affective ToM and Cognition Measures

	1	2	3	4	5	6	7	8	9
1. Cognitive Irony	−	.83***	.03	-.11	-.09	-.05	-.05	-.33*	-.43**
2. Affective Irony	.83***	−	-.19	-.27	-.07	-.05	.07	-.40**	-.37*
3. Cognitive False-Belief	-.05	-.21	−	.70***	.38*	.23	-.19	.10	.22
4. Affective False-Belief	-.16	-.23	.66***	−	.31*	.19	.03	.05	.01
5. Verbal IQ	-.05	-.06	.28*	.27*	−	-.04	.35*	.19	-.01
6. General Communication	-.05	-.12	.25	.06	.15	−	.18	.08	.21
7. Working Memory	-.08	.08	-.04	.18	.31*	.08	−	.13	.05
8. Response Inhibition	-.30*	-.28*	.24	.17	.11	.01	.28*	−	.33*
9. Set-Shifting	-.34*	-.33*	.12	-.07	.02	.21	-.001	.08	−

Note. Partial correlations controlling for verbal IQ (for EF measures only) and SES are presented in the upper right portion of the table. Bivariate correlations are presented in the lower left portion of the table. Asterisks denote statistically significant correlations (* $p < .05$, ** $p < .01$, *** $p < .001$), with a Bonferroni-corrected alpha-level reported at .008.

ToM and Social Functioning

Partial and bivariate correlations can be seen in Table 3.3. Notably, partial and bivariate correlations showed similar results. Pearson's 2-tailed partial correlations, controlling for verbal IQ and SES, did not show a significant relationship between cognitive scores on the irony task and any of self-reported empathy on Bryant's Index of Empathy ($r = .02$, $p = .88$), parent-reported empathy on the Empathy Quotient ($r = -.05$, $p = .73$), victimization ($r = -.02$, $p = .91$),

or bullying (r = -.17, p = .30). Similarly, there was no significant relationship between affective scores on the irony task and any of Bryant's Index of Empathy (r = .11, p = .52), the Empathy Quotient (r = -.05, p = .73), victimization (r = .04, p = .83), or bullying (r = -.01, p = .98).

Pearson's 2-tailed partial correlations, controlling for verbal IQ and SES, did not indicate a significant relationship between cognitive scores on the false-belief task and any of self-reported empathy on Bryant's Index of Empathy (r = -.02, p = .89), parent-reported empathy on the Empathy Quotient (r = .16, p = .32), victimization (r = -.11, p = .53), or bullying (r = -.18, p = .28). Similarly, there was no significant relationship between affective ToM scores on the false-belief task and any of Bryant's Index of Empathy (r = .04, p = .81), the Empathy Quotient (r = .16, p = .31), or victimization (r = .10, p = .56). However, there was a significant correlation between affective ToM scores on the false-belief task and bullying (r = -.35, p = .02).

In summary, no significant relationships were found between either second-order false-belief reasoning or irony comprehension and any of the social functioning measures at a Bonferroni-corrected alpha-level of .006. Notably, affective second-order false-belief reasoning had a significant negative relationship with bullying prior to applying a Bonferroni correction.

Table 3.3: Correlations Between Cognitive and Affective ToM and Social Functioning Measures

	1	2	3	4	5	6	7	8
1. Cognitive Irony	−	−	−	−	.02	-.05	-.17	-.02
2. Affective Irony	−	−	−	−	.11	-.05	-.01	.04
3. Cognitive False-Belief	−	−	−	−	-.02	.16	-.18	-.11
4. Affective False-Belief	−	−	−	−	.04	.16	-.35*	.10
5. Bryant's Index of Empathy	.06	.09	.10	.11	−	.37*	-.14	.14
6. Empathy Quotient - Child	-.01	-.09	.16	.04	.37**	−	-.30	-.08
7. Bullying others	-.10	.05	-.20	-.27	-.20	-.21	−	.24
8. Victimization	-.01	.09	.00	.12	-.03	-.14	.31*	−

Note. Partial correlations controlling for verbal IQ and SES are presented in the upper right portion of the table. Bivariate correlations are presented in the lower left portion of the table. Asterisks denote statistically significant correlations (* $p < .05$, ** $p < .01$), with a Bonferroni-corrected alpha-level reported at .006.

CHAPTER 4: DISCUSSION

ToM research to date has largely focused on younger children, though a recent interest in examining ToM across the lifespan has led to findings that suggest ToM continues to mature across childhood, adolescence, and into early adulthood (e.g., Devine & Hughes, 2012; Dumontheil et al., 2010). This preliminary evidence, coupled with the fact that middle childhood is associated with unique social changes that may interact with a child's development of his or her ToM skills, points to the need for greater examination of ToM abilities in older age groups, including how these abilities are related to other important aspects of functioning.

