Executive Function, Social Emotional Learning, and Social Competence in Autism Spectrum Disorder

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By
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Nathalie Catherine Marie Berard, candidate for the degree of Doctor of Philosophy in Clinical Psychology, has presented a thesis titled, *Executive Function, Social Emotional Learning, and Social Competence in Autism Spectrum Disorder*, in an oral examination held on April 14, 2014. The following committee members have found the thesis acceptable in form and content, and that the candidate demonstrated satisfactory knowledge of the subject material.

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ABSTRACT

The main objective of this study was to investigate the concurrent role of multiple antecedents of social competence in a group of children with Autism Spectrum Disorder (ASD). Existing models of social competence were adapted to include three domains of executive function (EF: Cognitive, Behavioural, and Emotional Regulation), and two domains of Social Emotional Learning (SEL: Nonverbal Awareness, Social Understanding). The EF domains were related to sustained attention, working memory, planning, behavioural inhibition, and affective decision making; SEL domains included social comprehension, and identification and interpretation of social cues. Social competence was defined in terms of social skills and adaptive social functioning. The relationships amongst the EF and SEL domains, and social competence were examined in a sample of 49 boys with ASD and 48 neurotypical boys, aged 8 to 13 years. Results showed that the ASD group performed significantly below the control group on most SEL and EF domains. Children with ASD were also rated significantly lower on social competence measures and parental ratings of EF. Importantly, the EF domain of Cognitive Regulation predicted social competence in boys with ASD whereas the SEL domain of Social Understanding predicted social competence in neurotypical boys. These findings contribute significantly to our understanding of social competence and quality of life in boys with ASD. The observation that Cognitive Regulation predicts social competence in boys with ASD has important clinical implications for specifically targeting EF in both assessment and treatment.
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Dedication

The support of my family has been invaluable to the completion of this dissertation. I want to express my deep appreciation to my parents, Norbert and Claudette, for the endless support they have given me throughout my life and for always believing in me. Merci de m'avoir appuyé toute ma vie et lors de se long trajet difficile et parfois frustrant. Cet accomplissement est pour vous, car malgré tous les détours de la vie, vous m'avez appris qu'il faut garder le but en tête et persévéré.

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1.0 Overview

Social competence, broadly defined as the ability to effectively engage in social interactions (Rose-Krasnor, 1997), is a robust and critical predictor of positive outcomes throughout the lifespan in both neurotypical and clinical populations. (Burt et al., 2008; Caprara, Barbaranelli, Pastorelli, Badura & Zimbardo, 2000; Crick & Dodge, 1994; Eberly & Montemayor, 1998; Kumpfer, 1999; Rys & Bear, 1997; Mangham, McGrath, Reid, & Stewart, 1995; McKown, Gumbiner, Russo & Lipton 2009; Smart & Sanson, 2003).

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder whose cardinal feature is social impairment (Volkmar & Klin, 2005). Children with ASD are thus at higher risk for poorer overall quality of life. Despite this increased risk, there is currently limited understanding of social competence in ASD, factors that contribute to the heterogeneity of social abilities in ASD, or effective clinical management strategies.

Developmental theories of social competence have tended to focus on the effects of either socio-cognitive or socio-affective processes on social competence (Lipton & Nowicki, 2009), and research on ASD has similarly tended to focus on socio-cognitive and/or socio-emotional processes as a means of explaining deficits associated with the diagnosis. More recent models have identified executive function (EF) as an additional important potential contributor to social competence in children (Beauchamp & Anderson, 2010). To date, however, the role of EF in the social competence of children with ASD is unclear.

Typical interventions to assist children in learning behaviours to improve social
interactions generally fall under the rubric of social emotional learning (SEL) skills, which encompass socio-cognitive skills and socio-emotional skills, such as emotion recognition, social problem solving, and taking the perspective of others. SEL skill interventions, however, have not proven as effective in clinical populations such as children with ASD, particularly those with high functioning ASD (Rao, Beidel & Murray, 2008; White, Keonig & Scahill, 2007). An important limitation to such conventional interventions is the assumption SEL skills are the primary antecedents to social competence. However, the recent identification of EF as an important antecedent to social competence warrants a more comprehensive approach to understanding and improving social competence in ASD. There are thus clear theoretical grounds to revisit current models of social competence, particularly with respect to the important role that EF, either alone or in conjunction with SEL skills, play in the development of social competence in both neurotypical children and those with ASD. The ultimate aim is to inform the literature and to improve upon current interventions to increase social competence in ASD.

In the following sections, a brief overview of ASD is provided, highlighting the heterogeneity in this population. Existing theories of social competence are reviewed with a focus on identifying a more comprehensive set of antecedents to social competence that can be applied to children with ASD. Next, recent conceptualisations of EF as a form of executive control of cognitive, behavioural, and emotional functioning are explored (Wasserman & Wasserman, 2013). Particularly, the literature highlighting the potential role of executive functions (EF) in the social competence of children is examined. Thereafter, limitations and controversies in the ASD and EF literature are
identified. Finally, the implications of a comprehensive model of social competence that includes different domains of EF and SEL in ASD is addressed.
2.0 Introduction

2.1. Social Competence

Social competence is commonly conceptualized as a multifaceted construct that occurs along a continuum and which predicts the effectiveness of interactions with others (Bohlin & Hagekull, 2009; Odom, McConnell & Brown, 2008; Burt, Obradovic, Long & Masten, 2008; Rose-Krasnor, 1997; Segrin, 2000; Trentacosta & Fine, 2010). Social competence includes behaviours such as sharing, helping, cooperating, initiating and maintaining relationships, sensitively interacting with others, negotiating needs and effectively handling conflict situations. From a developmental perspective, social competence involves “the active and skilful coordination of multiple processes and resources available to the child to meet social demands and achieve social goals in a particular type of social interaction (e.g., parent-child, peer relations) and within a specific context (e.g., home, school)” (Iarocci, Yager & Elfers, 2007, p. 113).

While social competence develops throughout childhood, there is a correlation between social competence in early childhood and later adolescence, suggesting that it is typically established early and is stable across time (Eisenberg et al., 1997; Masten & Coatsworth, 1998). Social competence has been found to predict quality of peer relationships, academic success in late childhood, and work competence in adolescence (Burt et al., 2008; Caprara et al., 2000; Eisenberg et al., 1997; Masten et al., 1995a, 1995b). Social competence is also one of the most frequently identified attributes of resiliency and overall mental health in children (Parrila, Ma, Fleming & Rinaldi, 2002). When a mental disorder is present, poor social competence has been correlated with
greater severity of illness, a higher risk of co-morbid disorders, and a poorer prognosis (Jewel, Jordan, Hupp, & Everett, 2009). Given the importance of social competence to quality of life, understanding the variables associated with social competence in child mental health populations with social impairments is an important area of study. Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder whose prime feature is social impairment (Volkmar & Klin, 2005). This research will focus on increasing our understanding of social competence in ASD, factors that contribute to the heterogeneity of social abilities in ASD, and implications for effective clinical management strategies.

2.2 Autism Spectrum Disorder

ASD is an aetiologically complex neurodevelopment disorder characterized by core deficits in social functioning. It has been well-established that children with ASD exhibit multiple pervasive deficits in social competence, including initiating interactions, joint attention, play skills, reciprocal interactions, nonverbal communication, and peer relations (Carter, Davis, Klin & Volkmar, 2005).

ASD subsumes three disorders that fall under the umbrella of ‘Pervasive Developmental Disorders’ (PDD) in the Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition, Text Revision (DSM-IV-TR) (APA, 2000): Autistic Disorder, Asperger's Disorder, Pervasive Developmental Disorder Not Otherwise Specified (PDD NOS). All three disorders are defined by a core ‘triad’ of qualitative impairments in social interaction, verbal and nonverbal communication deficits, and restricted, repetitive, and stereotyped interest. The term autism spectrum disorder (ASD) is frequently used in the literature to encapsulate these three disorders due to evidence that has suggested a substantial overlap among them (Szatmari, 1992; Volkmar, Lord, Bailey, Schultz & Klin,
This approach is also taken in the recent DSM-5, which has identified ASD as a single diagnostic category encompassing Autistic Disorder, Asperger’s Disorder, and PDD NOS based on the idea that a single spectrum better reflects the behavioural pathology (Swedo, 2009, p.1). In keeping with this, the term ASD will be utilised for the remainder of this study.

The most recent prevalence rates for ASD range from 15 to 23 per 1,000 (Centers for Disease Control and Prevention, 2012); the prevalence of ASD in Canada has been estimated to be 11 per 1,000, with the majority (82%) being male (NHSR, 2013).

### 2.2.1 Social competence in ASD

The pathognomonic feature of ASD is social impairment (Mundy, 2003). Children with ASD have multiple social deficits, including impairment in the use of non-verbal behaviours to regulate social interaction, difficulty establishing and maintaining peer relationships, a lack of shared enjoyment in the interests and accomplishments of others, and a general paucity of social or emotional reciprocity (APA, 2000). Nevertheless, ASD is also a disorder marked by variability that is evident in symptom manifestation, cognitive abilities, and developmental course and outcomes. For example, children with ASD and normal intellectual functioning are referred to as having high-functioning autism spectrum disorder (HFASD), and different social trajectories have been demonstrated for children with and without co-morbid intellectual disabilities (Szatmari, Bryson, Boyle, Streiner & Duku, 2003; Klin & Jones, 2009). Predictors of social competence have also been found to be different for children with HFASD and those with ASD and intellectual disabilities, who comprise approximately 30% of the population (CDC, 2012). Specifically, IQ and language abilities were found to predict social competence in children with ASD and low
intellectual function but found to have only weak associations in those with HFASD (Lis et al., 2001; Sigman & Ruskin, 1999; Szatmari et al., 2003). Since language and IQ do not necessarily predict social competence in children with HFASD, examining other factors, such as social emotional comprehension and executive functions (EF), may provide valuable information regarding social competence in this particular population. Given the well-documented differences between children with ASD with and without an intellectual disability, all information subsequently presented will specifically relate to children with ASD without intellectual disabilities, unless otherwise mentioned.

It is also well demonstrated in the literature that children with ASD display a wide range of social competence, with some doing better or worse than others. For example, some children with ASD have reciprocal friendships whereas others do not (Orsmond et al., 2004). In fact, within the triad of impairments associated with ASD, children with ASD show significantly more variability in the social domains as compared to the domains of communication and repetitive behaviours (Hazlett et al., 2009). Given the variability in behavioural and clinical manifestations of ASD, examining the heterogeneity in the social competence of children with average intelligence has important clinical implications, particularly since the majority are in mainstream classrooms and have to negotiate daily social demands with peers and teachers.

Significant variability in the social competence of children with ASD has been identified (Szatmari et al., 2003; Volkmar, Lord, Bailey, Schultz & Klin, 2004), but the reason for the variability remains unclear and has not been a focus of research. Why are some children with ASD able to maintain peer relationships? Why are some children with ASD able to respond appropriately to certain social demands? Research in this area has
likely been hindered by a focus on social deficits and maladaptive behaviours rather than intact abilities. For example, social competence is primarily measured using the Autism Diagnostic Interview-Revised (ADI-R) [Rutter, Le Couteur, & Lord, 2003] or Autism Diagnostic Observation Schedule (ADOS) [Lord et al., 1989], which are diagnostic tools designed to identify presence or absence of ASD symptoms and deficits. Equally problematic is the measurement of social competence using brief screening instruments, such as the Social Responsiveness Scale (SRS: Constantino & Gruber, 2005), which assesses non-social aspects of impairment, such as reactions to sensory stimuli and repetitive behaviours. Although these measures evaluate difficulties salient to ASD and provide meaningful information regarding the triad of impairments associated with the disorder, they do not evaluate many other important aspects of social functioning, such as sharing, helping, and cooperating. The singular focus of deficit or disability models thus has inherent limitations in terms of accounting for the heterogeneity in social functioning in ASD. Furthermore, recent reviews have documented that most individual and group-based social skills training programs designed for children with ASD fail to demonstrate significant improvements in social competence (Rao et al., 2008; White, Keonig, & Scahill, 2007), perhaps due to a restricted view of factors relevant to social competence.

It is now well-established in the developmental literature that social competence encompasses multiple variables. In this light, researchers have recently begun to explore the heterogeneity of ASD using multidimensional conceptualisations of social competence. The following section addresses these new conceptualizations. This population bears particular importance to the study of social competence. Children with ASD are at high risk for co-morbid mental health disorders that do not form part of
diagnostic criteria for ASD (Mattila et al., 2010; Midouhas, Yogaratnam, Flouri and Charman, 2013), as well as poor quality of life by virtue of the significant social impairments associated with the disorder (Howlin et al., 2013; Baird, 2014). Moreover, current social interventions have been fairly ineffective in improving social competence. The importance of identifying better mechanisms for improving their quality of life via increased social competence is therefore quite valuable.

2.3 Models of Social Competence

Early models of social competence focused predominantly on either social-cognitive or social-affective processes or skills, as the key antecedents to social competence. Socio-cognitive models emphasized the thought processes involved in social competence and the importance of perception and interpretation of social information (Crick & Dodge, 1994). Socio-affective models, on the other hand, emphasized the importance of the perception of emotions in the development of social competence (Halberstadt et al., 2001; Saarni, 1990).

One drawback of the above models is that they tend to focus on the contributions of either emotion or cognition alone in social functioning rather than both. It is now generally agreed that multiple processes must operate concurrently for the development of effective social competence (Bierman, 2004; Crick & Dodge, 1994; Lipton & Nowicki, 2009; McKown, 2007; McKown et al., 2009; McKown, Allen, Russo-Ponsaran & Johnson, 2013). Another drawback is that while both models emphasize the importance of self-regulation to social competence (Crick & Dodge, 1994; Eisenberg & Fabes 1992; Eisenberg et al., 1997; Fabes et al., 1999; Halberstadt et al., 2001; Masten & Coasworth, 1998; Smart & Sanson, 2003), self-regulation is not well-defined.
Self-regulation is an umbrella term referring to the capacity to manage one’s thoughts, feelings and actions in adaptive and flexible ways across a range of contexts (Saarni, 1997; Vohs & Baumeister, 2004; 2011), and the importance of self-regulation in social functioning is well-documented in the literature (Duckworth & Seligman, 2005; Heatherton & Wagner, 2001; Tangney et al., 2004; Vohs & Baumeister, 2004; 2011). Recent conceptualizations of social competence that incorporate self-regulation have been significantly advanced by the notion of Executive Function (EF) (Beauchamp & Anderson, 2010; McKown et al., 2009; Yeates et al., 2004). EF refers to a multiple higher order process system that serves as an integrated supervisory control mechanism for thought and action that is mediated by prefrontal areas of the brain (Golstein, Naglieri, Princiotta & Otero, 2014). Self-regulation is generally conceived of as the ability to guide, monitor, and direct one’s performance to successfully manage behaviour and achieve goals (Singer & Bashiri, 1999, Hofmann, Schmeichel & Baddely, 2012). EF and self-regulation are thus inextricably linked (Hofmann et al., 2012; Rueda, Possner & Rothburt, 2005), but have largely been examined separately in relation to social competence. This is likely because the concept of self regulation has been studied predominantly in social and personality research, whereas EF has been examined predominantly in cognitive psychology and the neurosciences. In the last few years, however, there has been some attempt to link these concepts, and there is accumulating support for the idea that EF skills in fact promote self-regulation in terms of direction and control across the domains of cognition, action, and emotion (Hofmann et al., 2012; McCloskey, 2009, 2011).

Conceptually, it makes sense that EF contributes to self-regulation. For example,
when a child wants to hit a sibling but refrains from doing so, he/she is self-regulating an impulse. When a child follows-through with a promise to help a friend with homework instead of engaging in a fun activity, he/she is resisting temptation. Self-regulation also includes the ability to delay gratification, such as when a child overrides the desire to buy candy in order to save money to purchase a future item. Attention helps a child to resist distraction, working memory helps to keep a goal in mind, inhibition helps withhold predominant responses, and planning helps a child think ahead. Thus, in order to successfully self-regulate behaviour, a child must successfully use various EF skills.

EF abilities are, therefore, central to self-regulatory processes and contribute significantly to the development of socially acceptable behaviour. Recent conceptualisations have emphasized the importance of EF skills in self-regulation (Barkley, 2012; McCloskey, 2009, 2011), and have asserted that self-regulation should indeed be subsumed under the overarching umbrella of EF (Berkman, Graham & Fisher, 2012; McCloskey, 2011).

2.3.1 The McKown model of social competence. This model represents a recent integration of SEL and self-regulation (McKown et al., 2007). SEL skills comprise various social-emotional comprehension skills, which constitute an integrated representation of socio-cognitive and socio-affective factors. An important contribution of this model is the robust empirical analysis of SEL antecedents to social competence. McKown et al. (2013) proposed a two-factor and a three-factor model of SEL that includes nonverbal awareness (affect recognition), social meaning (interpretation of social cues) and social reasoning (social problem solving); the two-factor model included nonverbal awareness in one domain and an amalgamation of social meaning and social
problem solving in the other domain. McKown et al. decided on the three factor model due to its better fit with the empirical data and closer correspondence to their conceptualisation of SEL (see Figures 1a & 1b). McKown et al. (2009; 2013) subsequently demonstrated that SEL skills are independent predictors of social competence for both typically developing children and children with various mental health disorders. Each domain in the two and three factor models of SEL was positively correlated with social competence. Overall, the better developed a child’s SEL, the more positive their social interactions and peer relationships. The McKown model thus has important theoretical and clinical implications because it demonstrates that SEL skills have concurrent, incremental and discriminative validity for social competence (Lipton & Nowicki, 2009; McKown, 2007; McKown et al., 2009; McKown et al., 2013). Moreover, McKown et al. (2013) demonstrated that the construct of social emotional comprehension can be reliably assessed with psychometric measures that directly reflect the critical dimensions of SEL. Also, the McKown model includes the concept of self regulation, defined as "the ability to modulate attention and behaviour in response to a situation" (McKown et al., 2009; p.860) and provides data demonstrating that both SEL and self-regulation are significant independent predictors of social competence; indeed, self-regulation was shown to be more highly correlated to ratings of social competence than SEL.

One drawback of the McKown model, however, is the narrow measurement of social competence using only three subscales of the Social Skills Rating System (SSRS: Gresham & Elliot, 1990) in one study and two subscales of the Behavior Assessment System for Children (BASC: Reynolds & Kamphaus, 1992) in another. Together, these
Figure 1a: McKown et al. (2009) three-factor model of the relationship between social-emotional learning (SEL) skill, self-regulation, and social competence

Figure 1b: McKown et al. (2009) two-factor model of the relationship between social-emotional learning (SEL) skill, self-regulation, and social competence
subscales reflect important aspects of social competence for children related to cooperation, assertiveness and self-control, but do not tap the full range of indicators of social competence. Another limitation with the McKown model is the narrow measurement of self-regulation that focused only on attention and inhibition, and that was assessed only through parental ratings. Further, the measurement of self-regulation and social competence similarly used the same parental report, potentially influencing the findings due to shared rater and method bias. The McKown Model could also be expanded to include consider a wider range of self-regulatory behaviours that might be re-conceptualised as the broader range of EF skills. Specifically, while the McKown Model includes inattention, which is one component of cognitive regulation, there are other aspects of cognitive regulation, such as planning and working memory, which may also play a role in social competence. Similarly, while the McKown Model includes inhibition, which is one component of behavioural regulation, it neglects to consider other aspects of behavioural regulation, such as self-monitoring and suppression of automatic impulses that may also be important. Moreover, despite being identified as a basic element in social interactions and a critical component of social competence (Eisenberg et al., 2000b; Halberstadt et al. 2001; Saarni, 1999; Smrud-Clikeman, 2007; Sigman & Ruskin, 1999), emotion regulation is not addressed in the McKown Model.

The McKown Model, therefore, might be improved upon by expanding the range of indicators of social competence and by including a more comprehensive conceptualization of cognitive, behavioural and emotional regulation consistent with recent notions of EF. Specifically, direct evaluation of a broad range of EF skills that subserve self-regulatory processes may provide a more comprehensive examination of
antecedents of social competence and provide valuable information for targeted intervention (Hofmann et al., 2012). To address these limitations, the present study extends the McKown Model of social competence to include a comprehensive evaluation of EF within the three domains of regulation – cognitive, behavioural and emotion regulation – in order to determine the specific antecedents to social competence in ASD. Such a comprehensive approach to studying factors that directly and indirectly interact in the development and maintenance of social competence in both neurotypical and clinical populations has previously been proposed (Beauchamp & Anderson, 2010; Yeates et al., 2007). For example, in a study of 228 adolescents, Rinsky and Hinshaw (2012) demonstrated that direct measures of planning, inhibition and working memory predicted social competence in teens with and without ADHD. Interventions targeting specific EF skills have demonstrated improvements in social behaviour in typical young children (Diamond, Barnett, Thomas & Munro, 2007), and reduction in behaviour problems in school-aged children (Riggs, Greenberg, Kusche & Pentz, 2006), and those with ADHD (Berkman, Graham & Fisher, 2012).

2.4 Executive Functions

EF is generally defined as a multiple process system that serves to control and integrate higher order cognitive processes that are involved in thought, action, and goal-directed behaviour (Anderson, 2002; Kerr & Zelazo, 2004; Rasmussen & Bisanz, 2009). Self-regulatory functions are considered a hallmark feature of EF (Giurak et al., 2009; McCloskey, 2009, 2011; Wasserman & Wasserman, 2013; Ylisaker & Feeney, 2002; Zhou, Chen & Main, 2012) and may be best understood as a core element of EF that is
involved in the conscious regulation of thought, emotion, and behavior (McCloskey, 2006; Zelazo, 2010).

Recent conceptualizations of EF propose a multifaceted construct based on three distinct but interrelated dimensions of self-regulatory processes: cognitive, behavioural and emotion regulation (Ganesingham et al., 2006; 2007a; 2007b; Gioia et al., 2002; Jahromi & Stifter, 2008; McCloskey, 2011; Wasserman & Wasserman, 2013; Zhou et al., 2012). Cognitive regulation is typically operationalised as attention, planning, working memory, flexibility and processing speed (Anderson, 2002; Hill, 2004; Roberts & Pennington, 1996; Russo et al., 2007). Behavioural regulation refers to various aspects of inhibitory control, including the ability to regulate activity level, self-monitor and suppress automatic impulses (Hinnant & O'Brien, 2007). Emotion regulation is distinguished from Behavioural and Cognitive Regulation by the extent to which it involves affect and regulation. Emotion regulation has been defined as the ability to modulate emotional expressions to meet situational demands and achieve personal goals (Blandon, Calkins & Keane, 2010; Dennis, 2010; Lewis, Lamm, Segalowitz, Stieben & Zelazo, 2006). While some have conceptualised EF dimensions as interrelated and interdependent (Anderson, 2002), others have conceptualised them as interrelated but distinct (Korkman, Kirk & Kemp, 2007; Lehto et al. 2003; Miyake et al., 2000). EF regulatory processes, however, are fundamentally and conceptually linked at the behavioural and neural levels (Calkins, 2010; Ganesalingam et al., 2007).

Developmentally, EF skills emerge at different times during early childhood and continue to improve throughout adolescence and early adulthood (Best & Miller, 2010). An integrated model of EF thus considers developmental aspects of EF and the important
contributions of cognitive, inhibitory and emotional aspects of EF to a child's developing social competence (Barkley, 1997; Best & Miller, 2010; Blair, Zelazo & Greenberg, 2005; Hongwanishkul et al., 2005; Jahromi et al, 2008; McCloskey, 2009, 2011; Ylvisaker & Sweeney, 2002).

While this three-dimensional conceptualisation of EF is supported in recent literature (Egeland & Fallmyr, 2010; Gioia et al., 2002; Gioia et al., 2010; Jahromi & Sifter, 2008), it has not been investigated in children with ASD. However, correlations have been found among the cognitive, behavioural and emotion regulation domains in young neurotypical children (Jahromi & Stifter, 2008) and children with acquired brain injuries (Ganesingham et al., 2006, 2007). A three-part approach also accords with present knowledge of multifaceted brain functioning (Egeland & Fallmyr, 2010; Ganesingham et al., 2007; Gioia et al., 2002; Zelazo & Muller, 2002).

In sum, the three domains of EF – namely, cognitive, behavioural and emotional regulatory processes – provide a more current and broader conceptualisation of EF to explore in relation to social competence. While the McKown model provides an empirically sound avenue to evaluate the role of SEL in the social competence of children with ASD, adapting it in accordance with the tri-partite conceptualization of EF allows for the direct and independent evaluation of two potential important antecedents of social competence, namely SEL and EF. The current study extends McKown's SEL model to further explore the relationship between the three domains of SEL, the three domains of performance-based and parent-rated EF and social competence in children with high functioning ASD (see Figure 3). Next, the three domains of EF – cognitive, behavioural and emotional regulation – will be further explored in relation to children with ASD.
2.5 EF in Relation to ASD and Social Competence

Cognitive, behavioural and emotion regulation domains of EF have been linked to social competence in typically developing children and certain clinical groups (e.g. ADHD; TBI), and the conceptualisation of EF as comprising cognitive, behavioural and emotion regulatory processes has been supported in the recent literature (Ganesingham et al., 2006; 2007a; 2007b; Gioia et al., 2002). Deficits in some executive functions are also well-documented in school-age children with ASD (see reviews: Hill, 2004; Pennington & Ozonoff, 1996; Russo et al., 2007; Sergeant, Geurts, & Oosterlaan, 2002). For example, it has been demonstrated that, as a group, children with ASD perform significantly worse than neurotypical children on both performance-based and parent-rated measures of EF, and that their performance is not correlated with IQ (Landa & Goldberg, 2005; Liss et al., 2001). However, there is still no consensus on which specific aspects of EF are most impaired in school-aged children with ASD (Barron- Linnankoski et al., 2014; Corbett et al., 2009; Narcizi et al., 2013; Rinehart, Bradshaw, Tonge, Brereton & Bellgrove, 2002; Semrud-Clikeman et al., 2010; van Rijn et al., 2013) and no study has yet examined cognitive, behavioral, and emotional regulatory aspects of EF in relation to social competence in ASD.

2.5.1 Cognitive regulation and social competence. Three aspects of cognitive regulation - attention, planning and working memory – have been well-studied in children with ASD. Attention processes include the capacity to selectively attend to specific stimuli (selective attention) and to focus on a specific task and suppress
Figure 3. The proposed tripartite EF and SEL domains using McKown and colleagues' 2009 three-factor model of SEL as a framework.
irrelevant stimuli (sustained attention) (Anderson, 2002). Planning is a "complex, dynamic operation in which a sequence of planned actions must be constantly monitored, re-evaluated, and updated" (Hill, 2004, p.192). Working memory entails simultaneously remembering and manipulating incoming information (Russo et al., 2007).

A child's ability to attend to relevant social cues or social information is thought to impact his/her behaviour in social situations. Furthermore, effective social interactions rely on the ability to hold context- and content-specific information in mind regarding the verbal and nonverbal messages being provided by another person, and then planning how to respond appropriately in order to achieve a goal, be it social interaction, making a request, or negotiating (Bennetto, Pennington & Rogers, 1996). In a series of studies with typically developing children, sustained attention was significantly associated with positive peer relationships in school-aged children (Hughes, Dunn, & White, 1998; NICHD 2003; NICHD, 2009; Murphy, Brinkman & McNamara, 2007). In a longitudinal study, attention and planning in childhood were significantly related to peer competence in adolescence (Landry & Smith, 2010). Working memory has also been correlated with factors related to social competence, such as facial affect recognition (Mathersul et al., 2009), and with Theory of Mind (ToM) in children (Hughes, 1998). The importance of working memory in social competence is often cited (e.g. Beauchamp & Anderson, 2010), but has rarely been directly examined in typically developing children.

Although there is some evidence that children with ASD perform significantly worse than neurotypical peers on three aspects of cognitive regulation: sustained attention, planning and working memory (Hill, 2004; Russo et al., 2007), findings are mixed. For example, while some studies have also found that children with ASD perform
significantly worse than neurotypical controls and children with ADHD on measures of attention (Corbett et al., 2009; Corbett & Constantine, 2006; Kenworthy et al., 2009; van Rijn et al., 2013), others have not (Goldberg et al., 2005; Johnson et al., 2007; Sanders et al., 2008). The inconsistent findings may be a result of the differences in the populations sampled. For example, Goldberg and colleagues (2005) excluded children who were rated above the cut-off scores on parent-rated measures of inattention, hyperactivity or impulsivity. It is also unclear if both visual and auditory modes of sustained attention are equally impacted in ASD (Corbett & Constantine, 2006; Corbett, Constantine, Hendren, Rocke & Ozonoff, 2009).

There is substantial evidence that children with ASD have significant impairments in planning tasks compared to neurotypical children (Hill, 2004; Liss et al., 2001; Ozonoff & McEvoy, 1994; Robinson, Goddard, Dritschel, Wisley & Howlin, 2009) and children with ADHD (Sergeant, Geurts & Oosterlaan, 2004). There is some evidence that children with ASD have deficits in working memory, although the results are mixed. Variable results appear to be a function of the task, with children doing better when required to respond to verbal rather than visual stimuli. Therefore, while children with ASD performed the same as neurotypical peers on measures of verbal working memory (Geurts et al., 2004; Ozonoff & Strayer, 2001), they performed significantly worse on measures of visual working memory (Landa & Goldberg, 2005; Goldberg et al., 2005). In one well-designed study, the Goldberg research team (2005) demonstrated that children with ASD performed significantly worse than neurotypical peers on measures of planning and visual working memory despite being matched on age, verbal and performance IQ and social economic status (SES). These findings emphasize that the nature of the task
needs to be considered in any study design and analysis, and that visual working memory should be specifically targeted in studies with the ASD population.

