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# Outcomes Associated with Participation in a Social Intervention for Adolescents with Autism Spectrum Disorder

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UNIVERSITY OF CALGARY

Outcomes Associated with Participation in a Social Intervention for Adolescents  
with Autism Spectrum Disorder

by

Ryan Luke Matchullis

A THESIS

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## **Abstract**

Adolescents with Autism Spectrum Disorder (ASD) and without intellectual impairment face a myriad of social and relational challenges targeted by many social skills training programs (SSTPs). One such program, the Program for the Education and Enrichment of Relational Skills (PEERS), has an existing evidence base supporting the learning of curricular objectives.

However, adolescents with ASD have additional challenges that may impact or be impacted by their social difficulties, including potential mental health problems, executive functioning (i.e., cognitive flexibility and inhibition) impairment, and parent-child relationship challenges. The current study expanded on previous research by examining the above-mentioned factors in adolescents who attended PEERS in a Canadian context. After inclusionary criteria were applied and data quality were examined, the final sample included 42 families (78% male), with adolescents ranging in age from 13 years, 6 months to 18 years, 8 months. Participation was associated with initial significant gains in social skills that were not maintained at follow-up. Though no improvements were seen in adolescent participants' cognitive flexibility, their inhibitory control was significantly improved and maintained. Contrary to hypotheses, no changes in important markers of adolescent mental health were noted. Examination of parent-child relationships revealed significant positive relations between both attachment and communication and the social skills improvements made by adolescents. The findings from this study have important implications for the ongoing delivery of PEERS and provide insight into the relations between improving social relationships and skills for adolescents with ASD and other important secondary outcomes.

*Keywords:* Autism Spectrum Disorder, social skills training, parent-child relationships, executive function, anxiety, depression

## **Acknowledgements**

Though the initial impetus for this study was largely academic in nature, it was when I began running PEERS and meeting the participants and families that I became truly inspired. Working with over 60 adolescents with Autism Spectrum Disorder (ASD) and their parents over 3 years opened my eyes beyond what I could glean from reading literature and attending graduate training. I was able to see the uniqueness, struggles, triumphs, hopes, and the true resilience of these individuals. I would like to recognize study participant families and others in the community of those with ASD. I am overwhelmingly grateful for what you have taught me through sharing your life stories and experience with me. You have my admiration, respect, and sincere thanks.

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## **Dedication**

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## **List of Abbreviations**

ABA.....	Applied Behaviour Analysis
AD/HD.....	Attention-Deficit/Hyperactivity Disorder
ADOS-2.....	Autism Diagnostic Observation Schedule, Second Edition
ANCOVA.....	Analysis of Covariance
APA.....	American Psychiatric Association
ASD.....	Autism Spectrum Disorder
AUC.....	Area Under the Curve
BASC-2.....	Behavioural Assessment System for Children, Second Edition
BRIEF.....	Behavior Rating Inventory of Executive Function
BYI-II.....	Beck Youth Inventories, Second Edition
CASS.....	Contextual Assessment of Social Skills
CDC.....	Centers for Disease Control and Prevention
CDI.....	Child Depression Inventory
CEFI.....	Comprehensive Executive Function Inventory
CFREB.....	Conjoint Faculties Research Ethics Board
CHEXI.....	Childhood Executive Function Inventory
DSM-5.....	Diagnostic and Statistical Manual of Mental Disorders, 5 <sup>th</sup> Edition
DTC.....	Delayed Treatment Control
EEG.....	Electroencephalogram
EF.....	Executive Function
FSIQ.....	Full Scale Intelligence Quotient
ID.....	Intellectual Disability
IQ.....	Intelligence Quotient
K-CBCL.....	Korean Child Behavior Checklist
LAU.....	Life As Usual
MASC-2.....	Multidimensional Anxiety Scale for Children, Second Edition
MASSI.....	Multimodal Anxiety and Social Skills Intervention
PCRI.....	Parent-Child Relationship Inventory
PDD-NOS.....	Pervasive Developmental Disorder – Not Otherwise Specified
PEERS.....	The Program for the Education and Enrichment of Relational Skills

PRI.....	Perceptual Reasoning Index
PRQ.....	Parenting Relationship Questionnaire
PSI.....	Parenting Stress Index
RCASD.....	Revised Children's Anxiety and Depression Scale
RCMAS.....	Revised Children's Manifest Anxiety Scale
RMANOVA.....	Repeated Measures Analysis of Variance
ROC.....	Receiver Operating Characteristic
SAEC.....	The Social Adjustment Enhancement Curriculum
SCI.....	Social Competence Intervention
SDARI.....	Sociodramatic Affective Relational Intervention
SSIS.....	Social Skills Improvement System
SSRS.....	Social Skills Rating System
SSTP.....	Social Skills Training Program
STAIC.....	State and Trait Anxiety Inventory for Children
TASSK.....	Test of Adolescent Social Skills Knowledge
TD.....	Typically-Developing
ToM.....	Theory of Mind
UCLA.....	University of California Los Angeles
UOT.....	Unstuck and On Target
VCI.....	Verbal Comprehension Index
WAIS-IV.....	Wechsler Adult Intelligence Scale, Fourth Edition
WASI-II.....	Wechsler Abbreviated Scale of Intelligence, Second Edition
WISC-IV.....	Wechsler Intelligence Scale for Children, Fourth Edition

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## **Chapter 1: Introduction**

This paper describes the importance of social interaction and friendship and presents a population for which these relationships can pose a challenge. Specifically, individuals with Autism Spectrum Disorder (ASD) have distinct impairments in social communication and behaviour that can negatively impact their likelihood of developing and maintaining key social relationships. Thus, social skill training programs (SSTPs) designed to improve the development and maintenance of friendship for those with ASD are presented. The focus of this paper is the Program for the Education and Enrichment of Relational Skills (PEERS); one such intervention for which a research base does exist. Literature reviewed in the paper highlight the importance of friendship as protection from the development of mental health issues, particularly in adolescence. Additionally, the relations between social skills involved in developing and maintaining friendships and executive function (EF) are offered. Finally, PEERS involves parents in the intervention and therefore the nature of parent-child relationships in this population are described. The current study proposed research questions aimed to address gaps in research conducted on PEERS. Results were meant to support an understanding of how PEERS and other SSTPs may be improved or better understood as improving secondary areas of development. Research questions focused on understanding social skill improvements in the immediate and long term in a novel Canadian population with rigidly confirmed ASD diagnosis. Additionally, given the relations between friendship, mental health, and EF, these domains are also a focus of study. The final area of focus involved understanding how parent-child relationships may impact outcomes from PEERS, given parents' involvement in the program. The following chapters then present the methodology used to answer these questions, including methods of measurement and a data analysis used. Quantitative results are offered and those



related to each research question are discussed in detail. Finally, study strengths, limitations, and future directions are presented.

## **Background**

The social nature and quality of human interaction is regarded as a core feature of how the human mind operates (Smit, 2014). Social relationships permeate and comprise a significant portion of our daily life, as seen through interactions with family, coworkers, peers, fellow students, romantic partners, and even those met in passing. The ubiquitous concept of a friend represents a crucial social relationship, one in which mutual respect, affection, and care are present. Across the lifespan, friendship has been associated with a variety of benefits and protective factors over potential negative life outcomes. For children, the number of friends and friendship quality buffer against victimization and internalizing, externalizing, and social problems (Waldrip, Malcolm, & Jensen-Campbell, 2008). During adolescence, the presence and quality of friendship is associated with successful adjustment during significant life transitions such as attending university (Buote et al., 2007). Furthermore, the literature supports adolescence as a time during which friendship is a key source of social and emotional support, contributing to the development of personality and protecting from mental health problems (Masten et al., 2009; Spithoven et al., 2017; Wrzus & Neyer, 2016). Friendships, however, take effort and skill to initiate and sustain, and approximately half of friendships are not stable over time (Meter & Card, 2016). For various reasons, some individuals struggle to utilize typical social skills to make friends and may miss out on the protective factors associated with friendship.

Individuals with ASD, a neurodevelopmental disorder, present with distinct impairments in social-communication and restrictive and/or repetitive behaviours that make initiating, maintaining, and thus benefitting from friendship difficult (American Psychiatric Association

[APA], 2013; Scheeran, Koot, & Beeger, 2012). Adolescents with ASD and without intellectual impairment generally have greater language and communication skills than those with ASD and intellectual impairment. Thus, they are often more likely to be placed in typical educational settings with increased opportunity for social interaction. Although many such adolescents desire friendships, characteristic social skill impairments impact the duration, quality, and intimacy of peer relationships (Patrina, Carter, & Stephenson, 2014). As a result, adolescents with ASD and without intellectual impairment have an increased likelihood of experiencing loneliness, social stress, peer rejection and victimization, a sense of hopelessness, and problems with anxiety and/or depression; problems that their typically-developing (TD) peers may be protected from via peer relationships (Deckers, Muris, & Roelofs, 2017; Fung, Lunskey, & Weiss, 2015; Locke, Ishijima, Kasari, & London, 2010). Given the range of positive outcomes associated with successful social interactions and friendships, substantial efforts have been undertaken to design interventions that target this domain of functioning for this population.

### **Research Context**

A variety of SSTPs have been designed for children and adolescents with ASD without intellectual impairment. Typically, structured learning approaches, modeling, and role plays are used to teach this population verbal and nonverbal social skills and social problem solving (McMahon, Lerner, & Britton, 2013). SSTPs range widely in their procedures and components and may include parents or siblings, have homework assignments and other generalization opportunities, and differ in their duration. Mixed findings are present in the literature, with the majority of SSTPs initially improving adolescent knowledge of concepts taught, and some initial gains in social skills. However, most studies do not show long term improvement or include follow-up in methodology (McMahon, Lerner, & Britton, 2013).

A theoretically and pragmatically derived SSTP, PEERS (Laugeson & Frankel, 2010) is a manualized intervention designed to help adolescents with ASD and without intellectual impairment make and keep friends. Many studies have been conducted on PEERS, with improvements in knowledge of curriculum objectives and social skills, some decreases in social anxiety, changes in neural processing of social information, and mixed results regarding long term outcomes among the most prominent results (Laugeson et al., 2009; Laugeson et al., 2012; Mandelberg et al., 2014; Schohl et al., 2014; Van Hecke et al., 2013). Despite the breadth of studies conducted on PEERS, the current study aims to address limitations in aspects of previous methodology as well as investigate potential novel outcomes and factors related to success from program participation.

In particular, no research has been conducted in a Canadian context with a sufficient sample size to understand outcomes in this unique cultural and educational setting. Additionally, not all studies confirmed participant diagnosis or set strict inclusionary criteria for intelligence, nor did they conduct follow up with appropriate and consistent timelines to determine maintenance of improvements. Addressing these methodological issues will help to provide a comprehensive understanding of program efficacy that may in turn inform how SSTPs in general and PEERS in particular may be enhanced. Since friendship has been associated with protection from a variety of mental health problems (La Greca & Harrison, 2005; Wentzel, Donlan, & Danette, 2012; White et al., 2009), exploring key indicators such as anxiety and depression is warranted. Executive function (EF), the neuropsychological concept of top-down control of behaviour, has been linked to social skills and social problem solving (Jones et al., 2018; Pellicano, 2007) and is an area of impairment in those with ASD (Hill, 2004; Craig et al., 2016), yet has not been included in studies on SSTPs for this population to date. Finally, though parent

involvement is key to the design of PEERS and may help to generalize skills taught (Karst & Van Hecke, 2012), no investigation has focused on how parent-child relationships may impact participant outcomes.

### **Current Study**

Investigating these novel outcomes and factors in program success may shed light on how a program targeting social skills and friendship may further impact theoretically associated domains of functioning. Thus, the research questions proposed in the current study are:

1. Utilizing an appropriate sample with confirmed diagnosis, in a Canadian context, does completion of PEERS result in improved social skills on an empirically validated measure? Furthermore, are any gains maintained at long-term follow-up?
2. Will secondary improvements be observed in participants' EF in the domains of inhibition and cognitive flexibility?
3. Will completion of PEERS result in a reduction of internalizing mental health issues, including symptoms of anxiety and depression?
4. Will the parent-child relationship factors of attachment and communication be related to individual improvements in social skills seen through PEERS?

In summary, friendships have been associated with a multitude of benefits and protect against maladjustment through life and may be particularly important during adolescence. For individuals with ASD, characteristic impairments in social communication are often significant barriers to maintaining these crucial relationships. PEERS is a well-established SSTP designed for this population, but the current study aims to improve upon previous research by including adolescents with diagnostically confirmed ASD and without intellectual impairment in Canada. Additionally, a focus on potential secondary improvements in the domains of EF and symptoms

of mental health would allow for better understanding of how social skills and friendships impact other domains of these adolescents' lives. As well, examination of parent-child relationship factors would help to recognize the contribution of the parent-mediated aspect of PEERS.

## **Chapter 2: Literature Review**

This chapter will review the literature surrounding ASD, a neurodevelopmental disorder affecting social communication and resulting in behavioural impairment. Primary symptoms, secondary deficits, co-occurring conditions, and associated clinical features will be discussed. Following this overview, information pertaining to the social challenges of this population will be provided leading to a review of interventions designed to address these challenges. Subsequently, the chapter will review a unique intervention for adolescents with ASD including supporting evidence as well as the limitations from past research, which will form the foundation for the proposed study.

### **Autism Spectrum Disorder**

ASD is a neurodevelopmental disorder characterized by qualitative impairment of social communication in the presence of restrictive and/or repetitive behaviours and/or interests (APA, 2013). The prevalence of ASD is rising with 2013 data indicating an approximate prevalence of 1 in 68 school age children (1.4%: Centers for Disease Control and Prevention [CDC], 2013) and data from the 2014-2016 National Health Interview Survey in the United States showing an increase to 2.47% of children aged 3 to 17 years (Xu, Strathearn, Liu, & Bao, 2018). Among Canadian children 5-17, 2018 estimates indicate a prevalence of 1 in 66 across the country (Public Health Agency of Canada, 2018). In comparison, estimates of prevalence in Calgary, Alberta are that 1 in 94 school age children have a diagnosis of ASD (Lowe et al., 2014). Although an underlying cause for ASD has not been found, it is likely that the increase in incidence is due largely to improvement in diagnostic practices, public awareness, and increased referrals rather than a greater biological susceptibility or particular influences; however, genetic and environmental factors may contribute as well (CDC, 2013; Xu, Strathearn, Liu, & Bao,

2018). Males are more likely to be diagnosed with ASD, at a ratio of approximately 4:1 (Fombonne, 2005). A simple yet useful distinction for individuals with ASD is through an understanding of intellectual abilities (e.g., measured Intelligence Quotient; IQ). The use of verbal and nonverbal IQ to determine individuals who present with varying levels of intellectual abilities allows for targeted research and intervention aimed at their unique strengths and weaknesses (Grondhuis et al., 2018; Szatmari, 2000). Despite demonstrating clear areas of social and behavioural impairment, individuals with ASD with intact speech and intellectual abilities are often afforded placement in regular social and academic settings. The focus of this paper will largely be on individuals with ASD who do not have intellectual impairment (i.e.,  $IQ \geq 70$ ; APA, 2013). In the following sections, general clinical and diagnostic symptoms of ASD will be examined followed by a specific focus on the unique symptom manifestations and experiences of those without intellectual impairment.

### **Core Symptoms.**

The current diagnostic system in North America, the *Diagnostic and Statistical Manual of Mental Disorders 5<sup>th</sup> ed. (DSM-5)*, received its newest major revision in May 2013, (APA, 2013). The *DSM-5* framework will be utilized to describe the clinical features of ASD. Within the *DSM-5*, core symptoms fall within the two domains of social communication and restricted and/or repetitive behaviours/interests.