ToM Tasks

In this study, ToM abilities were examined in middle childhood – a developmental period that has largely been neglected in the ToM literature. Notably, no relationship was found between scores on the irony comprehension and second-order false-belief tasks – two tasks that are commonly used to measure ToM reasoning. Currently, there is a wide range of tasks being utilized to assess ToM, including false-belief tasks, appearance-reality tasks, character intention inference tasks, and tasks that require comprehension of pragmatic language (e.g., sarcasm, irony), among others. Moreover, numerous versions of each of these tasks have been developed for use by independent research groups, which leaves room for substantial study-to-study variations in language or verbal demands, demands on EFs (e.g., certain tasks might require more or less inhibitory control), or even the number of contextual cues provided to aid interpretation of the speaker's feelings or beliefs. In this case, the two tasks likely yielded different performances due to conceptual differences (i.e., inherent differences in comprehension

of false-beliefs vs. ironic remarks), as well as task demands and features (e.g., multiple-choice judgments vs. open-ended responses). The lack of association between these two measures speaks to the need for a standardized assessment battery for measuring social cognition.

Moreover, there is a need for standardized ToM measures that can be appropriately used with different developmental groups. Given that research on ToM reasoning in middle childhood is scarce, the current study required an examination of two novel tasks that were both adapted from previous research to be developmentally appropriate for the current age group. The second-order false-belief task resulted in adequate performance variability amongst 10-year-olds, as well as expected positive correlations with EF measures, which provides support for the validity of the adapted measure. Similarly, the irony task appeared to be a sound measure of irony comprehension in 10-year-olds, as scores on literal items were consistently very high, and scores on questions requiring comprehension of ironic criticisms were consistently higher than ironic compliments, which has been commonly reported in the literature (e.g., Hancock, Dunham, & Purdy, 2000; Pexman & Glenwright, 2007). Thus, these two new measures appear appropriate for measuring false-belief reasoning and irony comprehension in 10-year-olds.

As hypothesized, cognitive ToM abilities appeared to be more advanced than affective ToM abilities in 10-year-olds. This pattern was seen on both the false-belief task, though only for males, and the irony comprehension task. Moreover, affective irony comprehension was significantly more difficult for ironic compliments than ironic criticisms, suggesting that emotional perspective-taking is especially challenging for ironic compliments, and may be due to the fact that ironic compliments are less common in everyday speech (Pexman & Olineck, 2002).

Similar results were found in a study that directly compared cognitive and affective ToM abilities in middle childhood using stories that required comprehension of either a character's

beliefs, intentions, and thoughts, or a character's true feelings (Sutton et al., 1999). Using this task, 7- to 10-year-olds had higher scores on cognitive than affective story comprehension. In addition, a more recent study utilizing a similar measure found advancements in cognitive ToM reasoning over affective ToM reasoning in 9- and 10-year-olds (Lonigro et al., 2014). These findings are consistent with the literature on younger children, which typically find that tasks requiring interpretation of a person's beliefs or intentions, including most traditional false-belief tasks (e.g., Perner & Wimmer, 1985; Sullivan, Zaitchik, & Tager-Flusberg, 1994) are passed at a younger age than tasks requiring interpretation of a person's feelings, such as a social faux pas comprehension task (e.g., Baron-Cohen et al., 1999). However, the current study is one of the first to directly compare cognitive and affective ToM reasoning in children within the same tasks and, thus, provides stronger support for the increased difficulty associated with affective ToM comprehension in middle childhood.

ToM and EF in 10-year-olds

As predicted, cognitive second-order false-belief was positively associated with response inhibition and set-shifting abilities, though these correlations did not reach significance. This is similar to previous research on younger children, which has found that conflict inhibitory control tasks (i.e., when a dominant response needs to be suppressed while a sub-dominant response is activated) significantly predict performance on false-belief measures in preschool children (Carlson et al., 2002). Similarly, a card-sorting task, as a measure of set-shifting abilities, was significantly correlated with false-belief reasoning in 3- to 5-year-old children (Cole & Mitchell, 2000). In the few studies that have been conducted on the relationship between ToM and EF during middle childhood or adolescence, a similar positive correlation between second-order false-belief reasoning and inhibitory control was found in a sample of typically developing

children aged 10.1 to 17.9 years (Oswald, 2012), and a similar positive correlation was found between second-order false-belief reasoning and set-shifting abilities in 7- to 12-year-old children (Bock, Gallaway, & Hund, 2014). Taken together, it appears that set-shifting abilities and inhibitory control may be necessary for ToM expression, even in middle childhood.

In contrast, cognitive second-order false-belief reasoning had a negative, non-significant correlation with working memory abilities in the present study. This is different from many studies with younger children, which often find positive relationships between false-belief reasoning and working memory abilities (e.g., Carlson et al., 2002; Davis & Pratt, 1995; Gordon & Olson, 1998; Hughes, 1998). However, further examination of these studies indicates that the amount of variance accounted for in false-belief reasoning by working memory (i.e., backward digit span performance) was relatively small in one study, at only 6% (Davis & Pratt, 1995). Two of the other research groups found no relationship between false-belief reasoning and working memory in preschool children after controlling for age and verbal IQ (Carlson et al., 2002; Hughes, 1998). Research on children in a similar age group to the current study, though limited, has found significant positive correlations between working memory and second-order false belief in participants aged 10.1 to 17.9 years (Oswald, 2012). However, the association was lost after controlling for age and IQ (Oswald, 2012). Similarly, no significant relationship was found between second-order false-belief reasoning and working memory in 7- to 12-year-olds (Bock et al., 2014). Thus, the current literature is mixed on the relationship between cognitive false-belief reasoning and working memory, though it might be the case that working memory abilities may be more important for ToM emergence than ToM expression.