Few studies have examined the relationship between components of cognitive regulation and social competence of children with ASD. Both spatial working memory (Gilotty et al., 2002; Landa & Godlberg, 2005) and planning (Happe, Booth, Charlton & Hughes, 2006) have been significantly associated with social deficits in children with ASD. Happe and colleagues (2006) found that planning and working memory were related to social competence for children with ASD but not for those with ADHD or neurotypical children. In contrast, Joseph and Tager-Flusberg (2004) found no relationship between cognitive indices of EF and social deficits in ASD. Thus, while there is some evidence to support the hypothesis that the cognitive domains of EF are associated with social competence in ASD, most studies focused on social impairment and thus further study is clearly required (Riggs et al., 2006b).

2.5.2 Behavioural regulation and social competence. Behavioural regulation refers to various aspects of inhibitory control, including the ability to regulate activity level, self-monitor and suppress automatic impulses (Hinnant & Obrien, 2007). Effective social interactions often require the withholding of dominant responses (Rueda, Posner & Rothbart, 2005), and inhibitory skills are central in suppressing salient thoughts and behaviours in favour of those that are more socially appropriate (Channon & Watts, 2003; Ciairano et al., 2007). Many studies have evaluated the association between inhibition and social outcome in school-aged children, but most have focused on problematic behaviours rather than social competence. Decreased inhibition has been associated with problematic behaviours, such as aggression, non-cooperative behaviour, and
noncompliance (Huyder et al., 2012; Thorell, Bohlin & Rydell, 2004; Vuontele et al., 2012). The association between inhibition and aspects of social competence, such as cooperative behaviour, has been documented in neurotypical children (Ciairano, Visu-Petra & Settanni, 2007). Inhibition has also been found to predict concurrent and future levels of social competence in neurotypical children (NICHD 2003; NICHD, 2009; Nigg et al., 1999; Smith, 2010).

The evidence regarding inhibitory control in children with ASD remains inconclusive, with some studies reporting deficits relative to control groups (Kenworthy et al., 2009; Narzisi, Muratori, Calderoni, Fabbro, & Urgesi, 2013; Robinson et al., 2009; van Rijn et al., 2013) and others reporting intact inhibition (Barron et al., 2014; Christ et al., 2007; Hill & Bird, 2006). The inconsistency between studies is likely related to the type of inhibition evaluated. Specifically, children with ASD typically perform as well as neurotypical peers during tasks of neutral inhibition (e.g., push button for X and withhold for Y), but perform significantly worse when required to inhibit an over-learned or dominant response in favour of an unusual one (Hill, 2004; Homack & Riccio, 2004; Russo et al. 2007; Sanders et al., 2008). Only a few studies have directly compared the effect of modality on performance, and again, results are inconclusive. Sanderson & Allen (2013) administered multiple inhibitory tasks to 31 six to eleven year old children with ASD and a mental-age matched control group. They found intact performance on tasks requiring the suppression of a habitual response, but impaired performance on tasks that required both suppression of dominant response and the replacement with an opposing response. In contrast, another series of studies found that children and adolescents with ASD performed as well as a control group on both types of inhibition.
(Christ, Holt, White & Green, 2007; Christ, Kester, Bodner & Miles, 2011). It is possible that the wider age range in these studies had an impact on performance. Thus while it is clear that children with ASD do not demonstrate a global inhibitory impairment, there is evidence that performance differs across tasks and thus using multiple inhibitory tasks when examining inhibition in children with ASD is warranted. Furthermore, although task complexity likely impacts performance, it is unknown whether using stimuli that require visual or auditory responses makes a difference.

Several studies have examined the relationship between behavioural regulation and social functioning of children with ASD. Inhibition was significantly associated with adaptive socialisation (Happe et al., 2006), symptom severity (Lieb, 2011; Scheeren, Koot & Begeer, 2012) and behaviour problems (Lieb, 2011). Happe and colleagues (2006) found that inhibition was related to social competence for children with ASD but not for those with ADHD or the neurotypical children. In one small study of 3 to 10 year old children with ASD, parental ratings of inhibition were significantly associated with affect regulation (Konstantareas & Stewart, 2006). That is, children with lower inhibitory control had less adaptive affect regulation strategies. In contrast, one study found no significant association between inhibition and social deficits as measured by the ADOS (Joseph & Tager-Flusberg, 2004).

2.5.3 Emotion regulation and social competence. Emotion regulation is considered a 'hot' executive function (Kerr & Zelazo, 2004) in the neuropsychological literature, where it is more specifically defined as affective or value-based decision-making and measured through various gambling tasks or simulated high-risk situations (Ardila, 2013). The whole premise of these tasks is that those who have better affective
decision making are able to strategically adjust their decisions based on previous wins and losses in highly motivating situations where there is some sort of personal gain to be made (Blair, Zelazo & Greenberg, 2005; Faja, 2013; Hooper, 2004). It is the experience of emotion that is tied to, or guides the decision making process (Buelow & Suhr, 2009). Developmentally, successful performance thus requires that children forgo short-term gains for long-term benefits and also involves the ability to adjust behaviour on the basis of feedback cues (Cassotti et al., 2011), which helps children operate in emotionally and motivationally charged situations (Carlson, Zayas & Guthormsen, 2009; Zelazo & Carlson, 2012).

Emotion regulation was previously viewed as a separate functional dimension but has recently been incorporated as part of the tripartite EF construct. Neuro-imaging studies and neuropsychological research support the role of emotion regulation as a domain of EF. Neuro-imaging and lesion studies have demonstrated that affective decision making is associated with a distinct functional-anatomical network within the ventromedial prefrontal cortex (Glascher et al., 2012; Mitchell, Rhodes, Pine & Blair, 2008), sharing neural underpinnings with both behavioural and cognitive regulation (Dennis, 2010; Dennis, Malone & Chen, 2009; Hongwanishkul, Happaney, Lee & Zelazo, 2005; Lewis et al., 2006). Behaviourally, several recent confirmatory factor analyses of the Behavior Rating Inventory of Executive Functions (BRIEF) (Gioia, Isquith, Guy & Kenworthy, 2000) also demonstrated a distinction between cognitive, behavioural and emotion regulation (Egeland & Fallmyr; 2010Gioia et al., 2002).

The ability to regulate affect has been demonstrated to play an important role in the development of social competence, particularly peer relationships (Aldao, Nolen-
Hoeksema & Schweizer Lewis, 2010; Blandon et al., 2010; Carthy et al., 2010; Eisenberg et al., 1995, 1997; Gross & Thompson, 2007; Kochanska, Murray, & Harlan 2000; Lewis, Zinbarg & Durbin, 2010; Thompson, Lewis & Calkins, 2008;), but the relationship between affective decision making and social competence has not been explored. Affective decision making has been studied in relationship to some EF tasks (da Mata et al., 2011; Toplak, Sorge, Benoît, West & Stanovich, 2010), but not in relationship to social competence. A few studies have found a significant association between affective decision making and symptom severity of ADHD (Geurts, van der Oord & Crone, 2006; Groen, Gaastra, Evans & Tuche, 2013; Toplak, Sorge, Benoît, West & Stanovich, 2010). The few studies that investigated affective decision making within the ASD population have all reported no differences compared to a control group (deMartino et al., 2008; Faja, 2013; Johnson & Yechiam, 2006; Russo, 2002; Sawa et al., 2013; South, 2011; South et al., 2008; Yechiam et al., 2010). However, several studies reported that those with ASD respond differently to the emotionally relevant stimuli (deMartino et al., 2008; Johnson et al., 2006; South et al., 2011; Yechian et al., 2010). In a study of 8 to 18 year old children with ASD, South and colleagues (2011) demonstrated that those with ASD adjusted their behaviour based on losses (punishment) whereas the control group adjusted their behaviour based on gains (rewards). In addition, performance on affective decision making was significantly associated with parent-rating of behavioural inhibition. No studies to date, however, have examined the association between emotion regulation and social competence in children with ASD.

2.5.4 Parent-ratings of EF. In addition to performance-based measures, numerous studies incorporate parent-ratings when evaluating EF in children. Parent-ratings of EF
provide an alternate measure of EF as applied to everyday life, and are assumed to provide 'real-world context' to EF measurement. In the most commonly-used measure – the Behaviour Rating Inventory of Executive Function ((BRIEF: Gioia et al., 2002) – parent ratings provide information on a range of skills related to metacognitive, behavioural and emotion regulation skills, such as working memory, inhibition and emotional control. All published studies using the BRIEF with the ASD population have demonstrated significant EF deficits compared to neurotypical samples (Kalbfleisch & Loughan, 2012; Kenworthy et al., 2008; 2009; 2010; Rosenthal et al., 2013; Troyb et al., 2013), even for children and adolescents diagnosed with ASD before age five but who no longer met DSM-IV criteria (see Troyb et al., 2013).

Parent-ratings of EF have, however, also been criticized for their lack of correlations with performance-based measures. McAuley and colleagues (2010) reviewed 12 studies involving neurotypical children between ages 6 and 18 that compared performance-based EF scores with the Behaviour Rating Inventory of Executive Function (BRIEF), and found eight studies that reported some significant correlations between isolated EF tasks and parent ratings of EF. Given the wide range of performance-based EF measures used across these studies, the association between performance-based EF measures and parent ratings of their child's EF remains inconclusive. More recently, Toplak and colleagues (2013) reviewed 13 studies comparing performance-based and parent-rated EF and reported that 35 out of a total of 182 correlations (19%) were statistically significant. Despite these criticisms, researchers continue to use EF ratings in research with children (Denckla, 2002; Isquith, Roth & Gioia, 2013; Rosenthal et al., 2013; Toplak, West & Stanovich, 2013). It is important to recognize that performance-
based and parent-rated measures of EF are not equivalent measures per se, but that they are likely measuring parallel and distinct EF processes. Incorporating a parent measure of EF provides relevant information regarding a broad range of EF in everyday context and the application of EF in less structured and more complex contexts (Denckla, 2002; Donders & Larsen, 2012; Isquith, Roth & Gioia, 2013).

2.5.5 Summary. There is substantial evidence that children with ASD have deficits in EF related to cognitive regulation and behavioural regulation. Although emotion regulation has been largely ignored in the ASD research, there is some reason to believe that affective decision making may be impaired in children with ASD. While there is some evidence that the three domains of EF are associated with aspects of social competence in both ASD and neurotypical children, further study is clearly required (Happe et al., 2006; Riggs et al., 2006b). Studying the antecedents of social competence in ASD in the context of a comprehensive model that incorporates the tripartite model of EF and SEL may help to further explain the nature of social dysfunction in ASD and lead to more effective intervention strategies. The relationship between SEL and social competence of children with ASD is explored in the next section.

2.6 Social Emotional Learning

Social emotional learning skills are generally accepted as key antecedents of social competence and are often an important focus of intervention in ASD (Rao et al., 2008). The McKown (2013) model identifies three domains (Nonverbal Awareness, Social Meaning and Social Reasoning) relevant to SEL.

2.6.1 Nonverbal awareness. Nonverbal awareness generally refers to affect recognition, namely the ability to interpret nonverbal cues that signal others’ emotions.
Affect can be inferred via facial expressions, tone of voice and/or posture. Affect recognition is considered a core skill that promotes the development of more complex aspects of SEL (Lemerise & Arsenio, 2000; Izard, 2001; Singh et al., 1998). In other words, a child must be able to first accurately recognise facial affect in order to interpret the mental state of others, to understand others’ behaviour and to appropriately respond.

Izard (1971) first highlighted the role of affect recognition in the development of social competence in children, and that since has been demonstrated to be a significant predictor of longer-term social competence (Frith & Baron-Cohen, 1987; Izard et al., 2001; Joseph & Tager-Flusberg, 2004; Semrud-Clikeman, 2007). In a recent meta-analysis, Trentacosta and Fine (2010) found nonverbal awareness to be a significant correlate of social competence in a wide range of neurotypical samples. Furthermore, there is evidence to suggest that inferring affect through facial expressions, voices and posture is significantly correlated (McKown et al., 2009; Trentacosta & Fine, 2010). More importantly, an association between the ability to recognize complex emotions in faces and voices separately, as well as to recognize complex emotions when facial, vocal and contextual information is integrated, has been demonstrated. These findings suggest that isolated affect recognition tasks offer an ecologically valid assessment of nonverbal awareness.

Studies examining facial affect recognition abilities in children with ASD have found that they perform more poorly than neurotypical children when tasks involve the identification of more complex and intense emotions, such as pride and jealousy (Begeer et al., 2008). There is less agreement regarding the ability of children with ASD to recognize facial affect in regard to more simple and basic emotions, such as happiness,
anger, sadness and fear. Some studies have found significant deficits when compared to neurotypical peers (Bolte & Poustka, 2003; Mazefsky and Oswald, 2007; Rump, Giovannelli, Minshew & Strauss, 2009; Semrud-Clikeman, Walkowiak, Wilkinson & Butcher, 2010), whereas others have not (Adolf, Sears & Piven, 2001; Castelli, 2005; Gross, 2004). This disparity may be due to the different levels of emotion intensity used across studies, which is often not identified or examined. For example, it is possible that children with ASD are able to identify more obvious (i.e., high intensity) but not more subtle (i.e., low intensity) demonstrations of affect. One study that directly examined the role of intensity found that children with ASD performed more poorly than neurotypical children when the tasks involved identifying more subtle facial expressions (i.e., low intensity) and tone of voice (Mazefsky & Oswald, 2007). Therefore, studies examining affect recognition with the ASD population need to consider both the intensity and complexity of the emotions being assessed.

Data on voice affect recognition of children with ASD is sparse and the findings are mixed. Some report that children with ASD show deficits compared to typically developing peers (Lindner & Rosen, 2006; Oerlemans et al., 2013; Peppe, McCann, Gibbon, O'Hare & Rutherford, 2007), while others do not (Brooks & Ploog, 2013; Mazefsky & Oswald, 2007; Paul, Augustyn, Klin & Volkmar, 2005). For example, Mazefsky and Oswald (2007) found that children with HFASD performed significantly worse than the standardization sample whereas children with Asperger's performed within expected range. Paul et al. (2005) found that qualitatively adolescents with ASD relied solely on rate of speech to match voice to affect whereas typically developing peers
used both rate of speech and intonation to recognize emotion. These results were recently replicated by Brooks and Ploog (2013) using a novel video game format.

Affect recognition has also been significantly associated with social competence and social impairments in some studies (Braverman, Fein, Lucci, and Waterhouse, 1989; Joseph and Tager-Flusberg, 2004) but not others (Wong, Beidel, Sarver & Sims, 2012). For example, Wong and colleagues (2012) found that although 9 to 13 year old children with ASD performed significantly worse than neurotypical children in terms of affect recognition, their performance was not related to social competence.

2.6.2 Social meaning. Social meaning involves the understanding and interpretation of others’ communication. It encompasses the ability to interpret others’ intentions (ToM), interpret the social meaning of language (pragmatic language) and appropriately respond to others’ emotions (empathy) (McKown et al., 2009). Two aspects of social meaning – ToM and pragmatic language – have been thoroughly studied in children with ASD whereas empathy has been less examined with this population.

Theory of mind (ToM) is the ability to perceive others’ mental states, such as their beliefs and intentions (Baron-Cohen, 2009; McKown et al., 2009). The ability to understand that other’s thoughts and beliefs guide their behaviour allows a person to understand, predict or explain the behaviour of others (Baron-Cohen, 2009; Peterson, Garnett, Kelly & Attwood, 2009, p. 106). These 'mindreading' skills are considered a critical element for social competence because they allow a person to consider the perspective of others, which is critical to social competence.

Numerous studies have demonstrated a developmental progression of these skills. Mastery of less complex, or first order ToM tasks (Sally thinks friend A believes X)
typically occurs around age five, and mastery of more complex, or second order ToM tasks (Sally thinks friend A believes friend B believes X) by age eight (Miller, 2009). Simple and complex ToM skills have been demonstrated to be significantly correlated with social competence (Astington, 2003; Hughes & Leekam, 2004; Miller, 2009; Peterson et al., 2009) and to be predictive of future social competence (Razza & Blair, 2009). There is consensus that the majority of children with ASD are able to pass simpler ToM tasks (e.g., A believes X), but results are mixed regarding more advanced ToM tasks (e.g., A believes B believes X). While most studies found a deficit compared to neurotypical peers (Baron-Cohen, Jolliffe, Kaland et al., 2008; Mortimore & Robertson, 1997; Nilsen & Fecica, 2011; Peterson et al., 2009; Wellman & Liu, 2004;), others did not (Begeer, Malle, Nieuwland & Keysar, 2010; Peterson et al., 2009). It has been demonstrated that when mastery does occur, it is usually at a much older age than typically developing peers (Miller, 2009; Peterson, Garnett, Kelly & Attwood, 2009).

ToM has been the most studied SEL in relation to social competence for children with ASD. For example, Peterson et al. (2009) demonstrated that children with ASD who passed ToM tasks were more socially competent than those who failed them. Tager-Flusberg (2003) found that ToM was significantly associated with socialization skills in 4 to 14 year old children with ASD, findings consistent with other studies (Frith et al., 1994; 2003; 2009; Peterson et al., 2009; Razza et al., 2009; Tager-Flusberg, 2003). However, several studies have failed to find a significant relationship between ToM and social competence (Begeer et al., 2011; Bennett et al., 2013) in similar-aged children with ASD.

**Empathy** is the ability to respond to someone else’s emotions in an appropriate manner (McKown et al., 2009; Baron-Cohen, 2009). It involves the ability to affectively
take the perspective of someone else and to demonstrate an emotional response congruent to their emotional state (Eisenberg, 2003). Two meta-analyses found a significant correlation between empathy and social competence (Eisenberg & Miller, 1987; Underwood & Moore, 1982) in neurotypical children and a recent longitudinal study of social competence (Smart & Sanson, 2003) reported that empathy was the most stable skill from early childhood to early adulthood. The significant association between social competence and empathy thus has important treatment implications for high-risk populations.

Poor empathy is a hallmark of ASD, but there are relatively few studies examining empathy in children with ASD. The majority of studies have demonstrated that children with ASD perform significantly worse than neurotypical peers across the age span (Auyeung et al., 2009; Baron-Cohen & Wheelwright, 2004; Charman et al., 1997; Wakabayashi et al., 2007; Yirmiya, Sigman, Kasari & Mundy, 1992), but there are some exceptions (Charman, Sweetenham, Baron-Cohen, Cox, Baird & Drew, 1997; Mcdonald & Messinger, 2012). For example, in one recent study where adolescents were asked to look at vignettes of emotionally charged situations and rate how they would feel if they were the actors, no difference between teens with ASD and neurotypical peers was found (Jones et al., 2010). The inconsistent findings may be explained by several factors. First, the modality used may impact results. In the Jones and colleagues (2010) study, the adolescents were not required to identify the emotion but rather rate the intensity of a designated emotion (e.g., "How guilty would you feel?"). Thus, while children with ASD may be able to rate emotions in a similar way to neurotypical peers, they may have more difficulty when asked to identify or respond to the observed emotions (e.g. Yirmiya et al.,
1992). Second, the inconsistent findings might be related to the inclusion of children of all developmental levels, as studies that include children with lower cognitive levels tend to demonstrate impairment in empathy (Bacon, Fein, Morris, Waterhouse & Allen, 1998; Scambler et al., 2007). Third, most ASD research focuses on cognitive empathy (the ability to infer someone else's feelings), not affective empathy (having a congruent response to others' emotions). Dissociation between cognitive and affective empathy has been demonstrated in several studies. For example, impaired cognitive empathy but intact affective empathy was demonstrated in children and adults with ASD using self-rated questionnaires (Jones et al., 2010; Rogers et al., 2007), as well as a direct measure of empathy (Dziodek et al., 2008; Schwenck et al., 2012). Given that cognitive empathy likely parallels ToM, more information on the affective empathy of children with ASD is needed. There has been some study on the relationship between affective empathy and social competence in ASD, with mixed results; positive correlations between empathy and quality of social interaction have been found in young children with ASD (Scambler, Hepburn, Rutherford, Wehner & Rogers, 2007; Travis, Sigman & Ruskin, 2001) but not in older school-aged children (Scheeren, Koot, Mundy, Mous & Begeer, 2013).

**Pragmatic language** refers to the use and interpretation of language for social meaning (Adams, 2002). Pragmatic skills involve “being able to use social contextual cues in order to understand a speaker’s meaning” (Coplan & Weekes, 2009 p. 240). They include rules for social communication, such as turn taking, responding to statements made by others, and maintaining a topic of conversation, as well as understanding subtleties of language, such as sarcasm and idioms. Pragmatic skills are significantly associated with social competence in preschool (Gertner, Rice, & Hadley, 1994; McCabe

While pragmatic language impairments are frequently cited in the ASD literature, they have not been extensively examined in empirical research. For example, in a recent review Loukusa and Miliken (2009) found only 20 studies on pragmatic language in the past two decades. In these studies, there was agreement across age ranges that children with ASD performed significantly worse than neurotypical peers on pragmatic language tasks. Few studies have directly examined the relationship between the pragmatics of language and social competence in the ASD population, and the studies that have been done produced mixed findings (Landa & Goldberg, 2005; Leonard, Milich & Losch, 2011).

2.6.3 Social reasoning. Social reasoning refers to the ability to problem solve when faced with social dilemmas or social provocations. It involves detecting a problem, and generating appropriate and effective solutions. Social reasoning is based on Crick and Dodge's (1994) Social Information Processing (SIP) model. SIP is a robust theory of social competence that has had a tremendous influence on our understanding of the manner in which social information is processed.

A plethora of research confirms that social problem-solving skills account for significant variance in social functioning throughout the life span (e.g. Bauminger, Edelsztein, & Morash, 2005; Ganesingham, Yeates, Sanson & Anderson, 2007b; Mayeux & Cillessen, 2003; Sibley, Evans & Serpell, 2010; Tur-Kaspa, 2004). Social problem-solving skills also account for significant variance in social functioning in different populations, such as children with ADHD (Sibley et al., 2010), children with internalising
disorders (Luebbe, Bell, Allwood, Swenson & Early 2010; Siu & Shek, 2010) and typically developing children (McKown, 2007; McKown et al., 2009).

There is general consensus that children with ASD are significantly poorer at social problem solving compared to neurotypical peers. A number of studies have consistently demonstrated that children (Meyer et al., 2006; Ziv, Hadad & Khateeb, 2013), adolescents (Flood, Hare & Wallis, 2011; Channon, Sharman, Heap, Crawford & Rios, 2001) and adults (Goddard, Howlin, Dritschel & Patel, 2007) with ASD perform significantly worse than neurotypical peers. Two studies specifically examining social problem solving skills in 7 to 13 year old children with ASD are particularly noteworthy. Demopoulos et al. (2013) studied 436 children with ADHD and 137 children with ASD with varying levels of intelligence, and found significant differences in social problem solving between the children and adolescents with ASD compared to the children with ADHD, and in comparison to normative sample data. In a series of studies by Channon et al., (2001), children were presented with short videos of situations involving some type of social problem, such as a neighbour's dog constantly barking and interfering with the actor's ability to do homework and sleep. The children were then asked a series of questions regarding what the actor should do. The researchers found that while children with ASD could identify the problem and come up with as many solutions as their neurotypical peers, they needed more prompts to do so, and the social appropriateness and effectiveness of their responses was significantly poorer. These impairments were found during both videotaped and story format vignettes.

Significant relationships have also been found between social problem solving and prosocial behaviours (Flood, Hare & Wallis, 2011), social difficulties and anxiety
(Meyer et al., 2006), as well as problem behaviours (Ziv, Hadad & Khatee, 2013) in children with ASD.

Overall, there is certainly some clear evidence that children with ASD do more poorly across the three domains of SEL (Nonverbal Awareness, Social Meaning, Social Reasoning) compared to neurotypical peers. Furthermore, although less well studied, there is reason to assert that the three domains of SEL contribute to social competence in neurotypical children, and several studies have demonstrated that SEL skills are significantly associated with some aspects of social functioning in children with ASD. Most of these studies, however, examined SEL skills in relation to social impairment or problematic behaviour, rather than social competence, the focus of the present study.

2.7 Heterogeneity in ASD

The clinical heterogeneity of children with ASD has been demonstrated throughout the SEL and EF literature. Statistically, a high degree of variances of scores in ASD have been reported on SEL skills (Wright et al., 2008; Yirmiya, Sigman, Kasari & Mundy, 1992), EF measures (Happe et al., 2006; Kenworthy et al., 2009) and parent ratings of EF (Boyd et al., 2009). Thus, in addition to overall deficient performance in EF and SEL areas of functioning, there is a greater range of skills and deficits in children with ASD than in their neurotypical counterparts. While comparisons with neurotypical peers have provided robust and valuable information regarding specific areas of SEL and EF in children with ASD, few studies have directly examined the wide variance in performance or explored the relationship between these skills and social competence. In short, even though a diagnosis of ASD denotes significant social impairments, there is still a wide range of social competence amongst this population (Bruining et al., 2010;
Exploring SEL and EF in the same study allows the thorough examination of factors that may help explain the heterogeneous nature of social competence in ASD.

### 2.8 Relationships Among SEL, EF and Social Competence

The relationship between EF and SEL skills in children with ASD is unclear. The EF components of working memory and sustained attention have been significantly associated with the SEL skill of affect recognition (Mathersul et al., 2009). The most robust findings come from the ToM literature and demonstrate that the SEL ability to understand others' beliefs is significantly associated with planning and inhibition (Carlson & Moses, 2001; Hill, 2004; Hughes, 2002; Joseph & Tager-Flusberg, 2004; Pellicano, 2010). It is also possible that the relationship between EF and ToM may be stronger for the ASD population than for neurotypical children. For example, Ozonoff et al., (1991) found significant positive correlations between EF and the SEL skill of ToM for children with ASD, but not for neurotypical children. While such findings offer important information regarding the association between EF and SEL, they do not allow for a comprehensive understanding of the relationship.

At present, there is limited knowledge of the mechanism by which EF and SEL may relate to social competence. One idea on how EF could affect social competence suggests that cognitive, behavioural, and emotion regulation could impact the detection, discrimination and processing of the subtle, dynamic, and complex cues in the social environment. Impaired EF could thus disrupt accurate processing of nonverbal cues, social meaning, and social reasoning, and thereby compromise a child's ability to appropriately navigate the social world. The argument could then be made that EF
impacts social competence via its relationship with nonverbal awareness, social meaning, and social reasoning. Support for this view comes from the ToM literature, which has demonstrated that EF predicts ToM, but not vice versa (Channon et al., 2001; Hughes et al., 1998; Hughes et al., 2004; Ozonoff et al., 1991). Longitudinal studies also provide compelling evidence that the EF components of working memory, planning, and inhibition play a critical role in the emergence of ToM in both the neurotypical and ASD population (Flynn, 2007; Hughes et al., 2000; Pellicano, 2010; Pellicano, 2007; Tager-Flusberg & Joseph, 2005).

Mediating factors in the relationship between EF and social competence have not yet been examined in ASD, but have been studied in other pediatric populations. For example, in the area of traumatic brain injury, studies by Yeates and colleagues found that SEL skills and EF independently predict social competence (Yeates et al., 2004; Yeates et al., 2007), and social problem solving and pragmatic language were found to partially mediate the effects of EF on social competence in children with frontal lobe injuries (Channon & Watts, 2003; Muscara et al., 2008). Thus, despite the complexities of the relationship between EF, SEL and social competence, the premise that SEL skills may mediate the influence of EF on social competence is worthy of further evaluation in children with ASD. As reviewed earlier, tripartite models for EF and SEL represent the best statistical and theoretical conceptualisations for such study (Ganesalingham et al., 2006; Gioia et al., 2010; McKown et al., 2009).

2.9 Limitations of the current literature

Most previous studies focused on: (1) differences between children with ASD and other diagnostic groups or neurotypical children; or (2) trying to explain social deficits in
Very few studies have explored the relationship between SEL or EF and social competence in children with ASD. Those that did typically targeted particular SEL or EF skills rather than explore the impact of the range of skills on social competence. While some significant associations have been demonstrated, the relationship between EF and SEL in relation to social competence for the ASD population is mainly speculative at this time. Further, the measurement of social competence is problematic in many previous studies. First, many studies that claim to examine social competence are in fact really looking at the association between SEL skills or amongst isolated components of an SEL skill and EF. For example, McCabe & Meller (2004) used measures of SEL skills of affect recognition and social problem solving to assess social competence. Second, the majority of studies in this area use the social interaction domain score from either the Autism Diagnostic Interview-Revised (ADI-R) or Autism Diagnostic Observation Scale (ADOS) to measure social functioning. This is problematic because the associations between social symptoms or deficits and social ability or adaptive functioning in daily life are weak (Klin et al., 2007). Furthermore, the ADI-R and ADOS focus on core DSM-IV symptoms rather than on a range of everyday social behaviours in natural settings, and therefore, information regarding a wide range of social behaviours and interactions is not considered. For example, the ADOS relies on an in-clinic administered assessment rather than on information obtained from more natural settings, and from those that involve peer interactions. There is also reason to believe that the ADOS social domain scores overestimate everyday social functioning in children with ASD. For example, in one study, 17% of the ASD sample did not reach criteria for an ASD diagnosis on the ADOS
but were included because of confirmation of social impairment through comprehensive interview and expert opinion (Landa & Goldberg, 2005).