***Impairment in social communication.*** The diagnostic criteria in the *DSM-5* describe the need for observed impairment in multiple domains of social communication throughout development. Such impairments may include a reduction or lack of social-emotional reciprocity (e.g., to-and-fro conversation), lack of interest in or initiation of social interaction, or reduced sharing of affect. As well, individuals with ASD struggle with social relationships as they may

not vary their behaviour to different contexts, have difficulty making friends, or may be uninterested in relationships. Moreover, both verbal and nonverbal modalities may be affected as demonstrated by a lack of gesture use, poor integration of verbal and nonverbal communication, and reduced or lack of body language and facial expressions (APA, 2013).

Regarding individuals with ASD without intellectual impairment, basic verbal communication (e.g., first words, babbling, use of sentences, etc.) usually develops within normal ranges and is largely spared. However, communication may be impaired by the presence of echolalia (i.e., the repetition of phrases or single words spoken by another person), reversing pronouns (e.g., confusing “I” for “me”, or saying “he” instead of “I”), or substantial problems with pragmatic language such as a lack of awareness of how to greet others, requesting help or assistance, changing how one speaks in different social situations (e.g., in a church vs. a gymnasium), taking appropriate turns in conversations, or acknowledging personal space (Loukusa & Moilanen, 2009; Mizuno et al., 2011; Tager-Flusberg, 2001; Verhoeven, 2012). To-and-fro conversation is often impaired as individuals with ASD may speak pedantically on preferred topics and ignore attempts to shift to new topics with conversational partners (Loukusa & Moilanen, 2009; Tager-Flusberg, 2001). They may also use strange, advanced, or age inappropriate vocabulary that alienates those with whom they are talking (Eigsti, de Marchena, Schuh, & Kelley, 2011; Ghaziuddin & Gerstein, 1996). In general, they are unable to keep up with the quickly changing shared attention present in social interactions, impairing their capacity for developing and maintaining social relationships (Mundy & Sigman, 2006).

***Restricted/repetitive patterns of behaviour.*** A diagnosis of ASD, regardless of intellectual abilities, must include two or more of the specified impairments in the domain of restricted and/or repetitive patterns of behaviour, activities, and/or interests. Examples include



repetitive motor movements (e.g., hand flapping), repetitive use of objects (e.g., lining up or stacking toys), ritualized patterns of behaviour (e.g., need to eat same foods every day), fixated and restricted interests (e.g., intense interest in unusual objects such as garbage cans; extreme knowledge of airplane models), or hyper- or hypo-sensitivity to sensory input (e.g., extreme negative reactions to normal sounds; interest in smelling or tasting non-food items; seeking specific visual stimuli), among others. These behaviours are often observed in childhood and may change from more overt behaviours to restricted interests as the individual ages, particularly for those without intellectual impairment (APA, 2013).

Turner (1999) originally distinguished between higher and lower level repetitive behaviours in ASD. Lower level behaviours include repetitive motor movements (e.g., hand flapping, repetitive jumping, toy stacking or lining, etc.) and are more prevalent in those with intellectual impairment. Those without intellectual impairment are likely to display higher-level behaviours such as an insistence on sameness in activities such as self-care routines, eating and daily schedules, and traveling routines (Leekam, Prior, & Uljarevic, 2011). This preference for ritual and routine is present in other developmental disorders (e.g., Down syndrome) but has been identified as more severe in those with ASD as demonstrated by significant distress when routines are not followed (Bodfish, Symons, Parker, & Lewis, 2000; Munson et al., 2008). As well, those with ASD may display circumscribed or intense interests with no functional or social purpose, focusing on unusual objects, aspects of objects, or physical portions of the environment (e.g., people's shoes, window frames, furniture manufacturers, airplane models, etc.). Though these interests are often part of typical development, those with ASD are more likely to become abnormally invested and immersed in the subject to the detriment of other responsibilities or

potential social engagements (Bodfish, 2011; Leekam, Prior, & Uljarevic, 2011; Spiker, Lin, Van Dyke, & Wood, 2012).

In summary, individuals with ASD display impairments in social communication and restricted and/or repetitive patterns of behaviour. These impairments are demonstrated in a heterogeneous fashion, such that each person with ASD can present with unique yet specific symptoms within these domains. Further, many individuals also demonstrate additional clinical features (i.e., co-occurring conditions) that are worthy of consideration.

### **Co-occurring Conditions.**

Individuals with ASD are frequently identified as having one or more secondary co-occurring disorders; identifiable conditions that co-exist with the primary diagnosis. These co-occurring conditions are often overlooked or can be a challenge for clinicians to recognize due in part to the complex nature of ASD (Mannion & Leader, 2013). In general, studies have found that children and adolescents with ASD are more likely to have a co-occurring psychiatric condition than their typically-developing (TD) peers and those with other disorders such as Down Syndrome and Intellectual Disability (ID) alone (Joshi et al., 2010; Mannion, Leaer, & Healy, 2013; Matson, Fodstad, & Dempsey, 2009; Simonoff et al., 2008). For example, the prevalence of Attention-Deficit/Hyperactivity Disorder (ADHD) in conjunction with ASD ranges from 14% to 78% (Gargaro, Rinehart, Bradshaw, Tonge, & Sheppard, 2011). Mayes, Calhoun, Mayes, and Molitoris (2012) highlight that though ASD and ADHD are distinct disorders, similar neuropsychological deficits (e.g., attention problems, hyperactivity, impulsivity) are likely to underlie both disorders. As described previously, intellectual ability can vary across individuals with ASD. Similar to what is seen in ADHD and ASD, those with ID alone and ASD alone share behaviour and adaptive challenges. Thus, it can be challenging to

determine co-occurring ID and ASD in some cases and individuals may be diagnosed with one and not the other despite having both (Matson & Shoemaker, 2009). Nonetheless, ID ( $IQ \leq 70$ ) is typically identified in ASD at a rate of approximately 31% (CDC, 2014).

A review of the literature highlights other psychological and medical co-occurring conditions commonly experienced by those with ASD. For example, epilepsy is reported to be present in up to 30% of individuals with ASD but only 2-3% of the general population (Tuchman & Rapin, 2002). Though not fully understood and inconsistent in findings, gastrointestinal symptoms are often reported in those with ASD, ranging from 9 to 91% (Mannion & Leader, 2013). It is unclear whether these symptoms are the result of psychotropic medications, anxiety, sensory sensitivity, language and communication problems, or potentially a characteristic of ASD itself. Emerging evidence has begun to reveal the important role of gut microbiota in immune and endocrine function. Problems with gut microbiota have been implicated in a range of medical conditions and immune disorders (Hooper, Littman, & Macpherson, 2012; Taur et al., 2012). More recently, with an understanding that the gut microbiome has implications for brain function, research has focused on these connections in ASD. Indeed, significant differences have been found in the quantities and functioning of various important microbes found in the guts of individuals with ASD when compared to TD individuals (Ding, Tuar, & Walkup, 2017). However, more research is necessary to determine the direction of association between neurological differences and the microbiome differences found in the gastrointestinal system.

Sleep problems also affect those with ASD, with an estimated 34 to 81% prevalence rate (Mannion et al., 2013; Veath, Maxwell-Horn, & Malow, 2015). Unfortunately, research has shown that those reporting gastrointestinal problems are more likely to experience sleep anxiety and sleep problems, leading to additional challenges with attention and problem behaviours

during the day (Goldman et al., 2011; Mannion et al., 2013). Finally, children and adolescents with ASD are likely to have feeding problems such as excessive “pickiness” and may eat a limited range of foods, impacting nutrition (Schreck, Williams, & Smith, 2004).

Kanner (1943) noted features of anxiety in his original description of autism; however, researchers have only recently begun to focus on the mental health of individuals with ASD, particularly those without intellectual impairment. Traditionally, it has been difficult to assess mental health issues in this population due to challenges communicating emotions and internal symptoms, as well as potential intellectual deficits that impair self-awareness in those with ASD. A meta-analysis of 31 studies indicated that 40% of children and adolescents with ASD with variable intellectual abilities were estimated to have clinical levels of anxiety or at least one identifiable anxiety disorder (van Stenseel, Bogels, & Perrin, 2011). Specifically, nearly 17% met criteria for Social Anxiety Disorder and 15% for Generalized Anxiety Disorder; whereas the overall prevalence for anxiety disorders in TD children and adolescents ranges from 2.2 - 27% combined (Costello, Egger, & Angold, 2005). In general, more mental health problems are observed in individuals with ASD and who do not have intellectual impairment when compared to those who do (Mayes et al., 2010). Mayes and colleagues (2010) reported that 79% of children and adolescents in their ASD sample without intellectual impairment had significant anxiety, and 54% had significant depression symptoms according to maternal ratings. Other researchers have concluded that the average prevalence of anxiety in this population is 40-50% (White et al., 2009) and that these rates are higher than those reported by individuals with Mental Retardation (i.e., Intellectual Disability), epilepsy, Conduct Disorder, or language disorders (Chalfant, Rapee, & Carroll, 2007). In a review of 627 families of children with ASD (Age 1-17, IQ range 16-146), Mayes and colleagues (2011) found a strong relation between anxiety and depression suggesting

that these mental health problems may have a common pathway of origin in this population. Furthermore, verbal IQ and age were positively correlated with increased levels of anxiety and depression. Though some studies show mixed findings (Davis et al., 2011; Mazurek & Kanne, 2010; Strang et al., 2012; Sukhodolsky et al., 2008), much of the available research and meta-analyses seem to support that anxiety symptoms and related clinical diagnoses increase with age in those with ASD (Mayes et al., 2011; van Steensel et al., 2011; Vasa et al., 2013). Thus, children and adolescents with higher intellectual abilities are most likely to exhibit mental health symptoms. A variety of theories have been put forth and established in the research to help conceptualize the myriad of symptoms observed in ASD. Below, a brief discussion of Central Coherence and Theory of Mind will be followed by a more in-depth discussion of Executive Function as this concept is explored in the current study.

### **Symptom Theories.**

**Central coherence.** Frith (1989) identified that typically, information processing involves the drawing together of separate pieces of information to construct a higher-level meaning in a specific context. For example, when looking at a large grouping of trees with thousands of individual leaves on each, growing on a large hill with millions of blades of grass, one would see the whole and term it a “forest”. She termed this “central coherence” and theorized that it is impaired or biased in those with ASD. Even original descriptions of ASD highlighted the “inability to experience wholes without full attention to the constituent parts” and a need for sameness (Kanner, 1943, p. 246). Weak central coherence may underlie symptoms such as perseverative behaviour, resistance to trivial change, focus on small parts of items, intense interests, and social impairment such as problems integrating facial and emotional expressions,

aspects of communication, and recognition of social partner status and relationships (Booth & Happe, 2010; Frith & Frith, 1999; Hoy, Hatton, & Hare; 2004).

***Theory of mind.*** During typical communication and social interaction, the ability to infer and understand another's mental state (e.g., emotions, reactions, physical perspective, etc.) is highly important. Thought to underlie ASD impairments in pragmatic language and social interaction, the theory of mind (ToM) hypothesis postulates that those with ASD are unable to or atypical in their ability to infer others' mental states or desires (Baron-Cohen, 1988; Best, Moffat, Power, Owens, & Johnstone, 2008; Premack & Woodruff, 1978). Thus, for those with ASD and ToM deficits, limitations appear present in ability to mentally represent objects, thoughts, feelings, or perspectives that are not directly observed or experienced.

***Executive function.*** Executive functions (EFs) are theoretical neuropsychological processes that are needed to organize and control an individual's performance on complex problem-solving tasks and general goal-directed behaviour. Core EFs referenced in the literature include inhibition, cognitive flexibility, working memory, planning, organization, and emotional regulation (Best & Miller, 2010). In essence, EF is like the conductor of a symphony, directing the timing, sequence, rhythm, and cooperation of the orchestra, dealing with and taking responsibility for following a set plan but also being ready for unexpected situations. Observation of the characteristic social challenges in those with ASD point to potential EF impairment (Hill, 2004). Individuals with ASD can have difficulties adapting to changing social situations or conversational topics flexibly (i.e., cognitive flexibility). Extensive evidence has been found for reduced cognitive flexibility in this population linked to their rigidity in thinking and perseveration on ideas or conversation topics (Craig et al., 2016; Hill, 2004). These individuals can also be impulsive in behaviours and speak what is on their mind instead of

inhibiting themselves for social purposes (Haq & LeCouter, 2004). Overall difficulties inhibiting behaviour have also been found in the research literature (Craig et al., 2016; Russell, Hala, & Hill, 2004; Verte, Guerts, Roeyers, Oosterlaan, & Sargeant, 2006). Furthermore, a link has been established between primary brain regions associated with EF and abnormal brain function in similar locations in individuals with ASD (e.g., orbitofrontal cortex, left inferior and orbital frontal gyrus, areas of parietal lobes, right middle temporal gyrus etc.; Girgis et al., 2007; Schmitz et al., 2006, Yerys et al., 2015). It has also been recognised that EF is involved in ToM judgements, important to social success, and that both are deficient in individuals with ASD regardless of intellectual abilities that may be intact (Jones et al., 2018; Pellicano, 2007).

**Summary.** Individuals with ASD may have potential challenges with central coherence that are likely to impair their ability to integrate the subtle yet important parts of social interaction and communication. Furthermore, deficits in ToM are theorized to underlie challenges with understanding others' thoughts, perspectives, and feelings. Finally, difficulties in cognitive flexibility and inhibition can lead to problems regulating behaviour and participating in conversation in social settings. Considering these problems, the current proposed research aims to focus on intervention for the social impairments in those with ASD without intellectual impairment. As such, an overview of the development of social skills in this population will allow for greater insight into the issue.

### **Social Development in ASD**

Social communication impairment is a core feature of ASD and is likely most impairing for those without intellectual impairment who are in typical educational and social environments. These social deficits are present in early development, though the specific presentation may vary. Up to 50% of children later diagnosed with ASD often appear to develop typically or only mildly

atypical until 15 to 24 months of age (Lord, Schulman, DiLavore, 2004; Luyster et al., 2005; Ozonoff, Williams, & Landa, 2005). Retrospective parent report and review of home videos indicates that ASD-related abnormalities can, however, be seen by the first birthday including decreased orientation to social stimuli, babbling, gestures, imitation, joint attention (i.e., following the attention of a social partner), eye contact, and response to name (Osterling, Dawson, & Munson, 2002; Poon, Watson, Baranek, & Poe, 2012). These early problems interfere with subsequent development of important social skills and social communication abilities. For example, an impairment in joint attention reduces the child's ability to learn new vocabulary, begin to understand others' internal states and intentions (i.e., ToM), and share experiences with others (Mundy, 2016; Tomasello, Carpenter, Call, Behne, & Moll, 2005). Furthermore, toddlers with ASD not only have reduced social abilities and understanding when compared to their TD peers, they also often experience reduced motivation to interact with others (Landa, Holman, & Garrett-Mayer, 2007). Young children with ASD experience a reduced amount and diversity of social interaction that is required for typical experience-dependent brain development associated with social interaction and communication (Johnson & Munakata, 2005; Klin, Jones, Schultz, & Volkmar, 2003; Landa, Holman, & Garrett-Mayer, 2007). As evidence, observation of the social interactions of young children with ASD by McGovern and Sigman (2005) showed that their social skills were somewhat improved the more time that was spent interacting spontaneously with peers. Overall, these early developmental disturbances greatly impact the ability to co-create social learning opportunities with peers and adults.