In contrast, no relationship was found between affective second-order false-belief reasoning and EFs in 10-year-olds. Though it was predicted that this relationship would be

weaker than the relationship between cognitive false-belief and EFs, the lack of association may be seen as unusual. Research on the relationship between affective ToM and EFs is relatively scarce. One study found a significant positive relationship between affective ToM and both inhibition and set-shifting in adolescents aged 12 to 22 years (Vetter et al., 2013a). However, the ToM task used in this study consisted of describing the emotions of actors in silent clips, which may tap into a different aspect of ToM reasoning than the current second-order false-belief task. Similarly, a study looking at performance on the Reading the Mind in the Eyes Task (a measure of affective ToM) was also significantly correlated with inhibitory control in 18- to 27-year-olds (Ahmed & Miller, 2011). Notably, performance on a different measure of affective ToM, the Faux Pas test, which required participants to interpret the negative feelings of one character after another character inadvertently made an inappropriate comment, was not significantly associated with inhibitory control or cognitive flexibility in 18- to 27-year-olds (Ahmed & Miller, 2011). In a study comparing affective ToM to EFs in children aged 10.1 to 17.9 years, similar results were found to the current study, as no association was found between the Reading the Mind in the Eyes Task and either working memory or inhibitory control (Oswald, 2012). Taken together, the relationship between affective ToM and EFs is less clear than the relationship between cognitive ToM and EFs. Importantly, it appears that the content of the affective ToM task that is used has an impact on the relationship found with EFs. However, further research on this relationship is required across all developmental periods.

In contrast to the false-belief task, both cognitive and affective irony comprehension were negatively associated with response inhibition and set-shifting abilities, and had no relationship with working memory in 10-year-olds. The differences seen between the two ToM measures and their relationships with EFs has been documented in the past, as it has been shown that different

ToM measures utilize unique cognitive mechanisms (Ahmed & Miller, 2011). The lack of relationship between irony comprehension and working memory may be due to the fact that the ironic statement was repeated in the comprehension questions that were posed after each story and, thus, minimized the working memory requirements of the irony task. Given that the cognitive and affective aspects of irony comprehension have not been examined separately in previous research, no direct comparisons can be made on the relationship between EFs and cognitive and affective irony comprehension independently. However, in general, the relationship between irony comprehension and EFs in young children has been supported (e.g., Hala, Pexman, Climie, Rostad, & Glenwright, 2010; Pexman, 2008). For example, research on young children has found a significant relationship between irony comprehension and working memory abilities, as measured by the digit span task (Filippova & Astington, 2008). In contrast, research has found no relationship between the Strange Stories Task (a test that requires comprehension of irony, figure of speech, misunderstanding, joke, and other common forms of social communication) and either mental flexibility or inhibitory control in adults (Ahmed & Miller, 2011), suggesting that EFs may not be necessary for mature aspects of social cognition.

However, studies on the relationship between irony comprehension and EFs in older age groups have yielded mixed results. In one study, no significant relationship was found between a story comprehension task (which included two irony stories, a pretence, a threat, a dare, a white lie, and an excuse) and working memory abilities in a sample of adolescents and adults (Vetter, Leipold, Kliegel, Phillips, & Altgassen, 2013b). In another study examining a group of typically developing 9- to 16-year-olds, correct interpretation of ironic speaker intent was negatively correlated with set-shifting abilities (Agbayewa, 2010), similarly to the present study. Unexpected negative correlations between EFs and ToM abilities have been found in other

studies examining middle childhood and early adolescence as well. For example, performance on Happé's Strange Stories Task (Happé, 1993) was negatively associated with working memory abilities in children aged 10.1 to 17.9 years after controlling for age and IQ, and advanced cognitive perspective-taking was negatively associated with inhibitory control, though these correlations did not reach significance (Oswald, 2012). Thus, the relationship between ToM and EFs in older children and adolescents may not be as clear as what is typically seen with younger children. Research to date suggests that those in middle childhood or adolescence may even be showing evidence of 'over-thinking' ironic narratives, such that persons with more developed EF abilities tend to have poorer performance on irony comprehension tasks. However, further research is needed to clarify whether EFs are necessary for maturing irony comprehension.

ToM and Social Functioning in 10-year-olds

Finally, the relationship between ToM and measures of social functioning in 10-year-olds indicated that affective false-belief reasoning was significantly correlated with bullying, such that higher affective false-belief scores were associated with less instances of bullying. However, no association was found between either cognitive or affective irony comprehension and any of the social functioning measures. Similarly, cognitive second-order false-belief was not associated with social functioning in this sample.