2.10 Integration and Aims of the Current Study

Social competence clearly plays an important role in overall quality of life in ASD. While the previous literature has demonstrated that children with ASD have specific deficits in SEL and EF compared to neurotypical children, few studies have examined the relationship between these variables and social competence in ASD. There is also a wide range of social competence in children with ASD that has not yet been fully studied.

The recent tri-partite model of EF allows a much broader conceptualization of cognitive, behavioural and emotion regulation than has previously been used in the ASD literature. Expanding on the previous narrow approaches to EF in the ASD literature allows for the study of multiple possible antecedents to social competence and provides a potential practical basis for targeted interventions. A comprehensive model of SEL has also yet to be used in the study of children with ASD. Incorporating the empirically validated and robust domains of SEL from the McKown model with the tripartite model of EF provides a more comprehensive approach to studying the social competence of children with ASD. Concurrently examining multiple domains of SEL and EF will also allow the assessment of important relationships between the constructs. A mediation model whereby SEL and EF impact social competence in children with ASD can also be taken into consideration. Further, prior studies have tended to rely on social impairment or behaviour problems rather than social ability or competence. More comprehensive measures of social competence, such as parent observations of peer relations, social skills
and adaptive social behaviour are needed to better examine the relationships among SEL, EF, and social competence (Ladd, 2005; Brown et al., 2008).

The overall aim of the current study is to thoroughly examine the relationship between SEL and EF abilities of children with ASD in relation to social competence. This study addresses many of the limitations of previous research in this area by comprehensively examining SEL and EF using recent tripartite models, and by conceptualizing and assessing social competence using a broad multidimensional approach (see Figure 4). The goal is to contribute valuable information regarding theoretical relationships among SEL, EF, and social competence in ASD, as well as implications for targeted clinical intervention to enhance social competence in children with ASD.
Figure 4. The proposed relationship between social competence, SEL and EF: a partial mediation pathway using McKown and colleagues' 2009 three-factor model of SEL as a framework.
3.0 Research Hypotheses

**Hypothesis 1:** Children with ASD will perform significantly different than neurotypical children in specific domains of EF, SEL and social competence.

a. It is hypothesized that, overall, children with ASD will score significantly lower than neurotypical children on all measures.

b. It is hypothesized that a greater percentage of children with ASD than neurotypical children will score within the clinical impairment ranges on measures of SEL, EF and social competence.

**Hypothesis 2:** Measures of Nonverbal Awareness, Social Meaning and Social Understanding will represent latent SEL domains for the ASD and control groups.

a. It is hypothesized that the factor-derived Nonverbal Awareness domain will comprise scores from tests of facial affect and voice affect recognition.

b. It is hypothesized that the factor-derived Social Meaning domain will comprise scores from tests of ToM, pragmatic language, and empathy.

c. It is hypothesized that the factor-derived Social Reasoning domain will comprise scores from tests of social problem solving.
Hypothesis 3: The measures of Cognitive, Behavioural and Emotional regulation will represent three latent EF domains for the ASD and control groups.

a. It is hypothesized that the factor-derived Cognitive Regulation domain will comprise scores from visual attention, visual working memory, visual attention, auditory attention, and planning.

b. It is hypothesized that the factor-derived Behavioural Regulation domain will comprise scores from auditory inhibition reaction time, auditory inhibition accuracy, and visual inhibition.

c. It is hypothesized that the factor-derived Emotional Regulation domain will comprise scores from affective problem solving.

Hypothesis 4: The proposed model of SEL and EF will account for significant variance in social competence among neurotypical children and children with ASD.

a. It is hypothesized that SEL will be significantly correlated with social competence, such that children scoring higher on measures of SEL will be rated higher in social competence by parents.

b. It is hypothesized that EF will be significantly correlated with social competence, such that children scoring higher on measures of EF will be rated higher in social competence by parents.
c. It is hypothesized that SEL and EF will independently predict significant variance in social competence.

d. It is hypothesized that EF will be more strongly associated with social competence for the children with ASD than neurotypical children.

**Hypothesis 5:** SEL will partially mediate the effect of EF on social competence.

a. It is hypothesized that SEL will be significantly correlated with EF.

b. It is hypothesized that the EF will have a significantly smaller effect on social competence after controlling for SEL.
4.0 Methods

4.1 Participant Recruitment

Ethical approval was obtained from the University of Regina, the Regina Qu'Appelle Health Region and Five Hills Research Ethics Boards (see Appendix A). Children with ASD were recruited through three Saskatchewan-based Autism Programs: The Autism Centre in Regina (Regina Qu’Appelle Health Region), Autism Spectrum Disorders Program in Moose Jaw (Five Hills Health Region) and Autism Services of Saskatoon. The coordinator at each program emailed the recruitment letter (see Appendix B) to the parents of children with ASD registered in their program. The researcher also attended ASD parent support meetings and parent psycho-educational groups at the Autism Centre to give a brief presentation about the study. Potential participants were provided the recruitment letter and information on how to contact the researcher. Posters about the study were put up at the Autism Centre and contact information was available at the reception desk. Finally, social media was used to recruit children. The moderator of the Saskatchewan Parents of Children with Autism Spectrum Disorders Facebook group posted the recruitment flyer for the study on the group webpage.

Children for the control group were recruited through a variety of means in the Regina area. These included posts on Facebook and emails to friends requesting that they forward to anyone who may be interested; emails to University of Regina and Regina Qu'Appelle Health Region employees; posters at pediatrician's offices, in community centers and grocery stores. The researcher also handed out recruitment flyers to parents at community soccer, baseball, and football games. The families who expressed interest in
the study were provided written information about the study and the researcher's contact information.

4.2 Data Collection

Prior to participating in the study, parents were provided an electronic copy of the consent and assent forms to read (see Appendix C). Data collection occurred at the University of Regina and University of Saskatchewan. Upon arrival, parents were provided a written copy of the consent form and signatures were obtained. Parents of children with ASD provided diagnostic reports or their consent to access health records to confirm the diagnosis of ASD, which had previously been made by either psychiatrists or psychologists based on DSM-IV-TR criteria (American Psychiatric Association 2000) as part of the clinical care of the child. Parents of children in the control group provided verbal confirmation that their son did not have any mental health diagnoses or learning disabilities. Before beginning, the researcher reviewed the assent form with the child and provided a Cineplex Cinema gift certificate worth $10.00. Children were then provided a visual schedule of all tasks they would be doing and instructed that they could ask for a break at any time. Individual testing sessions took approximately 100 to 130 minutes. Participants chose from a basket of small rewards (e.g. Mario cards; Star Wars stickers) at the end of the session.

Parents completed the demographic form and questionnaires while the researcher was administering the measures to the child in an adjoining room. All testing was completed individually in a room free from distractions. The administration of the tasks, which was the same for all participants, was in counterbalanced order, alternating between SEL and EF measures. While the children were doing a task on the computer
and again at the end of the session, the researcher reviewed the parental forms to ensure full completion.

4.3 Clinical File Review

As per RQHR ethics approval, the researcher reviewed 31 health records from the RQHR to confirm diagnoses. Eighteen parents of children with ASD provided psychological or psychiatric assessment reports as confirmation of an ASD diagnosis. Intellectual assessment scores for 11 children with ASD were obtained from the RQHR file review. These 11 children had completed the Wechsler Intelligence Scales for Children (WISC-IV) within the past 3 years and their full scale IQ scores were used for the analyses.

4.4 Participants

A sample of 99 boys, aged 8-13 years and their parent(s) participated in this study. The clinical group consisted of 51 boys with ASD and the control group consisted of 48 boys without mental health diagnoses or learning disabilities. Data from two participants with ASD were not used in the analyses because to the researcher they seemed to demonstrate inadequate comprehension of the instructions for the tasks. In terms of ASD diagnoses, seven children had a diagnosis of autistic disorder, 22 had a diagnosis of Pervasive Developmental Disorder Not Otherwise Specified and 20 had a diagnosis of Asperger’s Disorder. The children with ASD had received their diagnosis between 2.5 and 10 years of age \(M = 6.12, SD = 1.97\).

Table 1 provides demographic information on the children and parents in this study. As intended, the two groups did not significantly differ in terms of age, \(F(1, 96) = 1.10, p = .30\), family income, \(F(1, 96) = 3.21, p = .076\), or parent education level, \(F(1, 96) = 3.73, p = .055\).
Parents in both groups reported high family incomes (77% percent of participants had annual family incomes over $75,000) and high levels of education (86% of parents had completed post-secondary education). Children in the control group had slightly higher full scale IQ scores \((m=110.81, SD=10.00)\) than the children in the ASD group \((m=105.69, SD=13.77)\), \(F(1, 96) = 4.37, p = .04\). None of the children in the control group were taking any stimulant medications or other psychopharmacological interventions and 18 boys (36.7%) from the ASD group were on stimulant medication specifically targeting attention problems, including Methylphenidate (Concerta), Lisdexamfetamine (Biphentin), Dimesylate (Vyvanse) and Atomoxetine (Strattera).

### 4.5 Child Measures

Children were administered a measure of intellectual functioning to estimate IQ, 6 SEL tasks, and 8 EF tasks. A complete list of measures and can be found in Appendix E.

#### 4.5.1 Intellectual ability.

The Wechsler Abbreviated Scale of Intelligence (WASI) ([Wechsler](https://www.nimh.nih.gov/health/topics/assessment/intelligence/ameasur.html)) (Wechsler, 1999) was used as a brief estimate of intellectual ability. The WASI is part of a wide series of individually-administered Wechsler standardized instruments designed to assess general intelligence, IQ. The WASI has a wide age range (6-89 years) and is commonly used to estimate general intelligence in studies involving child clinical populations (Blunden, Lushington, Lorenzen, Martin & Kennedy, 2005; McClure et al., 2005; Raggio, Scattone & May, 2010), including ASD (Barnea-Goraly et al., 2004; Fuentes, Mostofsky & Bastian, 2010; Garcia-Nonell et al., 2008). The WASI uses a measure of Verbal Comprehension (Vocabulary) and Perceptual Reasoning (Matrix Reasoning) to provide an estimate of full scale IQ (FSIQ). The construct validity of the WASI has been demonstrated through various convergent validity coefficients \((r=0.85\) to...
Table 1.  
Demographic Variables for ASD and Control Group

<table>
<thead>
<tr>
<th></th>
<th>ASD Mean (SD)</th>
<th>CONTROL Mean(SD)</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>49</td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (yrs.)</td>
<td>10.0 (1.60)</td>
<td>10.31 (1.69)</td>
<td>.36</td>
<td>.73</td>
</tr>
<tr>
<td>Range</td>
<td>8-13</td>
<td>8-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ Range</td>
<td>105.69 (13.77)</td>
<td>110.81 (10.00)</td>
<td>4.37*</td>
<td>.04</td>
</tr>
<tr>
<td>Range</td>
<td>83-140</td>
<td>90-131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education (yrs.)</td>
<td>15.27 (2.19)</td>
<td>16.13 (2.20)</td>
<td>3.73</td>
<td>.06</td>
</tr>
<tr>
<td>Range</td>
<td>8-16</td>
<td>8-22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>105 549 (43 068)</td>
<td>120 000 (36 495)</td>
<td>3.21</td>
<td>.08</td>
</tr>
<tr>
<td>Range</td>
<td>&lt;25 000-</td>
<td>67 500-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;150 000</td>
<td>&gt;150 000</td>
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</table>

*indicates significance at \( p < .05 \)
0.89) (Canivez & Konold, 2009; Hays, Reas & Shaw, 2002) and exploratory and confirmatory factor analyses (Canivez & Konold, 2009). Correlations between the WASI estimated IQ score and the WISC-IV FS IQ is .83 (Saklofske, Prifitera, Rolphus, Zhu & Weiss, 2005).

WASI subtests are scaled in $T$ score units ($M=50, SD=10$), and the IQ scores are scaled in traditional IQ - standard score units ($M=100, SD=15$). The WASI Vocabulary and Matrix Reasoning subtests were administered to all children in the control group and to those children in the ASD group without a prior IQ score. Standard administration and scoring were conducted according to instructions in the manual.

4.5.2 Social Emotional Learning. SEL was assessed using both structured and semi-structured tasks. SEL domains that were assessed included Nonverbal Awareness, Social Meaning, and Social Reasoning.

Tasks of facial and voice affect recognition were used to evaluate Non-Verbal Awareness. The Diagnostic Analysis of Nonverbal Accuracy 2 (DANVA – 2; Nowicki & Duke, 1994) was used to measure nonverbal awareness. The DANVA-2 measures the ability to identify nonverbal cues regarding the emotional states of others. Reliability and validity data for these measures suggests it is an appropriate measure of facial affect and voice affect recognition for 8 to 13 year old children (Nowicki 1997; Nowicki & Carlton, 1993; Nowicki & Duke, 1994; Nowicki & Mitchell, 1998). In a trend analysis of 8 studies, accuracy scores were shown to increase with age (Nowicki and Rowe, 1997) and social competence (McKown et al., 2009).

In this study, children were asked to identify whether faces or voices were happy, angry, sad or worried. In the Child Faces condition, participants viewed 24 photographs
of children between the ages of 7 and 12 on the computer. The pictures included 12 female and 12 male expressions showing an equal number of happy, sad, angry and fearful faces of high and low intensity. In the Child Voices condition, the participants made judgments about the emotions of others from audio recordings of children repeating the same sentence ("I’m going out of the room now but I’ll be back later"). The recordings included 12 male and 12 female voices with equal amounts of happy, sad, angry and fearful tone of voice of high and low intensity. The four emotions were printed on a piece of paper to help participants remember the choices. The number of correct choices and errors was tallied for each test. Raw scores were used for most analyses but standard scores were also derived from a table of age norms.

Tasks of ToM, empathy, and pragmatic language were used to evaluate Social Meaning. The Strange Stories task (Happe, 1994; White, Hill, Happé, & Frith, 2009) was used to assess ToM. The Strange Stories were originally designed for children and adolescents with ASD and has become one of the most widely used ToM tasks in published research (Miller, 2009). The Strange Stories task is considered a second-order reasoning task designed to assess the ability to understand mental states such as belief, intention and deception, as well as the ability to understand that others have their own thoughts and ideas which may be different from their own. It consists of a series of brief vignettes in which participants have to accurately identify the underlying intention behind a character's statement. Normative data for the Strange Stories is based on typically developing 5-12 year old children (O'Hare et al., 2009). Strong validity, inter-rater and test-retest reliability have consistently been reported across studies (Hughes et al., 2000; Kaland et al., 2002; Kaland et al., 2005; Korkman, Kirk, & Kemp, 2007; O'Hare et al.,
Performance on Strange Stories has been significantly correlated with age (McKown et al., 2009) but not IQ (Happe, 1994; Jolliffe & Baron-Cohen, 1999; Kaland et al., 2008). Five vignettes from Happe’s (1994) set were used in this study. All participants were provided a written copy and also read the scenario and then asked two questions. The first question checked for comprehension ("was it true, what X said?") and the second question asked for justification ("Why did X say/do that"?), which requires knowledge of another individual’s point of view to answer correctly. Scoring is based on the participants' response to the mental state question, which can be scored as 0 (incorrect), 1 (partial) or 2 (full and accurate, which involves thoughts, feelings, desires). Total number of correct items was used as the raw score.

The Bryant Empathy Index (BEI) was used to assess affective empathy. The BEI is a widely used seven-item self-report questionnaire that measures a child's empathy-related responses. Consistent with previous studies (Krevans and Gibbs, 1996; Michalska et al., 2013; Robinson & Strayer 2007; and Zoll & Enns, 2005), questions tapping attitude were eliminated and the seven questions measuring affective empathy from the BEI were used in the current study. Participants rated to what extent they would feel a given emotion based on various situations, such as "It makes me sad to see a boy who can’t find anyone to play with" and "I really like to watch people open presents, even when I don’t get a present". The affective portion of the BEI has good internal consistency (Aristu et al., 2008, del Barrio et al., 2004 & de Wied et al., 2007) and demonstrates strong test–retest reliability for 8 -15 year old children (Bryant,1982; de Wied et al., 2007; Krevans & Gibbs, 1996). Concurrent validity has been demonstrated through significant correlations with the Empathy Continuum (deWied et al, 2005; Cohen & Strayer, 1996;
Fraser, 1996; Krevans & Gibbs, 1996; Strayer, 1993) and with the Eisenberg self-report questionnaire (Krevans & Gibbs, 1996). In this study, the seven questions were read to the children and they were also provided a written copy. All children understood the procedure, as indicated by their responses to trial items such as "I like ice cream/chocolate" and "I like soap in my eyes" (taken from Strayer & Roberts, 1989). A 4-point visual rating system was used in which participants chose whether the statement was 'not at all true' (0), 'a little true' (1), 'pretty much true' (2) or 'very much true' (3). The parents were also asked to complete this questionnaire based on their observations of their sons' behaviours in order to examine whether participants' self-ratings of empathy corresponded to parental ratings. The sum of points was used as the total raw score.

Pragmatic language was assessed using the Test of Pragmatic Language – Second Edition (TOPL-2; Phelps-Terasaki and Phelps-Gunn, 2007). The TOPL-2 is a 43-item norm-referenced oral language assessment for children aged 6 to 18. It is a well-designed assessment tool that provides a comprehensive evaluation of pragmatic language and allows the evaluation of an individual's ability to view a social situation and make judgments from the vantage point of an objective bystander (Hoffman et al., 2013). It assesses seven underlying areas of pragmatic language, including Physical Context, Audience, Topic, Purpose, Visual-Gestural Cues, Abstractions, and Pragmatic Evaluation. The TOPL-2 used a standardization sample of 1136 children between the age of 6 and 18. Good content, criterion and construct validity were demonstrated in the development of the TOPL-2. Concurrent and discriminant validity was also established in recent independent studies (Hoffman & Martens, 2013; Volden & Philips, 2010). The TOPL-2 was also demonstrated to predict outcomes beyond the contribution of general
language skills and nonverbal IQ (Volden & Philips, 2010). In this study, the 18 questions from the Pragmatic Evaluation component were administered to all participants in order to reduce redundancy and overlap with other measures of SEL, such as facial-affect recognition (visual-gestural cues), and ToM (abstractions). The Pragmatic Evaluation questions measure the awareness of rules of language in relation to specific social situations, while considering the situational context and intent of the communication (Phelps-Terasaki & Phelps-Gunn, 2007). Participants were shown pictures of common social situations, read a short vignette, and then asked to generate a response for one of the characters in the picture. One example depicts a boy holding broken roller blades whose parents are telling him they do not want to buy him new ones because he didn't take care of his old ones. The child is first asked, “What can Chad say to talk his parents into getting him new rollerblades?” and subsequently "how do you know what he says will talk them into it?". The child’s response was scored as correct (1) or incorrect (0) according to criteria provided in the TOPL-2 manual. The sum of the points for the 18 questions was used as raw score.

The Test of Social Problem Solving (TOPS-3E: Bowers, Huisingh & LoGiudice, 2005) was used to evaluate Social Reasoning. The TOPS-3E is a standardized measure of social reasoning composed of 18 photographs that depict different social situations. Children are asked to interpret information about social situations by responding to questions based on six areas of social reasoning. These include defining problems, identifying the causes of social situations, predicting outcomes, understanding social conventions, and generating solutions to social problems. For example, for one picture of a group of children sitting on the lawn, participants are told "this group was coming home
from their fieldtrip", then asked a series of questions, such as "how can you tell something went wrong on their way home" and also "they've been waiting a long time, why hasn't the school sent another bus to pick them up".

The TOPS-3E has a normative sample of over 1000 six to twelve year-old children. Strong validity, test–retest reliability and inter-rater reliability for the elementary edition have been demonstrated (Bowers et al. 2005; Zachman, Huisingh, Barrett, Orman & LoGiudice, 1994). Strong correlations with a social information processing interview were also reported (McGee et al., 2009). The TOPS-3E has been used in several studies with children with ASD (Baghdadli, Binot-Dubois, Pinot & Michelon, 2010; Stichter, O’Connor, Herzog, Lierheimer & McGhee, 2012; Stichter, O’Connor, Hertzog, Lierheimer & McGhee, 2012) as well as children with FASD (McGee, Bjorkquist, Price, Mattson & Riley, 2009), with both clinical groups performing significantly worse on the TOPS-3E than neurotypical children (Baghdadli et al., 2010; McGhee et al., 2009). Participants in this study were administered an abbreviated version of the TOPS-3E which included answering 50 questions based on 9 pictures targeting all 6 areas of social reasoning. Responses were scored on a 3-point scale (0-2) according to criteria provided in the TOPS-3E manual. Total points were tallied and used as raw the score.

4.5.3 Executive function. EF was assessed using structured performance-based tasks and parent ratings. The performance-based EF tasks were chosen on the basis of their reported sensitivity to EF in children within the 7-12 year old range, which corresponded well with the age range of the study sample. The measures that were used
assessed a theoretically meaningful range of executive functions. The EF domains that were assessed included measures of Cognitive, Behavioural and Emotion Regulation.

Measures of attention, planning and working memory were used to evaluate Cognitive Regulation. The Auditory Attention subtest of the NEPSY-II (Korkman, Kirk & Kemp, 2007) was used to assess auditory selective and sustained attention. The standardization sample of the NEPSY-II included 1200 children between the ages of 3 and 16. Strong psychometric properties for reliability and validity were reported for the 8 to 13 year-old range. Construct validity was obtained by various means, including expert review, extensive literature reviews, concurrent validity and empirical clinical evaluations with clinical populations. For this task, children are required to point to a colored circle each time they hear a target word in a series of random words on an audio-recording. Accuracy scores were calculated by summing total items correct on the target words, with a maximum score of 30.

The Tasks of Executive Control (TEC: Isquith, Roth, & Gioia, 2010) is computer-administered measure that was used to assess visual attention and visual working memory. The visual attention task is a simple choice response task. Participants are asked to sort all zebras appearing in the center of the screen into a red box, while non-zebra objects are to be sorted into the blue box. Sorting is done by pressing the relevant shift key, identified with a red or blue dot, with the corresponding right or left hand. Participants were not allowed to proceed with the task until they demonstrated adequate understanding of the task (defined as correctly completing the 10 practice items for each condition). Participants performed 100 trials per each task. The working memory task uses an n-back paradigm – a well-established measure of working memory (Owen,
McMillan, Laird, & Bullmore, 2005). Participants are required to monitor a series of visual stimuli and to respond whenever a stimulus is presented that is the same as the one presented in a previous trial from \( n \)-steps back in the sequence. Two levels of working memory demand were presented (1, 2-back). In the first working memory task, participants were asked to place an object in the red box if it appeared twice in a row (1-back). In the second working memory task, participants were asked to place objects in the red box if it appeared 2 objects back in the sequence (2-back).

Psychometric evaluation of the TEC has been primarily conducted through the standardization sample of 1138 children aged 5 to 18 years old, although some recent studies have demonstrated convergent validity with other measures of EF and in clinical populations, including ADHD (Gomez-Guerrero, 2011; Mairena et al., 2012) and mild TBI in children (Isquith, Roth & Gioia, 2010; Krivizty et al., 201; Roebuck-Spencer, Roth, Blackstone, Johnson & Gioia, 2011; Wolfe et al., 2013). The computerized scoring produces accuracy scores for the two tasks. Visual attention has a maximum score of 100 and working memory tasks have a combined maximum score of 40.

The Tower of London Drexel University – Second Edition (TOL\textsuperscript{DX}-2: Culbertson & Zimmer) was used as a measure of planning ability. This task is modeled after Shallice’s (1982) Tower of London. In this modified version, children are asked to rearrange three different colored beads situated on three vertical pegs of descending height, in order to replicate a pattern on the examiner’s peg board. Participants were instructed to replicate the examiner's bead configuration in as few moves as possible without violating two rules (moving only one ball at a time directly from one peg to another; and not putting more beads on a peg than it will accommodate). There are 10
trials, which increase in difficulty from a minimum of three to seven moves. The validity of the Tower task has been demonstrated in numerous neuropsychological studies conducted during the past few decades (Kaller, Unterrainer & Stahl, 2012; Swanson, 2005). The ToL$^{DX}$-2 standardization sample consisted of 990 7 to 80 year olds, of which 370 were between the ages of 8 and 12. Criterion, convergent and divergent validity have been established, in addition to moderate to high test-retest reliability. Numerous published studies have demonstrated that the ToL$^{DX}$-2 is sensitive to executive-function deficits in clinical populations, including children with ADHD (Culbertson & Zillmer, 1998, 2005), pediatric traumatic brain injury (Donders & Larsen, 2012) and ASD (Wallace, Silvers, Martin & Kenworthy, 2009). The children’s version (7-15 years old) of the ToL$^{DX}$-2 was administered to all participants. The raw 'total moves' score was used for analysis.

Behavioural regulation was measured using two inhibition measures, one from the TEC and one from the NEPSY-II. The TEC measure is a visual inhibition task that uses a go/no-go paradigm, in which a child must execute a response to visual stimulus 'A' but withhold a response to visual stimulus 'B'. It involves a continuously presented series of visual stimuli composed of frequent “go” cues to which participants respond as rapidly as possible and infrequent “no-go” cues to which participants are not to respond. The higher frequency of go cues creates a dominant tendency to respond that must then be inhibited for no-go cues (Schulz et al., 2007). The computerized scoring is based on accuracy of targets correct, with a maximum of 20. The NEPSY-II measure is an auditory inhibition task that assesses the ability to inhibit automatic responses in favour of novel ones. The task is a variation of the Stroop Color and Word Test (Homack &
Riccio 2004; Stroop, 1935). There are two components to this task. For the naming task, participants are asked to name a series of shapes and direction of arrows (up and down). In the inhibition component, participants are asked to name the opposite shape (e.g. when see circle say square) or direction (when the arrow is up say down). The reliability and validity of this task is well-established for the 7-12 year old range (Korkman et al., 2007). Scores are based on completion time and errors (a combination of self-corrected and uncorrected errors).

The Hungry Donkey Task (HDT: Crone & van der Molen, 2004) was used to assess Emotional Regulation; it is an affective decision making measure based on the Iowa Gambling Task (IGT: Bechara, Damasio, Damasio, & Anderson, 1994), a well-established and widely-used adult measure. In the HDT, participants are asked to ‘‘feed’’ as many apples as possible to the hungry donkey by selecting from either two or four doors, which have different proportions of gains and losses of apples. The premise is that the tasks resemble real-life decisions in terms of reward, punishment, and uncertainty of outcomes (Crone, Bunge, Latenstein, & van der Molen, 2005). There are three versions of the Hungry Donkey task. Task complexity and punishment frequency are manipulated in each version by using two or four doors and a 10% or 50% punishment schedule (Crone et al., 2005). For this study, the two choice - 10% condition was chosen because the two-choice version reduces demand on working memory (Kerr and Zelazo, 2004) and developmental changes in decision making are only apparent when the loss is infrequent (Crone et al., 2005).

Discriminant validity for the HDT has been demonstrated in several studies (Crone, Vendel & van der Molen, 2003; Geurts et al., 2006; Hooper, Luciana, Conklin &
Yarger, 2004; van Duijvenvoorde, Jansen, Visser & Huizenga, 2010). Age was positively associated with making more advantageous choices (Crone et al., 2004, 2005, 2007; Huizenga, Crone & Jansen, 2007), indicating HDT performance is sensitive to developmental changes in childhood and adolescence. Furthermore, individual differences in 8-12 year old children’s affective decision making could be detected at the neural level (P300) (Carlson, Zayas & Guthormsen, 2009) and physiological level (Crone et al., 2005) when losses incurred.

For this study, participants had to choose between two identical decks of cards, behind which unpredictable losses of 10 or 50 apples were presented on 10% of the trials. All pictures presented for this task were obtained from Inquisit Millisecond software. On the side facing down, door A has either a picture of 2 apples or a picture of 10 apples with an X through them while door B has either a picture of 4 apples or a picture of 50 apples with an X though them. Immediately after indicating their response and turning over a card, the examiner either placed beads in or took them out of a glass jar in correspondence to the card selection. This provided a visual stimulus for the gains and losses of apples. In addition, prior to beginning the task, participants were shown a bin of high-desire prizes and told “if at the very end of the game, you have won more apples than you have lost, then you can chose a prize from this toy bin” in an effort to increase their motivation and personal desire to win (as per Crone & van der Molen, 2004). In reality, all participants were invited to select a prize at the end.

The HDT consisted of 100 trials. Door A is advantageous in the long run because it results in smaller immediate gain and smaller unpredictable losses whereas Door B results in high immediate rewards but also much higher unpredictable losses. Net
difference scores were calculated by subtracting the number of disadvantageous choices (Door B) from number of advantageous choices (Door A) (Bechara et al., 1994; Crone & van der Molen, 2004; Skogli, Egeland, Anderson, Hovik & Oie, 2013).

4.6 Parent Measures of EF and social competence

Parents completed a questionnaire package that included ratings of their child’s EF and social competence; demographic data was also obtained from the parents at this time (demographic questionnaire is in Appendix F).