As toddlers with ASD become children and adolescents, the continued effects of reduced social exposure and learning become more evident. However, given that individuals with ASD are heterogeneous in their display of characteristic symptoms, the social functioning of children



and adolescents can vary greatly. Wing and Gould (1979) were the first to propose that individuals with ASD tend to develop one of three social interaction styles as they age: aloof, passive, or active-but-odd. Aloof individuals prefer not to seek social interaction and do not respond to, or respond negatively to, the approach of another person. Passive individuals rarely initiate social interaction yet attempt to respond appropriately when someone approaches them. Lastly, active-but-odd persons are more active in seeking social interaction but clearly do so in an unusual way (e.g., speaking pedantically to someone about a single topic, standing too far from social partners, etc.). Children and adolescents with ASD and intact intellectual abilities are more likely to be characterized as active-but-odd or passive as research has shown that those with higher intelligence are inclined to attempt social interaction yet continue to do so with odd mannerisms and poorly developed social abilities (Bauminger, Shulman, & Agam, 2003; Castelleo & Dawson, 1993; Ghaziuddin, 2008; O'Brien, 1996; Scheeran, Koot, & Beeger, 2012)

Research on the course of ASD and accompanying symptoms indicates that problems in the social domain remain throughout development. In particular, adolescents without intellectual impairment may see increased opportunity to interact with others in later school years, but friendships continue to be impaired into adulthood and may be one of the most reported challenges at this age (Hendricks & Wehman, 2009). In an attempt to understand the social challenges in these individuals, some have suggested that these children and adolescents are simply less interested in social interaction than their TD peers (Chevallier, Grezes, Molesworth, Berthoz, & Happe, 2012). For TD individuals, social interest and acceptance can overshadow the importance of other incentives such as money, while exclusion or isolation can lead to severe psychological distress (Eisenberger et al., 2003). Chevallier and colleagues (2012) found that their sample of 10- to 16-year-olds with ASD without intellectual impairment reported less

enjoyment in social situations than TD control peers. However, this result may reflect a more complex situation where those with ASD often experience negative feedback from social interactions that results in less pleasure. In fact, findings show that children and adolescents with ASD are interested in social interaction and having relationships. Bauminger, Shulman, and Agam (2003) found that adolescents with ASD and without intellectual impairment in their study had a high rate of initiating interactions, though their time spent actually interacting was approximately half that of TD controls. The authors suggest that these initiations show both a desire to interact and that they may not receive sufficient initiations from peers. Though researchers have demonstrated that individuals with ASD can somewhat compensate for their social deficits with higher intellectual abilities (Gillespie-Lynch et al., 2012), the adolescents in Bauminger and colleagues' (2003) study struggled to link their understanding of social situations to actual behaviours once an interaction was initiated. These individuals with ASD continue to struggle with applying social cognition (e.g., understanding emotions and their causes, another person's perspective, etc.) to behaviour, being reciprocal in their interactions, and engaging others in meaningful relationships (Harms, Martin, & Wallace, 2010; van Ommeren, Boot, & Begeer, 2017).

In summary, young children with ASD are deficient in orienting to and learning from social experiences leading to continued social problems later in development. For adolescents with ASD and intact intellectual abilities, attempts to initiate interactions with peers are observed, although these interactions are confounded by poor social skills and abilities that often lead to negative experiences and reduction in pleasure gained from social situations.

## **Adolescent Friendships in ASD**

The evidence commonly supports that having one or more friends can buffer the impact of stressful life events, improve self-esteem, and reduce symptoms of anxiety and depression (La Greca & Harrison, 2005; Masten et al., 2009). For individuals with ASD without intellectual impairment, characteristic social communication problems and, to a lesser extent, ToM deficits, can create significant barriers for the initiation and maintenance of relationships (Daniel & Billingsley, 2010). In fact, these individuals frequently report greater feelings of loneliness and poorer friendship quality than their TD peers (Bauminger & Kasari, 2000; Mazurek & Kanne, 2010; O'Hagen & Hebron, 2017; Solomon, Bauminger, & Rogers, 2011). In a recent review of 24 studies on friendship in ASD, Petrina, Carter, and Stephenson (2014) report that friendships were typically shorter in duration and statistically lower in feelings of companionship, closeness, security, intimacy, helping, and general reciprocity.

Difficulties with friendships increase for individuals with ASD as they enter adolescence. During this time, typical social communication and interaction become more complex, and there is a greater need for an understanding of the social cues from others. This changing social landscape is likely to place more demands on those without intellectual impairment who are in typical social and educational environments as there are greater expectations for social behaviour and social success. The rise in social complexity and demand during adolescence can lead to significant problems in daily life and interpersonal relationships for these adolescents with ASD (Klin & Volkmar, 2003; Sreckovic, Hume, & Able, 2017). During adolescence, an increased focus on peer relationships is crucial to developing emotional well-being and self-esteem (Wentzel, Donlan, & Danette, 2012).

Adolescents with ASD may be rejected by peers, experience poor social support and feelings of isolation, and have overall higher levels of loneliness (Humphrey & Lewis, 2008; Petrina, Carter, & Stephenson, 2014). Specifically, those without intellectual impairment often have insight into their difficulties and are keenly aware that their interactions with peers are abnormal and causing them problems. In fact, many identify their social challenges as a barrier to fitting in, seeing their ASD-based differences as a problem or obstacle underlying their acceptance in social spheres. In adolescence, fitting in with their peers, having friends, and being part of a social group can be of great importance to those with ASD; however, a lack of friendships and integration with social groups can leave this population vulnerable to bullying, isolation, and rejection (Roekel, Scholte, & Didden, 2010; Tse et al., 2007).

In summary, adolescents with ASD face challenging obstacles to overcome at a time when peer relationships and acceptance are increasingly adaptive and important for development. Core deficits in social interaction, such as conveying emotions through facial expressions, using conversational and social skills, joint attention, and other difficulties can lead to experiences of isolation, bullying, and a lack of true friendships and relationships. In turn, these individuals are at risk of significant mental health problems and challenges with later life adjustment, particularly for those with ASD without intellectual impairment who are more likely to have the capacity and tendency to reflect on these challenges.

### **Mental Health and Peer Relationships in ASD**

There are numerous explanations as to why older individuals with ASD and those with greater intellectual abilities may experience increased internalizing mental health issues such as anxiety and depression. As outlined above, many adolescents with ASD are aware of their social problems and loneliness, yet report desire for social interaction (Deckers, Muris, & Roelofs,

2017). Myles et al. (2001) outlined how the social challenges of those with ASD likely lead to bidirectional effects with anxiety, such that their anxiety about social situations may lead to less social interaction, increased avoidance, the experience of negative interactions, and promotion of further isolation and lack of opportunities to develop social skills. This idea has been expanded upon by Bellini (2006) who described a feedback loop in this population consisting of physiological arousal, social anxiety, and negative social interactions, which create a cycle of worsening symptoms and social anxiety. White and colleagues (2009) also discuss the importance of realizing that adolescents with ASD without intellectual impairment experience loneliness that can be clearly linked to social anxiety. Similarly, Fung, Lunsy, and Weiss (2015) suggest an explanation via the diathesis-stress model (see Burke & Elliot, 1999) in which individual characteristics and vulnerabilities interact with various stressors to impact the presence of depression in individuals with ASD. In their study, age and intellectual abilities were individual vulnerabilities associated with depression. Parents reported higher depression scores for those with ASD who had higher intellectual abilities; however, they found age to be negatively correlated with depression, a result contradicting much of the existing literature. Ultimately, adolescents with ASD without intellectual impairment are likely to desire healthy friendships as much as their TD peers; however, they can get caught in a cycle of social anxiety, failure, and loneliness that negatively impact their mental health and may lead to depression.

Adolescence is a time of increased self-evaluation of skills and abilities for TD individuals and those with ASD alike. This is particularly the case for skills in the social domain. In turn, self-evaluation and self-awareness are likely to lead to self-consciousness, apprehension, and increased withdrawal, loneliness, and social isolation for those with ASD (Kuusikko et al., 2008; Locke, Ishijima, Kasari, & London, 2010). In one study, Vickerstaff et al. (2007) found

that children with ASD had lower self-perceived social competence or the belief that they have skills to function competently in social situations when compared to TD peers. This effect was greater for those with higher levels of intelligence. In turn, lower self-perceived social competence was a significant predictor of depressive symptomology. Other studies have confirmed that those with ASD with low perceived self-competency of their social skills and lower friendship quality have been reported to have higher levels of depressive symptomology (Lee, 2010; Whitehouse et al., 2009). Not only is lower self-competency a risk factor, but actual parent- and teacher-rated general social skills impairments likewise correlate to problems with child mental health (Ratcliffe, Wong, Dossetor, & Hayes, 2015). Additionally, students with ASD and without intellectual impairment are at greater risk for being victims of bullying, an experience that has been associated with a variety of negative outcomes, including depressive and anxious symptoms and poor social and emotional adjustment (Cappadocia, Weiss, & Peplar, 2012; Little, 2002; Mitchell, Ybarra, & Finkelhor, 2007). Fung, Lunskey, and Weiss (2015) also found that youth with ASD who had difficulties with friendships had increased scores on measures of depression. Accordingly, the social challenges of adolescents with ASD coupled with an acute awareness of their difficulties put them at higher risk for mental health problems as they experience the pressures of social integration and “fitting in”.

In typical education settings, individuals with ASD are exposed to increasingly complex social demands and interactions in later grades (Soironoff, Dark, & Stone, 2010). Interventions designed to enhance social skills may result in improved peer relationships and, therefore, decreased loneliness and reduced mental health concerns. To explore this hypothesis, Schohl et al. (2014) investigated the potential secondary effects that a social intervention may have on anxiety for adolescents with ASD without intellectual impairment. They found that the

participants' social anxiety was reduced significantly even though it was not a direct target of the intervention. The authors speculated that it is likely that confidence and self-perceived social competence was boosted, which, in turn, reduced social anxiety and increased positive social interactions with peers.

In conclusion, adolescents with ASD and without intellectual impairment are at risk for the development and maintenance of mental health problems. Due to their self-awareness and intellectual abilities, it is likely that problems with peer interactions and friendships are strong contributors to these internalizing symptoms. Parents are a primary source of knowledge and support in most children's lives. The involvement of parents and their relationships with their children should, therefore, be strongly considered when attempting to understand factors related to the mental health and social challenges of children and adolescents with ASD. Particularly, the nature of the parent-child relationship is likely an important target of intervention in supporting those with ASD.

### **Parent-Child Relationships**

**Attachment.** Initially described by Bowlby (1969/1982) and Ainsworth (1963), attachment theory is a well-established description of the relationship between parents, primarily mothers, and their children. In general, attachment theory defines the parent-child relationship as a base from which children can securely and safely explore their world and develop an internal working model of how relationships can be pursued. The attachment relationship serves as a context for understanding emotions and communication in relationships and helps to develop self-regulation of personal responses to others' emotions (Flaherty & Sadler, 2011). Key to the importance of attachment theory has been the suggestion that early attachment experiences affect future socio-emotional development (Fearon & Roisman, 2017). Recent meta-analyses indicate

that for TD children, attachment security is somewhat negatively correlated to later internalizing problems (Groh, Roisman, Bakermans-Kranenburg, & Fearon, 2012; Madigan, Atkinson, Laurin, & Benoit, 2013) and more strongly positively correlated to social competence and negatively to the development of externalizing problems (Fearon, Bakermans-Kranenburg, van IJzendoorn, Steele, & Roisman, 2010; Groh et al., 2014).

**Attachment in ASD.** Original accounts of ASD described distant and cold parent interactions as contributing to the disorder (Bettelheim, 1959). Children with ASD were thought to be fully unable to form proper attachment relationships with parents as their TD peers would (APA, 1980). However, research has not supported these initial thoughts. Stern (2004) posited that though ASD may negatively affect a child's social communication and social understanding related to group belonging, the drive for personal safety and physical closeness in an attachment relationship is less likely to be inhibited. Two reviews have investigated the limited research in attachment in ASD. Rutgers, Bakermans-Kranenburg, van IJzendoorn, and van Berckelaer-Onnes (2004) reviewed 16 studies and found that though children with ASD were less likely to form secure caregiver attachments than TD children, most (53%) still did. Teague, Gray, Tonge, and Newman (2017) reviewed 40 studies and provided a number of distinctions important to the current paper. They summarized several studies that revealed that problems with attachment were most likely to be present with children with ASD and with intellectual impairment when compared to those who did not have intellectual impairment (Naber et al., 2006; Rutgers et al., 2007). Further, those with ASD and intellectual impairment had greater problems with caregiver attachment than children with ID alone (Rutgers et al., 2007). Contradictory to evidence in TD populations, some research has shown that emotional and behaviour problems in children with ASD are not significantly associated with attachment or quality of parent-child relationships;



instead, parent stress is a more important predictor (Bauminger, Solomon, & Rogers, 2010a). However, there has been very little research investigating emotional and behavioural outcomes of early attachment experiences in children with ASD. Finally, strong attachment relationships appear to be positively associated with the social and cognitive development of children with ASD, including joint attention, social skills, and more friendships; a finding consistent with the literature in TD populations (Teague et al., 2017).

**Relationships in Adolescence.** Relationships between parents and their TD children change in adolescence with the potential for increased conflict and reduced positive communication and interaction. Limited research is present that describes the nature of attachments and parent-child relationships for adolescents with ASD. In general, individuals diagnosed with ASD in childhood tend to show improvements in social interaction and emotional responsiveness as they age while continuing to meet diagnostic criteria (McGovern & Sigman, 2005). However, unfortunately, relationships between parents and their adolescent children with ASD may be impacted due to the child's characteristic behavioural and social challenges that can impair the formation of meaningful relationships (Burrell & Borrego, 2012). Yet, some studies have found that parents of children with ASD do not report differences in relational or emotional closeness when compared to parents of TD children (Hoffman et al., 2009; Montes & Halterman, 2007). Despite the potential for normal feelings of emotional closeness between parents and their children with ASD, these parents have been shown to be more stressed and experience poorer communication with their children (Montes & Halterman, 2007). Moreover, literature supports the likelihood of a bidirectional relation between the parental stress that is likely to be experienced in families of children with ASD and the behavioural and mental health problems experienced by the children themselves. Over time,

parent and child mental health may exacerbate one another, further highlighting the importance of the parent-child relationship as a necessary consideration for intervention (Fung, Lansky, & Weiss, 2015; Stewart, McGillivray, Forbes, & Austin, 2017).

As parents and families are the most stable and knowledgeable people in their children's lives, they are important in the implementation of treatment (Karst & Van Hecke, 2012). Parents have the capacity to understand the unique problems experienced by their children with ASD and may be able to adapt intervention to fit their lives when possible. Researchers have shown that parent involvement can facilitate generalization of skills taught in intervention programs to other contexts and parent-child and family interactions may then be improved as well (Karst & Van Hecke, 2012; Strauss, Mancini, Fava, & SPC Group, 2013).