Previous research on the relationship between social cognition and bullying/victimization has been mixed. For example, one research group found that deficits in social cognitive processing in 6- to 8-year-olds were predictive of later aggressive behaviours at the age of 10 to 12 (Dodge et al., 2003). Similarly, 8- to 11-year-old children who were peer-nominated as being a bully had relatively weaker ToM abilities, particularly affective ToM, compared to children who received a different peer nomination (e.g., defender, outsider) (Gini, 2006). In contrast,

another research group found that ringleader bullies had relatively more advanced ToM abilities than other children (Sutton et al., 1999). The difference in findings may be the result of the different samples assessed, as Sutton et al. (1999) assessed identifiably effective bullies, while Dodge et al. (2003) and Gini (2006) assessed bullies that may have been considered both effective and ineffective. The current study, which was also not exclusively focused on ringleader bullies, found relative deficits in ToM reasoning in 10-year-olds who bully others, which is consistent with the deficit hypothesis of bullying.

Similarly, variable results have been found for victims of bullying. While young children, aged 4 to 6, who were victims of bullying were found to have relatively more advanced ToM abilities (Monks et al., 2005), older children, aged 7 to 10, who were victims of bullying were found to have relative deficits in both cognitive and affective ToM abilities (Sutton et al., 1999). Notably, one study found that victims of bullying had comparably weaker cognitive ToM abilities, though relatively more advanced affective ToM abilities than other children (Gini, 2006). Thus, it may be the case that children who are better at identifying others' emotional perspectives are a greater target for being bullied in middle childhood. Alternatively, differences in results seen may be due to differences in self-reported experiences with bullying vs. peer-nominated bullies and victims. Notably, very few instances of bullying were self-reported in the present study, which may be due to a sampling bias (i.e., the families recruited were largely middle to upper class) or may be due to biased responses associated with social desirability.

The lack of association between ToM measures and empathy in the current study may also be due to sampling bias (i.e., most empathy scores were relatively high) or to social desirability effects. Notably, positive bivariate correlations between self- and parent-reported empathy and both cognitive and affective second-order false-belief reasoning were found. This is

similar to previous studies that have found positive associations between empathy and ToM abilities in young children (Deković & Gerris, 1994) adolescents (Gini, Albiero, Benelli, & Altoè, 2007) and young adults (Hooker et al., 2008). Alternatively, the lack of relationship seen between ToM abilities and empathy in the current sample may be due to the fact that cognitive and affective aspects of empathy were not measured separately. Research has shown that cognitive and affective aspects of empathy are related to ToM differently, such that levels of affective empathy are better at differentiating children with 'nice' vs. 'nasty' ToM traits (Lonigro et al., 2014). Moreover, it may be the case that cognitive aspects of empathy and ToM, as well as affective aspects of empathy and ToM are most related to one another. Future research investigating these relationships between hot and cold aspects of empathy and ToM is warranted.

Limitations and Future Directions

Future research might benefit from using an open-ended version of the false-belief task in order to see more variability in scores, as well as to be more comparable with the irony task. Other limitations of the current study include a possible sampling bias, given that all families were recruited from community events around the city and, thus, likely represent those who are more eager to enroll their children in extracurricular learning activities. In addition, the current study did not manipulate EF demands within the ToM tasks, which would have provided stronger evidence for or against the expression hypothesis of EF in ToM reasoning. Finally, the use of self-report measures of social functioning, particularly experiences with bullying and victimization, likely led to biased responses due to social desirability effects. This is evident in the low means reported on the bully/victim questionnaire. Future research would benefit from comparing self-reported experiences with bullying and victimization to peer nominations.

Summary

Overall, it is clear that ToM abilities are still continuing to mature in middle childhood and that cognitive false-belief and irony comprehension are more advanced than affective false-belief and irony comprehension in this age group. In addition, there may be gender differences in the discrepancy between cognitive and affective ToM abilities, at least in middle childhood. Thus, future research would likely benefit from continuing to investigate these two domains separately, in order to better understand the diverse nature of ToM development and how it is related to other aspects of functioning. The current study provides support for the use of the adapted false-belief and irony comprehension tasks in future studies on middle childhood.

Results of the current study support expressive theories for the role of EFs in false-belief reasoning, suggesting that EFs are important for utilizing more mature ToM abilities, not only for initial ToM development. Moreover, the neurocognitive demands associated with understanding an individual's beliefs may be different than the demands associated with understanding an individual's emotions. In contrast, the relationship between EFs and irony comprehension in middle childhood may be more complicated than what is typically seen with younger children. It may be the case that children at this developmental period 'over-think' ironic statements and, consequently, show a negative relationship between irony comprehension and EFs at this age. However, further research is needed to clarify this relationship.

Finally, the current study supports the social deficit view of bullying, as a negative relationship was found between affective second-order false-belief reasoning and bullying others. However, only weak associations were found between empathy and either false-belief reasoning or irony comprehension, which may be due to sampling bias, social desirability effects, or the lack of distinction between cognitive and affective empathy in the current study.

REFERENCES

Agbayewa, A. S. (2010). *Verbal irony comprehension for children and adolescents with high-functioning autism and Asperger's syndrome in computer-mediated communication* (Master's thesis). Retrieved from http://mspace.lib.umanitoba.ca

Ahmed, F. S., & Miller, L. S. (2011). Executive function mechanisms of theory of mind. *Journal of Autism and Developmental Disorders*, *41*(5), 667-678.