4.6.1 Ratings of EF. The Behavior Rating Inventory of Executive Functions (BRIEF: Gioia, Isquith, Guy, & Kenworthy, 2000) was used to obtain parent ratings of children's EF. The BRIEF is a psychometrically sound and well-established standardized parent report inventory of executive functioning for 5 to 18 year olds (Baron, 2000; Strauss, Sherman & Spreen, 2006). The BRIEF is often used as a complement to traditional performance-based measures of executive function to provide information regarding everyday application of executive functions. It is sensitive to a broad range of neurologic and developmental conditions such as ASD (Gilotty et al., 2002; Kenworthy et al., 2008), ADHD (Reddy, Hale, & Brodzinsky, 2011; Toplak, Bucciarelli, Jain, & Tannock, 2009) and TBI (Mangeot, Armstrong, Colvin, Yeates & Taylor, 2002). The standardized Parent Report version comprises 86 items that tap a wide range of executive functions involved in the regulation of attention, behavior and emotion.

The BRIEF was normed on a sample of 2139 children between the ages of 5-18, of which 1191 were 8 to 12 year olds (Gioia et al., 2000). Reliability was demonstrated through internal consistency, interrater reliability and test-retest reliability. Validity for the BRIEF was demonstrated though content and construct validity. The BRIEF was
originally produced with eight subscales and two indices (Metacognition and Behavioral Regulation). However, exploratory and confirmatory factor analyses based on both parent and teacher report subsequently identified nine subscales and three indices: Cognitive, Behavioural and Emotional Regulation (Egeland & Fallmyr, 2010; Gioia, Isquith, Retzlaff, & Espy, 2002).

The BRIEF is the most widely-used parent EF rating for clinical use and research (Donders, DenBraber & Vos, 2010; Toplak, West, & Stanovich, 2013) and it has demonstrated its reliability and validity as a measure of everyday executive function (Huizinga and Smidts, 2013; Kenworthy, Yerys, Anthony, & Wallace, 2008; Mahone et al., 2002; Mangeot et al., 2002; Toplak, Bucciarelli, Jain, & Tannock, 2009). Of note, significant age effects have been reported, indicating that parental ratings of executive functions improved with age throughout childhood on all scales (Huizinga and Smidts, 2013). The BRIEF has also been significantly correlated to measures of adaptive functioning in a small group of children (n=53) with ASD (Gilotty et al., 2002) and predicted severity level of injury and adaptive and problem behaviours in a group of 189 children with TBI (Mangeot et al., 2002).

Parents rated the frequency of their child's behaviour on 3-point scale (never; sometimes; often), with higher scores indicating more difficulties with executive functioning. Questions include "underestimates time needed to finish tasks", "has trouble thinking of different way to solve a problem when stuck", "needs to be told to begin a task even when willing" and "has explosive angry outbursts". The nine subscales of the BRIEF were calculated in this study (Initiate, Working Memory, Plan/Organize, Organization of Materials, Task Monitor, Self Monitor, Inhibit, Shift and Emotional
Control) according to procedures described in the literature (Egeland & Fallmyr, 2010; Gioia et al., 2002). Scores for the total Global Executive Composite (GEC) were calculated by summing all points according to procedures in the manual.

**4.6.2 Ratings of social competence.** Social competence was measured using the Social Skills Improvement Rating System (SSIS 2008: Elliott & Gresham) and the Socialisation Domain of the Vineland Adaptive Behavior Scales, Second Edition (VABS-2: Sparrow, Cicchetti & Balla, 2005). The SSIS is the most widely-used measure of social skills in children (White et al., 2007) and the VABS-2 is the most widely-used adaptive measure in ASD research (Lopata et al., 2013).

Parent ratings of the SSIS were used to measure functional pro-social behaviours. The SSIS parent questionnaire includes 46-items divided into seven subscales targeting communication, cooperation, assertion, responsibility, empathy, engagement and self-control. Examples of questions include "invites others to join in activities", "makes eye contact when talking " and "stays calm when teased". The US national standardization sample of the SSIS was large (n = 4,550) across 3 broad age groupings (3-5 years, 5-12 years, and 13-18 years). Validity has been demonstrated by moderate to high correlations with other widely used instruments such as the Behavioral Assessment System (BASC–2; Reynolds & Kamphaus, 2004) and the SSRS (Gresham & Elliott, 1990). Internal consistency and test–retest reliability for parent ratings was strong (Elliot and Gresham, 2008; Gresham et al., 2010). Parents indicated the frequency with which their child exhibits each social skill on a 4-point scale of never, seldom, often, and almost always. A total score was derived from summing points from 7 subscales according to standardized procedures.
Parent ratings on the Socialization domain of the VABS-2 was used as the second measure of social competence. The VABS-2 Socialisation Domain is a commonly used measure of social competence in clinical populations, particularly ASD (Gillespie-Lynch et al., 2012). It measures a range of personal and interaction skills needed for everyday adaptive social behaviour and independence in three areas: interpersonal relationships (how child interacts with others), play (how child uses toys and leisure time) and coping skills (how child demonstrates sensitivity to others and manages social challenges). Examples of questions include "invites friends over", "takes turns without being asked" and "acts when another person needs a helping hand (for example, holds door open, picks up dropped items". The VABS-II was standardized using a representative American sample of 3,695 children (Sparrow, Cicchetti & Balla, 2005). Concurrent and divergent validity and test-retest and inter-rater reliability of the Socialization domain are well-documented in the manual and independent studies (Anderson, Oti, Lord & Welch, 2009; Perry et al., 2009). Parents indicated the frequency with which their child performs social behaviours on a 3-point scale of never, sometimes or partially, and usually. Scores were derived from summing points on the three subscales according to procedures in the manual.
5.0 Results

5.1 Data Analysis Plan

All analyses were performed using IBM SPSS 21.0. Preliminary data screening was performed to examine basic assumptions of parametric data. Outliers were examined using Boxplots and assumptions of normal distribution were assessed via group-based histograms and Q-Q Plots. Homogeneity of variance was assessed via Levene’s statistic. There was no missing data and for all analyses p < .05 was considered statistically significant.

One outlier was identified from the parent ratings of the ASD group and subsequently removed from all analyses involving social competence scores or parent EF ratings. This outlier was discarded because the SSIS and Vineland scores were over three standard deviations higher than the mean of the ASD group and it was having significant impact on the results of the correlation and regression analyses. However, since the adjoining child-based SEL and EF scores for this participant were not outliers and all analyses subsequently performed with and without this participant's EF and SEL scores found no significant differences in outcome, the child data was retained for group comparisons.

In order to compare performances across scales and age ranges, two scores were calculated. First, scores were transformed to an age-corrected z-score because standardized scores were not available for all tasks. Since children's performance on many skill-based measures of EF and SEL normatively improves with age (Ganesalingham et al., 2006; McKown et al, 2009; McKown et al., 2013; White et al.,
2010), the same raw score has a different meaning for children at different ages. Thus, to minimize the impact of age, the scores on the SEL and EF tasks were converted to an age-corrected standard score. To do so, each score was regressed separately on age and then the residual score, which indicates the individual variance not explained by age, was used to calculate $z$-scores based on the control group’s mean and standard deviation. These $z$-scores were then used to examine group differences. Second, in order to investigate levels of clinical impairment, the percentage of children who scored one standard deviation or more below the normative mean was calculated (McKown, 2007; Rasmussen et al., 2013) for parent and child measures when standardized norms were available.

The results are divided into six sections. In the first section, descriptive analyses are provided. The five sections that follow are divided according to the main research hypotheses. These include group comparisons on all measures; creation of SEL and EF domains and calculation of composite scores; correlations and regressions of SEL and EF domains with Social Competence to determine the extent to which SEL or EF predicts social competence; and finally, further correlational analyses between SEL and EF to evaluate the hypothesized partial mediation relationship.

5.2 Descriptive Information

Since 37% of children from the ASD group were taking stimulant medications, analysis of variance (ANOVA) was conducted to determine whether there were any significant within-group differences on predictor and outcome measures between those children taking medication and those who were not. There were no significant within-group differences between the children taking medication and those not taking
medications on any child measures, but there were significant differences on the SSIS, $F(1, 47) = 11.40, p < .01$ but not on the Vineland, $F(1, 47) = 3.12, p = .08$, or the BRIEF, $F(1, 47) = 3.84, p = .06$. On further analysis, within-group differences on the SSIS were only significant for 8 to 10 year old children, $F(1, 23) = 10.37, p < .01$, but not the 11 to 13 year olds, $F(1, 22) = 4.14, p = .06$.

5.2.1 Correlation analysis. Pearson product-moment correlation coefficients were calculated to examine the relationship between age, IQ and all predictor and outcome measures. The analyses were conducted separately for the control and ASD groups (see Tables 2-5).

Age. Preliminary analysis examined the relationship between age and raw scores on each measure. For the control group, age was positively correlated with 4 of 6 SEL and 7 of 8 EF measures but not with parental EF ratings. In terms of SEL, performance increased with age on facial affect recognition, $r(48) = .37, p = .01$, voice affect recognition, $r(48) = .37, p < .01$, pragmatic language, $r(48) = .59, p < .01$ and problem solving, $r(48) = .396, p < .01$. In terms of EF, performance improved with age on all EF measures except for affective decision making. Specifically, there were significant correlations between age and visual attention, $r(48) = .40, p < .01$, auditory attention, $r(48) = .31, p < .01$, working memory, $r(48) = .383, p < .01$, planning, $r(48) = -.30, p = .04$, visual inhibition $r(48) = .41, p < .01$, auditory inhibition time, $r(48) = -.32, p = .029$ and auditory inhibition accuracy $r(48) = -.33, p = .02$. As expected, age was positively correlated with raw scores on both the Vineland, $r(48) = .40, p < .01$ and SSIS, $r(48) = .39, p < .01$, indicating that social competence increased with age. When using standard scores, there was a significant correlation between age and the SSIS, $r(48) = 0.35 p = .01$,.
but not the Vineland, $r(48) = - .11, p = .45$ or the BRIEF, $r(48) = 0.10, p = .49$. For children in the control group, older children performed better on most measures of SEL and EF and obtained higher parent ratings of social competence and EF.

Age was not significantly correlated with any SEL task for children with ASD. Age was, however, significantly correlated with four EF tasks. As age increased, performance improved on visual attention, $r(49) = .40, p < .01$, working memory, $r(49) = .36, p = .01$, auditory inhibition (time), $r(49) = -.34, p = .02$ and affective decision making, $r(49) = .28, p = .05$. There were no significant correlations between age and raw scores on the Vineland, $r(48) = .03, p = .86$, the SSIS, $r(48) = -0.05, p = .71$, or the BRIEF, $r(48) = .04, p = .80$. When using standard scores, there was a negative association between age and the Vineland, $r(48) = -0.53, p < .01$ but not on the SSIS, $r(48) < 0.01, p = .94$ or the BRIEF, $r(48) = 0.07, p = .64$. These results indicate that performance on SEL, social competence and parent-rated EF did not improve with age for the children with ASD. In fact, the standard scores suggest that there is an inverse relationship between age and social adaptation. The significant correlations between age and measures of SEL and EF are problematic because it indicates that the same raw score has a different meaning for children at different ages. As such, age-corrected $z$ scores were calculated as described previously and used for all subsequent analyses.

**IQ.** For the control group, IQ was not significantly associated with any performance-based EF measures or parent ratings of EF, but was positively associated with 2 SEL tasks. Higher IQ scores were associated with higher scores on the Voice
Table 2
Correlations among measures of Age, IQ, measures of SEL and social competence for the CONTROL group

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Note: Age-corrected z scores used for SEL and standard scores used for Vineland and SSIS
^1Pragmatic Language; ^2Social Problem Solving
P<.05
Table 3.
Correlations among measures of Age, IQ, measures of SEL and social competence for the ASD group

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Note: Age-corrected z scores used for SEL and standard scores used for Vineland and SSIS
¹Pragmatic Language; ²Social Problem Solving
P<.05
Table 4
Correlations between Age, IQ, measures of EF and social competence for the CONTROL group

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<td>.17</td>
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Note: Age-corrected z scores used for EF and standard scores used for Vineland and SSIS

1Auditory attention; 2Visual Attention; 3Working memory; 4Auditory inhibition time; 5Auditory inhibition errors; 6Visual inhibition; 7Affective decision making

*p<.05
Table 5  
Correlations between Age, IQ, measures of EF and social competence for the ASD group

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<td>.53*</td>
<td>.70*</td>
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<td>.49*</td>
<td>.31*</td>
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<td>-.04</td>
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</table>

Note: Age-corrected z scores used for EF and standard scores used for Vineland and SSIS  
¹Auditory attention; ²Visual Attention; ³Working memory; ⁴Auditory inhibition time; ⁵Auditory inhibition errors; ⁶Visual inhibition; ⁷Affective decision making  
*p<.05
Affect Recognition $r(48) = .31, p = .03$ and with lower scores on Empathy $r(48) = -.30, p = .04$. IQ scores were also negatively correlated with SSIS, $r(48) = -.34, p = .02$. As such, children in the control group with higher intelligence performed better on voice affect recognition but rated themselves lower on empathy and received lower scores on the social skills measure.

For the ASD group, IQ was significantly correlated with 5 of 6 SEL tasks and 5 of 8 EF tasks. Higher IQ scores were associated with better performance on the facial affect recognition, $r(49) = .31, p = .03$, voice affect recognition, $r(49) = .33, p = .02$, ToM, $r(49) = .37, p = .01$, pragmatic language, $r(49) = .36, p = .01$, and problem solving, $r(49) = .46, p < 0.01$. Performance also improved as IQ increased on the visual attention, $r(49) = .30, p = .04$, planning, $r(49) = -.39, p = .01$, working memory, $r(49) = .32, p = .02$, auditory inhibition time, $r(49) = -.41, p < .01$ and accuracy, $r(49) = -.391, p = .005$. There were no significant correlations between IQ scores and the Vineland, $r(48) = .05, p = .76$, the SSIS, $r(48) = .15, p = .33$, or the BRIEF, $r(48) = -.04, p = .80$. As such, children with ASD and higher intelligence performed better on most SEL and EF tasks but were not rated higher in social competence or parent-measured EF.

**Age of diagnosis.** For children with ASD, the age at which they were diagnosed was significantly correlated with one SEL and two EF tasks. The older the children were when they received their ASD diagnosis, the better their performance on ToM, $r(49) = .32, p = .037$, visual attention, $r(49) = .390, p < .01$, and planning, $r(49) = -.34, p = .02$. Age of diagnosis was not significantly correlated with the Vineland, $r(48) = -.03, p = .83$, the SSIS, $r(48) = -.03, p = .84$, or the BRIEF, $r(48) = .10, p = .50$. As such, although children who received an ASD diagnosis at a later age performed better on ToM, visual
attention and planning, they were not rated as having higher social competence or parent-measured EF.

5.3 Hypothesis 1: Children with ASD will perform significantly different than neurotypical children in specific domains of EF, SEL and social competence.

In order to test the hypothesis that children with ASD would perform more poorly on measures of SEL, EF and social competence, a series of ANOVAs were performed to examine group differences between the tasks. The Brown-Forsythe statistic is reported where scores violated assumptions of normality (Fagerland, 2012; Field, 2005). Since the correlation analyses demonstrated that the relationship between age and measures of SEL, EF and social competence differed across groups, using age as a covariate violated the assumptions of homogeneity of regression slopes and thus the age-corrected scores were used. See Table 6 for means and standard deviations of the SEL, EF and social competence measures for the ASD and control groups.

5.3.1 SEL measures. There were significant differences on 4 of 6 measures. Children with ASD performed significantly lower on voice affect recognition, $F(1, 94) = 10.52, p < 0.01$, ToM, $F(1, 54) = 31.79, p < 0.01$, pragmatic language, $F(1, 75) = 50.97, p < 0.01$, and social problem solving, $F(1, 66) = 41.84, p < 0.01$. There were no significant differences between the groups on facial affect recognition, $F(1,94) = 2.18, p = .12$, and empathy, $F(1,94) = 2.47, p = .20$. In terms of clinical impairment, more children with ASD performed at least one standard deviation below normative mean on all SEL
measures that had standardized scores. These included the DANVA facial affect recognition (14% versus 4%), DANVA voice affect recognition (28% versus 8%), Happe Strange Stories -ToM (22% versus 0%), TOPL pragmatic language (15% versus 2%) and the TOPS problem solving (37% versus 2%). Interestingly, 41% of children with ASD and 88% of neurotypical children passed all ToM questions.

5.3.2 EF measures. In terms of performance-based EF, there were significant differences between the groups on 6 out of 8 tasks. Children with ASD performed significantly lower than controls on auditory attention, $F(1, 82) = 4.84, p = 0.03$, visual attention, $F(1, 94) = 9.39, p < 0.01$, working memory, $F(1, 94) = 4.23, p = 0.04$, auditory inhibition time, $F(1, 85) = 5.63, p = 0.02$, auditory inhibition accuracy, $F(1, 78) = 7.08, p = 0.01$, and planning, $F(1, 94) = 3.83, p = 0.05$. In terms of clinical impairment, more children with ASD performed at least one standard deviation below normative mean on all these measures. These included Planning (27% versus 15%), Auditory Attention (47% versus 23%), Visual Attention (12% versus 4%), Visual Working Memory (25% versus 8%) and Auditory Inhibition (40% versus 20%). Although there were no significant differences between the groups on Visual Inhibition, more children in the ASD group scored within the clinical impairment range (20% versus 12%).

5.3.3 Parent rated EF. With respect to parental ratings of EF, scores on the BRIEF were significantly higher for children with ASD compared to the control group, indicating greater overall executive dysfunction, $F(1, 95) = 137.08, p < .01$. When looking at the two domains of the BRIEF, children with ASD were rated as having more difficulties with Metacognition, $F(1, 95) = 100.43, p < 0.01$, and Behavioural Regulation, $F(1, 95) = 150.23, p < 0.01$. In terms of clinical impairment, 90% of children with ASD
performed at least one standard deviation below normative mean compared to 8% of
children from the control group on the General Executive Composite overall score.

5.3.4 Social competence. There were significant differences between groups on
both measures of social competence. As expected, children in the control group were
rated as significantly more socially competent than children in the ASD group on both the
Vineland $F(1, 72) = 221.03$, $p < 0.01$, and the SSIS $F(1, 81) = 146.94$, $p < 0.01$. In terms
of clinical impairment, 90% of children with ASD performed at least one and a half
standard deviations below normative mean on the Vineland compared to 8% of children
from the control group. On the SSIS, 65% of children with ASD one and a half standard
deviations below the normative mean compared to no children from the control group.

5.4 Hypothesis 2: Measures of Nonverbal Awareness, Social Meaning and Social
Understanding will represent latent SEL domains for the ASD and
control groups.

In order to test the hypothesis that the SEL measures are associated, Pearson
product-moment correlation coefficients between SEL measures were calculated for the
ASD and control groups separately (see Tables 2 and 3). Exploratory factor analysis was
then performed to examine whether the SEL measures represent three distinct domains:
Nonverbal Awareness (facial and voice affect recognition); Social Meaning (ToM,
empathy and pragmatic language); and Social Reasoning (social problem solving). For
the control group, empathy and ToM were not significantly correlated with any SEL task.
Table 6. Descriptive Statistics of Measures of SEL, EF and Social Competence

<table>
<thead>
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<th>Variable</th>
<th>Control M (SD)</th>
<th>ASD M (SD)</th>
<th>F-value</th>
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<td><strong>N = 49</strong></td>
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<td>20.81(2.22)</td>
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<td>15 – 23</td>
<td></td>
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<tr>
<td>Voice Affect Recognition(^2)</td>
<td>18.53(2.88)</td>
<td>16.33(4.16)</td>
<td>10.52**</td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>ToM(^3)</td>
<td>9.77(0.66)</td>
<td>7.61(2.68)</td>
<td>31.79**</td>
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<tr>
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<td>0 – 10</td>
<td></td>
</tr>
<tr>
<td>Empathy (child ratings)(^4)</td>
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<td>10.29(3.84)</td>
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</tr>
<tr>
<td>Range</td>
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<td>4 – 21</td>
<td></td>
</tr>
<tr>
<td>Empathy (parent ratings)(^4)</td>
<td>12.53(3.54)</td>
<td>9.68(4.00)</td>
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</tr>
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<td>70.90(15.40)</td>
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<td>Visual Attention(^8)</td>
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<td>79.84(11.55)</td>
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<td>7.55(5.57)</td>
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<td>70.64(10.88)</td>
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<td>40 – 107</td>
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Note: Raw scores used for SEL and EF; standard scores used for Vineland, SSIS and BRIEF
As expected, there were positive correlations between the facial and linguistic affect recognition tasks, $r(46) = .32, p = .03$. Pragmatic language was positively correlated with facial affect recognition, $r(46) = .34, p = .02$, voice affect recognition, $r(46) = .46, p < .01$ and social problem solving, $r(46) = 0.55, p < .01$. Social problem solving was also positively correlated with voice affect recognition, $r(46) = .29, p = .05$. For the ASD group, empathy was also not significantly correlated with any other SEL measures.

Similar to the control group, there were positive correlations between the facial and linguistic affect recognition tasks, $r(47) = .47, p < .01$. In contrast to the control group, ToM was positively correlated with facial affect recognition, $r(47) = .34, p = .02$, pragmatic language, $r(47) = .56, p < .01$ and social problem solving, $r(47) = .50, p < .01$.

Pragmatic language was positively correlated with voice affect recognition, $r(47) = .36, p = .01$ and social problem solving, $r(47) = .61, p < .01$. Lastly, social problem solving was also positively correlated with voice affect recognition, $r(47) = .46, p < .01$.

5.4.1 Principal components analysis of SEL. A principal components analysis (PCA) with varimax rotation was conducted to identify SEL domains and to create composite scores. Creating composite scores allowed for data reduction for subsequent analyses. All analyses were performed separately for the control and ASD groups.

Initially, data screening was performed on the SEL variables to determine the suitability of the data for factor detection. Several well-recognized criteria were examined, including inspecting inter-correlations between variables and ensuring some correlations above 0.30. Two measures of sample adequacy were consulted – the Kaiser-Meyer Olkin (KMO) index and the anti-image diagonal correlations of sampling adequacy, which above 0.50 is considered suitable for factor analysis and are particularly important when
the sample sizes are small (Tabachnick & Fidell, 2009). Bartlett’s Test of Sphericity was consulted to determine whether the data forms an identity matrix and to further determine suitability for structure detection. The determinant of the correlation matrix detects multicollinearity, which should be greater than 0.00001, was also checked. Multiple extraction techniques were then utilised to ensure the best fit of the data, as recommended in the literature (Field, 2009). These included Kaiser’s criteria of eigenvalues > 1 and examination of the scree plot, communalities and cumulative percent of variance extracted. Absolute values below 0.50 were suppressed to account for the small sample sizes (Field, 2009). Finally, the variables that did not correlate with any other measures were excluded from further analysis (Field, 2009). As a result of the differing correlations between variables in each group, which is common in research with clinical groups (Dowling, Hermann, LaRue & Sager, 2010; Meredith & Teresi, 2006; Raykov, Marcoulides & Cheng-Hsien, 2012), different variables were entered for the control and ASD groups, as described below.

Five variables were entered into the PCA analysis for the control group. These included facial and voice affect recognition, empathy, pragmatic language and social problem solving. ToM was excluded from analyses because it had very low correlations with all other variables. Although there were no significant correlations between empathy and the other SEL variables for the control group, it was retained because it was approaching significance with pragmatic language, $r(46) = 0.23$, $p=0.06$ and social problem solving, $r(46) = 0.22$, $p=0.07$. Empathy had a diagonal anti-image correlation of 0.77 and communalities above 0.80 for all analyses, which further supports its retention. The KMO Index was 0.699 and the Bartlett’s test of Sphericity was significant, $x^2 (48) =$
The diagonals of the anti-image correlations ranged from 0.65 to 0.79. Finally, the communalities ranged from 0.580 to 0.970. Initial eigenvalues indicated a 2-factor solution that accounted for 63.57% of the variance, but the communalities were low, with three of the five being below 0.55. A three-factor solution was preferred based on previous theoretical support and because the eigenvalues leveled off after three factors, which accounted for 78.70% of the variance. Extracted components ranged from 0.51 to 0.98. The first factor included pragmatic language and social problem solving and accounted for 34.31% of the variance. The second factor included voice and facial affect recognition, accounted for 24.11% of the variance and the third factor of empathy accounted for 20.28% of the variance. Voice affect recognition loaded equally on the first and second factors, but was retained for the second factor based on several robust theoretical grounds, including that these two variables were designed to conceptually measure different aspects of the same underlying construct and also confirmation that these same two variables loaded on the same factor in previous research with larger samples (Lipton & Nowicki, 2009; McKown et al., 2009; McKown et al., 2013). The factor labels of ‘nonverbal awareness’, ‘social meaning’ and social reasoning’ proposed by Lipton & Nowicki (2009) and McKown and colleagues (2009; 2013) were modified to suit the current data. The three distinct underlying SEL factors for the control group used in subsequent analyses are Social Understanding (pragmatic language and social problem solving), Nonverbal Awareness (facial affect and voice affect recognition), and Empathy (empathy) (see Figure 5a).

Five variables were also entered into the PCA analysis for the ASD group. These included facial and voice affect recognition, ToM, pragmatic language and social
problem solving. Empathy was excluded from analyses because it had very low correlations with all other variables. The KMO Index was 0.72 and the Bartlett’s test of Sphericity was significant, $x^2 (49) = 67.28, p < 0.01$. The diagonals of the anti-image correlations ranged from 0.65 to 0.79. Finally, the communalities ranged from 0.64 to 0.78. Initial eigenvalues indicated a 2-factor solution that accounted for 71.90% of the variance. The first factor included ToM, pragmatic language, and social problem solving, and accounted for 41.95% of the variance. The second factor included voice and facial affect recognition and accounted for 29.95% of the variance. There were no cross loadings and extracted components ranged from 0.78 to 0.87. The factor labels proposed by Lipton & Nowicki (2009) and McKown and colleagues (2009; 2013) were again modified to suit the current data. The two distinct underlying SEL factors for the ASD group used in subsequent analyses are Social Understanding (ToM, pragmatic language and Social Problem Solving) and Nonverbal Awareness (facial affect and voice affect recognition) (see Figure 5b).

5.5 Hypothesis 3: The measures of Cognitive, Behavioural and Emotional regulation will represent three latent EF domains for the ASD and control groups.

In order to test the hypothesis the EF measures are associated, Pearson product-moment correlation coefficients were first calculated for the ASD and control groups separately using eight EF measures: auditory attention, visual attention, planning, visual working memory, visual inhibition, auditory inhibition reaction time, auditory inhibition
Figure 5a. The SEL domains for the control group

Figure 5b. The SEL domains for the ASD group
accuracy and affective decision making (see Tables 4 and 5). Exploratory factor analysis was then performed to examine whether the EF measures represented three distinct domains: Cognitive Regulation (planning, auditory attention, visual attention, visual working memory); Behavioural Regulation (auditory inhibition accuracy, auditory inhibition time, and visual inhibition); and Emotional Regulation (affective decision making).

For the control group, planning and affective decision making were not significantly correlated with any other EF measures. Although there were no significant correlations between visual attention and auditory attention, they were both positively correlated with the same measures. Visual working memory was positively correlated with auditory attention, $r(46) = .36, p = .01$ and visual attention, $r(46) = .54, p < .01$. Visual inhibition was also positively correlated with auditory attention, $r(46) = .39, p = .01$ and visual attention, $r(46) = .66, p < .01$. Visual working memory was positively correlated with visual inhibition, $r(46) = .61, p < .01$. Visual inhibition was negatively correlated with auditory inhibition accuracy, $r(46) = -.34, p = .02$ indicating better performance on visual inhibition was associated with fewer errors on auditory inhibition. Lastly, auditory inhibition errors and reaction time were positively correlated, $r(48) = .32, p = .03$. For the ASD group, visual attention was significantly correlated with all EF tasks and visual working memory was significantly correlated with all EF tasks except affective decision making. Auditory attention was positively correlated with visual attention, $r(47) = .61, p < .01$, working memory, $r(47) = .53, p < .01$, visual inhibition, $r(47) = .33, p = .02$, and affective decision making, $r(47) = .36, p = .01$. Unlike the control group, planning and affective decision making were each correlated with four EF
tasks. Better performance on planning was correlated with better performance on visual attention, $r(47) = -.44, p < .01$, visual working memory, $r(47) = -.40, p = .01$, auditory inhibition reaction time, $r(47) = .45, p < .01$, and auditory inhibition accuracy, $r(49) = .58, p < .01$. Better performance on affective decision making was correlated with better performance on visual attention, $r(49) = .35, p = .01$, auditory attention, $r(47) = .36, p = .01$, visual inhibition, $r(47) = .29, p = .04$ and auditory inhibition reaction time, $r(47) = -.31, p = .03$. Lastly, the two auditory inhibition tasks were positively correlated, $r(47) = .38, p < .01$.

There were no significant correlations between the parent ratings and any performance-based EF tasks for the control group. For the ASD group, parent EF ratings were negatively correlated with two performance-based EF measures for the ASD group. Higher overall ratings of executive dysfunction were associated with lower scores on auditory attention, $r(46) = -.37, p = .01$ and visual inhibition, $r(46) = -.44, p < .01$. This confirms the importance of conducting separate analyses for performance-based and parent-rated EF.

**5.5.1 Principal components analysis of EF.** A principal components analysis (PCA) with varimax rotation was conducted to identify EF domains and to create composite scores. All analyses were performed separately for the control and ASD groups. Data screening was initially performed on the EF variables to determine the suitability of the data for factor detection using the well-recognized criteria previously described.