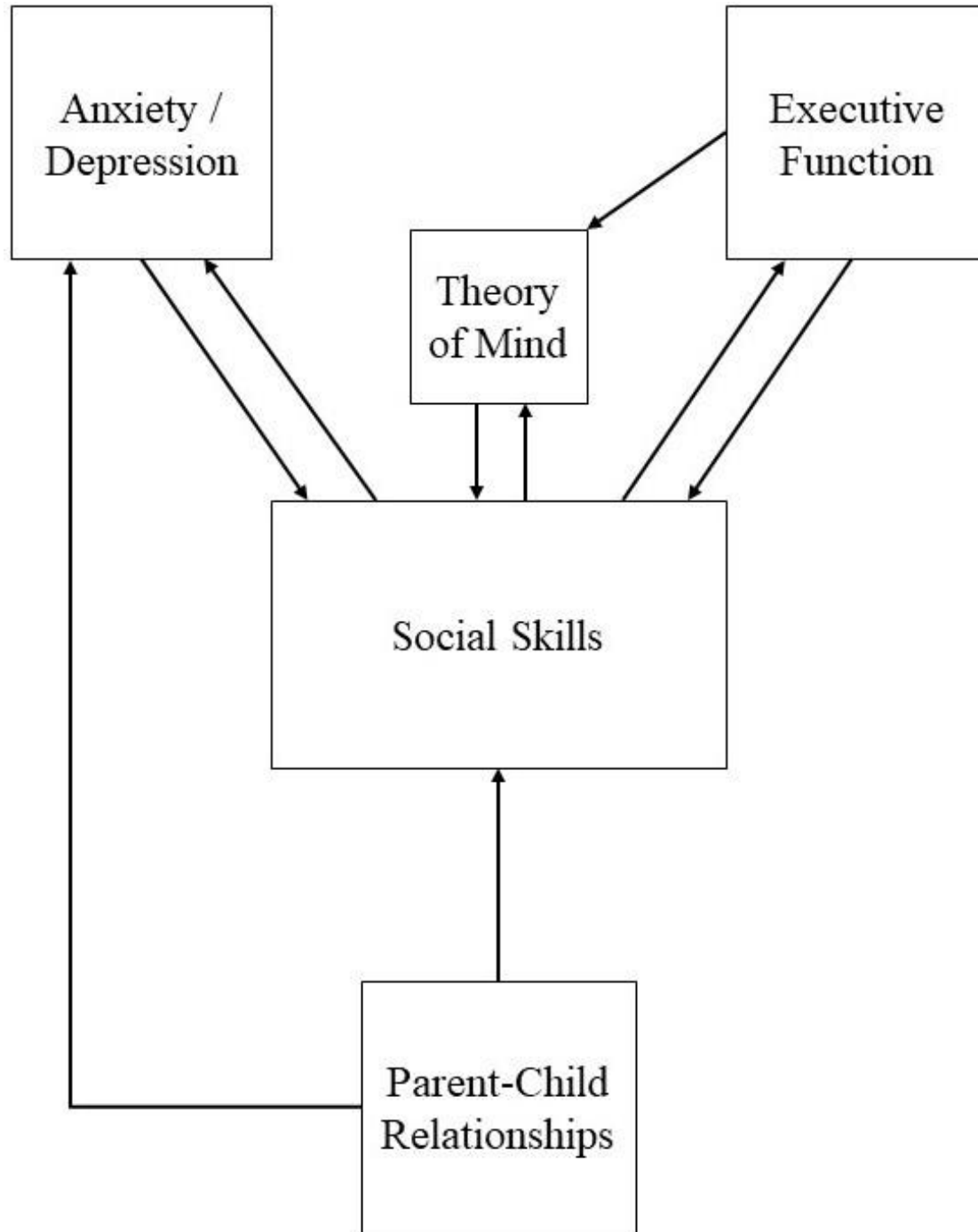
To date, little research has been conducted on the impact of family factors on the efficacy of treatments for those with ASD and without intellectual impairment. Though some manualized treatment programs involve parents, researchers have not focused on family factors, such as the parent-child relationship, that may influence intervention outcomes (Karst & Van Hecke, 2012). Though parent involvement in intervention has been shown to be useful, unique factors in each parent-child relationship may contribute positively or negatively to intervention efficacy. For example, Osborne and colleagues (2008) found that parental stress negatively impacted child outcome gains from an intervention. Notably, no research has focused on parent-child relationship factors for adolescent intervention in this population.

### **Summary of Theoretical Variable Relationships**

EF, anxiety, depression, and parent-child relationships are related to the development of social skills and interaction in both typically-developing children and children with ASD. Figure 1 provides a visual summary of these interrelations. Successful social interactions require the

inhibition of inappropriate behaviour and the ability to be flexible in a constantly changing social milieu; these skills are components of EF. Furthermore, social interaction may be an important component in the development of EF (Pan et al., 2017). Social interaction is facilitated by and impacts skills in ToM, an ability also conceptually influenced by EF. Mental health problems including anxiety and depression are also bidirectionally linked to social skills in those with ASD. Adolescents with ASD and without intellectual impairment are often aware of their social skills impairments and tend to experience loneliness. Poorer perceived self-competence and social skills are typically associated with increased mental health concerns. Moreover, problems with anxiety and depression hold these adolescents back from attempting social interactions and they may experience physiological symptoms that co-occur with negative experiences, leading to further isolation and worsening social skills. Finally, parent-child relationships are important both for their impact on social development as well as their involvement in mental health problems in youth with ASD. Parent and child mental health negatively impact each other in a bidirectional cycle. Parents of children with ASD typically experience significant stress and poor communication with their children during adolescence. However, strong relationships appear to be important to the social and cognitive development of their child in areas such as joint attention, social skills, and numbers of friends. Thus, EF, anxiety, depression, and parent-child relationships all hold important linkages to the learning and use of social skills for children with ASD that can support the making and maintenance of peer relationships.

Figure 1. Summary of Theoretical Variable Relationships



Given the range of implications that social skill deficits have for those with ASD (e.g., loneliness, mental health problems, etc.), significant efforts have attempted to address these areas

of need. The following section describes interventions designed for those with ASD, with a focus on improving social skills for this population.

### **Social Skills Training Programs for Adolescents with ASD**

Due to the nature and pervasiveness of impairments demonstrated by individuals with ASD, research on interventions has focused on all characteristic areas of impairment. Since the 1960s, behavioural interventions such as applied behaviour analysis (ABA) have used the principles of reinforcement and repetition to teach a variety of behaviours. Research has demonstrated the efficacy of ABA for teaching adaptive skills, communication, basic social skills, and reducing problem behaviours, particularly in early life, but also continuing into adulthood (Ivy & Schreck, 2016).

Researchers have increasingly focused on training programs for social interaction skills, particularly for those with ASD who do not have intellectual impairment. These SSTPs are often designed to teach individuals with ASD to integrate with adults and peers successfully. Many of these programs are delivered in group format, which affords the opportunity to provide an intervention to multiple individuals at once. There are many such programs available and the majority have been created and studied on the broad population of individuals with ASD, with minimal work involving those without intellectual impairment and/or during adolescence in particular (Rao, Beidel, & Murray, 2008).

A literature review by McMahon, Lerner, and Britton (2013) identified 40 studies that evaluated SSTPs for adolescents with ASD and without intellectual impairment; 39 between 2002 and 2013. They found that most of these programs taught skills involving verbal and nonverbal communication, social interaction, and problem solving. A structured learning approach is often used with direct lessons taught to participants followed by modeling and role-

plays. This approach is in contrast to the less often used social performance model, in which participants engage in drama, games, or other activities where skills are not explicitly taught but are fostered and reinforced as they occur. The final method of teaching is the use of support groups for participants to discuss, reflect, and get feedback on their social experiences.

A wide variety of additions and modifications to teaching are present in these SSTPs: the inclusion of parents or siblings, the inclusion of TD peers as role models, and structured opportunities for generalization of skills (e.g., homework-like assignments, community outings, monthly reunions, etc.). Most programs are implemented once per week for 1-2 hours, lasting from a few weeks to a full academic year. It is important to note that 23 of the SSTPs reviewed were not manualized nor required fidelity assessment, meaning facilitators were likely to vary in their adherence to and delivery of the program.

It is not surprising that mixed findings of efficacy are reported with SSTP studies varying in design, length, delivery format, measurement, and methodology. Most results indicate improved adolescent knowledge of social skills and parent and participant satisfaction with the program. However, results from teacher-reports, measures of generalization of skills, and maintenance of gains at long-term follow up have been mixed or infrequently included in the methodology (McMahon, Lerner, & Britton, 2013). What is not clear is whether one single SSTP can be said to be uniformly effective for adolescents with ASD who do not have intellectual impairment. Rather, continued development of programs and rigorous study is needed to determine the domains of efficacy influenced by participation as well as the unique factors in the intervention that contribute to them. A select few established SSTPs that target individuals with ASD and which have been published in peer reviewed journals will be reviewed. Those selected for review targeted those with ASD, had established manualized delivery with outlined

curriculum, were representative of typical SSTPs, and had one or more studies published in peer-reviewed journals.

**The Social Adjustment Enhancement Curriculum (SAEC).** Solomon, Goodlin-Jones, and Anders (2004) created The Social Adjustment Enhancement Curriculum (SAEC), an SSTP designed for children and adolescents with ASD and without intellectual impairment. The program runs 20 weeks for 1.5 hours per week. The program was designed to target recognition of facial expressions, ToM impairments in perspective taking, and EF via group problem solving. Lessons include conversational skills, nonverbal communication, understanding feelings and expressions, and solving problems in groups. Lessons are taught to participants in didactic and conversation format, and through games with some role-playing components. Parents are taught lesson content and work together to solve unique individual problems for their children. In their initial study of 8- to 12-year-olds with ASD, Solomon and colleagues (2004) found participants' recognition of facial expressions and use of EF improved; however, no improvements were observed in ToM. In a study using older participants (10-16 years), McMahon, Vismara, & Solomon (2013) modified the SAEC over 22 weeks and reported increased peer interactions and peer vocalizations.

**Skillstreaming.** Goldstein and McGinnis (2000) created Skillstreaming, a program designed to teach prosocial skills to adolescents with ASD, though not necessarily only those without intellectual impairment. The program uses didactic training, modeling, role-playing, performance feedback, and exercises for generalization of skills. Skill areas focused on include classroom survival, friendship making, how to deal with feelings, alternatives to aggression, and how to deal with stress. The manual includes information on suggested lesson plans and progression through the 50 separate skills that can be implemented in the school curriculum to

take a full school year. Tse and colleagues (2007) used select skills and exercises from Skillstreaming to create a 14-week, 2 hour per week intervention for adolescents 13-18 with ASD. They reported statistically significant improvement in post-test social skills as rated by both the adolescents and their parents. Finally, Lerner and Mikami (2012) compared the results of Skillstreaming to another social intervention (Sociodramatic Affective Relational Intervention; SDARI, Lerner & Levine, 2007) for young boys (mean age of 11.3 years) with ASD. The core Skillstreaming curriculum was abridged by the authors, who ran the program over 4 weeks. Results showed slight improvements in peer interactions and friendship making within-groups that are likely due to the short intervention implementation timeline. Research on Skillstreaming appears positive; however, it has been conducted with small populations of primarily pre-adolescents and has not used the entire curriculum as outlined in the manual.

**Multimodal Anxiety and Social Skills Intervention (MASSI).** Developed to address the social anxiety symptoms that often co-occur with the social skills problems faced by adolescents with ASD without intellectual impairment, White and colleagues (White, Koenig, & Scahill, 2010; White et al. 2010) developed the manualized Multimodal Anxiety and Social Skills Intervention (MASSI). The MASSI is delivered for approximately 20 sessions: 13 individually to the participant with parent involvement near the end of each session and seven group sessions where social skills are practiced with others. A cognitive-behavioural framework is applied to teach lessons such as understanding anxiety, problem solving, coping with worry, conversational skills, initiating with peers, flexibility and recognizing the cues of others, handling rejection, and more (see White et al., 2010 for detailed description). Their initial study (White, Koenig, & Scahill, 2010) found a slight reduction in social impairment and anxiety symptoms; however, these were not statistically significant. A follow up study indicated



statistically significant improvements in social responsiveness scores when compared to wait-list participants (White et al., 2013). Though some individual participants showed reductions in social anxiety statistical analysis was not significant.

**Summary.** This brief overview presents information on three SSTPs that have been developed to target specific impairments experienced by the ASD population with a focus on those without intellectual impairment. It is important to note that these programs tend to be modified from original designs, either for older ages than initially intended or for a population not originally intended (e.g., varying intellectual abilities). Furthermore, there is a lack of concrete attempts to build an intervention from the ground up based on solid theoretical foundations with the goal of creating a curriculum that can be followed and replicated with fidelity. For adolescents with ASD facing high school and post-secondary social settings, intervention should combine a clear framework with skills that are truly useful. The following section presents an SSTP that can address these limitations and provide replicable training to adolescents with ASD who do not have intellectual impairment through well-established methods and supported by research evidence.

### **The Program for the Education and Enrichment of Relational Skills**

The Program for the Education and Enrichment of Relational Skills (PEERS; Laugeson & Frankel, 2010) is a 14-week manualized, evidence-based intervention that targets 13-to 18-year-old adolescents with ASD who do not have intellectual impairment, and their parents. The primary focus of PEERS is to help youth with ASD make and keep friends (Laugeson, Frankel, Gantman, Dillon, & Mogil, 2012; Laugeson, Frankel, Mogil, & Dillon, 2008). PEERS was derived from the structure and clinical experiences of the Children's Friendship Training program (Frankel & Myatt, 2003), which was based on a developmental understanding of how

children successfully form and maintain peer relationships. During sessions, adolescents are taught social skills through didactic lessons which include Socratic questioning, watching role plays, practicing the skills in session and receiving immediate behavioural feedback. They are also required to use the skills through weekly home practice and socialization assignments. Topics have been chosen to reflect ecologically valid skills adolescents are likely to use such as conversational skills, electronic communication, using humour and good sportsmanship, entering and exiting conversations smoothly, handling conflict and peer rejection, and more. Adolescents attend 90-minute sessions once per week taught by a facilitator and two or more behaviour coaches. Concurrently, parents attend sessions led by two facilitators where they learn how to support their teen with practice and assignments during the program, and how to continue to apply lessons and skills once the program is complete (Laugeson & Frankel, 2010).

**Current PEERS research.** Current research investigating the efficacy of PEERS indicates promising results. Many studies have been published on PEERS that have included behavioural results via ratings and observations, brain changes, family improvements, and implementation with individuals of varying genders and from diverse cultures.

In a study of 28 adolescents, Laugeson et al. (2009) found significant improvements in adolescent knowledge of taught social skills. Participants also demonstrated increases in hosted get-togethers with friends and reported better quality friendships when compared to a delayed treatment control group. Parent ratings of overall social skills were also improved. In 2012, Laugeson and colleagues replicated these outcomes. Furthermore, adolescents improved significantly in their overall social skills as rated by parents and teachers and demonstrated improved social responsiveness (Laugeson et al., 2012). Follow-up at 14-weeks post intervention showed that most gains were maintained except for those in social cognition and social

motivation. In a similar study of 16 adolescents participating in PEERS, Lordo et al. (2017) sought to determine improvements in additional areas of functioning. Specifically, they found significant improvements in some aspects of overall behaviour (e.g., withdrawal, adaptability, leadership, activities of daily living) and emotional responsiveness as rated by parents. However, despite study hypotheses, no improvements were noted through program participation on measures of affect recognition, positive and negative affect, or emotion regulation. Mandelberg and colleagues (2014) extended previous research on PEERS by gathering long term follow up data between 1-5 years after participation in the program. Results indicated maintenance of adolescent gains in parent-rated overall social skills, reduced problem behaviours, improved social responsiveness, and increased get-togethers.

Dolan et al. (2016) reinforced existing research on PEERS by evaluating effectiveness through observer-coded peer interactions of adolescents who had participated in the program. Adolescents participated in 10-minute interaction with a gender-matched, unfamiliar typically developing adolescent. The study utilized the Contextual Assessment of Social Skills (CASS: Ratto et al; 2010) to gather Likert type ratings on social skills during the 10-minute interaction. Coding was completed by trained undergraduates blind to participant condition (i.e., waitlist control vs. experimental group). Results from Dolan and colleagues (2016) study revealed that adolescents with ASD who participated in PEERS improved in their quality of rapport with the other adolescent and used more typical vocal expressiveness (e.g., variation of vocal tone for emotion communication).