Apperly, I. A., Samson, D., & Humphreys, G. W. (2009). Studies of adults can inform accounts of theory of mind development. *Developmental Psychology*, *45*(1), 190.

Arseneault, L., Bowes, L., & Shakoor, S. (2010). Bullying victimization in youths and mental health problems: 'Much ado about nothing'. *Psychological Medicine*, *40*(5), 717-729.

Auyeung, B., Wheelwright, S., Allison, C., Atkinson, M., Samarawickrema, N., & Baron-Cohen, S. (2009). The children's empathy quotient and systemizing quotient: Sex differences in typical development and in autism spectrum conditions. *Journal of Autism and Developmental Disorders*, *39*(11), 1509-1521.

Baron-Cohen, S., O'Riordan, M., Stone, V., Jones, R., & Plaisted, K. (1999). Recognition of faux pas by normally developing children and children with Asperger syndrome or high-functioning autism. *Journal of Autism and Developmental Disorders*, *29*(5), 407-418.

Bishop, D. V. (2006). *The Children's Communication Checklist - 2nd Edition*. London: Harcourt Assessment.

Blakemore, S. J., den Ouden, H., Choudhury, S., & Frith, C. (2007). Adolescent development of the neural circuitry for thinking about intentions. *Social Cognitive and Affective Neuroscience, 2*, 130-139.

Bock, A. M., Gallaway, K. C., & Hund, A. M. (2014). Specifying links between executive

functioning and theory of mind during middle childhood: Cognitive flexibility predicts social understanding. *Journal of Cognition and Development*. Advanced online publication. doi:10.1080/15248372.2014.888350

Brothers, L. (1990). The neural basis of primate social communication. *Motivation and Emotion*, 14(2), 81-91.

Brüne, M., & Brüne-Cohrs, U. (2006). Theory of mind—evolution, ontogeny, brain mechanisms and psychopathology. *Neuroscience & Biobehavioral Reviews*, *30*(4), 437-455.

Bryant, B. K. (1982). An index of empathy for children and adolescents. *Child Development*, *53*(2), 413-425.

Bull, R., Phillips, L. H., & Conway, C. A. (2008). The role of control functions in mentalizing: Dual-task studies of theory of mind and executive function. *Cognition*, *107*(2), 663-672.

Calero, C. I., Salles, A., Semelman, M., & Sigman, M. (2013). Age and gender dependent development of Theory of Mind in 6-to 8-years old children. *Frontiers in Human Neuroscience*, *7*, 281-300.

Carlson, S. M., Mandell, D. J., & Williams, L. (2004). Executive function and theory of mind: Stability and prediction from ages 2 to 3. *Developmental Psychology*, *40*(6), 1105.

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development*, *72*(4), 1032-1053. doi:10.1111/1467-8624.00333

Carlson, S. M., Moses, L. J., & Breton, C. (2002). How specific is the relation between executive function and theory of mind? Contributions of inhibitory control and working memory. *Infant and Child Development*, *11*(2), 73-92.

Carlson, S. M., Moses, L. J., & Hix, H. R. (1998). The role of inhibitory processes in young children's difficulties with deception and false belief. *Child Development*, *69*(3), 672-691.

Chevalier, N., Huber, K. L., Wiebe, S. A., & Espy, K. A. (2013). Qualitative change in executive control during childhood and adulthood. *Cognition*, *128*(1), 1-12.

Cole, K., & Mitchell, P. (2000). Siblings in the development of executive control and a theory of mind. *British Journal of Developmental Psychology*, *18*(2), 279-295.

Corradi-Dell'Acqua, C., Hofstetter, C., & Vuilleumier, P. (2013). Cognitive and affective theory of mind share the same local patterns of activity in posterior temporal but not medial prefrontal cortex. *Social Cognitive and Affective Neuroscience*. Advanced online publication. doi:10.1093/scan/nst097

Cousineau, D., & Chartier, S. (2010). Outliers detection and treatment: A review. *International Journal of Psychological Research*, *3*(1), 58-67.

Dadds, M. R., Hunter, K., Hawes, D. J., Frost, A. D., Vassallo, S., Bunn, P., ... & El Masry, Y. (2008). A measure of cognitive and affective empathy in children using parent ratings. *Child Psychiatry and Human Development*, *39*(2), 111-122.

Davis, H. L., & Pratt, C. (1995). The development of children's theory of mind: The working memory explanation. *Australian Journal of Psychology*, *47*(1), 25-31.

Deković, M., & Gerris, J. R. (1994). Developmental analysis of social cognitive and behavioral differences between popular and rejected children. *Journal of Applied Developmental Psychology*, *15*(3), 367-386.

Delis, D. C., Kaplan, E., & Kramer, J. H. (2001). *Delis-Kaplan executive function system (D-KEFS)*. San Antonio, Texas: Psychological Corporation.

Devine, R. T., & Hughes, C. (2012). Silent films and strange stories: Theory of Mind, gender, and social experiences in middle childhood. *Child Development, 84*(3), 989-1003.