For the **control group**, six variables were used for PCA analysis: auditory attention, visual attention, visual working memory, visual inhibition, auditory inhibition
time and accuracy. Planning and affective decision making were excluded from analyses because they had very low correlations with all other variables. The KMO Index was 0.68 and the Bartlett’s test of sphericity was significant, $x^2 (48) = 76.31$, $p < 0.001$. The diagonals of the anti-image correlations ranged from 0.50 to 0.81. Finally, the communalities ranged from 0.65 to 0.95. Initial eigenvalues indicated a 3-factor solution that accounted for 77.55% of the variance, Extracted components ranged from 0.76 to 0.96. The first factor included visual attention, visual inhibition and visual working memory and accounted for 35.63% of the variance. The second factor included auditory inhibition reaction time and accuracy and accounted for 22.65% of the variance. The third factor included auditory attention and accounted for 19.28% of the variance. The three EF labels originally proposed - cognitive, behavioral and affective self regulation were not suitable for naming these factors. The three distinct underlying EF factors for the control group included Visual Executive Control (visual working memory, attention and inhibition), Inhibition (auditory inhibition reaction time and auditory inhibition accuracy) and Auditory Attention (auditory attention) (see Figure 6a).

For the ASD group, the eight measures of EF were also entered into a PCA analysis. The visual inhibition variable had a low diagonal correlation on the anti-image matrix and thus was not retained for the analyses. With the remaining seven variables, the KMO Index was 0.78 and the Bartlett’s test of sphericity was significant, $x^2 (49) = 110.68$, $p < 0.01$. The diagonals of the anti-image correlations ranged from 0.75 to 0.82. Finally, the communalities ranged from 0.70 to 0.86. Initial eigenvalues indicated a 3-factor solution that accounted for 76.03% of the variance. Extracted components ranged from 0.64 to 0.89. The first factor included visual attention, auditory attention and visual
working memory and accounted for 31.03% of the variance. The second factor included planning, auditory inhibition reaction time and accuracy and accounted for 28.03% of the variance. The third factor included affective decision making and accounted for 16.98% of the variance. There was some cross loading with auditory inhibition reaction time as it loaded on the second (0.64) and third factors (-0.54). It was retained for the second factor based on higher loading score and the theoretical basis that is conceptually related to auditory inhibition accuracy.

The three EF labels originally proposed of cognitive, behavioral and emotional regulation were suitable for these factors. The three distinct underlying EF factors for the ASD group included Cognitive Regulation (visual working memory, visual attention and auditory attention), Behavioural Regulation (planning, auditory inhibition reaction time and auditory inhibition accuracy) and Emotion Regulation (affective decision making) (see Figure 6b).

5.5.2 Principal components analysis of parent-rated EF. Exploratory factor analysis for both groups was performed using all 9 subscales of the BRIEF to determine whether the three domains recently identified in the literature (Egeland & Fallmyr, 2010; Gioia, Isquith, Retzlaff, & Espy, 2002) were also appropriate in this sample.

For the control group, the KMO Index was 0.76 and the Bartlett’s test of sphericity was significant, \( \chi^2 (48) = 199.80, p < 0.01 \). The diagonals of the anti-image correlations ranged from 0.69 to 0.83. Finally, the communalities ranged from 0.45 to 0.83. Initial eigenvalues indicated a 2-factor solution that accounted for 63.85% of the variance, Extracted components ranged from 0.66 to 0.91. The first factor included plan/organize, task monitor, initiate, working memory and organisation of material and accounted for
34.83% of the variance. The second factor included self monitor, shift, inhibit and emotional control and accounted for 28.02% of the variance.

For the ASD group, the KMO Index was 0.81 and the Bartlett’s test of sphericity was significant, \( x^2 (49) = 181.54, p < 0.01 \). The diagonals of the anti-image correlations ranged from 0.63 to 0.89. Finally, the communalities ranged from 0.46 to 0.78. Initial eigenvalues indicated a 2-factor solution that accounted for 62.05% of the variance. Extracted components ranged from 0.57 to 0.88. The first factor included self monitor, shift, inhibit and emotional control and accounted for 34.61% of the variance. The second factor included plan/organize, task monitor, initiate, working memory and organisation of material and accounted for 27.44% of the variance. The three labels originally proposed for the parent EF ratings, which included cognitive, behavioral and emotional self regulation, were not suitable for these factors for either the control or ASD group. Rather, the two domains of Metacognition and Behavioural Regulation provided in the BRIEF manual were maintained for both groups. As such, the two distinct underlying parent-rated EF factors for both groups included Metacognition (plan/organize, task monitor, initiate, working memory and organisation of material), and Behavioural Regulation (self monitor, shift, inhibit and emotional control) (see figure 6b). \( p = .01 \) whereas the BRIEF Metacognition index did not \( (b = -.26, \beta = -.12, p = .46) \). For the ASD group, parent EF ratings predicted 54.2% of the variance in social competence \( (r^2 = .54) \). Coefficients showed age \( (b = -1.52, \beta = -.22, p = .05) \) accounted for significance variance in Social Competence but not IQ \( (b = .07, \beta = .08, p = .44) \). Behavioural Regulation \( (b = -1.6, \beta = -.58, p < .01) \) predicted significant variance in social competence but Metacognition \( (b = -.49, \beta = -.17, p = .21) \) did not for the ASD group.
Figure 6a. The EF domains for the control group

Figure 6b. The EF domains for the ASD group
5.5.3 Creation of composite scores. To reduce the number of variables and limit the number of interactions tested, the SEL and EF factors identified in the previous sections for the control and ASD groups were used to create composite scores. Multiple indicators of a latent factor remove biasing effects of measurement error (Kenny, 2003) and reduce probability of a Type I error (Field, 2009). The PCA of the SEL measures had indicated that five measures were indicators of three latent SEL domains for the control group: Social Understanding (pragmatic language and social problem solving); Nonverbal Awareness (facial affect recognition and voice affect recognition); and Empathy (empathy). For the ASD group, five SEL measures reflected two latent SEL domains: Social Understanding (pragmatic language, social problem solving and ToM); and Nonverbal Awareness (facial affect recognition and voice affect recognition). The PCA of the EF measures had indicated that five measures were indicators of three latent EF domains for the control group: Visual Executive Control (visual attention, visual working memory and visual inhibition); Inhibition (auditory inhibition time and auditory inhibition errors); and Auditory Attention (auditory attention). For the ASD group, seven measures were indicators of three EF domains: Cognitive Regulation (visual attention, visual working memory and auditory attention); Behavioural Regulation (auditory inhibition time, auditory inhibition errors and planning); and Emotion Regulation (affective decision making). The PCA analysis for the parent ratings of EF had indicated that the 9 scales were indicators of two latent domains: Metacognition (plan/organize, task monitor, initiate, working memory and organisation of material) and Behavioural Regulation (self monitor, shift, inhibit and emotional control). Z-scores for SEL and EF variables were summed according to each latent factor identified for the control and ASD
groups separately. The z-scores of the SSIS and Vineland were combined to provide one social competence score.

5.6 Hypothesis 4: The proposed model of SEL and EF will account for significant variance in social competence among neurotypical children and children with ASD.

To test the hypothesis that better scores on the SEL and EF domains would be related to higher ratings of social competence, Pearson product-moment correlation coefficients between the SEL and EF domains, and Social Competence were calculated for each group separately (see Tables 7 and 8). Preliminary analyses were conducted by examining histograms, Q-Q plots and Boxplots to ensure that composite score data met assumption criteria for use in correlation analyses. As mentioned earlier, one case in the ASD group was identified as an outlier because of very high social competence ratings, and it was removed from the ASD group.

For the control group, Social Competence was positively correlated with two SEL domains - Social Understanding, \( r(46) = .44, p < .01 \), and Empathy, \( r(46) = .29, p = .05 \), but not Nonverbal Awareness, \( r(46) = .21, p = .16 \). Thus, neurotypical children who performed better on two SEL domains - Social Understanding and Empathy - were also rated higher in Social Competence. There were no significant correlations between Social Competence and the three EF domains - Visual Executive Control \( r(46) = .14, p = .36 \), Inhibition, \( r(46) = -.16, p = .27 \) or Auditory Attention, \( r(46) = .10, p = .51 \). Therefore,
neurotypical children with better performance on any EF domains were not rated higher in Social Competence.

For the **ASD group**, there were no significant correlations between Social Competence and the two SEL domains - Nonverbal Awareness, \( r(46) = .20, p = .17 \) or Social Understanding, \( r(46) = .17, p = .24 \). Thus, children with ASD who performed better on either SEL domain were not rated higher in Social Competence. Social Competence was positively correlated with two EF domains - Cognitive Regulation, \( r(46) = .41, p < .01 \), and Emotional Regulation, \( r(46) = .32, p = .02 \), but not with Behavioural Regulation, \( r(46) = -.23, p = .12 \). Thus, children with ASD who performed better on Cognitive Regulation and Emotion Regulation were rated higher in Social Competence. In terms of parent ratings, Social Competence was negatively correlated with the BRIEF Behavioural Regulation Index, \( r(46) = -.50, p < .01 \) but not with the BRIEF Metacognition Index, \( r(46) = -.18, p = .21 \) for the control group. Thus, neurotypical children who were rated as having better Behavioural Regulation were also rated as having higher Social Competence. For the **ASD group**, Social Competence was negatively correlated with the BRIEF Behavioural Regulation, \( r(46) = -.73, p < .01 \) and BRIEF Metacognition, \( r(46) = -.57, p < .01 \). Thus, children with ASD who were rated as having better Behavioural Regulation and Metacognition were also rated as having higher Social Competence.

**5.6.1. Regression analyses.** To test the hypothesis that SEL and EF independently predict significant variance in social competence over and above the influence of age and IQ, a series of multiple hierarchical regressions were performed for each group separately. Parent-rated EF ratings were analysed separately based on the
Table 7
Correlations between SEL and EF domains for the CONTROL group

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Note: SEL1 = Social Understanding; SEL 2 = Nonverbal Awareness; SEL 3 = Empathy
EF 1 = Visual Executive Control. EF 2 = Inhibition EF 3 = Auditory Attention
¹BRIEF Metacognition Index; ²BRIEF Behavioural Regulation Index;
³SC=sum of Vineland and SSIS
*p< .05
Table 8
Correlations between SEL and EF domains and social competence for the ASD group

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SEL= Social Understanding; SEL 2= Nonverbal Awareness.
EF 1 = Cognitive Regulation. EF 2 = Behavioural Regulation. EF 3 = Emotional Regulation
1BRIEF Metacognition Index; 2BRIEF Behavioural Regulation Index; 3SC=sum of Vineland and SSIS
*p< .05
results of the correlation analyses. Age and IQ were entered in as predictors in the first block of each regression and social competence was entered as the criterion variable for all analyses. Data screening was performed according to Field (2005).

For the control group, Social Understanding, Nonverbal Awareness and Empathy were entered as predictor variables in the SEL analysis. Results indicated that the overall SEL model was significant, $F(5, 47) = 3.30, p = .01$ and that two predictors accounted for 28.2% of the variance in Social Competence ratings ($r^2 = .28$). Coefficients showed that IQ ($b = -.34, \beta = -.34, p = .03$) significantly predicted Social Competence whereas age ($b = -.95, \beta = -.15, p = .41$) was not significant in predicting Social Competence. Social Understanding significantly predicted Social Competence beyond the effect of age and IQ ($b = .23, \beta = .40, p = .04$) for neurotypical children whereas Nonverbal Awareness ($b = .37, \beta = .06, p = .70$) and Empathy ($b = 1.72, \beta = .17, p = .28$) did not predict significant variance in Social Competence for this control group. For the EF analysis, Visual Executive Control, Inhibition and Auditory Attention were entered as predictor variables. Results indicate that the overall EF model was not significant, $F(5, 47) = .96, p = .46$, and explained 10.2% of the variance in Social Competence ratings ($r^2 = .10$). In terms of the control variables, coefficients show that age ($b = .68, \beta = .11, p = .54$) and IQ ($b = -.29, \beta = -.29, p = .06$) were not significant in predicting Social Competence. Visual Executive Control ($b = -.32, \beta = -.08, p = .64$), Inhibition ($b = -.48, \beta = -.08, p = .65$) and Auditory Attention ($b = -.29, \beta = -.03, p = .86$) did not predict significant variance in Social Competence for neurotypical children.

For the ASD group, Social Understanding and Nonverbal Awareness were entered as predictor variables in the SEL analysis. The results indicated that the overall SEL
model was not significant, F(4, 47) = 1.5, *p* = .23, and accounted for 12.2% of variance in Social Competence (*r^2* = .12). Coefficients show that age (b = -2.21, β = - .31, *p* = .05) significantly accounted for variance, but IQ (b = -.09, β = -.11, *p* = .56), Social Understanding (b = .38, β = .21, *p* = .26) and Nonverbal Awareness (b = 1.02, β =-.18, *p* = .30) were not significant in predicting Social Competence for children with ASD.

Cognitive Regulation, Behaviour Regulation and Emotion Regulation were entered as predictor variables in the EF analysis. The results indicated that the overall EF model was significant, F(5, 47) =3.19, *p* = .02 and accounted for 28% of the variance in Social Competence (*r^2* = .28). In terms of the control variables, the coefficients showed that age (b = -.35, β = -.50, *p* < .01) significantly predicted Social Competence whereas IQ (b = -.14, β =-.16, *p* = .33) did not. Cognitive Regulation (b = 1.2, β =.44, *p* = .01) predicted significant variance in Social Competence whereas Behavioural Regulation (b = -.56, β =-.18, *p* = .31) and Emotional Regulation (b = 2.76, β =.24, *p* = .11) did not account for significant variance.

In terms of parent ratings, the BRIEF Behavioural Regulation and Metacognition indices were entered into separate regression analyses for each group. Overall, parent ratings of EF significantly predicted Social Competence for both the control group, F(4, 48) = 4.82, *p* < .01 and the ASD group, F(4, 48) =13.34, *p* < .01. For the control group, parent EF ratings predicted 31% of the variance in Social Competence (*r^2* = .31). Coefficients showed that IQ (b = -.27, β =-.27, *p* = .04) accounted for significant variance in Social Competence but age (b = .02, β =<.01, *p* = .98) did not; the Behavioural Regulation index predicted significant variance in Social Competence (b = -1.31, β =-.41,
Table 9
Summary of Regression Analyses Predicting Social Competence for the CONTROL Group

<table>
<thead>
<tr>
<th>Domain</th>
<th>R</th>
<th>R²</th>
<th>R²Change</th>
<th>F</th>
<th>F change</th>
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<td></td>
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<td>Age &amp; IQ</td>
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<td>.09</td>
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<td>.09</td>
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<tr>
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<td>.09</td>
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*Note. SEL Model 1 age, IQ, Social Understanding, Nonverbal Awareness, Empathy
EF Model 2 = age, IQ, Visual Executive Control, Inhibition, Auditory Attention.
Parent-rated EF Model 3 = age, IQ, Metacognition, Behavioural Regulation.
* p<.05
Table 10
Regression Coefficients of the SEL and EF Composite Scores for the CONTROL Group

<table>
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<td>Empathy</td>
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Table 11
Summary of Regression Analyses Predicting Social Competence for the ASD Group

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<th>F change</th>
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<td></td>
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<td>.06</td>
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<td>.07</td>
<td>1.46</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Age &amp; IQ</td>
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<td>.06</td>
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<td>.28</td>
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<tr>
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</tr>
<tr>
<td>Age &amp; IQ</td>
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<td>.06</td>
<td>1.31</td>
<td>1.31</td>
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<td>12.44</td>
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*Note.* SEL Model 1 = age, IQ, Social Understanding, Nonverbal Awareness. EF Model 2 = age, IQ, Cognitive Regulation, Behavioural Regulation, Emotional Regulation Parent-rated EF Model 3 = age, IQ, Metacognition, Behavioural Regulation. *p<.05
Table 12
Regression Coefficients of the SEL and EF Composite Scores for the ASD Group

<table>
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<td>Social Understanding</td>
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<td>.26</td>
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<tr>
<td>Nonverbal Awareness</td>
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<td><strong>EF</strong></td>
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<td>-3.51</td>
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<td>-2.01*</td>
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<td>IQ</td>
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<td>-.16</td>
<td>-.72</td>
<td>.33</td>
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<td>Cognitive Regulation</td>
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<td>.44</td>
<td>2.62*</td>
<td>.01</td>
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<td>Behaviour Regulation</td>
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<td>-.18</td>
<td>-1.04</td>
<td>.31</td>
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<tr>
<td>Emotional Regulation</td>
<td>2.76</td>
<td>.24</td>
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<td>.11</td>
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<tr>
<td><strong>Parent Rated EF</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-1.52</td>
<td>-.22</td>
<td>-2.03*</td>
<td>.05</td>
</tr>
<tr>
<td>IQ</td>
<td>.07</td>
<td>.08</td>
<td>.78</td>
<td>.44</td>
</tr>
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<td>Metacognition</td>
<td>-.49</td>
<td>-.17</td>
<td>-1.28</td>
<td>.21</td>
</tr>
<tr>
<td>Behavioural Inhibition</td>
<td>-1.62</td>
<td>-.58</td>
<td>-4.34*</td>
<td>.00</td>
</tr>
</tbody>
</table>
1.31, $\beta = -.41, p = .01$) whereas the BRIEF Metacognition index did not ($b = -.30, \beta = -.12, p = .46$). For the **ASD group**, parent EF ratings predicted 54.2% of the variance in social competence ($r^2 = .54$). Coefficients showed age ($b = -1.52, \beta = -.22, p = .05$) accounted for significant variance in Social Competence but not IQ ($b = .07, \beta = .08, p = .44$). Behavioural Regulation ($b = -1.62, \beta = -.58, p < .01$) predicted significant variance in social competence but Metacognition ($b = -.49, \beta = -.17, p = .21$) did not for the ASD group.

**5.7 Hypothesis 5:** SEL will partially mediate the effect of EF on social competence.

Pearson product-moment correlation coefficients were calculated to test for relationships among SEL and EF domains (see Table 7 and 8).

For the **control group**, two SEL domains were significantly correlated with one EF domain. The EF domain of Visual Executive Control was significantly correlated with SEL domains Social Understanding, $r(48) = .31, p = .03$ and Nonverbal Awareness $r(48) = .31, p = .03$. In terms of parent ratings, Behavioural Regulation was negatively correlated with both Social Understanding $r(48) = -.49, p < .01$ and Nonverbal Awareness, $r(48) = -.34, p = .02$. As such, children in the control group who performed well on Visual Executive Control also performed well on Social Understanding and Nonverbal Awareness. Similarly, children in the control group who were rated as having less executive dysfunction on the BRIEF Behavioural Regulation domain performed better on both SEL domains of Social Understanding and Nonverbal Awareness. Affective decision making was significantly correlated with one SEL domain - Empathy
(r(48) = .31, p = .04) and affective decision making had even higher correlation with parent ratings of empathy (r(48) = .61, p < .01).

For children with ASD, both SEL domains were significantly correlated with two EF domains. Social Understanding was significantly correlated with Cognitive Regulation, r(48) = .49, p < .01 and Behavioural Regulation, r(48) = -.56, p < .01. Nonverbal Awareness was also significantly correlated with Cognitive Regulation, r(48) = .39, p < .01 and Behavioural Regulation, r(48) = -.41, p < .01. As such, children with ASD who performed well on Cognitive Regulation and Behavioural Regulation also performed well on Social Understanding and Nonverbal Awareness. However, children's performance on either SEL domain was not associated with parent ratings of EF.

The partial mediation hypothesis was not tested because the basic conditions required to determine the presence of a partial mediation relationship were not met for either group. For a partial mediation relationship to exist, EF and SEL must be significantly correlated with each other and with Social Competence (Baron & Kenny, 1986; Holmbeck, 1997). Although there are significant correlations between SEL and EF domains in both groups, SEL and EF were not significantly correlated with Social Competence. In the control group, SEL was significantly correlated with Social Competence but not EF. In the ASD group, EF was significantly correlated with Social Competence whereas SEL was not.
6.0 Discussion

The development of social competence is critical to overall mental health and is associated with a range of positive outcomes throughout the lifespan. The results of this study add significantly to our understanding of social competence in children with high functioning ASD in a number of important ways. First, the results highlight the variability in social competence, SEL, and EF in children with ASD. Second, the results emphasize the relationships between multiple antecedents of social competence in terms of SEL and EF domains in both children with ASD and neurotypical children. Third, the results of this study demonstrate the unique contributions of performance-based and parent-rated measures of EF in understanding social competence. Finally, this study identifies EF as an important predictor of social competence for children with ASD.

6.1 Social Competence

Based on the previous literature, it was hypothesized that children with ASD would score significantly lower than neurotypical controls on measures of social competence. The results indicated that children with ASD were rated significantly lower on both the Vineland-II Socialization domain and the SSIS, with their mean scores on these measures consistent with other studies (Hus et al., 2013; Klin et al.2007; Lee & Park, 2007; Lerner et al., 2011; Liss et al., 2001; Lopata et al., 2013; Matchullis, 2012; Schohl et al., 2013; Weiss et al., 2013). The ASD group, on average, were rated within the Low to Moderately Low range on the Vineland and within the Below Average range on the SSIS. Moreover, one-half of the children with ASD scored at least two standard deviations below the normative mean on the Vineland Socialisation domain and one third
scored at least two standard deviations below the normative mean on SSIS. These findings are consistent with significant clinical impairment in these social skills areas in the ASD group. It also highlights the magnitude of the deficits in daily adaptive socialisation and social skills despite intact IQ for many children with ASD. In contrast, the control group, on average, scored in the Adequate range on the Vineland and in the Average range on the SSIS; no children in the control group scored two standard deviations below the normative mean on either measure. These findings are consistent with no significant clinical impairment being identified in the control group.

The children with ASD also had a wide range of scores on the social competence measures. Individual scores on the Vineland ranged from the Low to the Adequate range on the Vineland and from the Well Below Average to the Average range on the SSIS. While this range of social competence in children with ASD has not received much attention in the literature, it is noteworthy. This finding suggests that although a diagnosis of ASD entails shared core diagnostic features of social dysfunction, it merely characterizes the diagnostic parameters of the disorder, and does not convey an individual child's range of social functioning. This is important clinically, because many intervention studies target aspects of social deficits or problem behaviours within this population, without first assessing children's’ social functioning ability. It may thus be more helpful to assess children's’ specific social functioning as part of intervention planning, as opposed to targeting interventions generally based on the diagnosis of ASD alone. Moreover, as demonstrated in this study, assessing the child’s social adaptation (e.g., using the Vineland) and social skills (e.g., using the SSIS) allows for a more comprehensive examination of social competence in children with ASD. This
information can then be used to inform individual interventions or measure changes in social functioning throughout childhood. This is particularly important given the evidence that the gap in social functioning between children with ASD and their peers typically widens with age.

### 6.2 Demographic factors and social competence

This study explored whether other child-demographic factors - age, IQ, medication use, and age at diagnosis - were associated with social competence. Standard scores and raw scores were used to explore the relationship between age and social competence. Raw scores tell whether children perform more skills with age whereas standard scores provide scores in relation to other same-aged children from the standardization sample, thus accounting for typical increases in skills. Consistent with the literature, the results of this study demonstrated that social competence decreased with age for children with ASD, (Klin et al., 2007; Lee & Park, 2007; Perry et al., 2009; Szatmari et al., 2003). For this group, decreasing standard scores on the Vineland Socialisation Domain with age likely reflected the widening gap throughout elementary years between children with ASD and neurotypical peers (Klin et al., 2007), rather than a loss of skill with age, as indicated by the positive, albeit non-statistically significant, correlation between age and raw scores. For the control group, the significant positive correlation between age and raw scores on the Vineland suggests that neurotypical children gain considerable social abilities as they age. However, there was no significant relationship between age and standard scores on the Vineland, indicating that age did not account for significant variance in social adaptive functioning for the control group and
that increasing raw scores likely reflected typical developmental gains in social behaviours.

In terms of the SSIS, there was no association between age and social skills using either raw or standard scores for children with ASD. For the control group, both raw and standard scores on the SSIS demonstrated that social skills increased significantly with age. The SSIS does not provide standard scores for each year of age, as does the Vineland, and the same standard scores are provided for all children across the age range in this study. Given this, the Vineland may be a better measure of social competence than the SSIS for researchers and clinicians specifically interested in developmental changes in social skills across this age group.

Despite a wide range of IQ scores from Low Average to Superior, there was no significant correlation found between IQ and social competence for children with ASD in this study. At first glance these results may seem contradictory to the previous robust finding that intelligence is associated with social outcomes in this population (Baird, 2014; Howlin, Goode, Hutton & Rutter, 2004; Howlin & Moss, 2012; Volkmar et al., 2005). However, this association may only hold true when researchers include children with a range of intellectual ability. Studies that restricted their participants to children with IQs over 85 have not found intelligence to be associated with social functioning on the Vineland Socialisation domain (Anderson et al., 2009; Howlin et al., 2004; Kenworthy et al., 2010; Klin et al., 2007; Liss et al., 2001; Lopata et al., 2013; Szatmari et al., 2000) or parent rated social skills (Vickerstaff et al., 2007). Furthermore, longitudinal studies have also failed to find a relationship between intelligence in childhood and social functioning in adulthood for those ASD and average or above
average IQ (Gillepsie-Lynch, 2012; Howlin et al., 2004; 2014). The results of this study thus support this notion that social competence is independent of intelligence for children with ASD and intact IQ. This suggests that IQ may not have any added benefit to social competence once a certain level is reached and that the gap in social competence in children with ASD relative to their peers is not impacted by intelligence.

For the control group, IQ was significantly correlated with social skills as measured by the SSIS but not the Vineland, with SSIS scores decreasing with higher IQ. These results are consistent with other studies using the SSIS or its predecessor - the SRS (McKown et al., 2007) and are also found in the standardization sample of the SSIS. The reason for this apparent trend is not well-established. It may be that parents of more intelligent children have higher social expectations or underestimate positive social behaviours (Lupowski, 1989). Nevertheless, as mentioned previously, researchers may want to consider using the Vineland instead of the SSIS as a measure of social competence as the ratings on the Vineland Socialisation domain do not appear to be associated with IQ in neurotypical children.

IQ was not used as a covariate in this study for several reasons. First, it had different associations across groups, and thus does not fulfill methodological requirement as a covariate. Second, IQ was not associated with either measures of social competence for the ASD group and was not a significant contributor to social competence in the regression analyses. Furthermore, researchers advise against using IQ as covariate in studies involving neurodevelopmental populations, and particularly when other neurocognitive factors, such as EF, are being examined (Dennis et al., 2009; Miller & Chapman, 2001). Dennis et al. (2009) argue that IQ is always confounded by and
inseparable from the ASD condition, and that controlling for IQ removes variability in the outcome measure that is directly related to the underlying skill or component being measured.

Consistent with prior studies, 37% of children in the ASD group in this study were taking psychostimulant medications. Such medications are typically prescribed to reduce symptoms of hyperactivity, impulsivity and attention (Nickels et al., 2008). The percentage of children with ASD taking psychostimulant medication in this study is similar to other studies, which have reported rates between 31% and 52% (Nickels et al., 2008; Pearson et al., 2012; Tureck et al., 2013). The high prevalence of medication use in this group may reflect the notion that inattention and impulsivity are a common feature of the disorder (Frazier et al., 2001; Sinzig et al., 2009; van der Meer et al., 2012). In general, medication use was not significantly correlated with performance on any SEL or EF task, or on any parent ratings of EF and social competence on the Vineland. However, children with ASD on medication were rated lower on the SSIS social skills by their parents when compared to children with ASD not taking medication. Prior research looking at the effects of medication on social skills for children with ASD has been inconsistent. Some studies demonstrated that children with ASD on psychostimulant medications had poorer social skills (Turygin, Matson & Tureck, 2013; Yerys et al., 2009) whereas others found increased social skills (Handen et al., 2010; Jahromi et al., 2009; Pearson et al., 2013; RUPP, 2005). One explanation for these discrepancies is that measures of social functioning vary across the studies, and that different measures are likely tapping different aspects of social functioning. For example, the SSIS focuses more on aspects of compliance and cooperation than the Vineland, and these abilities are often
decreased in children who have difficulties with attention and impulsivity (Barkley & Benton, 2013). This is consistent with recent findings that children with ASD are often prescribed stimulant medications to manage externalising behaviours (Tureck, Matson, Turygin & Macmillan, 2013).

Consistent with previous studies, children with ASD in this study were diagnosed, on average, at age 6 (range: 3 to 10 years) (Daniels & Mandell, 2012; Maenner et al., 2013; Mandell, Novak & Zubritsky, 2005). As some researchers suggest that children who receive ASD diagnoses at earlier ages suffer from more impairment than children diagnosed later, (Daniels & Mandell, 2012; Maenner, 2013), age of diagnosis was included in this study as a child-based demographic factor. To the researcher’s knowledge, this is the first study to explore the relationship between age at diagnosis and multiple measures of social abilities in high functioning children with ASD. Age at diagnosis was not significantly correlated with social competence for children with ASD in this study, a finding inconsistent with previous studies (e.g., Daniels & Mandell, 2012; Maenner, 2013). While the reasons for this are unclear, it may be that age of diagnosis matters more for children with ASD with lower IQ and less for children with ASD with average or above average IQ. To further assess this, researchers could study the relationship between age at diagnosis and social competence in children with ASD across a broader range of IQ. Alternatively, this finding may reflect the focus on social ability rather than deficits in this study. In the previously cited studies, age at diagnosis was related to severity level, as measured by number of diagnostic criteria met in all three diagnostic categories (social interactions, communication, and restricted interests/repetitive behaviours). While it may be that children diagnosed earlier have
more clinical symptoms, it may also be that those diagnosed at a later age have specific difficulties which are equally as disadvantageous to social functioning. For example, although children who are diagnosed at a later age tend to have fewer symptomatic deficits, they are more likely to have specific deficits in conversational ability, idiosyncratic speech, and relating to peers (Daniels & Mandell, 2012; Maenner, 2013), which may clearly have a significant impact on social competence. The results of this study thus demonstrate the importance of assessing social competence at the level of the individual when designing interventions for children with ASD.