Additional studies have explored other aspects of PEERS. Schohl and colleagues (2014) were the first to independently replicate previous results with 58 families demonstrating improved social skills, reduction of problem behaviours and some core ASD symptoms, and

increased knowledge of social skills and get-togethers with friends at post-test. Schohl and colleagues also measured anxiety and determined that adolescents had significant decreases in their social anxiety – a domain not specifically targeted by PEERS.

Chang et al. (2014) studied pre-existing skills and characteristics of adolescent PEERS participants to determine predictors of participation outcomes. They found that adolescent improvement was greater for those with higher baseline social skills, lower baseline self-ratings of social competence, and greater parent-reported social skills and self-control.

In a unique extension, Van Hecke et al. (2013) studied 87 adolescents who participated in the program with electroencephalogram brain readings before and after participation. They concluded that participating adolescents with ASD showed neural changes associated with their behavioural improvements. These neural changes more closely resembled the social processing of TD comparison individuals. In particular, they concluded that adolescents who participated in PEERS demonstrated more left-hemisphere dominant change in gamma activity, which was not observed in the waitlist-control group. Furthermore, a relation was found wherein those who had greater knowledge of PEERS curriculum post-test, more social contacts, and fewer ASD symptoms showed the higher degree of gamma activity in the left-hemisphere. Additionally, a recent Korean version of PEERS has been published and its efficacy in this population studied by Yoo and colleagues (2013). Findings included improved social interaction, increased social skills knowledge, and decreased depressive symptoms in addition to reduced maternal anxiety. With the understanding that there is a significant underrepresentation of females in much of research conducted with ASD populations, McVey and colleagues (2017) conducted a study to determine whether PEERS has differing treatment effects for males versus females. Their study combined participants from studies of PEERS for adolescents, as well as a newly adapted

PEERS for young adults (Laugeson, Gantman, Kapp, Orenski, & Ellingsen, 2015). A sample of 27 female and 150 male participants was used in data analysis. Though females with ASD were described as beginning the program with more positive social behaviours as compared to males, they continued to make similar gains relative to their differing skills at pre-intervention. The researchers did not find any other differences regarding patterns of improvement that would suggest PEERS has varying effectiveness for adolescents or young adults based on gender. McVey and colleagues did highlight that further research should explore qualitative aspects of female experience of participating in largely male groups as studies may determine whether all-female PEERS groups may be beneficial.

As PEERS includes parents as a primary mediator of intervention, research by Karst and colleagues (2014) explored how participation in the program may affect the parents themselves. The study included 64 parent-child dyads with 32 families in an intervention group and 32 families in a waitlist control group. Utilizing brief parent-report questionnaires pre- and post-intervention and comparing to the waitlist-control group, Karst and colleagues determined that participation in PEERS did show some positive impact on order and structure within the family home. Furthermore, small changes were observed in parenting stress (decrease) and parenting self-efficacy (increase); however, these were not significant. The authors suggest that although PEERS appears to have added benefits for parents who participate, additional research would help to clarify the domains in which this may be expected or improved.

**Limits to research with PEERS.** Although previous research on PEERS has indicated significant improvements in many important domains of adolescent functioning, this past work includes a variety of limitations. Addressing these limitations would help to improve our understanding of the efficacy of PEERS for adolescents with ASD in additional domains of

functioning and with greater generalization to this unique population. First, the use of a sufficient sample size is necessary to improve data analysis and the ability to investigate multiple variables associated with participation. Samples sizes have been observed between 28 (Laugeson et al., 2009; Laugeson et al., 2012) and 87 (Van Hecke et al., 2013) families. Second, except for Yoo and colleagues' Korean study, PEERS research has been conducted in the United States, primarily at the University of California Los Angeles where the program was developed. Additional independent study in a Canadian setting allows for an understanding of potential unique educational and cultural factors. Third, while some studies confirmed the diagnosis of ASD participants (Schohl et al., 2014; Van Hecke et al., 2013, Yoo et al., 2013), the majority did not and instead relied on previous diagnostic report (Chang et al., 2014; Laugeson et al., 2009; Laugeson et al., 2012; Mandelberg et al., 2014). Strict confirmation of diagnosis using rigorous ASD-specific diagnostic measures would allow for stronger conclusions and generalization to the target population. Fourth, the majority of studies set inclusion for intellectual abilities at a verbal intelligence  $IQ > 70$ ; however, some included participants with lower scores despite the program being designed for those without intellectual impairment (Chang et al., 2014; Yoo et al., 2013). Strict intellectual ability cut-offs should be established and enforced to determine if benefits from the intervention are applicable to those with ASD and without intellectual impairment. Fifth, follow-up was conducted in some of the studies, but not all. Additionally, the length of elapsed time between program completion and follow-up study varied from shortly after participation (14 weeks: Laugeson et al., 2012) to 3 months later (Yoo et al., 2013) and between 1-5 years after PEERS (Mandelberg et al., 2014). The use of consistent follow-up time to demonstrate maintenance of improvements is needed for all outcome domains being assessed. Sixth, past research utilized measures specific to social skills and ASD symptoms but did not

evaluate skills or abilities that support social development. More specially, though behavioural regulation via EF has been theorized as an underlying mechanism of many ASD-related impairments this construct has not been evaluated in the context of PEERS. Moreover, although social anxiety was observed to be reduced in one study (Schohl et al, 2014), there has been no additional comprehensive investigation of other mental health concerns such as general anxiety or depression. Though Yoo and colleagues (2013) measured depressive symptoms, they chose a measure designed and normed for TD children aged 8-13 as opposed to the study sample of 12- to 18-year-olds with ASD. Finally, PEERS relies significantly on parent and family involvement in immediate and long-term treatment efficacy yet no evaluation of family factors has been conducted. The measurement of these family factors, such as attachment and communication may lead to more understanding of pre-existing predictors of improvement or secondary domains in which improvements can be seen.

## **Summary**

Social relationships are highly important to human development and functioning. Children begin their young lives intensely interested in what others are doing and start playing with peers. Parents and school are two of the greatest factors in the social development of children where they learn social skills from adults and peers. As children become adolescents, peer relationships become more important as they begin to exert independence from parental control. Adolescence is a time of great change neurologically, behaviourally, and emotionally that impacts how social skills are translated into successful interaction. Peer friendships are incredibly important, and a lack of friends has been associated with mental health problems, poor life adjustment, low self-esteem, and more. Having good social skills in adolescence is paramount to maintaining friendships.

For those with ASD who do not have intellectual impairment, primary challenges with behavioural control and social communication significantly impact on their ability to form peer relationships. For many such adolescents, consistent struggles with peer social interactions and relationships can be related to significant general anxiety, social anxiety, withdrawal, loneliness, and depression. The improvement of social skills for adolescents with ASD may be an important contributor to the improvement of behavioural regulation due to the bidirectional nature of these constructs and the reduction of anxiety and depression through increased friendships.

There have been many programs designed to improve the social functioning of individuals with ASD, including PEERS. Past research has shown significant improvements in social skills knowledge, get-togethers with friends, ratings of observed social skills, reduction in social anxiety, and some functional brain changes. However, past research may be improved upon by using a clearly sufficient sample size, conducting the study outside of the United States with rigorous confirmation of ASD and intellectual abilities via standardized and well-normed measures, implementing long-term follow-up measures of outcome variables, and investigation of additional skills or abilities that may be affected by PEERS or contribute to program success such as parent-child relationships.



### Chapter 3: Methods

The current chapter will discuss the methodological foundations of the study. The research questions and hypotheses are outlined, followed by the philosophical standpoint guiding the research methodology. Subsequently, the specific method and procedures are presented along with a comprehensive outline and discussion of the measurement tools used. Finally, data analysis techniques and ethical considerations are highlighted.

#### Research Questions and Expected Results

The present study addresses the following research questions, hypotheses (in italics), and rationale:

1. Does completion of PEERS result in improved social skills? *A significant improvement will be seen on a measure of social skills as rated by parents at both post-intervention and at long-term follow up when compared to pre-intervention and baseline data.*

Previous research shows social skill knowledge increases as a result of participation in PEERS, as well as some improvements in general social skills on various measures.

2. Will secondary improvements be observed in participants' EF in the domains of inhibition and cognitive flexibility? *Participants are expected to demonstrate significant improvement on inhibition and cognitive flexibility as rated by parents at both post-intervention and long-term follow up when compared to pre-intervention and baseline.*

Given the importance of core EF to social skill development and perspective taking (i.e., ToM), improvements in social skills may impact EF.

3. Will completion of PEERS result in a reduction of internalizing mental health issues? *Participants' internalizing symptoms (i.e., anxiety, depression) as rated by adolescents will be significantly reduced from baseline/pre- to post-intervention and be maintained at*

*follow up.* Peer relationships are important protective factors in reducing internalizing mental health problems in adolescence. Furthermore, participation in PEERS has been shown to have some implications for social anxiety. It may be the case that participation in PEERS could reduce adolescent symptoms of more general anxiety and/or depression.

4. Will the parent-child relationship factors of attachment and communication be related to individual improvements in social skills seen through PEERS? *Parent-child factors including attachment and communication as rated by parents will be significantly related to the improvements made by participants through the course of the intervention compared to pre-intervention and baseline data. Specifically, greater attachment and communication scores will be related to greater increases in social skills.* Parents are an important component of adolescent's success in PEERS. A stronger relationship is likely to have implications for how the adolescent learns and continues to be supported in PEERS concepts, lessons, and behavioural practice.

In approaching the scientific study of phenomena in the social realm, a careful consideration of the approach, or research philosophy, is needed to ensure that action is guided by an informed framework for interpretation (Denzin & Lincoln, 2003). The following section will review the ontological and epistemological framework guiding study design, data collection, and interpretation.

### **Ontological and Epistemological Perspectives that Inform Methodology**

**Critical Realism.** When approaching the pursuit of new knowledge, researchers are faced with the task of considering the best way to collect information from the world surrounding them. Thus, their inquiry should be driven by an epistemology, defined as a view on what knowledge is and what the sources of knowledge are in a given field (Eriksson &

Kovalainen, 2008). With the current study in mind, knowledge will be gained from observable phenomena in the form of participant behaviours rated on norm-referenced and standardized questionnaires. This viewpoint is reflected in a positivist epistemology whereby researchers attempt to be independent of results and value free through the use of structured methodology and quantifiable observations (Howe, 2009; Saunders, Lewis, & Thornhill, 2009).

Finding its basis in positivism, critical realism is a philosophy that asserts truth can only be gained through logic, mathematics, and things that can be reported through sensory experience (Macionis & Gerber, 2010). Those who would consider themselves positivists believe that the researcher can be independent of what is being researched. In contrast, post-positivists accept that the researcher may influence observations as a function of their personal beliefs, biases, and knowledge (Robson, 2002). The traditional viewpoint in critical realism sees knowledge as existing within three domains: the real, actual, and empirical (Bhaskar, 1998; Ogutle, 2013). The experience of the individual is considered in the empirical domain, and these are the experiences and observations that can be studied and measured (Jeppensen, 2005; Marshall, 2012). Surrounding the empirical domain of personal experience and measurement, actual events are considered those generated by mechanisms beyond our control and ability to observe. Finally, these mechanisms are all generated and occur in the real domain, influencing all that happens in the world beyond our observation (Johnston & Smith, 2008; Marshall, 2012). The critical realist perspective can be illustrated in the thought experiment, “if a tree falls in the forest and no one is around to hear it, does it make a sound?” (Engle & Taylor, 1968). In this case, some mechanism generated in the real domain influenced something in the actual (e.g., ageing of the tree, weight of snow, wind force) to cause the tree to fall. The sound generated by

the tree falling, if observed and experienced by an individual, would occur in the empirical domain of knowledge.

It is important to consider that critical realism claims that knowledge is created socially in many ways and that the real structures that do exist may not be fully known or understood (Flowers, 2009). Critical realists understand that measurements and observations gathered in the empirical domain rely on personal sensations and, thus, there is the potential for disconnect between what is observed and what truly happens (Saunders et al, 2009). However, this epistemology accepts the imperfection of information gathered from observations, such that the importance lies in how measurements are taken and then interpreted (Archer, 2000, Hood, 2013). The proper interpretation of study results is meant to then produce practical and useful knowledge (Gorski, 2013; Pilgrim, 2014).

The case may be made that measurement of physical and tangible characteristics (e.g., blood pressure, geological features, chemical compounds, temperature, etc.) are much more easily classified in the natural sciences as being a part of an objective and tangible reality; potentially, these observations reflect not just the empirical, but the actual in some cases. Conversely, social sciences often aim to measure constructs such as observed behaviours, tendencies, choices, culture, power, and personality. The question becomes if these constructs exist only through those who experience them or if they are independent of those who live them (Hatch & Cunliffe, 2006). In the context of the proposed study, critical realism allows for the acceptance of measurement and observations of constructs such as social skills, EF, and mental health, despite these being aspects of the empirical domain which may or may not be correct descriptions and understandings of the real or actual (Pilgrim, 2014).

**Pragmatism.** Many who accept the critical realist perspective to knowledge acquisition and generation also adopt the philosophical standpoint of pragmatism (Johnson & Duberley, 2000a; Mearns, 2011; McEvoy & Richards, 2006). Traceable to the Greek philosopher Carneades (Johnson & Duberley, 2000b), the modern idea and term of pragmatism was first introduced by Charles Sanders Peirce whose thoughts can be summed as, “we can seek truths for the sake of their applications or, as in experimental science, we can seek applications, even intrinsically trivial or useless ones, for the sake of testing theories and, thus, arrive at truths” (Short, 2001, p. 296).

Specifically, a pragmatist is concerned with conducting a study with outcomes that will be of true and practical value, bringing positive consequences to those within the value system of the researcher (Tashakkori & Teddlie, 1998). Thus, the most important aspect in determining research methodology is to choose the best way to answer the posed research questions carefully (Johnson & Duberley, 2000b; Saunders, Lewis, & Thornhill, 2009). The pragmatic approach is adopted in the current study through selection of norm-referenced and standardized measures of participant behaviour tailored to the research questions allowing for clear answers and results that can be easily disseminated to families and professionals.

To summarize, the approach of critical realism allows for the study of observable and measurable human experience, with the acceptance that what is measured may not represent a true reality. In the social sciences, there is an understanding that much of human experience and knowledge is socially created and may be fallible. However, it is still important to pursue knowledge through research for the purposes of obtaining results that are of value and have use to people that may benefit from them. Pragmatically, the pursuit of this knowledge is best executed by carefully selecting a methodology that aims to answer selected research questions. A

pragmatic and critical realist approach allows for the study of various constructs that, despite being constructed by humans, are aimed at informing theory and practice with the ultimate goal of producing useful knowledge on multiple levels to better the life of the population chosen by the researchers. For the proposed study the generation of knowledge from participants' experiences in PEERS is hoped to lead to practical information for the participating families, practitioners considering using PEERS or other SSTPs, and future researchers looking to replicate or create similar studies of value.

**Quantitative Methodology.** A final step in determining how the current study will be conducted involves the selection of a methodology that best suits the researcher's ontological and epistemological framework. Given the use of a critical realist perspective outlined previously, data collected via a variety of quantitative methods is accepted.