Dodge, K. A., Lansford, J. E., Burks, V. S., Bates, J. E., Pettit, G. S., Fontaine, R., & Price, J. M.

(2003). Peer rejection and social information‐processing factors in the development of aggressive behavior problems in children. *Child Development*, *74*(2), 374-393.

Dumontheil, I., Apperly, I. A., & Blakemore, S. J. (2010). Online usage of theory of mind continues to develop in late adolescence. *Developmental Science*, *13*(2), 331-338.

Duval, C., Piolino, P., Bejanin, A., Eustache, F., & Desgranges, B. (2011). Age effects on different components of theory of mind. *Consciousness and Cognition*, *20*(3), 627-642.

Filippova, E., & Astington, J. W. (2008). Further development in social reasoning revealed in discourse irony understanding. *Child Development*, *79*(1), 126-138.

Giedd, J. N., Blumenthal, J., Jeffries, N. O., Castellanos, F. X., Liu, H., Zijdenbos, A. (1999). Brain development during childhood and adolescence: A longitudinal MRI study. *Nature Neuroscience, 2*, 861- 863.

Gifford-Smith, M. E., & Brownell, C. A. (2003). Childhood peer relationships: Social acceptance, friendships, and peer networks. *Journal of School Psychology*, *41*(4), 235-284.

Gini, G. (2006). Social cognition and moral cognition in bullying: What's wrong? *Aggressive Behavior*, *32*(6), 528-539.

Gini, G., Albiero, P., Benelli, B., & Altoè, G. (2007). Does empathy predict adolescents' bullying and defending behavior? *Aggressive Behavior*, *33*(5), 467-476.

Gordon, A. C., & Olson, D. R. (1998). The relation between acquisition of a theory of mind and the capacity to hold in mind. *Journal of Experimental Child Psychology*, *68*(1), 70-83.

Greimel, E., Schulte-Rüther, M., Fink, G. R., Piefke, M., Herpertz-Dahlmann, B., & Konrad, K. (2010). Development of neural correlates of empathy from childhood to early adulthood: An fMRI study in boys and adult men. *Journal of Neural Transmission*, *117*(6), 781-791.

Güroğlu, B., van den Bos, W., & Crone, E. A. (2009). Fairness considerations: Increasing understanding of intentionality during adolescence. *Journal of Experimental Child Psychology*, *104*(4), 398-409.

Hackman, D. A., & Farah, M. J. (2009). Socioeconomic status and the developing brain. *Trends in Cognitive Sciences*, *13*(2), 65-73.

Hala, S., Hug, S., & Henderson, A. (2003). Executive function and false-belief understanding in preschool children: Two tasks are harder than one. *Journal of Cognition and Development*, *4*(3), 275-298.

Hala, S., Pexman, P.M., Climie, E., Rostad, K., & Glenwright, M. (2010). A bidirectional view of executive function and social interaction. In B. Sokol, U. Muller, J. Carpendale, A. Young, & G. Iarocci (Eds.), *Self- and social-regulation: Exploring the relations between social interaction, social cognition, and the development of executive functions*. Oxford: Oxford University Press.

Hancock, J. T., Dunham, P. J., & Purdy, K. (2000). Children's comprehension of critical and complimentary forms of verbal irony. *Journal of Cognition and Development*, *1*(2), 227-248.

Happé, F. G. (1993). Communicative competence and theory of mind in autism: A test of relevance theory. *Cognition*, *48*(2), 101-119.

Heaton, R. K., Chelune, G. J., Talley, J. L., Kay, G. G., & Curtiss, G. (1993). *Wisconsin Card Sorting Test manual: Revised and expanded*. Odessa: Psychological Assessment Resources.

Hooker, C. I., Verosky, S. C., Germine, L. T., Knight, R. T., & D'Esposito, M. (2008). Mentalizing about emotion and its relationship to empathy. *Social Cognitive and*

Affective Neuroscience, *3*(3), 204-217.

Hughes, C. (1998). Executive function in preschoolers: Links with theory of mind and verbal ability. *British Journal of Developmental Psychology*, *16*(2), 233-253.

Huizinga, M., Dolan, C. V., & van der Molen, M. W. (2006). Age-related change in executive function: Developmental trends and a latent variable analysis. *Neuropsychologia*, *44*(11), 2017-2036.

Kalbe, E., Grabenhorst, F., Brand, M., Kessler, J., Hilker, R., & Markowitsch, H. J. (2007). Elevated emotional reactivity in affective but not cognitive components of theory of mind: A psychophysiological study. *Journal of Neuropsychology*, *1*(1), 27-38.

Kalbe, E., Schlegel, M., Sack, A. T., Nowak, D. A., Dafotakis, M., Bangard, C., ... & Kessler, J. (2010). Dissociating cognitive from affective theory of mind: A TMS study. *Cortex*, *46*(6), 769-780.

Kim, H. (2013). Statistical notes for clinical researchers: assessing normal distribution using skewness and kurtosis. *Restorative Dentistry and Endodontics, 38*(1), 52-54.