In summary, for the ASD group, age at diagnosis and IQ were not significantly correlated with social competence; medication use correlated significantly with one measure of social skills. In the control group, the results varied with the measure of social functioning. The latter results suggest that neurotypical children’s’ social adaptive behaviours, as measured by the Vineland - which includes how well they adapt to and cope with different demands and situations, how well they relate to others and manage in play or extracurricular activities – was not associated with age or IQ. Neurotypical children's social skills as measured by the SSIS – which includes behaviours related to cooperation, responsibility, communication, engagement with others and self control – increased with age and decreased with higher IQ.

6.3 Social Emotional Learning

Children with ASD performed significantly below the children in the control group on most measures of SEL. Children with ASD scored lower on measures assessing the ability to recognize emotional tone from voice, understand the perspectives of others,
interpret social cues in communication, and find solutions to common social conflicts and situations.

The significant differences in performance between the two groups on the four SEL measures is consistent with the plethora of studies that have demonstrated that children with ASD, as a group, perform worse than typically developing peers on measures of ToM (Nilsen & Fecica, 2011; Wellman & Liu 2004) and pragmatic language (de Villiers, Szatmari & Yang, 2014; Lam, 2014). Although the group differences observed in this study on the ToM task seem to support the notion of a general deficit in the ability of children with ASD to take others' perspective, these results should be interpreted with caution since almost one-half of the children (41%) in the ASD group successfully answered all ToM questions. While the scores may be inflated by the relatively low demands of the Strange Stories task used in this study, high success rates have also been reported in other studies in this population using multiple ToM tasks of varying complexity (Begeer, Malle, Nieuwland & Keysar, 2010; Peterson et al., 2009). Thus, the general usefulness of including targeted ToM training in interventions for children with ASD (e.g., Stichter et al., 2012) might be questioned if a large percentage of children do not actually demonstrate deficits in this area (Rao et al. 2008; Reichow and Volkmar 2010). However, given the range of success of children with ASD on the ToM task in this study, particularly as some children with ASD were not able to answer any questions correctly, clinicians may want to consider administering measures, such as the Strange Stories task, prior to planning individualised interventions. This would allow clinicians to determine which children would be more likely to benefit from targeted ToM training. In terms of problem solving, the findings are consistent with the literature
that children with ASD perform more poorly than neurotypical children (Demopoulos et al., 2013; Meyer et al., 2006; Ziv, Hadad & Khateeb, 2013). These findings were robust across age, stimuli used, and means of evaluation. For example, children with ASD performed more poorly than neurotypical peers when responding to questions based on story vignettes, pictures or videos and regardless of whether number of solutions, effectiveness of responses or style of response (e.g. passive or assertive) was used as the target score.

The finding that children in the ASD group in this study were significantly worse at recognizing affect in voices than the control group is important for two reasons. First, there is much less research in this area as most studies focus on facial affect recognition in the ASD population. These results add support to the growing literature that children with ASD have deficits in voice affect recognition (Lindner & Rosen, 2006; Oerlemans et al., 2013; Peppe, McCann, Gibbon, O'Hare & Rutherford, 2007). These results are inconsistent with a few studies that did not find differences between children with ASD and neurotypical children (Mazefsky & Oswald, 2007; Paul et al., 2005). However, in one of these studies (Paul et al., 2005) both groups obtained near-ceiling scores, suggesting that the task used of matching voices to only two emotions might have been too simple to differentiate between the groups. In contrast, using the more complex DANVA task in this study may have led to better detection of differences between children with ASD and controls. Second, by using parallel tasks of both facial and voice affect recognition, this study showed that children with ASD were able to adequately identify varying levels of the four basic emotions (happiness, sadness, anger and fear) in faces but not in voices. This highlights the importance of examining various modalities
when assessing emotion recognition in children with ASD. Future research should consider examining voice affect recognition in addition to other less explored areas, such as recognizing affect in gait and posture (Doody & Bull, 2013). It may be that there are specific rather than global deficits in affect recognition in ASD which are worthy of further study.

Children with ASD in this study performed similarly to the control group on measures of facial affect recognition and empathy. These findings support the notion that children with ASD can accurately identify emotions through facial expressions. Despite ample research dedicated to this topic, there are inconsistencies throughout the literature. Some studies found significant deficits in facial affect recognition (Lindner & Rosen, 2006) whereas others have not (Robel et al. 2004). Several recent reviews have suggested that the group differences found in the literature may be related to the particular emotions or modalities used in the studies rather than a global deficit in affect recognition for children with ASD (Harms et al., 2013; Uljarevic & Hamilton, 2012). Findings from this study support this idea, in that children in the ASD group were able to identify the four basic emotions as well as the control group. As such, children with ASD do not appear to have a global deficit in facial affect recognition. Future studies may want to include more facial expressions, such as jealousy and pride, to explore whether facial affect recognition is still intact with more complex emotions. In this study, the DANVA was chosen as the measure of facial affect because it allows for of the identification of varying levels of emotional intensity. However, the DANVA also provides children with four choices of possible emotions from which to identify the facial affect. It may be that this structure helped children be more successful on this task. As such, this ability to identify emotions
may not be able to translate to more natural situations, where this choice-component is not typically provided. From a clinical perspective, since children with ASD are able to recognize facial emotions when provided the vocabulary, it may be important to offer this same support in other settings such as school. For example, when assisting with a social situation or teaching children with ASD, it may be more effective to ask 'Is Jimmy feeling sad or angry' rather than 'how is Jimmy feeling'. The use of static pictures, however, has been criticized for a lack of ecological validity in studies of facial affect recognition, but this criticism may not apply to the ASD population. For example, while recent studies demonstrated that neurotypical children change their visual scanning patterns based on the nature of the stimuli, children with ASD maintained the same viewing pattern regardless of whether looking at static pictures or being involved in face to face interactions (Horlin et al., 2013). In addition, children with ASD rely on specific facial features to identify emotions whereas neurotypical children rely on more global, configural-based strategies (e.g., Behrmann et al., 2006). The inclusion of eye tracking methods in future studies may help to delineate further the factors associated with facial affect recognition in children with ASD.

Interestingly, the ASD group scored similarly to the control group on the empathy measure in this study. The general consensus in the literature is that individuals with ASD lack empathy (Lai, Lombardo, Chakrabarti, Baron-Cohen, 2013; Wing, Gould & Gillberg, 2011). For example, the DSM-IV specifically includes a lack of awareness or failure to offer comfort when others are hurt or upset as diagnostic criteria for ASD (APA, 2004). However, there are few studies dedicated to this topic and of those, the results are inconsistent (Dziobek et al., 2007; Schulte-Rüther et al., 2013). The mixed
results appear to be related to two factors. First, they may be due to the inclusion of children with a range of IQ, since children with lower IQ tend to demonstrate more impairment in empathy (Bacon, Fein, Morris, Waterhouse & Allen, 1998; Scambler et al., 2007). Second, it may be related to the idea that different measures are tapping different aspects of empathy. For example, there is reason to believe that the deficits for children with ASD may lie in one type of empathy-cognitive empathy but not in another type of empathy- affective empathy (Dziodek et al., 2008; Jones et al., 2010; Rogers et al., 2007; Schwenck et al., 2012). Whereas most research with this population focuses on cognitive empathy – the ability to infer someone else's feelings, the current study specifically examined affective empathy – the congruent response to someone else's emotional distress. As ToM tasks are often purported to measure components of cognitive empathy, an affective empathy measure was chosen for this study to reduce overlap between the ToM and empathy measure. Results from this study support the recent conceptualisations that children with ASD have specific rather than global deficits in empathy, where they are stronger on tasks of affective empathy than cognitive empathy (Scheeren et al., 2013).

In sum, compared to the control group, children with ASD generated less effective solutions to everyday problems, had more difficulty taking the perspective of others and interpreting social cues, and were less adept at both recognizing emotions by tone of voice and appraising the effectiveness of a response based on social context. However, they were equally skilled at recognizing basic facial emotions and congruently responding to others' distress or emotions.
6.4 Executive Functions

This study contributed to the literature by using both performance-based and parent measures of EF to provide a more comprehensive examination of executive functioning in children with ASD. The ASD group scored more poorly than the control group on all but two performance-based measures of EF. More specifically, children with ASD performed significantly worse on visual attention, auditory attention, visual working memory, planning, and auditory inhibition. While prior literature has demonstrated mixed results, comparisons are difficult due the wide range of tasks and stimuli used to tap similar underlying EF skills (Pellicano, 2012). In addition, most previous studies focus on isolated EF tasks. Nevertheless, the results of this study are consistent with others which have simultaneously examined a range of EF in this same age range (Corbett et al., 2009; Narcizi et al., 2013; Semrud-Clikeman et al., 2010; van Rijn et al., 2013). Moreover, the finding of significant differences between groups when the direct assessment of EF was conducted under optimal conditions (i.e. limited distractions; breaks when needed; one-on-one with an adult) is clearly suggestive of significant deficits in EF in ASD.

The use of both auditory and visual modalities in this study allows for a more comprehensive look at attention and inhibition in children with ASD. Children with ASD performed more poorly on both tasks of sustained attention. Although diminished attention to social stimuli is well-documented for children with ASD (Riby & Hancock, 2008), the present results suggest that difficulties with sustained attention are also evident with non-social stimuli presented in both visual and oral formats. In terms of inhibition, the ASD group performed worse than the control group on auditory inhibition but not visual inhibition, findings consistent with another recent study using the same
It is possible that the ASD group performed well on the visual inhibition task because it was computer-administered as researchers have reported that non-social administration of tasks attenuates deficits found on person-administered tasks (Ozonoff & Strayer, 2001; Russell, Hala & Hill, 2003). However, since there were significant group differences on the two other computer-administered tasks in this study, this factor likely did not account for the findings. The better performance on visual inhibition is more likely related to the complexity of the tasks. The visual inhibition task is simpler in that it requires only one response (withholding a dominant response). whereas the auditory inhibition task is a dual processing task that requires two responses (withholding a dominant verbal response while saying the opposite word). These results are consistent with recent studies that have reported differential performance across task complexity for children with ASD (Sanderson & Allen, 2013) and provide support for selective inhibitory deficits in children with ASD.

This study included a measure of affective decision making, an area of functioning commonly referred to as 'hot' EF. On this task, complexity was decreased by using two decks instead of four (Crone et al., 2005) to reduce possible effects of random responding often reported in young typically developing children (Duijvenvoorden, Jansen, Bredman, & Huizenga, 2012; Lambek et al., 2010; Skogli et al., 2013). Marbles were used to provide a visual representation of the wins and losses to reduce demands on working memory (Crone et al., 2005). Although few studies have examined affective decision making in children with ASD, the lack of differences found between the ASD and control group on this task is consistent with the sparse literature with both children...
(Faja, 2013; South et al., 2006, 2011) and adolescents (Johnson et al., 2006; Yechiam et al., 2010). However, these results should not necessarily be considered evidence of intact affective decision making in this population for several reasons. The whole premise of this task is that children who have better affective decision making are able to strategically adjust their decisions based on previous wins and losses in highly motivating situation that have an element of risk. However, other studies have demonstrated that children and teens with ASD are able to obtain similar overall scores as typical peers despite using a frequent switching strategy not related to outcome or feedback (Johnson et al., 2006; South et al., 2008; Yechiam et al., 2010) and having stronger autonomic responses to feedback (Faja et al., 2013). Additionally, the role of motivation is also a critical aspect of this task as it is measuring the ability to make decisions when there is some sort of personal gain. It has been postulated that the instructions to make choices for a donkey rather than for themselves might not be motivating enough (Skogli et al., 2013). However, to increase motivation in this study, participants were told they would receive a reward if they were successful at this task (in fact they all received a prize after this task). Behavioural observations of high frustration and repeated comments made by children with ASD when losses occurred suggest that this element of deception provided a strong motivational component. Therefore, given the strong negative reactions the researcher observed in participants throughout this task and the previous findings that adolescents with ASD had similar overall scores to their peers despite not adjusting their responses based on the feedback, it is possible that equal performance between groups in this study was not actually indicative of their ability to make better decisions in emotionally-charged situations. Analysing strategy use while measuring physiological reactions
during an affective decision making task may afford more valuable information regarding the impact of emotion on decision making and shed some light on the nature of 'hot' EF in this population.

Parent-ratings of EF can provide useful information regarding the application of EF under more emotion-laden circumstances and were examined in this study. The results indicated that parents of children with ASD reported significantly more deficits compared to the control group on the BRIEF, which is consistent with the literature (Kalbfleisch & Loughan, 2012; Kenworthy et al., 2008; 2009; 2010; Rosenthal et al., 2013; Troyb et al., 2013). By virtue of reliance on typical day to day behaviours, the BRIEF targets multiple abilities and thus has been criticized for its inability to isolate discrete EF processes while also possibly measuring non-EF behaviours (Isquith et al., 2013; Kenworthy et al., 2009). Although the results of this study may thus not provide information about specific EF impairments, it does demonstrate the striking deficits in the application of EF in daily tasks for children with ASD. Studies of EF in children should consider using parent ratings of EF along with performance-based measures as they are likely tapping two different yet important aspects of EF. Performance-based measures of EF typically capture optimal performance and provide information regarding efficiency of various self-regulatory processes whereas parent-ratings provide more information regarding the engagement and application of these processes in day-to-day and less structured situations (Toplak et al., 2013).

In summary, by using both performance-based and parent ratings of EF, this study found that children with ASD had deficits in specific aspects of EF as well as significant difficulties regulating their own behaviours in day to day activities and achieving age-
expected goals in daily tasks. Specifically, the ASD group was significantly worse than the control group at sustaining attention to verbal and auditory information, strategic planning, holding visual information in mind for short periods, and simultaneously inhibiting and replacing dominant responses. Children with ASD performed well on a single-level inhibition task and an affective decision-making task, although further study is required to examine whether these findings reflect intact abilities in these areas. Parent ratings of EF demonstrated a breadth of deficits across all areas of daily functioning. The results also indicated considerable variability on both SEL and EF measures in the group of children with ASD. Although the ASD group performed significantly poorer on most measures of SEL and EF and had a higher percentage of children within the clinically impaired range, it is noteworthy that some children with ASD performed as well as the control group on many SEL and EF measures. For example, the maximum scores were similar for the ASD and control groups on all SEL measures, except pragmatic language and social problem solving. In terms of EF, the maximum scores were similar in both groups on all measures, except planning and auditory inhibition. Since different children obtained minimum and maximum scores on different tasks, the higher scores in the ASD group are not due to the same subgroup of children performing better across all tasks.

6.5 Model of Social Competence

It was hypothesized that EF and SEL domains would be significantly correlated with each other and with social competence for children with ASD and the control group. Furthermore, it was hypothesized that both SEL and EF would predict social competence and that the relationship between EF and social competence would be partially mediated by SEL. Separate exploratory factor analysis was conducted to examine the relationship
amongst SEL and EF tasks to determine whether proposed domains could be used in an overall model of social competence. Since performance-based and parent-rated EF are arguably distinct measures of EF with weak inter-correlations, they were included in separate models (Toplak et al., 2013).

6.5.1 Factor analysis of SEL domains. An existing model of social competence was initially used as a basis for examining SEL skills (McKown et al., 2009; 2013.). The McKown model proposes three SEL domains: Nonverbal Awareness, Social Meaning, and Social Reasoning. In this model, Nonverbal Awareness is assessed using tasks that measure affect recognition, Social Meaning is assessed using tasks that measure understanding and interpretation of others’ communication, and Social Reasoning is assessed using measures of social problem solving. McKown et al. specifically used measures of pragmatic language, ToM, empathy, and the Test of Problem Solving with their community sample, and measures of pragmatic language, social language comprehension, and social vignettes with their clinical sample. In a recent study, McKown et al. (2013) provided data to support a two-factor model of SEL. In this model, facial, voice, gait and posture affect recognition made up the Nonverbal Awareness domain, while measures of pragmatic language, social problem solving, and ToM make up the Social Understanding domain.

The results of this study support McKown’s two-factor model of SEL for the ASD group. The results of factor analysis for the ASD group produced two factors: Nonverbal Awareness – the ability to infer others' emotions based on nonverbal cues; Social Understanding – the ability to identify, monitor and appraise the effectiveness of responses to social problems based on contextual cues social and the understanding of
others' intentions. The results indicated that for children with ASD, the abilities to interpret social information and to effectively resolve social problems are intricately linked and should be considered as one domain of SEL. Although the social problem solving measure targets the ability to reason about social situations and conflict situations, it also likely involves the interpretation of the intentions underlying others’ words and actions, and thus having these tasks under one domain instead of two is likely more reflective of the joint processes involved in understanding social information. Additionally, results suggest that these two SEL domains are also robust for children with ASD and that they can also be reliably measured using tasks commonly found in clinical settings.

For the control group, the results of the factor analysis produce a three-factor model: Nonverbal Awareness – comprised of facial and voice affect recognition; Social Understanding - comprised of pragmatic language and social problem solving; Empathy - comprised of the affective empathy task. Consistent with the McKown model, pragmatic language and social problem solving were retained within the same domain for the control group. Contrary to the McKown model, ToM did not correlate well with the other SEL tasks and therefore was not included in any domain. It is unclear why the ToM task did not correlate well with the other SEL tasks for the control group. It could be that the task was simplified too much by using only five vignettes from Happe's Strange Stories, in comparison to the twelve used in the McKown studies (2007; 2009; 2013), as evidenced by the large proportion of children in the control group (86%) who obtained perfect scores on this task. Nevertheless, the pragmatic language task also required the ability to understand others' intentions. McKown’s two-factor model including Social
Awareness and Social Understanding was also initially a good fit for the control group in this study, but the decision was made to retain a third factor. A third domain comprising the empathy task was retained for the control group because the model with the Empathy domain was superior to the model without, and because of the importance of empathy in most conceptualisations of social competence. It is important to note that the Empathy factor was retained with some reservations, however, given the low correlations between Empathy and the other two factor domains. In their latest analysis, McKown et al. (2013) did not indicate why they excluded empathy as a critical contributor to children's ability to interpret the meaning of social information, but it is possible that empathy would be better categorized as part of another important contributor to social competence.

Alternatively, it is possible that the self-report questionnaire used in this study assessed the child's beliefs and expectations about the experience of empathy, which likely reflects societal norms and social desirability (Michalskaa, Kinzler & Decety, 2013). However, given the high correlations with parent ratings of their child's empathy, this is unlikely.

In summary, this study demonstrated that two domains – Nonverbal Awareness and Social Understanding – are significant contributors to SEL for both children with ASD and neurotypical children. These two dimensions have repeatedly demonstrated their importance to SEL and should be included when assessing children's social comprehension skills. Empathy also appears potentially important, particularly with neurotypical children.

6.5.2 Factor analysis of EF domains. In this study, EF is conceptualised as a multidimensional construct that includes multiple lower order skills related to self-regulatory processes (McCloskey, 2011; Zhou et al., 2012). An integrated model of EF -
as the broader domain of subcomponents and processes that exert control over a person's cognitive, behavioural and emotional regulation - was chosen because of recent evidence demonstrating the importance of considering the separate but integral contributions of cognitive, inhibitory and emotional aspects of EF to a child's social functioning (Barkley, 1997; Blair, Zelazo & Greenberg, 2005; Hongwanishkul et al., 2005; Jahromi et al., 2008; McCloskey, 2011). Such an integrated approach to EF expands upon the McKown model of social competence and includes a wider conceptualisation of self-regulation, subsumed under the realm of EF.

The hypothesized EF model proposed that Cognitive Regulation (attention, working memory, and planning), Behavioural Regulation (inhibition), and Emotional Regulation (affective decision making) were fundamental components of EF. The results of the factor analysis for the ASD group produced these three domains, with some modifications: *Cognitive Regulation* – comprised of visual attention, auditory attention and visual working memory; *Behavioural Regulation* - comprised of auditory inhibition time, auditory inhibition errors and planning; *Emotional Regulation* – comprised of affective decision making. There are several possible explanations for why the measures from the Behavioural Regulation domain were not associated as expected. First, the visual inhibition task was dropped as it did not correlate well with any other measures. As mentioned previously, this task, which only required withholding a dominant response, was a more simple inhibition task and was more associated with the visual attention task, which also used the same computerized stimuli. It may be that this more simple inhibition task relied more on visual attention than inhibiting a response because it did not require the second step of replacing with a non-dominant response. Second, planning was
included in this domain as it correlated most with tasks of auditory inhibition. The planning measure used in this study - Tower of London - is generally considered a more complex EF task and is robustly associated with inhibition in adults (Gonzalez et al., 2010; Miyake et al., 2000). However, the relationships between these EF tasks are inconclusive for children, with some studies reporting significant correlations (Lehto et al., 2003) but not others (Bull et al., 2004). Using the same measures as in this study, Lehto and colleagues (2003) found a significant association between planning and auditory inhibition while also failing to find a significant association between planning and auditory attention. Results suggest that children's performance on the planning task may have been related to their ability to delay their initial response (i.e. inhibition) in order to plan their moves (Albert & Steinberg, 2011). Finally, the identification of affective decision making as its own distinct but related domain of EF is consistent with the sparse literature examining affective decision making in children with ASD (South and colleagues, 2011).

In summary, three major domains of EF were distinguished in ASD: (1) those classically related to higher order cognition or cognitive control; (2) those related to inhibiting behaviour; and (3) those related to the coordination and control of emotional behaviour, supporting the notion that Cognitive, Behavioural and Emotional Regulation are different dimensions of EF. The findings further support the popular position that EF should be considered simultaneously uniform and diverse rather than as a single entity (Lehto et al., 2003; Miyake et al., 2000). The findings that performance on seven EF tasks was best accounted for by three separate domains represents diversity. The finding that there were significant correlations among the three EF domains represents unity.
Importantly, the findings indicated that the study of these three EF domains can be applied to children with ASD. In addition, the examination of EF through the domains of Cognitive, Behavioural and Emotional Regulation may allow for integration of other important areas related to children's self-regulation, such as temperament, emotional intelligence, and effortful control (Berkman et al., 2012; Hofmann et al., 2012; Jahromi et al., 2013; Rueda et al., 2005; Wasserman & Wasserman, 2013; Zhou et al., 2012). Importantly, the separate domains of EF may allow for more accessible intervention targets and research is clearly needed to determine whether these domains respond to targeted treatment in ASD.

The three hypothesized EF domains did not emerge from factor analysis in the control group. Instead, a three-factor model consisting of Visual Executive Control – made up of visual attention, visual working memory, and visual inhibition; Inhibition - made up of auditory inhibition time and errors; and Auditory Attention – made up auditory attention, was retained for the control group. The factor domains likely emerged differently for the control group for several reasons. First, visual attention and auditory attention were not significantly correlated. The findings that almost one-half the control group (47%) obtained perfect scores on the auditory attention task compared to none on the visual attention task also suggest that they were tapping different aspects of attention. Since the TEC battery is relatively new, there are no normative studies which have compared performance on visual attention to alternate measures of auditory attention. For the control group, the visual attention task was only significantly correlated with the other two TEC measures using the same visual stimuli. The identification of a distinct Visual Executive Control domain for the control group is, however, consistent with the results
from the analyses of the standardization sample for the TEC. These three tasks all loaded on the same factor in both the 5 to 7 year old and the 8 to 18 year old normative samples, as they all appear to tap an element of selective visual attention.

Second, the planning task did not correlate significantly with any other EF measures for the control group and thus was not retained in any domain. While it was expected that planning would correlate highly with working memory because of the evidence of an association between the ability to hold information in mind (working memory) while thinking of different responses while planning (Ardila, 2013), there are mixed results regarding the processes related to planning tasks in neurotypical children. Albert & Steinberg (2011) examined age-related differences in strategy use on the Tower of London in a large sample of 10 to 30 year olds and found that working memory and inhibition were only associated with performance on the planning task in late adolescence and adulthood. Furthermore, they suggested that the Tower of London task used in this study may not be a good measure of effortful planning for neurotypical children because the solutions for the more simple tasks require little planning and more complex tasks are commonly approached using a trial and error strategy. To further clarify the nature of effortful planning in both groups, studies comparing the strategies that children with ASD and neurotypical children use during the planning task are needed. Whereas it has been reported in the literature that total move scores is the most indicative of planning (Culbertson & Zillner, 2001), this may be not an accurate representation of strategic planning in children. Specifically, measuring how much time before making the first move and how long it takes them to complete each trial would shed some light on this issue. Furthermore, incorporating measures of initiation and execution time in addition to
total correct score – as is commonly done in the adult literature (Gonzalez et al., 2010) - will be very important to sorting out whether children with ASD rely on different processes for successful completion of this task.

Lastly, the affective decision making task did not load on any factor for the control group. The measure of affective decision making was included in the study to specifically explore its role in social competence of children with ASD, as this literature is sparse. However, the lack of significant correlations between affective decision making and other EF measures for the control group is consistent with findings in the literature that have also demonstrated clear distinctions between 'hot' and 'cool' EF tasks in neurotypical children (Barraclough, Conroy, & Lee, 2004; Crone & vanderMolen, 2004; Crone et al., 2005; Hooper, Luciana, Conklin & Yarger, 2004; Skogli et al., 2013; van Liejenhorst, Crone & Bunge, 2006). It is noteworthy that children with ASD performed as well as the control group on this task but that performance was only related to other aspects of EF for the ASD group. This again suggests that children with ASD may rely on different strategies to obtain similar overall scores. For example, it is possible that children with ASD rely more on sustained attention and inhibition for completion of this task. This would be consistent with recent findings that affective decision making was significantly correlated with the parent rated behavioural inhibition scale for the ASD group but not the control group (South et al., 2011). As mentioned previously, future research should investigate strategy use and its relationship to other EF tasks in children with ASD.

It is important to note that the generally low correlations between different EF tasks in the current study for both the control and ASD groups are consistent with the
literature. Low and statistically nonsignificant intercorrelations among EF tasks have repeatedly been reported in children (Huizinga et al., 2006 Lehto et al., 2003), adolescents (Lehto et al., 1996) and adults (Miyake et al., 2000). In their study of 108 neurotypical children, Lehto and colleagues (2003) reported low intercorrelations among 14 EF measures. These low correlations likely contribute to the myriad of discrepant or inconclusive findings within the EF literature (Wasserman & Wasserman, 2013). Furthermore, it is also fairly common to find differential group correlations when comparing children with ASD to neurotypical peers (Demopoulos et al., 2013; Dyck et al., 2006; Gepner et al., 2001; Oerlemans, 2013; Peppe et al., 2007), yet this is rarely the focus of discussion. Unfortunately, most studies focus on group differences and do not report correlations between measures (Barron-Linnankoski et al., 2014; Reinvall et al., 2013; Semrud-Clikeman, Goldenring Fine & Bledsoe, 2013; van Rijn et al., 2013), or else report combined group correlations (Demopoulos et al., 2013) or only those for the ASD group (Faja et al., 2013).

6.5.3 Parent rated EF. As expected, the parent ratings of EF were not significantly correlated with performance-based measures of EF for the control group (Toplak et al., 2013) and only significantly correlated with two out of eight performance-based EF measures (auditory attention and visual inhibition) for the ASD group. These results emphasize the importance of using parent-ratings of EF as complementary rather than equivalent measures of EF in research and clinical practice. Unfortunately, this has not been common in the literature, with several studies relying solely on the BRIEF (Kalbfleisch & Loughan; Rosenthal et al., 2013; Stichter et al., 2012), and others referring to BRIEF scores as equivalent to the broad construct of EF (e.g., Jahromi, Bryce
& Swanson, 2013; Kloosterman, Kelley, Parker & Craig, 2014; Scheeren, Koot & Begeer, 2012). Interestingly, Gomez-Guerrero et al. (2011) found significant correlations between BRIEF parent ratings and the TEC visual inhibition task in a group of eight to twelve year old children with ADHD. Moreover, the finding that the TEC visual inhibition task was significantly correlated with all BRIEF composite scores despite no group differences on this measure, has several implications. It may be that the TEC visual inhibition task is sensitive to the application of EF in daily tasks. However, it is also possible that the basic abilities of sustaining visual attention and withholding a dominant response are related to the overall regulation of behaviour in everyday context for children.