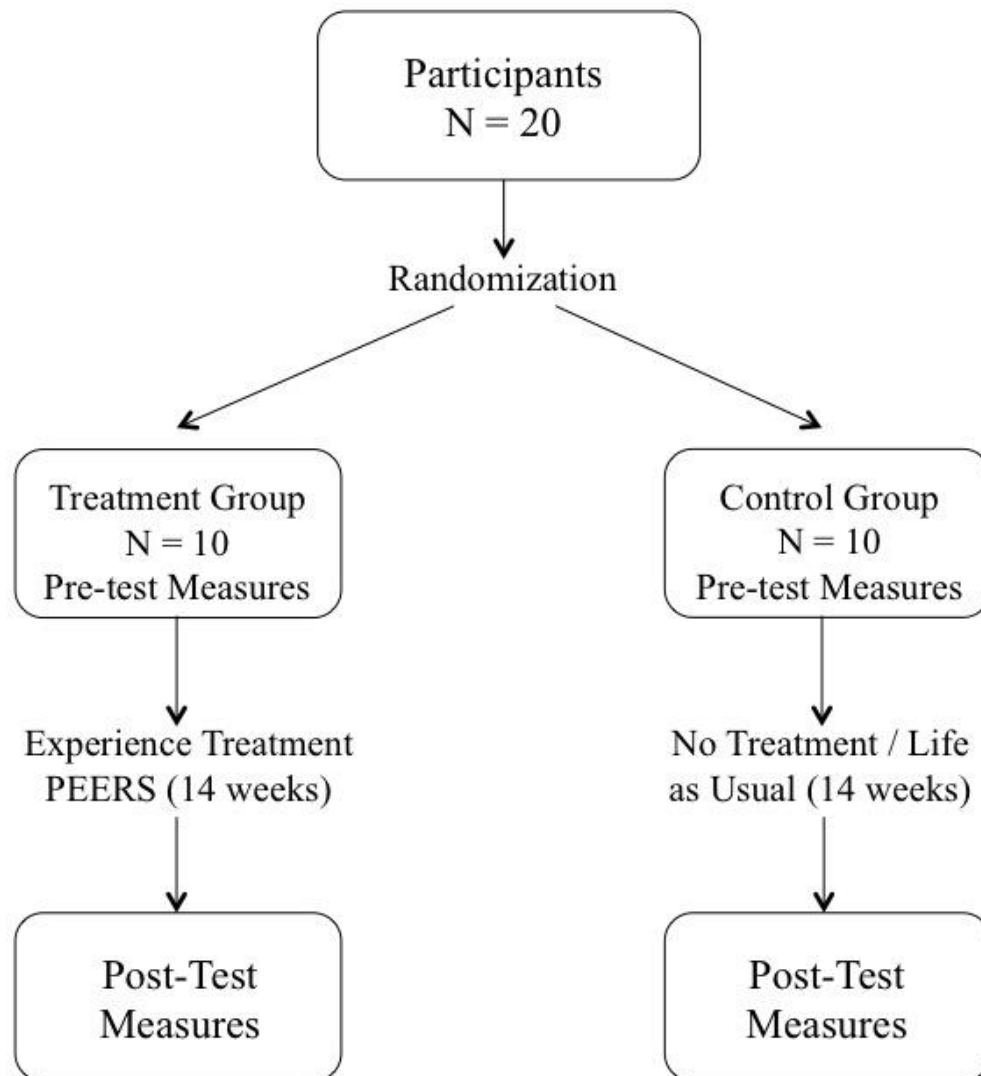
Though critical realism accepts that sensory observations may not represent objective reality, there remain certain assumptions that must guide methodology. Holden and Lynch (2004) summarize these assumptions, which include the need for operationalization and generalization. In considering operationalization, concepts need to be defined in such a way as to be measured quantitatively and categorized before study, which usually leads to statistical analysis after data collection. Furthermore, samples of sufficient size are necessary to generalize results to other human behaviour as much as is possible. The use of quantifiable data collection and sufficient sample size is meant to allow for better prediction, understanding, and explanation of the human behaviour under study. Notably, the critical realist and positivist perspectives underpin quantitative methodology which emphasises experimental designs to measure effects, particularly in measuring group effects (Neuman, 2003; Sarantakos, 2005).

**Summary.** The current proposed study is led by a pragmatic ontology, which proposes that in answering the posed research questions, useful results may be generated regardless of their place in subjective or objective reality. However, the researcher asserts that knowledge can be gained through observable occurrences within this framework. The critical realist perspective allows for the recognition that much of what is studied may be socially constructed and may not represent true reality, but nonetheless allows for more ecologically valid understandings. Anchored in post-positivism, it is recognized that despite attempts not to, the values, beliefs, and biases of the researcher may play a small part in data collection and methodology. Finally, quantitative methodology best suits these philosophical standpoints, allowing hypotheses to be tested with operationalized concepts through various established measurements of behaviour. In the following section an appropriate method will be presented for studying PEERS and answering the research questions.

### **Delayed Treatment Control Design**

With a careful consideration of pragmatic and critical realist philosophy, the chosen study must include quantifiable measurement and the ability to answer the research questions. Campbell and Stanley (1963) describe the pretest-post-test control group design as a well-established and recommended design in the methodological literature. Simply speaking, equivalent groups are created by randomization, one of which receives the independent variable (i.e., PEERS) and the other of which does not. Measurements are taken within the same time period for both groups taking a form visualized in Figure 2 below.

Figure 2. Randomized Pre-test Post-test Control Group Design.



This design is meant to control for potential effects of history with the assumption that any uncontrolled changes in one group would likely be present in the second. Furthermore, maturation as a developmental process occurs equally in both groups once randomized.

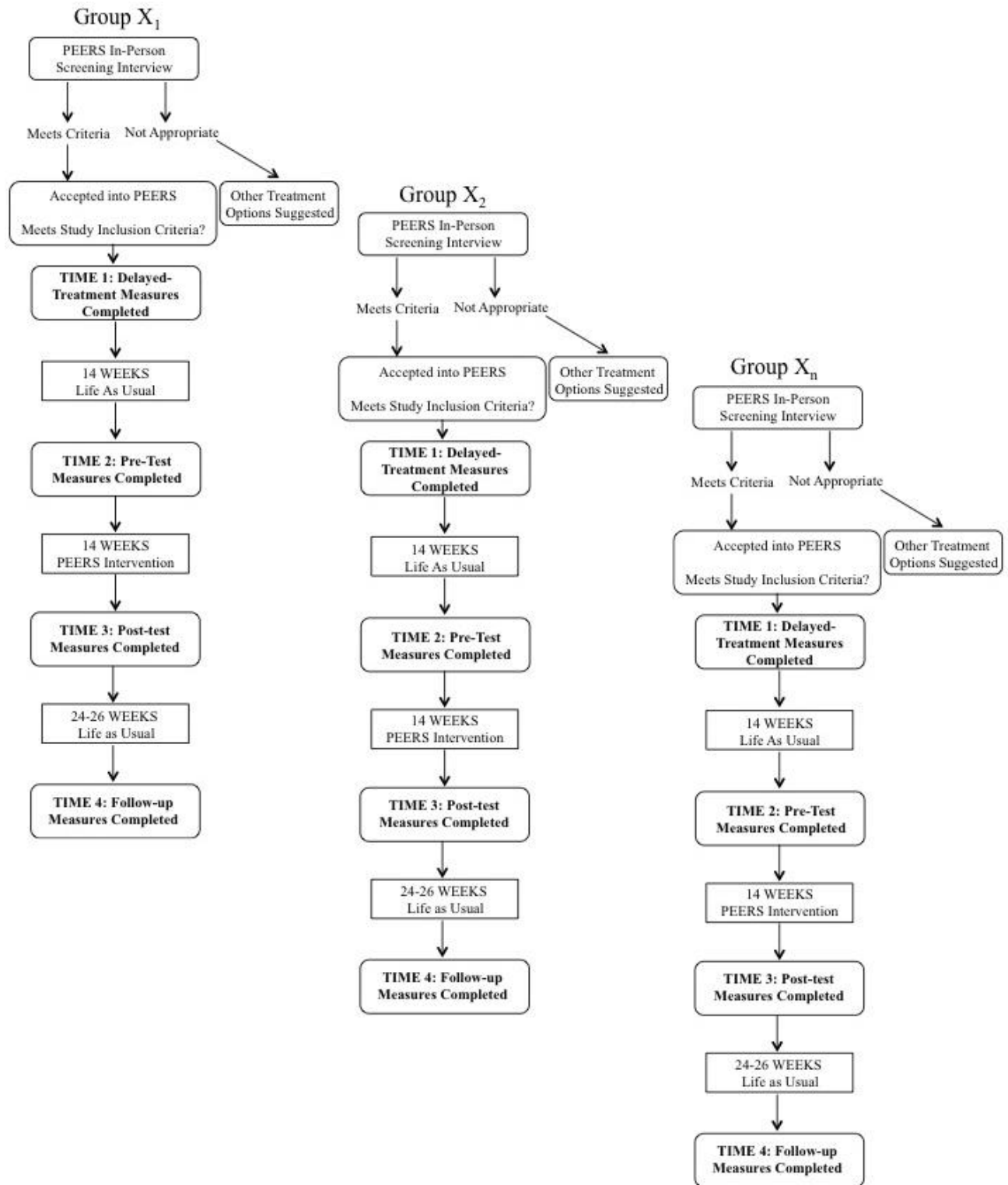
The randomized pretest-post-test design described above, though sufficient for data collection for the current study, presents with some issues. Specifically, individuals assigned to the control group are denied access to the treatment, which may be considered unethical.



Additionally, the use of control groups may present with practical challenges in that program facilitators and administrators may be pressured by referring agencies or individuals to accept a participant into the treatment group based on funding or other factors. Moreover, some participants may appear more “needy” and program staff may fear unethical treatment should certain individuals be placed in the control group (Cook, 1983). Although having the control group complete an alternate SSTP may allow them access to treatment, that approach does not answer the current research questions which are aimed at understanding the benefits of PEERS and not comparing its efficacy to other SSTPs.

To best meet the ethical considerations and research questions of the current study, a delayed treatment control (DTC) design as described by Heath, Kendzierski, and Borgida (1982) was planned. In a DTC design, participants are delayed in their treatment but are not denied treatment or given an alternate treatment. Outlined in Figure 3 below, a DTC design allows

Figure 3. Delayed Treatment Control Design.



all participants to receive PEERS yet contribute valuable control data over the delayed period. Participants who pass pre-screening procedures for the intervention are randomized to a subsequent PEERS session, no less than 14 weeks before its start. Participants complete study measures at this point, allowing 14 weeks to pass during which time they experience their typical daily routines and life experiences, but not participating in the intervention. After 14 weeks of “life as usual” (LAU) participants complete pre-intervention measures just before starting PEERS. Thus, a baseline of data is gathered during this 14-week period, capturing LAU data with the assumption that this represents variability in aging, development, time of year, life experiences, and other potential confounding factors. With larger numbers of participants delayed starting the intervention, aggregation of control data from this 14-week period of LAU becomes a stronger comparison for results of treatment with PEERS.

The sampling procedures in the current study involved both accidental sampling, where participants contact the researchers based on their level of interest and are accepted based on meeting criteria, and snowball sampling, where initial participants were likely to tell others of the study who may become future participants (Sahu, 2013). In this way, the participants used in the study, with a large enough sample size, was hoped to reflect the population of adolescents with ASD who do not have intellectual impairment in an urban Canadian setting appropriately. However, due to non-scientific sampling procedures, the extent to which the sample accurately reflects the broader population of individuals with ASD cannot be fully evaluated (Royse, Thyer, & Padgett, 2010). Sampling procedures may have missed families with transportation restrictions, those lacking access to information about PEERS, families for whom English is not a primary language, or other potential participants that would have made the sample more representative. It was hoped, however, that snowball and accidental sampling were more likely to

lead to participants that were representative of the families PEERS has been designed for. Snowball sampling and having families contact researchers was likely to result in participants who were likely of appropriate language ability, and of sufficient motivation and interest to meet program requirements.

In regard to randomization, accidental and snowball sampling procedures coupled with a DTC design was meant to reduce selection bias that may influence the placement of individuals into one or another treatment in traditional experimental designs (Slavin, 2007). For the current study, traditional randomization was not practical or possible. First, control is needed over participants to ensure they meet entrance criteria, thus making the sample non-random to improve generalization of results to the population for which the intervention was created. Second, as there was only one treatment (i.e., PEERS) and control data was to be collected for each participant (i.e., over the LAU period), there was no need to randomize to separate groups. Third, assignment to PEERS cohort and start time was based upon time of contact. When multiple groups were available, participants were randomized into their final group. When more participants were interested in PEERS than could be accommodated at a given cohort of the program, participants were randomized to different start times (e.g., fall versus winter).

Further discussion of specific procedures including inclusion criteria, randomization, and sampling will be outlined in the following section. This will be followed by a discussion of measures used, quantitative data analysis techniques proposed, and ethical considerations.

## **Method**

**Participants.** The participants were 55 adolescents between the ages of 13:0 to 18:1 with confirmed ASD, and one or more of their parents or caregivers. Details on ASD inclusionary criteria will be further detailed below. Eligible participants could be as old as 18 years, 1 month

when they first complete delayed treatment measures 14 weeks before starting PEERS. This age criterion meant that participants would not be 19 years old and thus within the normative age range of the measures described below when they completed long term follow up testing.

Previous research on PEERS has included sample sizes ranging from 28 to 87 participants (Laugeson et al., 2009; Laugeson et al., 2012; Van Hecke et al., 2013). Based on the number of analyses in the current study and power analysis further outlined below, as well as the practical implications of running PEERS (e.g., length of intervention, four time points of measurement, intake procedures and diagnostic confirmation), the sample size was considered justified.

Participants were recruited through community-based agencies (e.g., those supporting families of and those with ASD) and school boards in a large urban Canadian city. Recruitment followed a snowball sampling method in which current and past participants were likely to tell others of a similar age and diagnosis about PEERS and the associated research project. Demographic information (e.g., age and gender) is presented in the results. No information on ethnicity was collected and parents were not asked from where they heard of PEERS.

### **Measures.**

*Autism Diagnostic Observation Schedule, Second Edition.* Participants were required to have an official diagnosis of ASD (i.e., ASD, PDD-NOS, autism, autistic disorder, or Asperger syndrome) from a qualified professional. Confirmation of diagnosis occurred via the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al., 2012). The ADOS-2 is considered a highly rigorous instrument used often in the diagnosis of ASD. Using planned social activities, or “presses” (Murray, 1938), standard contexts are created in which communication, social interactions, and unique forms of behaviour synonymous with ASD are likely to manifest. Each of the ADOS-2’s five modules can be administered in approximately 35-75 minutes. For the 13- to 18-

year-olds in the current study, modules 3 and 4 were used. Module 3 is intended for adolescents under 16 who are verbally fluent, and uses both interactive play scenarios and interview questions. Module 4 is used with older adolescents and adults who are verbally fluent, and focuses primarily on interview questions and conversation. A complete list of symptoms and domains of functioning assessed and used in the diagnostic algorithm in Modules 3 and 4 can be found Table 1.

Table 1.