Lonigro, A., Laghi, F., Baiocco, R., & Baumgartner, E. (2014). Mind reading skills and empathy: Evidence for nice and nasty ToM behaviours in school-aged children. *Journal of Child and Family Studies*, *23*, 581-590.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*(1), 49–100.

Miller, S. A. (2009). Children's understanding of second-order mental states. *Psychological Bulletin, 135*, 749-773.

Monetta, L., Grindrod, C. M., & Pell, M. D. (2009). Irony comprehension and theory of mind

deficits in patients with Parkinson's disease. *Cortex*, *45*(8), 972-981.

Monks, C. P., Smith, P. K., & Swettenham, J. (2005). Psychological correlates of peer victimisation in preschool: Social cognitive skills, executive function and attachment profiles. *Aggressive Behavior*, *31*(6), 571-588.

Moses, L.J., Carlson, S.M., & Sabbagh, M.A. (2005). On the specificy of the relation between executive function and children's theories of mind. In W. Schneider, R. Schumann-Hengsteler, & B. Sodian. (Eds.), *Young children's cognitive development: Interrelationships among executive functioning, working memory, verbal ability, and theory of mind* (pp. 131-146). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Nickerson, A. B., & Nagle, R. J. (2005). Parent and peer attachment in late childhood and early adolescence. *The Journal of Early Adolescence*, *25*(2), 223-249.

Oswald, T.M. (2012). *Relations among theory of mind and executive function abilities in typically developing adolescents and adolescents with Asperger's Syndrome and High Functioning Autism* (Doctoral dissertation). Retrieved from https://scholarsbank.uoregon.edu/xmlui/

Ozonoff, S., & McEvoy, R. E. (1994). A longitudinal study of executive function and theory of mind development in autism. *Development and Psychopathology*, *6*(3), 415-431.

Perner, J., & Lang, B. (1999). Development of theory of mind and executive control. *Trends in Cognitive Sciences*, *3*(9), 337-344.

Perner, J., & Wimmer, H. (1985). "John thinks that Mary thinks that…" attribution of second-order beliefs by 5-to 10-year-old children. *Journal of Experimental Child Psychology*, *39*(3), 437-471.

Pexman, P. M. (2008). It's fascinating research: The cognition of verbal irony. *Current*

Directions in Psychological Science, *17*(4), 286-290.

Pexman, P. M., & Glenwright, M. (2007). How do typically developing children grasp the meaning of verbal irony? *Journal of Neurolinguistics*, *20*(2), 178-196.

Pexman, P. M., & Olineck, K. M. (2002). Does sarcasm always sting? Investigating the impact of ironic insults and ironic compliments. *Discourse Processes*, *33*(3), 199-217.

Pickup, G. J. (2008). Relationship between theory of mind and executive function in schizophrenia: a systematic review. *Psychopathology*, *41*(4), 206-213.

Sabbagh, M. A., & Taylor, M. (2000). Neural correlates of theory-of-mind reasoning: An event-related potential study. *Psychological Science*, *11*(1), 46-50.

Sabbagh, M. A., Xu, F., Carlson, S. M., Moses, L. J., & Lee, K. (2006). The development of executive functioning and theory of mind. A comparison of Chinese and US preschoolers. *Psychological Science*, *17*(1), 74-81.

Saltzman, J., Strauss, E., Hunter, M., & Archibald, S. (2000). Theory of mind and executive functions in normal human aging and Parkinson's disease. *Journal of the International Neuropsychological Society*, *6*(7), 781-788.

Samson, D., & Apperly, I. A. (2010). There is more to mind reading than having Theory of Mind concepts: New directions in Theory of Mind research. *Infant and Child Development, 19*, 443-454.

Sattler, J.M. (2008). *Assessment of Children Cognitive Foundations - Fifth Edition*. La Mesa, California: Jerome M. Sattler, Publisher, Inc.

Sebastian, C. L., Fontaine, N. M., Bird, G., Blakemore, S. J., De Brito, S. A., McCrory, E. J., & Viding, E. (2012). Neural processing associated with cognitive and affective Theory of Mind in adolescents and adults. *Social Cognitive and Affective Neuroscience*, *7*(1), 53-63.

Shakoor, S., Jaffee, S. R., Bowes, L., Ouellet‐Morin, I., Andreou, P., Happé, F., ... & Arseneault, L. (2012). A prospective longitudinal study of children's theory of mind and adolescent involvement in bullying. *Journal of Child Psychology and Psychiatry*, *53*(3), 254-261.

Shamay-Tsoory, S. G., & Aharon-Peretz, J. (2007). Dissociable prefrontal networks for cognitive and affective theory of mind: A lesion study. *Neuropsychologia*, *45*(13), 3054-3067.

Shamay-Tsoory, S. G., Shur, S., Barcai-Goodman, L., Medlovich, S., Harari, H., & Levkovitz, Y. (2007). Dissociation of cognitive from affective components of theory of mind in schizophrenia. *Psychiatry Research*, *149*(1-3), 11.