A three-factor model of parent rating of EF was hypothesized, based on previous clinical developmental research (Gioia et al., 2002). The results of the factor analysis produced an identical solution of two domains for both groups: Metacognition and Behavioural Regulation. The relationship between the three domains of the performance-based EF and the two domains of the parent-rated EF was subsequently examined. For the ASD group, the Behavioural Regulation domain was significantly correlated with the performance-based Cognitive Regulation domain. This is an interesting finding as it indicates that for children with ASD, performance on higher-order cognitive EF tasks is related to everyday use of inhibitory control, flexibility, and modulation of emotions, which has specific clinical implications for intervention. For the control group, there were no significant correlations between performance-based and parent-rated EF domains.
6.6 Relationship between SEL and EF Domains

The relationship between factor analysis derived SEL domains of Nonverbal Awareness and Social Understanding and the EF domains of Cognitive Regulation, Behaviour Regulation, and Emotion Regulation were explored for children with ASD. The results demonstrated some significant relationships between SEL and EF domains in the ASD group, findings consistent with the previous literature (Ahmed & Miller, 2011; Oerlemans et al., 2013). Specifically, two SEL domains – Social Understanding and Nonverbal Awareness – were significantly correlated with two EF domains - Cognitive Regulation and Behavioural Regulation. For the children with ASD in this study, the ability to sustain basic attention, keep things in mind while doing another task, and inhibit primary responses in favour of a dominant one are related to how well they can recognize affect in others, how effectively they can problem solve social situations, interpret social cues, and take the perspective of others. The relationship between affective decision making and SEL tasks has not been previously been explored in children with ASD. While it was hypothesized that the Emotion Regulation domain would be significantly related to SEL since 'hot' EF is purported to extend the EF construct to everyday social decision making, which is typically conducted in the presence of motivational or emotional influences (Zelazo & Carlson, 2012), this was not found. This lack of relationship between Emotion Regulation and SEL domains of Social Understanding and Nonverbal Awareness could be related to the strategies used to complete SEL tasks. It may be that children with ASD approach social comprehension tasks in a more logical and rational manner which are free from or absent of emotional or motivational influences. This is clearly an area for further study.
For the control group, the relationships between the factor analysis derived SEL domains of Nonverbal Awareness, Social Understanding, and Empathy and the EF domains of Visual Executive Control, Inhibition, and Auditory Attention were also explored. This is the first study to explore the relationship between a wide range of SEL and EF tasks in neurotypical children. Visual Executive Control (visual attention; visual working memory; visual inhibition) was significantly correlated with Social Understanding (pragmatic language; social problem solving) and Nonverbal Awareness (facial and voice affect recognition). The results suggest that for neurotypical children, the ability to sustain visual attention, keep images in mind and inhibit primary responses are related to how well they can recognize affect in others, effectively problem solve social situations, and interpret social cues. It is not clear why the Inhibition or Auditory Attention domains did not correlate with any of the SEL domains. In contrast to children with ASD, it is possible that socially competent neurotypical children do not engage or rely on these skills to succeed in social comprehension tasks. These differences between groups have been reported in the literature. In one study of 267 children and adolescents, facial and voice affect recognition was significantly correlated with inhibition and verbal working memory for the ASD but not the control group (Oerlemans et al., 2013).

The relationship between the factor analysis derived SEL and parent rated BRIEF domains was also examined for both groups. For children with ASD, there were no significant associations between either Metacognition or Behavioural Regulation and any SEL domain. For the control group, the parent rated Behavioural Regulation domain was significantly correlated with the SEL domains of Social Understanding and Nonverbal Awareness. The contrast between the two groups is interesting. These results suggest that
for neurotypical children, but not children with ASD, the ability to inhibit behaviour and modulate emotions flexibly in everyday settings appears related to their understanding of social situations and ability to recognize emotions.

6.7. SEL and EF in Relation to Social Competence

The results of this study supported the hypothesis that SEL and EF domains would be significantly correlated in the ASD group. The further hypothesis that SEL and EF domains would both be significantly correlated with social competence was only partially supported. Specifically, two EF domains were related to Social Competence, but there were no significant associations between any SEL domains and Social Competence for the ASD group. The lack of association between SEL and Social Competence was unexpected, particularly given the numerous publications outlining the specific deficits of the ASD population in relation to SEL skills (Chasson & Jarossiewicz, 2014) and the presumed importance of SEL skills in children's ability to navigate the social world that is emphasized throughout the ASD literature. Furthermore, the lack of association between SEL and social competence in children with ASD was surprising given the robust outcomes in the McKown studies that found that all three SEL domains – Nonverbal Awareness, Social Meaning, and Social Reasoning – predicted significant variance in social competence across community and clinical samples. The measures used in the McKown studies were comparable or identical to those used in the current study and the age range of the participants in the McKown studies, albeit a bit wider was similar to that of the current study. There are, however, some important differences. First of all, McKown et al. had much larger sample sizes, including 186 community-recruited neurotypical children and 119 clinic-referred children. Second, their clinical sample
included children with various DSM-IV diagnoses, such as ADHD, ASD and mood and anxiety disorders, as well as some who did not meet formal criteria for any clinical diagnosis. As such, their clinical group did not demonstrate overall deficits in SEL as the children in the current study; furthermore, the clinical group in the McKown studies demonstrated higher mean scores than their own control group on ToM and pragmatic language, and equivalent scores on all three measures of social problem solving. As such, clinical implications are potentially less meaningful when children with different diagnoses are grouped together. Therefore, since McKown et al. (2007; 2009) combined children with ASD with other groups of children who did and did not have other DSM diagnoses, their results may not accurately reflect clinical populations. Third, the McKown studies (2009; 2013) used Structural Equation Modeling (SEM), a sophisticated data analysis technique with potentially greater power to detect relationships that may be missed, even in the same data set, using bivariate correlation analyses (Wilcox, 2001). This is evident in McKown's own studies where nonverbal awareness was found to be significantly predictive of social competence only after the data were re-analysed using SEM. The sample size in the current study was simply too small for a more sophisticated data analysis.

Although McKown et al. demonstrated the predictive utility of SEL in relation to social competence in a diverse clinical sample, the relationship may not apply in the same manner with a specific ASD sample. It is possible that the lack of relationship between SEL and social competence emphasizes the distinction between 'knowing' which involves the ability to provide correct answers on social comprehension tasks and 'doing' which involves the application of these skills in more complex social situations. Since no
information was gathered regarding the children's past or present interventions, it is also possible that direct teaching of these skills, as is often done in both social skills groups and individual treatment, prepared children to answer social comprehension questions, thus providing children with the correct knowledge to correctly answer questions regarding various social scenarios, but not the skills to apply the knowledge in social situations. Alternatively, it may be that the children who were more successful on the SEL tasks were using a more cognitive-based strategy, which helped them perform better on the task but which may not necessarily translate to more real-world scenarios and situations, as tapped by the social competence measures. Therefore, future research may want to use role-play scenarios and more thoroughly evaluate what processes are used to arrive at the answer. Finally, although SEL is not associated with the aspects of social competence measured in this study, it may be related to other aspects of social functioning. For example, it is possible that SEL is associated with problem behaviours. Although this was not measured in this study, SEL domains predicted problem behaviours in the first McKown (2007) study.

Two domains of EF - Cognitive Regulation and Emotion Regulation - were significantly correlated with Social Competence in the ASD group. This finding suggests children with ASD who have better selective and sustained attention, working memory, and affective decision making are also more socially competent. There has been some research examining the relationship between inhibition and social functioning in children with ASD and most has measured deficits rather than competence. Some studies failed to find a relationship between inhibition and social impairments (Bishopp & Norbury, 2005) or social skills (Kentworthy et al., 2009) whereas other have reported a significant
association between inhibition and social impairments (Joseph & Tager-Flusberg, 2004). Certainly, the association between inhibition and behaviour problems has received the most attention with neurotypical children and those with ADHD and there is some consensus that poor inhibition is associated with behaviour problems for these populations (Nigg et al., 1998; Tilman, Brocki, Sorensen & Lundervold, 2013; White, Jarrett & Ollendick, 2013). The results of this study add to the literature by demonstrating that although children with ASD performed significantly worse than the control group on measures of Behavioural Regulation, this deficit was not associated with Social Competence. Further evaluation with alternate measures of behavioural inhibition should be conducted to explore whether other aspects of Behavioural Regulation may be associated with Social Competence. For example, using delay of gratification tasks, tasks of behavioral persistence (e.g. puzzle box; Zhou et al., 2012), the Touch Your Toes task (Ponitz et al., 2008), and/or the slow-down motor task (Lisonbee, Pendry, Mize & Gwynn, 2010).

In contrast, for the control group, two SEL domains – Social Understanding and Empathy - were significantly correlated with Social Competence. These findings suggest that having congruent emotional responses to others' distress, the ability to understand and apply the social meaning of language, and problem solve common social situations were related to children's social skills and social adaptive behaviours in the control group. As mentioned previously, the lack of significant correlations between Nonverbal Awareness and Social Competence is consistent with McKown (2007) and others that examined the four basic emotions (Adolf, Sears & Piven, 2001; Castelli, 2005; Gross, 2004; Harms et al., 2010). Furthermore, the Nonverbal Awareness domain from the
McKown et al. (2009) community sample included measures of gait and posture, as well as facial and voice affect recognition. It may be that these additional tasks are more highly associated with social competence. On the other hand, EF did not relate to social competence of children in the control group. Few studies have evaluated the association between EF and social functioning in neurotypical children in this age range, and of those that did, most focused on problematic behaviours rather than social competence (Huyder et al., 2013; Thorell et al., 2004; Vuontele et al., 2013). For example, Ciairano and colleagues found that inhibition predicted problematic but not cooperative behaviours in 7 to 12 year old neurotypical children. While it may be that better EF performance does not relate to prosocial behaviours and that worse EF performance is related to problematic behaviours, simultaneous investigations of pro-social and problematic behaviours are needed to clarify this relationship for neurotypical children. In addition, since the EF task in this study were specifically chosen because of expected sensitivity to deficits in children with ASD, there are many other components of EF which were not evaluated. The inclusion of other components of EF, such as processing speed, flexibility, and/or updating and shifting, may render different results. Furthermore, the tripartite EF model used in this study was chosen for its potential to inform specific ASD interventions. That is, more simple tasks were chosen in an attempt to minimize shared variance and to isolate specific underlying skills that could potentially be targets for intervention. Inclusion of more complex EF tasks, such as the Wisconsin Card Sorting Task or Rey-Osterrieth Complex Figure Test, may have been more sensitive to variations in social competence for neurotypical children.
Parent ratings of the Metacognition and Behavioural Regulation domains of EF were significantly correlated with Social Competence within both groups. It is important to note that these results may have been influenced by shared-rater bias since parents concurrently completed the BRIEF and social competence measures. The potential exists for parents to provide answers on both the BRIEF and Social Competence questionnaires based on the same behaviour because all three measures gather information based on a child’s behaviour in real life settings.

6.8 Predictors of Social Competence

An important aim of this study was to examine whether EF and SEL predicted social competence. The hypothesis that EF and SEL would predict Social Competence in children with ASD and children in the control group received partial support (see Figures 7-10). For the control group, the SEL model significantly predicted 28% of the variance in Social Competence. One domain, Social Understanding, and IQ were significant predictors of social competence, whereas age, Nonverbal Awareness, and Empathy did not significantly contribute. In a separate regression analysis, EF domains did not contribute significantly to Social Competence. These findings suggest that targeting SEL skills, particularly teaching social problem solving, rules of conversation, and the importance of adjusting language based on context should be considered in social skills interventions. In contrast, the performance-based EF model significantly predicted 28% of the variance in Social Competence in the ASD group, with the Cognitive Regulation domain and age being significant predictors. These contrasting results are theoretically and clinically important: SEL domains, which were impaired in the ASD group, did not predict Social Competence, but EF did. Most notably, this study demonstrated that for
children with ASD, Cognitive Regulation processes make an important contribution to Social Competence, providing an important basis for targeted clinical interventions. These results are consistent with other studies that have found that EF is involved in social abilities (Diamantopoulou et al., 2007; Rinsky & Hinshaw, 2011; Wahlstedt et al., 2008). The significant contribution of age demonstrated that increasing age predicted lower social competence for children with ASD.

Analyses with parent ratings of EF were conducted separately because of the weak correlations with performance-based EF found in this study and the idea that parent ratings and performance-based EF measures evaluate different facets of EF. Parent ratings of EF predicted significant variance in Social Competence for both the ASD and control group. One domain of the BRIEF - Behavioural Regulation - along with IQ, predicted 31% of variance for the control group. The BRIEF Behavioural Regulation domain – along with age, predicted 54% of variance in Social Competence for children with ASD. The BRIEF Metacognition domain did not contribute to significant variance to Social Competence for either group. These results are not surprising since the Behavioral Regulation domain captures children's ability to maintain appropriate regulatory control of their behavior and emotional responses, and some questions on the measure are specifically related to aspects of social relatedness. Nevertheless, there are important implications for these findings. The BRIEF Metacognition domain, which was impaired in the ASD group, did not significantly predict Social Competence in this group whereas the Behavioural Regulation domain did. These results support the premise that parent ratings of EF can provide valuable information regarding children's Social Competence. Furthermore, it suggests that those working in clinical settings should pay...
Figure 7. The relationship between social competence, SEL and EF for children with ASD
Figure 8. The relationship between social competence, SEL and parent-rated EF for children with ASD.
Figure 9. The relationship between social competence, SEL and EF for the control group.
Figure 10. The relationship between social competence, SEL and parent-rated EF for the control group
particular attention to the parent ratings on the Behaviour Regulation domain as it may be a good gauge of how children are managing socially. Additionally, clinicians should not dismiss or discount adequate parent ratings on the Metacognition domain as they may not be representative of the child's Social Competence.

Previous studies have primarily emphasized performance-based EF 'profiles' of children with ASD (e.g. Barron et al., 2014; Troyb et al., 2013) as a means of assessing clinical impairment. The results of this study extend this approach and highlight the important relationship between EF and social competence. Future studies should explore how this relationship is manifested in order to further understand the processes involved with the social competence of children with ASD. The finding that the parent rated Behavioural Regulation domain was significantly correlated with performance-based measures of Cognitive Regulation and that both were significantly predictive of Social Competence is important as it provides important information about how EF impacts Social Competence. It has been proposed that behavioural regulation is a precursor to cognitive regulation (Ardila, 2013; Gioia et al., 2000; MacKenzie, 2013), but further research is needed to explore the nature of this relationship. Since the results demonstrated that EF does not impact social competence through SEL skills (as initially hypothesized), researchers might explore other ways in which EF impacts social competence. The relationship between performance-based Cognitive Regulation and parent-rated Behavioural Regulation also has important clinical implications and provides support for interventions that specifically target both areas. The Self-Regulation Program for Awareness and Resilience in Kids (SPARK: MacKenzie, 2013) is noteworthy because it uses a progressive approach that specifically targets behavioural regulation before
targeting cognitive regulation through a variety of explicit and practical strategies. The age of the child should also be considered when implementing intervention strategies. There is some evidence that cognitive regulation strategies benefit older children more than younger ones (Riccio & Gomes, 2013). Determining whether different EF interventions are more effective at different stages in development will be instrumental to clinical practice and to addressing the increasing gap in social competence between children with ASD and neurotypical peers throughout childhood.

The results of the current study thus suggest that both performance-based and parent-ratings of EF should be included as integral components of assessment and intervention with children with ASD. Although leading researchers in the field of ASD have recently recommended systematic implementation of EF interventions for school aged children with ASD (Szatmari, Charman & Constantino, 2012), more research is needed to determine the efficacy and effectiveness of this intervention. Targeted interventions are needed to explore whether gains in Cognitive and Behavioural Regulation may in fact generalize to everyday behaviours and improve social competence. In three recent reviews of EF interventions for children, diverse targeted and multi-modal approaches are identified that have been shown to improve children's EF (Cicerone, Levin, Malec, Stiss & Whyte, 2006; Diamond, 2012; Riccio & Gomes, 2013). These include computerized training, biofeedback, verbal mediation, external cueing, environmental restructuring and mindfulness meditation. The scaffolding of external strategies is also recommended because the goal is not to train task-specific performance, but rather the training and internalisation of regulatory cognitive processes (McCloskey, 2011). There is some evidence that one aspect of Cognitive Regulation – working
memory can be improved with targeted training with long term gains in ability for both neurotypical children (Diamond & Lee, 2011, 2012) and those with HFASD (de Vries, Prins, Schmand, & Guerts, 2012). However, even though computerized working memory training has been effective in improving working memory, the transfer to other areas or skills has been narrow and thus programs that target more components of EF are recommended (Diamond, 2012). Multi-modal interventions that target both behavioral and cognitive regulation, have been found to have positive effects on inhibitory control, working memory, and cognitive flexibility in typically developing children (Diamond & Lee, 2011), but research is needed to determine whether these improvements in EF could also influence social competence. Although the efficacy of EF as a treatment to increase social competence has not been established, the results of this study provide clear support of this idea. Furthermore, a review of recent studies concluded that it is children with the poorest EF who gain the most from EF interventions (Diamond & Lee, 2011).

Interestingly, recent findings also suggest that children with ASD who had higher baseline social skills are the ones who benefited the most from group social skills interventions (Chang et al., 2013).

SEL skills are generally considered important in the normal development of social competence. The results of this study indicated that SEL domains were not significantly predictive of Social Competence in the ASD group, but nonetheless SEL might still be an important factor to consider. It is interesting to speculate that incorporating targeted EF training in more traditional social skills interventions may increase effectiveness. For example, the SPARK intervention mentioned earlier specifically targets cognitive, behavioural and emotional regulation for children with ASD (MacKenzie, 2013). The
specific inclusion of visual attention training in SPARK is supported by the results of the current study, particularly given the speculation that it may be a critical skill for children with ASD. Cognitive Behavior Intervention (CBI; Bauminger et al., 2002) and Social Competence Intervention (SCI: Stichter et al., 2010; 2012) have also shown promising results in reducing problematic behaviours and social deficits by specifically targeting metacognitive strategies, self-monitoring, and self-regulation in addition to teaching traditional social skills of emotion awareness and perspective taking. Moreover, it was found that children with higher self-regulation benefited most from social skills treatment (Chang et al., 2013), again providing support for the importance of targeting EF skills prior to or in combination with social interventions.

The finding that both performance-based and parent-ratings of EF predicted significant variance in the social competence of children with ASD is a novel and exciting result of this research. However, there is still much variance to be explained in the social competence of children with ASD. For example, this study was limited to two areas associated with social competence – SEL and EF – and, as such, is not an exhaustive examination of potential antecedents of social competence. In trying to adapt the established McKown model of social competence to specifically incorporate the role of EF, other potential influential factors were excluded. Temperament, parenting, siblings, mental health, motor skills, and emotional intelligence are all potential influential factors but were not examined in this study. The importance of considering other factors is demonstrated in several recent studies. For example, emotional intelligence predicted social interactions in a small sample of 16 to 21 year olds with Asperger Syndrome (Montgomery, Stoesz & McCrimmon, 2012), effortful control was
inversely related to social deficits (Konstantareas & Stewart, 2006; Jahromi et al., 2013) and associated with prosocial peer engagement in children with ASD (Jahromi et al., 2013), and negative affect temperament has also been negatively associated with social adaptive behaviour in ASD (Millea, Shea & Diehl, 2013).

6.9 Study Limitations

This study is limited by several factors. Children with intellectual disability were excluded and, as such, the results are not generalizable to the entire ASD population. However, the functioning level specified in this study (IQ > 80) was consistent with criteria used by other studies of EF in high-functioning children with ASD (e.g., Kenworthy et al., 2005; Landa & Goldberg, 2005; Troyb et al., 2013) and still allowed for a wide range of IQ scores. Girls with ASD were also excluded from this study. Given the 4.6 to 1 ratio of boys to girls (CDC, 2012), the sample in this study does nonetheless represent the majority of children with ASD. The decision to exclude girls in this study was made based on the consistent gender differences reported in the variables of interest in this study (SEL, EF, social competence) (Boghi et al., 2006; Gentzler, Kerns & Keener, 2010; Huizinga et al., 2011; Lemon, Gargaro, Erticott & Rinehart, 2001; Willoughby et al., 2009).

The small sample size limited the strength of the analysis and the ability to use more robust statistical analyses, such as SEM. The number of participants in this study, however, is typical of studies examining EF in clinical populations. Attempts were made to obtain more participants by recruiting children with ASD from two additional health regions and by attending all available ASD parent meetings within the geographic area.
Previous clinical diagnostic reports were also used to confirm the diagnosis of ASD rather than secondary confirmation using the Autism Diagnostic Interview—Revised (ADI-R; Lord et al. 1994) or Autism Diagnostic Observation System (ADOS; Lord et al. 1999), as is done in some studies. Importantly, other studies that did secondarily confirm a diagnosis of ASD using the ADOS or ADI-R demonstrated similar results in their Vineland Socialisation scores as in the present study, indicating that the current sample was characteristic of the larger samples in these studies (Liss et al., 2001; Topaka et al., 2013). Notably, whereas many studies also used the results from the ADOS or ADI-R as an outcome measure, the current study used a separate outcome measure that focused on ability rather than disability. In addition, the data was collected at a single time and performance on SEL or EF tasks may have thus been influenced by external factors on the day of assessment. Although the tasks were administered in the same order for both groups, many children with ASD needed more frequent breaks and thus the impact of frequent breaks and hence longer sessions on task performance is unknown. However, observations made by the researcher suggested that the frequent breaks improved rather than hindered performance.

The use of only parent ratings of social competence may have provided a limited or biased view of children's social competence. Although multi-method, cross-informant evaluation of social competence is ideal because it reduces the effects of measurement factors, particularly parent-related factors, on ratings of problem behaviours (Bennett et al., 2012), there is substantial research that supports the use of a single informant approach for social skills and adaptive behaviour. Studies have consistently found no significant differences between parent and teacher ratings on social skills (Gresham,
Elliot, Cook, Vance & Kettler, 2010; Murray, Ruble, Willis & Molloy, 2009; Vickerstaff et al., 2007) and on the Vineland (Gagnon, Nagle & Nickerson, 2007; Szatmari, Archer, Fisman & Streiner, 1994; Voekler, Shore, Hakim-Larson & Bruner, 1997) for children with ASD. This is in contrast to the low inter-rater agreement generally found among informants for problem behaviours and psychopathology (Kanne, Abbacchi, & Constantino, 2009; Salbach-Andrae, Lenz & Lehmkuhl, 2009). High parent-teacher agreement on social skills ratings suggests that social behaviours are more consistent across settings for children with ASD. Additionally, the measurement of social competence via parent ratings has several advantages. Rating scales assess a broad range of behavior often not observed during direct observation (McConaughy & Ritter, 2005). Furthermore, available normative data provide a standard for comparing behaviour with a typically large and representative sample (Gresham & Elliott, 2008; McConaughy & Ritter, 2005).

6.10 Conclusions and Future Research

This study aimed to clarify the role of SEL and EF in the social competence of children with ASD. Previous studies in the literature have failed to incorporate a range of EF components, have not comprehensively explored the relationship between EF and SEL in relation to social competence, and focused on measures of impairment or disability rather than social competence. This is the first study to concurrently evaluate important SEL components, performance-based and parent-rated domains of EF in children with ASD and a neurotypical control group. In addition, this study added significantly to the ASD literature by examining the relationship between SEL and EF domains specifically in relation to social competence.
Results of this study demonstrated that better performance on two SEL domains (Social Understanding and Empathy) and one parent rated EF domain (Behavioural Regulation) were significantly correlated with higher Social Competence for children in the control group. Social Competence was not associated with any performance-based EF domains in the control group. IQ, the SEL domain of Social Understanding and the parent-rated EF domain of Behavioural Regulation independently predicted significant variance in Social Competence for the control group. Performance-based EF did not predict significant variance in Social Competence for the control group. For children with ASD, better performance in performance-based Cognitive Regulation and the parent rated EF domains of Metacognition and Behavioural Regulation were significantly correlated with higher Social Competence. Social Competence was not significantly correlated with any SEL factors in the ASD group. Finally, performance-based Cognitive Regulation, parent rated Behavioural Regulation, and age independently predicted significant variance in Social Competence for the ASD group. IQ and SEL did not predict significant variance in Social Competence for children with ASD.

The importance of EF to the social competence of children with ASD was demonstrated through both performance-based measures and parent ratings. Performance-based and parent ratings of EF also highlighted the importance of considering the separate but integral contributions of cognitive, behavioural and emotional regulation to children's social functioning. Notable results of the current study are that (1) performance-based cognitive EF domains were related significantly to everyday behavioral regulation, based on parent ratings; (2) performance-based and parent ratings of EF significantly predicted social competence; and (3) SEL did not
contribute significant variance in social competence for the ASD group. This is particularly interesting in light of the contrasting findings for the control group where the SEL domain of Social Understanding significantly predicted social competence, whereas no EF domain did. The results also demonstrated that deficits in social competence tend to increase with age for children with ASD by virtue of a widening gap with that of their neurotypical peers. These results have important implications for clinical assessment and intervention in ASD: (1) both performance-based and parent-ratings of EF should be included as integral components of assessment and intervention; (2) targeted EF interventions may be an effective means of increasing social competence in children with ASD, and ultimately improving long-term mental health and behavioural outcomes.

Finally, although SEL domains were not significantly correlated with social competence in the ASD group in this study, such factors should still be considered an important area to assess in children with ASD. As it is likely that SEL domains are important to other areas of social functioning, evaluation of these skills should also be used to help guide individualised treatment.

Further research is needed to further explore the relationship between EF and social competence in children with ASD. The finding that Cognitive Regulation accounts for significant variance in social competence of children with ASD needs to be examined in studies with a larger sample that can make use of more sophisticated analyses, such as SEM. Other aspects of self-regulation should also be explored in further studies to additionally clarify the relationship between EF and social competence. The importance of assessing multiple integrated components may also allow for even more targeted intervention strategies (Wasserman & Wasserman, 2013) and is in line with recent
literature strongly encouraging a more integrated conceptualisation of EF and self-regulation (Ardila, 2013; Isquith, Roth & Gioiai, 2013; Koziol, 2013). Additionally, more focus on the developmental emergence and trajectories of Cognitive, Behavioural, and Emotional regulation is required. Longitudinal studies could help identify whether there are disparate developmental trajectories or maturational delays for children with ASD and inform at which age targeted EF interventions may be most beneficial. This would inform interventions to address EF impairments in early childhood in order to increase social competence. Although current findings demonstrate the important role of EF in social competence, more information is needed on how EF impacts social competence and on what factors indeed influence EF. For example, sociocultural factors, such as parent scaffolding and parent-child interactions, predict earlier EF development and better performance on EF measures in neurotypical children (Pellicano, 2012). Exploring factors that contribute to EF performance in children with ASD may provide another avenue for intervention, possibly even at a younger age.

Many researchers have alluded to a distinct EF profile in children with ASD (Happe et al., 2006; Reinvall et al., 2013), but to date the patterns of strengths and difficulties has not been solidified because of inconsistent results in the literature. It is unclear whether this is by virtue of the wide array of individual tasks purporting to measure the same aspects of EF, which are often accompanied by varying complexities and modalities. Alternatively, it could be that the nature of the heterogeneity within ASD eludes identifying the types of specific EF profiles that have been demonstrated in children with ADHD (Holmes et al., 2010) and FASD (Rasmussen et al., 2013). A current meta-analysis of studies examining EF in high-functioning children with ASD
may help clarify this issue, although the varying measures and complexity levels would make this a challenging task. Furthermore, children with ASD may use different strategies that rely on different underlying cognitive processes to complete SEL and EF tasks. A comprehensive review of correlation studies may prove indispensable to shed some light on this issue and further explore whether EF tasks are truly differentially affected in children with ASD. Incorporating strategy measures, specifically examining process-related elements of various tasks and physiological measures are critical for future EF research. The accumulating evidence that children with ASD use different strategies to successfully solve SEL and EF tasks, as well as the different correlations among age, IQ, SEL, and EF measures also highlight the need for future studies to focus on the heterogeneity within the ASD population. Exploring why some children are successful rather than focusing on what is associated with their deficits or impairments could also provide valuable clinical information. This may help to narrow the striking disparity between their cognitive abilities and social competence.

Finally, the results of the current study highlight the need to go beyond comparisons with neurotypical children and examine whether and why EF tasks are differentially affected in ASD. Despite overall group deficits in SEL, EF and social competence, the ASD group had scores ranging from the average to impaired range on most measures. This heterogeneity in SEL and EF is reflective of the reported behavioural heterogeneity in the ASD population. Given this intra-group heterogeneity, it is time to go beyond group comparisons and focus on which aspects specifically influence successful performance within this group, in order to reduce long-term negative impacts, and improve overall quality of life for children with ASD and their families.
7.0 References


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doi: 10.1002/jac.21816


APPENDIX A: Ethical Approval

UNIVERSITY OF REGINA

OFFICE OF RESEARCH SERVICES
MEMORANDUM

DATE: January 30, 2012

TO: Nathalie Berard
3111 Rozierac Street
Regina, SK S4S 1V6

FROM: Dr. Bruno Plouffe
Chair, Research Ethics Board

Re: The Role of Executive Functions and Social Emotional Learning Related to Social Competence of Boys with High-Functioning Autism Spectrum Disorder (File # 3751112)

Please be advised that the University of Regina Research Ethics Board has reviewed your proposal and found it to be:

☐ 1. APPROVED AS SUBMITTED. Only applicants with this designation have ethical approval to proceed with their research as described in their applications. For research lasting more than one year (Section 1F), ETHICAL APPROVAL MUST BE RENEWED BY SUBMITTING A BRIEF STATUS REPORT EVERY TWELVE MONTHS. Approval will be revoked unless a satisfactory status report is received. Any substantive changes in methodology or instrumentation must also be approved prior to their implementation.

☐ 2. ACCEPTABLE SUBJECT TO MINOR CHANGES AND PRECAUTIONS (SEE ATTACHED). Changes must be submitted to the REB and approved prior to beginning research. Please submit a supplementary memo addressing the concerns to the Chair of the REB. **Do not submit a new application.** Once changes are deemed acceptable, ethical approval will be granted.

☐ 3. ACCEPTABLE SUBJECT TO CHANGES AND PRECAUTIONS (SEE ATTACHED). Changes must be submitted to the REB and approved prior to beginning research. Please submit a supplementary memo addressing the concerns to the Chair of the REB. **Do not submit a new application.** Once changes are deemed acceptable, ethical approval will be granted.