*Domains Assessed from the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2)*

Domain	Subdomain	Symptoms / Specific Behaviours	
		Module 3	Module 4
Social Affect	Communication	<ul style="list-style-type: none"> <li>- Reporting of Events</li> <li>- Conversation</li> <li>- Descriptive, Conventional, Instrumental, or Informational Gestures</li> </ul>	<ul style="list-style-type: none"> <li>- Stereotyped / Idiosyncratic Use of Words or Phrases</li> <li>- Conversation</li> <li>- Descriptive, Conventional, Instrumental, or Informational Gestures</li> <li>- Emphatic or Emotional Gestures</li> </ul>
	Reciprocal Social Interaction	<ul style="list-style-type: none"> <li>- Unusual Eye Contact</li> <li>- Facial Expressions Directed to Examiner</li> <li>- Shared Enjoyment in Interaction</li> <li>- Quality of Social Overtures</li> <li>- Quality of Social Response</li> <li>- Amount of Reciprocal Social Interaction</li> <li>- Overall Quality of Rapport</li> </ul>	<ul style="list-style-type: none"> <li>- Unusual Eye Contact</li> <li>- Facial Expressions Directed to Examiner</li> <li>- Comments on Others' Emotions/Empathy</li> <li>- Responsibility</li> <li>- Quality of Social Overtures</li> <li>- Quality of Social Response</li> <li>- Amount of Reciprocal Social Interaction</li> </ul>
Restricted and Repetitive Behavior		<ul style="list-style-type: none"> <li>- Stereotyped / Idiosyncratic Use of Words or Phrases</li> <li>- Unusual Sensory Interest in Play Material / Person</li> <li>- Hand and Finger and Other Complex Mannerisms</li> </ul>	<ul style="list-style-type: none"> <li>- Compulsions or Rituals</li> <li>- Unusual Sensory Interest in Play Material / Person</li> <li>- Hand and Finger and Other Complex Mannerisms</li> <li>- Excessive Interest in Unusual or Highly Specific Topics/Objects or Repetitive Behaviors</li> </ul>

	- Excessive Interest in Unusual or Highly Specific Topics/Objects or Repetitive Behaviors
Imagination / Creativity	- Imagination / Creativity

During administration, the examiner takes detailed notes on target behaviours to later provide codes in the domains of Social Affect and Restricted and Repetitive Behaviours using a provided algorithm. For Module 3, the cut-off score for ASD is set at a total score of 7 or higher. In Module 4, individuals must have a combined score of 8 or greater for a total score to be considered on the autism spectrum based on updated *DSM-5* criteria (Lord et al., 2012; Lord & Hus, 2014).

Though the activities and questions in administration remain largely the same, the development of the ADOS-2 included revision of the original ADOS (Lord, Rutter, DiLavore, & Risi, 1999) through updated algorithms for scoring based on current research. The ADOS-2 used a total of 1,139 participants to update scoring algorithms, with a total of 1,630 total assessments with repeated assessments counted. For Module 3, 315 individuals with ASD and 83 TD individuals were used (Lord et al., 2012); for Module 4, 347 individuals with ASD and 90 who were TD were used for algorithm validation (Lord & Hus, 2014). Interrater reliability correlation coefficients for Module 3 are reported as .92 for Social Affect scores, .91 for Restricted and Repetitive Behaviour scores, and .92 for Overall Total score. For Module 4, interrater reliability coefficients were .93, .84, and .82 for the domains of Social Interaction, Communication, and Stereotyped Behaviours and Restricted Interests respectively. Additionally, the test authors report test-retest reliability coefficients of .81 for Social Affect scores, .82 for Restricted and Repetitive Behaviour scores, and .87 for Overall Total score. These test-retest reliabilities were calculated for Modules 1-3 only with 75 participants who were administered the same module twice within an average of 10 months. Important to the

diagnosis of ASD is a consideration of the predictive validity of the ADOS-2. Test creators report strong predictive validity for the ADOS-2 algorithms, with sensitivity for detecting ASD on Module 3 between 72-91%, and specificity between 76-84%. The administration of the ADOS-2 requires specialized training and all administrations for the current study were conducted by graduate students trained to research reliability level by a certified ADOS-2 Independent Trainer.

***Wechsler Abbreviated Scale of Intelligence, Second Edition.*** Participant intellectual ability was evaluated via the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler, 2012). The authors of PEERS indicate that adolescent participants must have adequate verbal abilities to participate in the program (Laugeson & Frankel, 2010). Previous research suggests that verbal intellectual abilities at or greater than 70 appear to be a sufficient indicator of fit with the program content and delivery (Gantman, Kapp, Orenski, & Laugeson, 2012; Laugeson et al, 2012; Laugeson et al., 2009; Schohl et al., 2014; Yoo et al., 2013). Thus, participants in the proposed project were required to demonstrate verbal cognitive abilities  $\geq 70$  on the WASI-II through scores on the Verbal Comprehension Index (VCI). The WASI-II is considered a brief measure of intellectual assessment that can be especially useful for the purposes of screening and research and is normed for individuals 6 to 90 years of age. Administration involves four subtests and takes approximately 30 minutes, with results reported as standard scores ( $M = 100$ ,  $SD = 15$ ). The VCI is obtained through scores from the Vocabulary and Similarities subtests which together measure verbal reasoning, acquired knowledge, and attention to verbal information. The PRI includes the Block Design and Matrix Reasoning subtests, which are theorized to measure visual-motor integration, fluid reasoning, spatial processing, and attention to detail. The Full-Scale IQ (FSIQ) then represents a general estimation of intellectual functioning.



The normative sample for the WASI-II included 2,300 individuals of a representative population based on 2008 census data in the United States. Standardization occurred between January 2010 and June 2011. Psychometric properties of the WASI-II have been well established as strong. For 13- to 18-year-olds, split-half reliability coefficients for the VCI and PRI both range from .92 to .94, while the FSIQ ranges from .95 to .96; all considered excellent. Test-retest reliabilities were measured by re-administering the WASI-II to 215 participants in intervals ranging from 12-88 days apart. Results of Pearson product-moment correlations for 13- to 18-year-olds ranged from .93 to .95 for the VCI, .86 to .93 for the PRI, and .92 to .96 for the FSIQ. The measure was designed to be similar to the well-established Wechsler Intelligence Scale for Children, Fourth Edition (Wechsler, 2003) and the Wechsler Adult Intelligence Scale, Fourth Edition (Wechsler, 2008). The internal structure of the WASI-II has also been supported via factor analytic studies (Wechsler, 2012).

***Social Skills Improvement System.*** The Social Skills Improvement System (SSIS; Gresham & Elliot, 2008) gathered parent ratings of adolescent social skills. The SSIS is a 46-item questionnaire evaluating social behaviour in real-life environments such as school, play, and home that takes 15-20 minutes to complete. Composite scales include Social Skills and Problem Behaviors, while raw score subscales include communication, cooperation, assertion, responsibility, self-control, engagement, and empathy. For the purposes of the proposed study, the parent form was used, on which parents answered whether their child “never”, “seldom”, “often”, or “almost always” engages in specified behaviours. Parents also indicated their perceived value of such behaviours by recording whether they believe the behaviour is “not important”, “important”, or “critical” to their child’s social success. Using the official software scoring program, the raw scores for both the Social Skills and Problem Behaviors domains are

entered and converted into standard scores. This scoring process considers the age of the child being rated. In the current study, the Social Skills standard score was examined.

The SSIS development included a revision of the previous Social Skills Ratings System (SSRS; Gresham & Elliot, 1990) used by many clinicians and educators for nearly 20 years. From an initial pool of over 400 items, 90% of which were new from the SSRS, 46 items were chosen by a panel of experts (e.g., social workers, school psychologists, special education teachers) and based on literature reviews of the specific social behaviours of youth and their relation to important social outcomes. For ages 13 to 18, the normative sample consisted of 400 parents or guardians of a representative sample from 2006 United States census data. The internal consistency for the parent rated Social Skills composite was determined using coefficient alpha and reported as .96, with the subscales ranging from .77 to .87. Test-retest reliabilities were measured by re-administering the SSIS to parents at a mean interval of 61 days later and are reported as .84 for the Social Skills composite and as ranging from .73 to .82 for the subscales. The SSIS Social Skills standard score shows moderate correlation to other measures, including the SSRS (.69 for ages 13 to 18) and the Social Skills scale (.74) on the Behavioral Assessment System for Children, Second Edition (Reynolds & Kamphaus, 2004).

As can be expected, scores on the Social Skills composite for individuals with ASD have been reported to be approximately 1.5 standard deviations below the mean ( $M = 75.8$ ) when a small sample ( $n = 50$ ) of parent ratings were studied; however, no intellectual abilities were reported for this sample (Gresham & Elliot, 2008). As the current study is meant to assess for change in social skills over time through multiple ratings, the base scores in relation to the normative sample are less of a concern but may be an interesting result to consider.

***Comprehensive Executive Function Inventory.*** The Comprehensive Executive Function Inventory (CEFI; Naglieri & Goldstein, 2013) was used to evaluate EF. The CEFI gathers information on a variety of EF factors such as emotional regulation, inhibition, self-monitoring, planning, flexibility, and more through behaviour ratings during the previous four weeks. Available in both online and paper-and-pencil formats, this 100-item measure has forms for parents, teachers, and youth ages 5 to 18. The CEFI is estimated to take 15 to 20 minutes to complete. For the purposes of this project, the Inhibitory Control and Flexibility subscales from the parent form were analyzed. The test authors describe the Inhibitory Control scales as measuring "...the youth's ability to control behaviour or impulses, including thinking about consequences before acting, maintaining self-control, and keeping commitments", and the Flexibility scale as measuring "...a youth's skill at adjusting behavior to meet circumstances, including coming up with different ways to solve problems, having many ideas of how to do things, and being able to solve problems with different approaches" (Naglieri & Goldstein, 2013, p. 28). In factor analytic work, 10 of the 100 items load on to the Inhibitory Control Scale, with a loading of .911 in the one-factor solution. For the Flexibility scale, 7 items with a loading of .854 are reported. Each question asks parents to rate the frequency of their child's behaviour by selecting "Never", "Rarely", "Sometimes", "Often", "Very Often", or "Always". Raw scores are converted into standard scores for each scale with higher scores indicating better behavioural regulation via EF.

The preliminary creation of the CEFI included review and application of current theory and review of items by experts in child psychiatry and clinical child psychology. The normative sample for the parent forms included 1,400 raters based on a representative sample from 2009 United States census data. The test creators describe internal consistency as high for the CEFI, as

coefficient alphas are specifically reported as .90 for the Inhibitory Control scale and .85 for the Flexibility scale. Test-retest reliability was measured using a sample of 171 parents who completed the CEFI a second time within 7 to 30 days. The test-retest reliability was reported as .88 and .80 for the Inhibitory Control and Flexibility scales, respectively. Factor analysis was reported to support both the individual items and scale construction of the CEFI forms. Additional analysis was conducted to examine differences between populations from the United States of America (USA) and Canada on the Full Scale CEFI score. Results of Analysis of Covariance (ANCOVA) indicated that the effect sizes of country of residence (i.e., USA vs. Canada) were small to negligible and therefore location did not have significant effects on CEFI scores or interpretation. The CEFI was also compared to the Behavior Rating Inventory of Executive Function (BRIEF: Gioia, Isquith, Guy, & Kenworthy, 2000). A significant correlation of .85 was found comparing the Global Executive Composite from the BRIEF and the CEFI Full Scale score; no data was available on individual subscales. Importantly, the CEFI was standardized on a nationally representative sample from the U.S. population based on census data (see above). However, the BRIEF was standardized on a population from schools in the State of Maryland only. This is suggested by test authors as a possible explanation for any differences in mean scores between the measures (Naglieri & Goldstein, 2013).

***Beck Youth Inventories, Second Edition.*** Symptoms of mental health, including depression and anxiety specifically, were measured through the Beck Youth Inventories Second Edition (BYI-II; Beck, Beck, Jolly, & Steer, 2005), a self-reported symptomology inventory. Each inventory scale on the measure (Depression, Anxiety, Anger, and Self-Concept) contains 20 statements about thoughts, feelings, or behaviours associated with emotional and social impairment, with the youth rating each statement on a 4-point scale of 0 (*never*) to 3 (*always*) for

frequency. Each of these scales takes an estimated 5-10 minutes to complete. Raw scores are converted to *T*-scores ( $M = 50$ ,  $SD = 10$ ), with higher scores indicating a greater degree of distress in that area, and separate conversions for gender and age group differences.

The BYI-II was normed on a mixed sample of 800 children aged 7 to 14, 200 adolescents aged 15-18, and another 178 13- to 18-year-olds in a clinical sample from the United States based on 1999 census data. The clinical sample included individuals previously diagnosed with various disorders related to depression, anxiety, bipolar disorder, conduct disorder, and others. Internal consistency coefficient alpha for the Anxiety and Depression scales range from .89 to .92, and .91 to .95, respectively, based on age and gender. Test-retest reliability was assessed through a sample of 105 individuals completing the scale a second time within approximately one-week of the first administration. Correlation coefficients between these administrations are reported at between .84 and .93 for the Anxiety scale, and between .90 and .92 for ages 11-18 on Depression scale for males and females. Validity was partially assessed through acceptable correlations between the Anxiety and Depression inventories and other measures assessing similar constructs, including the Revised Children's Manifest Anxiety Scale (.64; Reynolds & Richmond, 1985), and the Child Depression Inventory (.67; Kovacs, 1992).

***Parenting Relationship Questionnaire – Child and Adolescent.*** The Parenting Relationship Questionnaire – Child and Adolescent (PRQ; Kamphaus & Reynolds, 2006) was used to understand the factors involved in parent-child relationships that may affect program outcomes. The PRQ is a 71-item questionnaire completed by parents regarding various aspects of their relationship with their child and can be used for children 6 to 18 years. Specifically, the PRQ gathers information on seven scales: attachment, communication, discipline practices, involvement, parenting confidence, satisfaction with school, and relational frustration. Parents

indicate the frequency of a behaviour, feeling, or experience as “Never”, “Sometimes”, “Often”, or “Almost Always”. Scores generated from the PRQ on the seven scales are represented in *T*-scores ( $M = 50$ ,  $SD = 10$ ).

The PRQ was normed on a large representative sample of parents’ ratings in the United States. Relevant to the current study, for the age bands of 13 to 18, the normative sample included 1250 mothers and 220 fathers, though the children rated were equally male and female. Based on analyses by the test creators, separate norms were created for mothers’ and fathers’ ratings (Kamphaus & Reynolds, 2006).

As outlined in research question four, this study will focus on scales of Attachment and Communication. The Attachment scale is defined as measuring “The affective, cognitive, and behavioral relationship between a parent and child that results in feelings of closeness, empathy, and understanding on the part of the parent for the child”, whereas the Communication scale measures “The quality of information exchanged between the parent and child and the parent’s listening skills that promote a trusting relationship (Kamphaus & Reynolds, 2006, p. 3). Test-retest reliability was assessed by having 159 participants complete the PRQ a second time, with a median interval of 33 days between ratings. The resulting coefficients range from .85 to .87 for the Attachment scale and from .85 to .89 for the Communication scale, depending on rater (i.e., mother or father). Furthermore, the PRQ has shown acceptable correlations on similar scales to other measures of parent-child relationships, including the Parent-Child Relationship Inventory (Gerard, 1994) and the Parenting Stress Index, Third Edition (Abidin, 1995; Kamphaus & Reynolds, 2006).

## **Procedure**

**Initial PEERS Inclusion.** The PEERS Manual (Laugeson & Frankel, 2010) clearly outlines the parameters and suggestions for participation in PEERS. The program is designed for individuals with ASD between the ages of 13-18, without intellectual impairment. Furthermore, Laugeson and Frankel (2010) stress the need for one or more parents or guardians to participate and that the adolescent participant shows an awareness of their social difficulties and a willingness to participate in the program regardless of parent insistence and interest. Thus, all interested participants were interviewed in person for 10-30 minutes prior to acceptance into the program to ensure all questions about the intervention and associated research project had been answered, to ensure parental participation, and to speak alone with the adolescent to determine motivation and self-awareness. An example of the interview provided in the PEERS manual that was used in the current study is provided in Appendix A.