Shamay-Tsoory, S. G., Tomer, R., Berger, B. D., Goldsher, D., & Aharon-Peretz, J. (2005). Impaired" affective theory of mind" is associated with right ventromedial prefrontal damage. *Cognitive and Behavioral Neurology*, *18*(1), 55-67.

Smith, H., Polenik, K., Nakasita, S., & Jones, A. P. (2012). Profiling social, emotional and behavioural difficulties of children involved in direct and indirect bullying behaviours. *Emotional and Behavioural Difficulties*, *17*(3-4), 243-257.

Solberg, M. E., & Olweus, D. (2003). Prevalence estimation of school bullying with the Olweus Bully/Victim Questionnaire. *Aggressive Behavior*, *29*(3), 239-268.

Steinberg, L. (2005). Cognitive and affective development in adolescence. *Trends in Cognitive Sciences*, *9*(2), 69-74.

Sullivan, K., Zaitchik, D., & Tager-Flusberg, H. (1994). Preschoolers can attribute second-order beliefs. *Developmental Psychology*, *30*(3), 395-402.

Sutton, J., Smith, P. K., & Swettenham, J. (1999). Social cognition and bullying: Social inadequacy or skilled manipulation? *British Journal of Developmental Psychology, 17*,

435-450.

Vetter, N. C., Altgassen, M., Phillips, L., Mahy, C. E., & Kliegel, M. (2013a). Development of affective theory of mind across adolescence: disentangling the role of executive functions. *Developmental Neuropsychology*, *38*(2), 114-125.

Vetter, N. C., Leipold, K., Kliegel, M., Phillips, L. H., & Altgassen, M. (2013b). Ongoing development of social cognition in adolescence. *Child Neuropsychology*, *19*(6), 615-629.

Vollm, B. A., Taylor, A. N., Richardson, P., Corcoran, R., Stirling, J., McKie, S., ... & Elliott, R. (2006). Neuronal correlates of theory of mind and empathy: a functional magnetic resonance imaging study in a nonverbal task. *Neuroimage*, *29*(1), 90-98.

Wang, Z., & Su, Y. (2012). Age-related differences in the performance of Theory of Mind in older Aadults: A dissociation of cognitive and affective components. *Psychology and Aging*, *28*(1), 284-291.

Wechsler, D. (2003*). Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV)*. San Antonio, TX: The Psychological Corporation.

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta‐analysis of theory‐of‐mind development: The truth about false belief. *Child Development*, *72*(3), 655-684.

Welsh, M. C., Pennington, B. F., & Groisser, D. B. (1991). A normative‐developmental study of executive function: A window on prefrontal function in children. *Developmental Neuropsychology*, *7*(2), 131-149.

Whalen, J. M., & Pexman, P. M. (2010). How do children respond to verbal irony in face-to-face communication? The development of mode adoption across middle childhood. *Discourse Processes*, *47*(5), 363-387.

APPENDIX A

Second-Order False Belief Task.

Cognitive Example:

1. Brett and Sally are at the mall for lunch. Brett is standing in line for pizza and tells Sally that he is going to order a slice of pepperoni pizza to eat. Sally decides that she is not hungry and leaves to go check out a nearby toy store. Meanwhile, Brett decides that he would rather have a hot dog for lunch, so he moves to the hot dog line-up instead.

1) At the end of the story, Brett thinks that Sally thinks that…

A) Brett is ordering a hot dog B) Brett is ordering pizza

2) Does Sally know that Brett changed line-ups?

A) Yes B) No

Affective Example:

1. Kelly and Tim are sitting in the living room. They are watching a funny program on TV and having a good time. Kelly is hungry and goes to the kitchen to make some popcorn. Meanwhile, Tim switches channels and starts watching the news. On the news they say that there was a big earthquake, and Tim is very upset. When Kelly is leaving the living room, she glances back and sees Tim switching channels and becoming saddened by the news. Tim does not know that Kelly saw him.

1) At the end of the story, Tim thinks that Kelly thinks that…

A) Tim is happy B) Tim is sad

2) Does Kelly know that Tim changed the channel?

A) Yes B) No

APPENDIX B

Irony Task.

Ironic Criticism Example:

Shane and Kim spent the whole day making a great big sand castle at the beach. They couldn't wait to show their parents how great their sand castle looked. While they were running up the beach to get their parents, a huge wave came along and ruined their sand castle. Shane said, "What a wonderful way to end the day".

1) *Second-order cognitive intent*: When Shane said, "What a wonderful way to end the day', what did he want Kim to think that he believed about how their day turned out?

2) *Second-order affective intent*: When Shane said, "What a wonderful way to end the day', what did he want Kim to think about how he was feeling?

Ironic Compliment Example:

Liam and his little brother wanted to do something fun together outside for the day since it was so nice. They decided to go to the zoo because it was close by, but they thought it might just be boring. When they got to the zoo, they saw lots of cool animals and they didn't want to leave at all when it closed. Liam said, "That was a boring day at the zoo".

1) *Second-order cognitive intent:* When Liam said, "That was a boring day at the zoo", what did he want his brother to think that he believed about how their day turned out?

2) *Second-order affective intent:* When Liam said, "That was a boring day at the zoo", what did he want his brother to think about how he was feeling?