☐ 4. UNACCEPTABLE AS SUBMITTED. The proposal requires substantial additions or redesign. Please contact the Chair of the REB for advice on how the project proposal might be revised.

Dr. Bruno Plouffe

cc: U of Regina's Altano and Dr. Lynn Loutzenhiser - Psychology

**supplementary memo should be forwarded to the Chair of the Research Ethics Board at the Office of Research Services (Research and Innovation Centre, Room 523) or by e-mail to research.ethics@uregina.ca**

Phone: (306) 966-4775
Certificate of Approval
Research Ethics Board

PRINCIPAL INVESTIGATOR       Ms. Nathalie Berard
RQHR PROJECT #                REB-11-100

APPROVAL DATE                March 15, 2012
TITLE                        The Role of Executive Functions and Social Emotional Learning Related in Social Competence of Boys with High-Functioning Autism Spectrum Disorder

CERTIFICATION

The protocol and consent form for the above named project have been reviewed by the Chair of the Regina Qu’Appelle Health Region Research Ethics Board and the experimental procedures were found to be acceptable on ethical grounds for research involving human subjects.

The Regina Qu’Appelle Health Region Research Ethics Board meets the standards outlined by Canada’s Tri-Council Policy Statement for Ethical Conduct for Research Involving Humans.

The Regina Qu’Appelle Health Region Research Ethics Board has met the criteria for purposes of Section 29 of the Health Information Protection Act.

Please note that all future correspondence regarding this project must include the RQHR project number.

Best wishes in your continuing research endeavours.

Dr. Michelle McCarron, Acting Chair
Regina Qu’Appelle Health Region
Research Ethics Board

This Certificate of Approval is valid provided there is no change in the experimental procedures. Any significant changes to the protocol must be reported to the Chair for the Board’s consideration, in advance of implementation of such changes. You are required to provide a status report on an annual basis.
APPENDIX B: Recruitment Poster

**Project Title:** The Role of Executive Function and Social Emotional Learning Skills in Social Competence of Boys with and without High-Functioning Autism Spectrum Disorder

**Overview and Description:**
8-12 year old boys with and without high functioning autism spectrum disorder (Asperger's, PDD NOS, high functioning autism) and their parent(s) are being invited to take part in a study of social competence, which is how well we get along with others. Social competence is important because it is associated with academic success and overall mental health. Learning more about which factors best predict social competence may later help us provide useful treatments for children who have social difficulties. This study is designed to examine which factors are most important in getting along with others.

**What's involved in the study?**
Before you agree to participate, we would like to give you some information about what's involved with this study. Parents will be asked to complete 3 questionnaires – 2 about your child's daily social skills and 1 about Executive Functions (i.e., attention, planning, memory). Children will be asked to complete 10 short tasks. There is no reading, writing or mathematics involved in any of the tasks. Some are computerized activities where the child has to remember objects he saw on the screen, pay attention to instructions and solve problems. Others involve looking at pictures and answering questions about what the characters feel and think. This will take approximately 90 minutes. Breaks and snacks will be provided. To recognize your child's participation, he will be provided with a Cineplex gift certificate for a movie, popcorn and drink.

Please call or email me if you want more information or are interested in participating.

Nathalie Berard
Primary Researcher
Department of Psychology, University of Regina

Supervisors: Lynn Loutzenhiser, Ph.D., University of Regina (585-4078)
            Dennis Alfano, Ph.D., University of Regina (585-4220)

The Research Ethics Board of the University of Regina has approved of this project. If you have any questions or concerns about your rights as a research participant, you may contact Dr. Bruce Plouffe, Chair of the Research Ethics Board at the Office of Research Services (AH 505) at 585-4775 or by email to research.ethics@uregina.ca.

The Research Ethics Board of the Regina Qu'Appelle Health Region has approved of this project. If you have any questions or concerns about your rights as a research participant, you may contact Dr. Elan Paluck, Chair of the Research Ethics Board at (306) 766-5451.
APPENDIX C: Consent and Assent Forms

INFORMATION AND ASSENT FORM FOR CHILDREN


Student Researcher: Nathalie Berard, MEd, University of Regina: Department of Psychology
Supervisors: Dennis Alfano, Ph.D., University of Regina (585-4220)
Lynn Loutzenhiser, Ph.D., University of Regina (585-4078).

You are being invited to join a study that is looking at which things are most important for making friends and getting along with others.

What will I be asked to do?

(1) We will meet today for about 1.5 hours, with breaks when needed. You will be asked to complete 10 different activities, including answering questions about what people think and feel in stories, pictures and short social scenarios. You will also be asked to do some work on the computer. There is NO reading, writing or mathematics involved.

(2) You will get one gift certificate for a Cineplex movie theatre with popcorn and a drink to thank you for taking part in the study.

(3) You will be given a copy of this assent form to keep
Are there any risks if I do the study?

No, we do not think that there is any harm to you if you do this study. You may become tired during the tasks and can take a break at any time. We will also have scheduled breaks where you will be provided snacks and water or juice.

Are there any benefits if I do the study?

Your participation will help us learn important information, such as what skills are important for getting along well with others, and how we can help children learn those skills.

Will anybody know how I answered the questions?

It is our job to keep your answers private, which means that we do not talk to anyone else about what you tell us. All of the information we collect will be kept in a locked cabinet and on a computer that needs a password, at the University of Regina. Your name will not be stored on the computer or on any of your answer sheets.

Do I have to participate?

No, you only have to join the study if you want to. You can chose if you want to do it. Also, if you do choose to do the study you can stop at any time, you can skip any questions that make you uncomfortable, and/or you can ask that the answers you give not be used in the study. Nobody will be mad if you decide not to do it, or if you decide to stop doing the study before you are finished. It is your choice. If you decide to stop doing the study at any point, you will still receive the gift certificate to the movie theatre.

Who can I talk to if I have any questions?

If you have any questions or have something to say about the study you can call the person doing the study, Nathalie Berard at (306) 585 4078, or email her at nathalie.berard@gmail.com. You can also contact the (supervisors) people in charge, Dr.Lynn Loutzenhiser at (306) 585 4820 (email: lynn.loutzenhiser@uregina.ca) or Dr. Dennis Alfano, at (306) 585-4220 (email: dennis.alfano@uregina.ca).

If you have questions about your rights as a person doing it (participant), you may contact the Chair of the Research Ethics Board at (306) 585-4775 (email: research.ethics@uregina.ca).
I AGREE TO PARTICIPATE IN THE STUDY
• I UNDERSTAND I CAN STOP AT ANY TIME

______________________________________  ________________________________
Printed name of participant                    Date

______________________________________  ____________________________
Signature of Witness                           Date

______________________________________
Signature of principal investigator/designated
representative-if applicable                    Date

The Research Ethics Board of the University of Regina has approved of this project. If you have any questions or concerns about your rights as a research participant, you may contact Dr. Bruce Plouffe, Chair of the Research Ethics Board at the Office of Research Services (AH 505) at 585-4775 or by email to research.ethics@uregina.ca.

The Research Ethics Board of the Regina Qu'Appelle Health Region has approved of this project. If you have any questions or concerns about your rights as a research participant, you may contact Dr. Elan Paluck, Chair of the Research Ethics Board at (306) 766-5451.
INFORMATION AND CONSENT FORM FOR PARENTS


Student Researcher: Nathalie Berard, Doctoral student, University of Regina.
Supervisors: Dennis Alfano, Ph.D., University of Regina (585-4220)
Lynn Loutzenhiser, Ph.D., University of Regina (585-4078).

Introduction: You and your child are being invited to take part in a study that is looking at which factors are most important for making friends and getting along with others.

Purpose: The primary purpose of the study is to find out if and how certain skills predict social competence. Specifically, I am looking at whether social emotional learning (e.g. recognizing facial emotions, solving social problems, understanding others’ thoughts and feelings) and executive function (e.g. attention, memory, planning) are associated with children’s ability to interact well with others.

Voluntary Participation: Participation in this study is completely voluntary, so it is your decision whether or not you want to take part. To help you decide whether you do or do not want to participate, it is important to understand what this research involves. This consent form will describe the study, the purpose of the research, what will happen during the study, and the possible risks and benefits. If you do decide to take part in this study, you will be asked to sign this consent form to indicate your informed consent to participate. Although, even after you sign you can choose to drop-out at any time, refuse to answer any questions, as well as request that the information collected not be used. Lack of participation will not result in any negative consequences or affect any services you and your child access in the RQHR or any future services you may access.

Who is conducting the study: The Primary Investigator is Nathalie Berard. She is a registered psychologist who is completing her doctorate in clinical psychology at the University of Regina. This project is a part of a Ph.D. dissertation required for partial fulfillment of the University of Regina’s Psychology Ph.D. program.

Procedures: You and your child will come to the University of Regina to participate. First, you will be asked to read and sign an informed consent form. Then your child will be read information regarding the study and be asked to sign an assent form that says that he agrees to participate in the study. Following consent and child assent, you (the parent/guardian) will be asked to complete a short demographic form and three questionnaires asking your view of your child’s daily social skills and interactions with others as well as some executive function abilities (e.g. memory, planning,
attention). Next, your child will be asked to complete a series of questions and tasks related to social situations as well executive function.

These include 10 tasks that involve (1) answering questions about social situations in stories and pictures; and (2) tasks related to executive functions, that involves some work on the computer. There will not be any reading, writing or mathematics. The total time is expected to be approximately 1.5 to 2 hours, however it may take less time, and breaks will be provided when necessary.

In addition, if your child has been diagnosed with an autism spectrum disorder (Autism; Asperger's; PDD NOS), then you will also be asked to provide written confirmation of the diagnosis or provide permission for Nathalie Berard (principal researcher) to conduct a file review to confirm your child's diagnosis.

**Potential Risks:** There are no known or anticipated risks to you, or your child, by participating in this research. Your child may become tired during the tasks and can take a break at any time. We will also provide scheduled breaks where your child will be provided snacks and water or juice.

**Potential Benefits:** No direct benefit can be guaranteed. However, it is anticipated that the findings from this investigation will help us better understand the factors related to social interactions and friendships. Although participants may not benefit directly from this study, it has the potential to greatly improve our understanding of social competence.

**Compensation:** Children will be given a Cineplex movie and popcorn gift certificate for their participation. They will receive this even if they decide to discontinue the testing. Children will also be given small rewards during some of the tasks, such as fidget toys, bouncy balls; toy cars or pencils/erasers.

**Confidentiality:** Any information gathered during the data collection process is strictly confidential and will be used for research purposes only by the University of Regina. All information collected will be made anonymous. The electronic file will not contain any identifying information. The consent and assent forms (containing the participants' names) will be kept separate from the participant responses in a locked cabinet. Participant names will not be put on the demographics forms, questionnaires or response sheets. All of the information that we collect will be stored on a lab computer (requiring an access code) at the University of Regina in the Behavioural Neuroscience Research lab for 5 years, after which time the electronic files will be deleted and paper material will be shredded. This research does NOT involve a psychological assessment or intervention for your child and results will not be documented in any RQHR records or files.

**Right to Withdraw:** As a reminder, your participation as well as your child’s participation is voluntary and you and your child can answer only those questions that you are comfortable with. You may withdraw from the research project for any reason, at any time without explanation or penalty of any sort. Should you wish to withdraw, you may exit the study at any time and any information obtained will be permanently deleted from our data collection. Your right to withdraw data from the study will apply until data has been analyzed. After this it is possible that some form of research dissemination will have already occurred and it may not be possible to withdraw your data.
Participant Consent to Participate

- I have read and understand the information provided for the study as described herein.
- I have had the opportunity to have my questions answered.
- I agree to participate as well as permit my child to participate in this study.
- I agree to provide written confirmation of my child's diagnosis or allow the principal researcher to conduct a file review to confirm my child's diagnosis.
- I understand that I am not giving up my legal rights as a result of signing this consent form.
- I understand that I can withdraw from this study at any time and for any reason.
- I have been given a copy of this form.

I AGREE TO PARTICIPATE IN THE STUDY AND

(1) complete an information sheet and 3 questionnaires

______________________________________  ________________________
Printed name of participant's parent  Date

______________________________________  ________________________
Signature of participant's parent  Date

______________________________________  ________________________
Signature of Witness  Date

______________________________________  ________________________
Signature of principal investigator/designated  Date
(2) allow my child to participate in the study

______________________________________  _______________________
Printed name of participant's parent            Date

______________________________________  _______________________
Signature of participant's parent               Date

______________________________________  _______________________
Signature of Witness                            Date

______________________________________  _______________________
Signature of principal investigator/designated representative-if applicable Date
IF MY CHILD HAS A DIAGNOSIS OF AUTISM SPECTRUM DISORDER, I ALSO AGREE TO

(4) either provide confirmation of diagnosis through a letter or report, or allow the researcher to complete a file review to confirm diagnosis through a file review.

____________________________________ ______________________________
Printed name of participant's parent Date

____________________________________ ______________________________
Signature of participant's parent Date

____________________________________ ______________________________
Signature of Witness Date

____________________________________ ______________________________
Signature of principal investigator/designated representative-if applicable Date
Contact Information:

If you have any questions, feedback or comments about the research study or the results of the research study, please feel free to contact the Principal Investigator, Nathalie Berard, or her direct supervisors, Dr. Lynn Loutzenhiser or Dr. Dennis Alfano.

Primary Investigator:  Nathalie Berard  
Department of Psychology  
University of Regina  
3737 Wascana Parkway  
Regina, SK S4S 0A2  
Phone: (306) 585 4078  
Email: nathalie.berard@gmail.com

Research Supervisor:  Lynn Loutzenhiser, Ph.D., R. D. Psych.  
Professor  
Department of Psychology  
University of Regina  
3737 Wascana Parkway  
Regina SK S4S 0A2  
Phone: (306) 585-4180  
Email: lynn.loutzenhiser@uregina.ca

Research Supervisor:  Dr. Dennis Alfano, Ph.D., R. D. Psych.  
Professor  
Department of Psychology  
University of Regina  
3737 Wascana Parkway  
Regina SK S4S 0A2  
Phone: (306) 585-4220  
Email: dennis.alfano@uregina.ca

The Research Ethics Board of the University of Regina has approved of this project. If you have any questions or concerns about your rights as a research participant, you may contact Dr. Bruce Plouffe, Chair of the Research Ethics Board at the Office of Research Services (AH 505) at 585-4775 or by email to research.ethics@uregina.ca.

The Research Ethics Board of the Regina Qu'Appelle Health Region has approved of this project. If you have any questions or concerns about your rights as a research participant, you may contact Dr. Elan Paluck, Chair of the Research Ethics Board at (306) 766-5451.
APPENDIX D: Visual Schedule Provided to Children

Faces
Voices
Computer
Pictures & Questions
Computer
Pictures & Questions
Speed Game
Stories
Bead Game
Listening
I Feel Questionnaire
Hungry Donkey
Puzzles & Definitions
### APPENDIX E: List of Measures

<table>
<thead>
<tr>
<th>SEL Variables</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial affect recognition</td>
<td>DANVA-2: Child faces</td>
</tr>
<tr>
<td>Linguistic affect recognition</td>
<td>DANVA-2: Child Paralanguage</td>
</tr>
<tr>
<td>Theory of mind</td>
<td>Strange Stories (Happe, 1994)</td>
</tr>
<tr>
<td>Empathy</td>
<td>Bryant Empathy Continuum</td>
</tr>
<tr>
<td>Pragmatics</td>
<td>Test Of Pragmatic Language (TOPS-2)</td>
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<tr>
<td>Social problem solving</td>
<td>Test of Problem Solving (TOPS-3)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>EF Variables</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditory Attention</td>
<td>NEPSY-II: Auditory attention &amp; response set</td>
</tr>
<tr>
<td>Planning</td>
<td>Tower of London</td>
</tr>
<tr>
<td>Visual Attention</td>
<td>Test of Executive Control (TEC)</td>
</tr>
<tr>
<td>Working Memory</td>
<td>TEC: n-back</td>
</tr>
<tr>
<td>Inhibition</td>
<td>NEPSY-II Inhibition</td>
</tr>
<tr>
<td>Affective Decision Making</td>
<td>TEC: Go/No-Go task</td>
</tr>
<tr>
<td>Parent EF Ratings</td>
<td>Behavior Ratings Inventory of Executive</td>
</tr>
<tr>
<td></td>
<td>Functions (BRIEF)</td>
</tr>
<tr>
<td>Social Competence</td>
<td>Social Skills Inventory System (SSIS)</td>
</tr>
<tr>
<td></td>
<td>Vineland Adaptive Behaviour Scales 2 (VABS2):</td>
</tr>
<tr>
<td></td>
<td>Socialisation Domain</td>
</tr>
</tbody>
</table>
Dear Parent,

Thank you for volunteering to participate in our study. Please complete the following personal information. This confidential information will be kept separate from the parent and teacher questionnaires and your child's responses, and will be locked in a filing cabinet at the University of Regina.

PARENT'S NAME:

CHILD'S NAME:

CHILD'S DATE OF BIRTH:

DOES YOUR CHILD HAVE A DIAGNOSIS?

WHAT IS THE DIAGNOSIS:

AGE OF CHILD AT TIME OF DIAGNOSIS:

NAME OF MEDICATION (if any):
PARENT INFORMATION

What is the highest degree or level of school you have completed?

- No high school diploma
- High school diploma or the equivalent (for example: GED)
- College graduate
- Bachelor's degree
- Master's degree
- Doctorate degree (e.g. Ph.D.; Ed.D)
- Other: Please indicate

What is your total household income?

- Less than 24 999
- 25 000 – 50 000
- 50 000 – 75 000
- 75 000 – 100 000
- 100 000 – 125 000
- 125 000 – 150 000
- More than 150 000
APPENDIX G: Record Forms for SEL measures:
Answer Sheet for DANVA2 - Child Faces & Voices

1. Happy     Sad     Angry     Fearful
2. Happy     Sad     Angry     Fearful
3. Happy     Sad     Angry     Fearful
4. Happy     Sad     Angry     Fearful
5. Happy     Sad     Angry     Fearful
6. Happy     Sad     Angry     Fearful
7. Happy     Sad     Angry     Fearful
8. Happy     Sad     Angry     Fearful
9. Happy     Sad     Angry     Fearful
10. Happy    Sad     Angry     Fearful
11. Happy    Sad     Angry     Fearful
12. Happy    Sad     Angry     Fearful
13. Happy    Sad     Angry     Fearful
14. Happy    Sad     Angry     Fearful
15. Happy    Sad     Angry     Fearful
16. Happy    Sad     Angry     Fearful
17. Happy     Sad     Angry     Fearful
18. Happy     Sad     Angry     Fearful
19. Happy     Sad     Angry     Fearful
20. Happy     Sad     Angry     Fearful
21. Happy     Sad     Angry     Fearful
22. Happy     Sad     Angry     Fearful
23. Happy     Sad     Angry     Fearful
24. Happy     Sad     Angry     Fearful
### Answer Key For Child Faces 2

<table>
<thead>
<tr>
<th>Item</th>
<th>Emotion</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Angry</td>
<td>Low</td>
</tr>
<tr>
<td>2</td>
<td>Happy</td>
<td>High</td>
</tr>
<tr>
<td>3</td>
<td>Happy</td>
<td>Low</td>
</tr>
<tr>
<td>4</td>
<td>Fearful</td>
<td>Low</td>
</tr>
<tr>
<td>5</td>
<td>Sad</td>
<td>High</td>
</tr>
<tr>
<td>6</td>
<td>Sad</td>
<td>High</td>
</tr>
<tr>
<td>7</td>
<td>Angry</td>
<td>High</td>
</tr>
<tr>
<td>8</td>
<td>Happy</td>
<td>High</td>
</tr>
<tr>
<td>9</td>
<td>Angry</td>
<td>Low</td>
</tr>
<tr>
<td>10</td>
<td>Sad</td>
<td>Low</td>
</tr>
<tr>
<td>11</td>
<td>Fearful</td>
<td>Low</td>
</tr>
<tr>
<td>12</td>
<td>Happy</td>
<td>Low</td>
</tr>
<tr>
<td>13</td>
<td>Sad</td>
<td>High</td>
</tr>
<tr>
<td>14</td>
<td>Angry</td>
<td>Low</td>
</tr>
<tr>
<td>15</td>
<td>Fearful</td>
<td>Low</td>
</tr>
<tr>
<td>16</td>
<td>Happy</td>
<td>High</td>
</tr>
<tr>
<td>17</td>
<td>Sad</td>
<td>Low</td>
</tr>
<tr>
<td>18</td>
<td>Fearful</td>
<td>High</td>
</tr>
<tr>
<td>19</td>
<td>Fearful</td>
<td>High</td>
</tr>
<tr>
<td>20</td>
<td>Angry</td>
<td>High</td>
</tr>
<tr>
<td>21</td>
<td>Sad</td>
<td>Low</td>
</tr>
<tr>
<td>22</td>
<td>Fearful</td>
<td>High</td>
</tr>
<tr>
<td>23</td>
<td>Happy</td>
<td>Low</td>
</tr>
<tr>
<td>24</td>
<td>Angry</td>
<td>High</td>
</tr>
</tbody>
</table>
**ANSWER KEY FOR CHILD VOICES 2.**

<table>
<thead>
<tr>
<th>Item</th>
<th>Emotion</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Happy</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>Sad</td>
<td>Low</td>
</tr>
<tr>
<td>3</td>
<td>Angry</td>
<td>Low</td>
</tr>
<tr>
<td>4</td>
<td>Angry</td>
<td>High</td>
</tr>
<tr>
<td>5</td>
<td>Happy</td>
<td>Low</td>
</tr>
<tr>
<td>6</td>
<td>Fearful</td>
<td>Low</td>
</tr>
<tr>
<td>7</td>
<td>Angry</td>
<td>High</td>
</tr>
<tr>
<td>8</td>
<td>Sad</td>
<td>High</td>
</tr>
<tr>
<td>9</td>
<td>Fearful</td>
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<td>10</td>
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<tr>
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<tr>
<td>14</td>
<td>Angry</td>
<td>High</td>
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<tr>
<td>15</td>
<td>Sad</td>
<td>High</td>
</tr>
<tr>
<td>16</td>
<td>Fearful</td>
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</tr>
<tr>
<td>21</td>
<td>Angry</td>
<td>Low</td>
</tr>
<tr>
<td>22</td>
<td>Fearful</td>
<td>Low</td>
</tr>
<tr>
<td>23</td>
<td>Happy</td>
<td>Low</td>
</tr>
<tr>
<td>24</td>
<td>Sad</td>
<td>High</td>
</tr>
</tbody>
</table>
Bryant Empathy Questionnaire

It makes me sad to see a boy who can’t find anyone to play with

0 1 2 3

I get upset when I see a boy being hurt

0 1 2 3

Seeing a boy who is crying makes me feel like crying

0 1 2 3

I get upset when I see an animal being hurt

0 1 2 3

I really like to watch people open presents, even when I don’t get a present myself

0 1 2 3

Some songs make me so sad I feel like crying

0 1 2 3

Sometimes I cry when I watch TV

0 1 2 3

0 - not at all true
1 - a little true
2 - pretty much true
3 - very much true
**Happe Strange Stories**

**Lie (Dentist)**
John hates going to the dentist because every time he goes to the dentist he needs a filling, and that hurts a lot. But John knows that when he has toothache, his mother always takes him to the dentist. Now John has bad toothache at the moment, but when his mother notices he is looking ill and asks him “Do you have toothache, John?” John says “No, Mummy”.

1. Is it true what John says to his mother?
2. Why does John say this?

**White Lie (Hat)**
One day Aunt Jane came to visit Peter. Now Peter loves his aunt very much, but today she is wearing a new hat; a new hat which Peter thinks is very ugly indeed. Peter thinks his aunt looks silly in it, and much nicer in her old hat. But when Aunt Jane asks Peter, “How do you like my new hat?” Peter says, “Oh, it’s very nice”.

1. Was it true what Peter said?
2. Why did he say it?

**Sarcasm (Picnic)**
Sarah and Tom are going on a picnic. It is Tom’s idea, he says it is going to be a lovely sunny day for a picnic. But just as they are unpacking the food, it starts to rain and soon they are both soaked to the skin. Sarah is angry. She says “Oh yes, a lovely day for a picnic alright!”

1. Is it true what Sarah says?
2. Why does she say this?

**Joke (Haircut)**
Daniel and Ian see Mrs. Thompson coming out of the hairdressers 1 day. She looks a bit funny because the hairdresser has cut her hair much too short. Daniel says to Ian, “She must have been in a fight with a lawnmower!”

1. Is it true what Daniel says?
2. Why does he say this?

**Double Bluff (Bat)**
Simon is a big liar. Simon’s brother Jim knows this, he knows that Simon never tells the truth! Now yesterday Simon stole Jim’s bat and Jim knows Simon has hidden it somewhere, though he can’t find it. He’s very upset. So he finds Simon and he says “Where is my bat? You must have hidden it either in the cupboard or under your bed, because I’ve looked everywhere else. Where is it, in the cupboard or under your bed?” Simon tells him the bat is under his bed.
1. Was it true what Simon told Jim?
2. Where will Jim look for his bat? 3. Why will Jim look there for his bat?

_Happe Strange Stories Scoring Procedure_

**LIE(DENTIST)**

Incorrect: Physical
He didn’t have toothache
Incorrect: Psychological
He’s just saying it for a joke

Correct: Partial psychological state
He thinks it’s really sore and he’s ill
He doesn’t like going to the dentist
He doesn’t like the dentist
He hates going to the dentist
Correct: Physical state
It hurts when he gets a filling
It’s sore when he goes to the dentist
He’s got toothache/He had toothache
He needs to go to the dentist
It hurts when he gets the toothache
Because they hurt
Because when you get a filling it’s sore
So that he doesn’t have to go to the dentist
Correct: Psychological state full and accurate answer
He doesn’t want to go to the dentist
He doesn’t want a filling
He doesn’t want to get a filling because it hurts
He doesn’t want to get hurt
He knows that it’ll hurt a lot

**WHITE LIE (HAT)**

Incorrect: Physical
It’s got a(u)nts on it
It looked nice
Psychological
He liked the hat
He wanted one
He liked the old hat
Incorrect: Psychological
The lady asked him
It looked horrible
Partial psychological state
He didn’t want to get a row
He didn’t want to get into trouble
He didn’t like the hat
He loved his aunt

Psychological state full and accurate answer
To make his auntie feel that he likes it
He didn’t want his auntie to think that he didn’t like it
He didn’t want her to get sad/to make his auntie sad
He didn’t want to hurt her feelings
He didn’t want to upset his auntie
So his auntie wouldn’t be offended
He didn’t want to tell her he hated it
He didn’t want to be rude
He didn’t want to be nasty to her
He wanted to make his auntie feel good
He wanted to make his auntie happy

SARCASM (PICNIC)

Incorrect: Physical
Because she says it’s a lovely day but it’s not
If they’re eating sandwiches they might get wet
So that she could have a picnic
Incorrect: Psychological
She was exaggerating
She likes rain
She thinks it’s a sunny day
She wanted it to be sunny
She really wanted to go on a picnic
She wanted Tom to get wet
She was pretending
She didn’t want to hurt Tom’s feelings/make him sad
Because Tom thought she’d give him a row

Partial psychological state
She was cross
She was trying to be funny
People say stuff like that when they’re angry
She was annoyed with Tom
She’s angry
She’s copying what Tom says but it isn’t really
She’s joking
Physical state
It was sunny and it started raining
It’s raining
Because Tom said it was going to be sunny but it wasn’t
The boy thought it was going to be a lovely day but it wasn’t
Psychological state full and accurate answer
She’s being sarcastic

JOKE (HAIRCUT)

Incorrect: Physical
Because her hair is cut like the grass
She doesn’t wear nice clothes
She went to the hairdresser and got her hair cut
Incorrect: Psychological
He doesn’t want to upset her
He thinks that’s what it looks like
He doesn’t like it, he’s just pretending
He thought it looked like she’d got it cut by a lawn mower/had a fight with a lawnmower
He’s lying
He was being sarcastic

Physical state
Because her hair is funny
Because her hair looks quite short/hair is too short
Because her hair is too short for a woman, she’s in the army!
Because her hair got cut too short
Because she doesn’t look nice
Because it looks like a lawn mower has cut her hair
Because Mrs. T looks like a boy
Partial psychological state
He didn’t like her hair
Psychological state full and accurate answer
He wants to make his friend laugh/impress his friend
He wants to make fun of her
To have a laugh/to have a joke/be funny
To slag off Mrs. T
It’s a for a joke
To act smart
He’s being silly in front of his friend

Double Bluff (Bat)

Incorrect: Physical
He said it was under the bed or in the cupboard
Because it’s a good hiding place
He would look under the bed because he would see the lumps on it
I’d look everywhere just in case, may be in the shed
Incorrect: Psychological
He can’t remember
He thinks in there or in the cupboard
I think it’s broken and in the bin
I think it’s in the cupboard because he wouldn’t have hid it under
his bed in case his mum found it
He wants to play ping-pong/find it
He doesn’t know Simon never tells the truth
He doesn’t know where it is

Physical state
Because Simon said so/told him
Partial psychological state
It won’t be there because Simon lied
Simon never tells the truth
Because it’s the opposite from what Simon says
Because Simon is a liar/always lies
Simon never tells the truth
Psychological state full and accurate answer
Because he doesn’t believe Simon
Jim knows Simon is a liar/always lies
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