**Data Collection.** Initially, using the DTC design, the first group of interested participants began the program immediately and therefore did not complete baseline testing 14 weeks before starting PEERS. Interested parents and teens participated in the intake interview procedures and those deemed acceptable to be admitted into the intervention completed the inclusionary measures. Families were accepted into the program after qualifying for PEERS based on a) being 13-18 years old with a previous diagnosis of ASD, b) parent/guardian participation confirmation, and c) adolescent awareness of social deficits and motivation to attend. It was the case that a small number of adolescents admitted via these procedures then demonstrated inadequate diagnostic confirmation through procedures outlined below. In this case, participants were not rejected from the program, but were not included in data collection and analysis. Participants who met the inclusionary criteria were delayed to the next available cohort or randomized to a

start point if multiple groups are available (e.g., two fall groups, two winter groups). Except for the first cohort who did not complete baseline (i.e., LAU) measures by design, it was the aim of the project to have all other participants complete baseline, pre-intervention, post-intervention, and long-term follow-up measures. However, as outlined in detail in the results and discussion sections below, it became clear that full use of the LAU data was not possible. Many families did complete delayed treatment data; however, this was much less than those who provided pre-intervention, post-intervention, and follow-up data. The influences that led to this unanticipated outcome and the subsequent limitations will be described later.

Diagnostic confirmation was completed before the start of PEERS or early during program participation at a time arranged with and convenient for each family. As per the manual, Each PEERS cohort consisted of approximately 8-10 adolescents who would complete the SSIS, CEFI, and BYI-II at each of four rounds of testing: baseline (14 weeks prior to starting the intervention), pre-test (at the start of the intervention), post-test (within a short time upon completing the intervention), and follow-up (24-26 weeks' post-intervention). Parents/guardians also completed their respective forms of the SSIS, CEFI, and PRQ at these time points.

## **Analysis**

Collected data was input into the Statistical Package for the Social Sciences (SPSS 24) and aggregated. In essence, data from multiple PEERS cohorts was treated as if one large cohort participated in PEERS at the same time, where all pre-intervention, post-intervention, and follow-up data was analyzed together. To confirm that this aggregation was warranted, variable distributions were analyzed between groups to look for significant differences, and equivalence tests were performed which included analyzing skewness and kurtosis values and visually inspecting histograms. Additional details on data management are provided in the results section



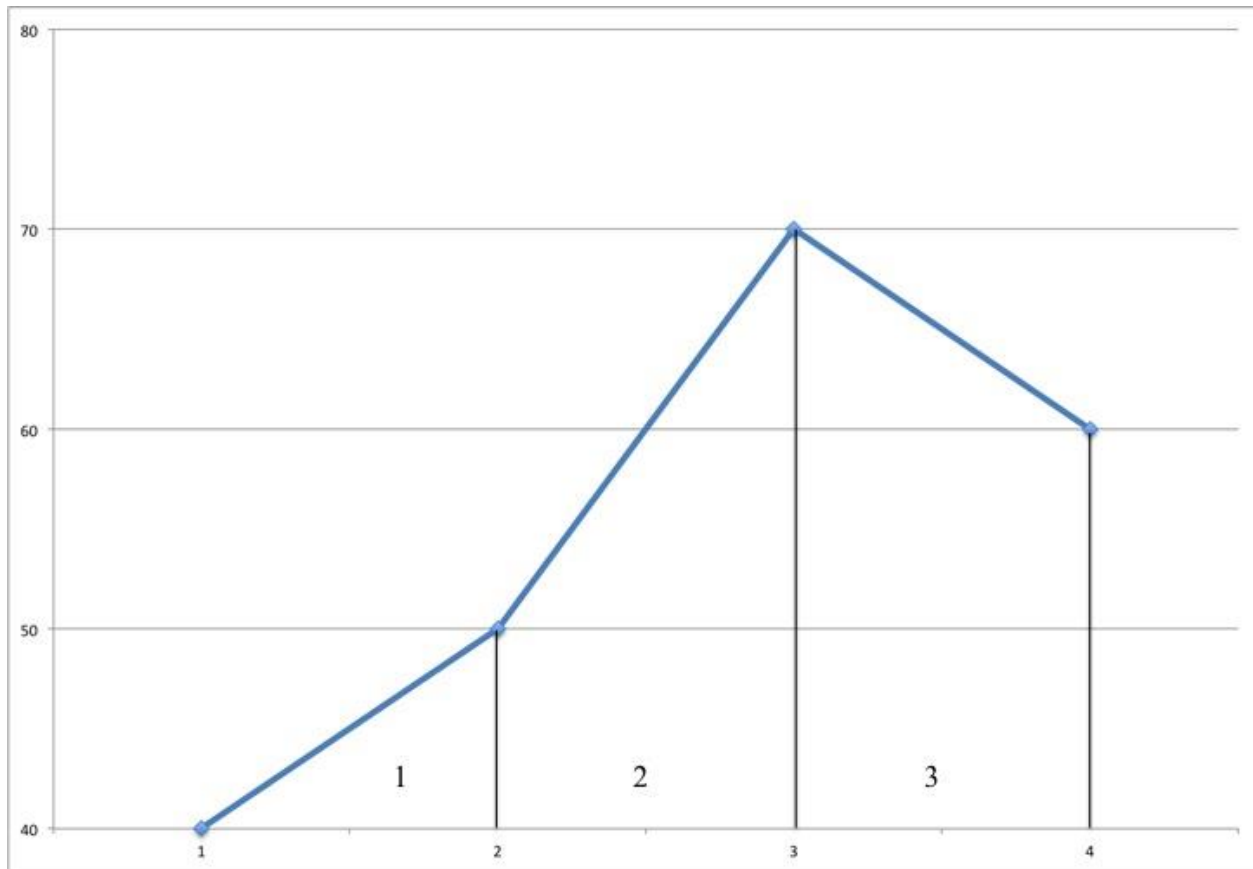
below. Moreover, the aggregation of data ensured adequate internal validity of the study by including a wider range of participants within study and PEERS parameters. For example, a single cohort of PEERS participants (e.g.,  $N = 10$ ) was likely to have variations in intellectual abilities, ASD symptoms, gender, etc. The grouping of all participants together (e.g.,  $N = 55$ ) was more likely to represent the population values of adolescents between 13-18 with ASD in the location where the intervention was offered. Finally, the sample size of 55 families is deemed appropriate based on power calculations. Assuming sphericity assumptions are met, a sample of 12 would be sufficient for the final decided measurement over 3 time points using Repeated Measures Analysis of Variance ( $p < 0.05$ , effect size 0.5, power 0.95, critical  $F = 3.443$ ; Faul, Erdfelder, Lang, & Buchner, 2009).

Analytic methods were chosen that were parsimonious and best suited to answering the research questions. For research questions 1 to 3, analyses focused on significant changes in scores from pre-intervention to post intervention, post-intervention to follow-up, and pre-intervention to follow up. One-way within group Repeated Measures ANOVA (RMANOVA) was used to explore possible significant differences on specific variables under investigation (i.e., social skills, inhibition, cognitive flexibility, anxiety, and depression). This analytic technique allowed for the evaluation of significant changes in mean scores over the 3 time points with the same participants measured at each time point. Before using RMANOVA, data was checked to ensure that assumptions of this analytic procedure were met. Specifically, an evaluation of normality of measured dependent variables and sphericity of variance between time point measurements was conducted. The use of Bonferonni corrections accounted for familywise error during the additional analysis of variables through confidence interval adjustment.

Should the data collected for research questions 1 – 3 have been significantly skewed and/or sphericity was violated and were not appropriate for RMANOVA, a non-parametric analysis was considered. The Friedman Test was available for use should the assumptions of RMANOVA, such as normality of data, had been violated (Friedman, 1937). This alternative approach is supported by the SPSS software. It was not the case that The Friedman Test was required.

Regarding research question 4, which explores the effects of family attachment and communication to improvements in social skills, a form of Receiver Operating Characteristic (ROC) analysis was utilized. Traditionally used in medical research, ROC has been used to test for the validity of a diagnostic test by answering questions such as, “does this diagnostic test accurately determine whether a patient is diseased or not diseased, and what is the operating point – or threshold of the instrument used?” (Metz, 1978; Zweig & Campbell, 1993). Furthermore, this test can be used with multiple time points to find optimal cut off points to determine these differences. In the current study, an application of the ROC method was used to see how pre-existing characteristics (i.e., attachment, communication) best predict whether adolescent PEERS participants are more or less likely to show significant increases in their social skills over time periods that are not uniform. The analysis is considered non-parametric, allowing for flexibility in sample size and applicable to data that may not appear normal in distribution (McNeil & Hanley, 1984). In particular, the Area Under the Curve (AUC) method of ROC was used. As seen in Figure 4 below, calculations of the AUC were made in trapezoidal segments.

Figure 4. Trapezoidal Method for Area Under the Curve Calculations.



The AUC was calculated using the Trapezoidal Method to obtain the relative area represented for specific portions of participant change over time (Cruz-Uribe & Neugebauer, 2002). For each participant, scores of attachment and communication were correlated to the individually calculated social skills AUC value between pre-intervention to post-intervention, and post-intervention to follow-up. This approach is similar to a change score but considers the unique differences in time that passed between measurements (e.g., 14 weeks vs. 26 weeks). Further, use of the AUC allowed for a determination of whether family characteristics contribute significantly to changes in social skills made by adolescents in PEERS at post-test and long-term follow up.

## **Ethical Considerations**

Approval from The University of Calgary Conjoint Faculties Research Ethics Board (CFREB) was obtained prior to initiation of the study. Involvement in the PEERS research program included gathering informed consent from a parent or legal guardian of the adolescent, as well as verbal assent from each adolescent. Importantly, families who contacted the research team and were accepted into PEERS were not required to participate in research. It was therefore possible for families to complete PEERS but not the research protocol. All families were also given the choice to withdraw at any time from research participation without impacting their ability to complete the intervention. They could also withdraw from PEERS should it have been their wish.

The degree of risk associated with participation was minimal. Specifically, there was no physical fatigue, stress, injury, or side effects associated with participation. Furthermore, there was unlikely to be psychological or mental fatigue, social risk, economic risk, or legal risk from participation. There was the slight risk of psychological or emotional stress, embarrassment, anxiety, or distress as completion of PEERS activities may serve to highlight participant's social difficulties. However, effort to reduce this risk was attempted via the initial intake interview and confirmation of adolescent interest and motivation to participate in the program. Participants may also have struggled with various questionnaires or direct testing research measures. Trained graduate student researchers/clinicians used rapport building techniques and psychological assessment experience to ensure participants were comfortable and experienced the least amount of stress and anxiety possible. If mental health concerns were made known to the research team, a registered psychologist was contacted for consultation and referral if needed. Participants were

reminded of their voluntary involvement in the study should they experience discomfort, and ongoing consent and assent was ensured.

Regarding anonymity, participants learned each other's names and worked closely with each other as per the intervention manual. It was therefore out of the researcher's control as to what data and information was shared between participants. At the first session, parents and adolescents were informed of the importance of confidentiality outside of sessions. The research and intervention teams did not share research data or participation status with other families. The use of a confidentiality agreement between the primary researcher and others involved in data collection and providing the intervention ensured that everyone was aware of the need to keep participant data and information confidential. All research communication was kept confidential and carried out via secure email or phone to individual families (e.g., organizing testing sessions, making meeting times for questionnaire completion, etc.). The data provided by participants was also kept confidential. Each participant was assigned a unique identification number, and all personal information and hard data was kept in locked filing cabinets in a locked room on university facilities. Data was analyzed as an aggregate and no individual information was analyzed or will be published. Digital information (e.g., scores, statistical program files, etc.) was kept on a research computer in a locked lab, with both operating system password protection and full hard drive encryption. All hard copy data will be securely stored for a minimum of five years from the date of final collection before being destroyed.

The current research project resulted in a number of likely benefits for immediate participants, future participants, and other individuals with ASD without intellectual impairment and their families. First, participation in the study involved the completion of an empirically supported SSTP. As such, participants were able to directly and immediately benefit from the

program. Second, the study results will add to the literature on the positive and varying outcomes of PEERS for the adolescent ASD population. By looking at previously studied domains of functioning in a new environment, as well as new domains of functioning, it may be possible to impact the mental health and developmental outcomes of adolescents with ASD positively by gaining a deeper understanding of PEERS. Third, final data analysis and notes taken through the delivery of PEERS may contribute to potential areas of programmatic improvement for future clinicians and community organizations planning to run PEERS in Canada and other locations. Finally, PEERS and associated research in this project involved much needed collaboration, both with parents and community organizations. The family unit as whole was likely to experience increased self-efficacy through new tools and methods, as well as the requirement of working together throughout the intervention. Moreover, the aim of PEERS is to give adolescents with ASD the tools and skills to integrate with society and maintain lasting relationships better, thus providing tangible benefits to society at large.

## Chapter 4: Results

This chapter reports the statistical analyses of collected data to address the research questions. Due to an unintended and unanticipated lack of completed/returned data, sufficient delayed control data (i.e., 14 weeks prior to program start) was not available as part of analysis. To increase the power of the study, three time points were therefore focused on for analyses and are from here forth labelled for ease of reading: pre-intervention (T1: at the start of the intervention), post-intervention (T2: 0-2 weeks upon completing the intervention), and follow-up data (T3: 24-26 weeks post intervention). Data for each group participating in PEERS was combined such that each group's data from one time point was analyzed as a single group (e.g.,  $X_1 + X_2 + X_3 \dots + X_N$ ).

Initially, a total of 55 participants consented to provide data for the study, receiving and completing at least two time points' worth of information, largely from T1 and T2. Seven participants were removed from analysis due to incomplete data at either T1 or T2. Furthermore, six participants did not receive ADOS-2 scores indicative of ASD as per inclusion criteria (i.e., Total Score < 6) and so were removed. The remaining 42 participants included 33 males, approximating the population prevalence. Demographic information for the sample appears in Table 2.

Table 2.

### *Participant Demographics*

	<i>N</i>	<i>M</i>	<i>SD</i>	<i>Minimum</i>	<i>Maximum</i>
Participant's Age at Program Start	42	16.03	1.54	13.6	18.8
ADOS-2 Total Score	42	12.78	3.23	7	21
WASI-II VCI Score	42	96.83	16.97	70	136
WASI-II PRI Score	42	102.38	23.185	51	147

Box plots were created for each variable to identify significant outliers. Instead of removing any outliers, these data were transformed using Winsorizing to retain participants to minimize the effects of possible spurious information. Normality checks with histograms revealed apparently normal data, further supported by skewness and kurtosis values within acceptable ranges (i.e., -2 to 2). Little's Missing Completely at Random Test indicated that data was most likely missing at random versus in a particular pattern of importance ( $\chi^2 = 202.064$ ,  $df = 212$ ,  $p = .676$ ), allowing for missing data to be imputed. Though Multiple Imputation (MI) can be used in smaller sample sizes such as in the current study, data analysis software (SPSS 24.0) did not allow for MI to effectively be used with RMANOVA, which were required to answer research questions. Instead, Cheema (2014) suggests that the Estimation-Maximization imputation method remains more effective than listwise deletion of data and mean imputation. With this in mind, variables for which less than 10% of data were missing had missing data imputed using the Expectation-Maximization imputation method. This was only applicable to pre-test and post-test data, as follow-up data was missing more than 10% and in a potentially non-random fashion (e.g., certain participants may have been unable to return packages compared to those that did). Thus, though  $N = 42$  participants were included in analyses, participants were excluded listwise where data were missing in amounts greater than 10% for a given variable. This process led to unequal sample sizes between analyses. The following sections outline the parametric and nonparametric (i.e., AUC) analyses used to answer the study's research questions.



### Research Question 1: Does completion of PEERS result in improved social skills?

A total of 32 participants provided data for T1, T2, and T3 measures of social skills on the parent form of the SSIS. Descriptive statistics for the SSIS standard score can be seen in Table 3.

Table 3.

*Parent-Rated Social Skills Standard Score Descriptive Statistics*

Variable		<i>M</i>	<i>SD</i>
SSIS Standard Score	T1	76.31	11.7
	T2	79.94	13.67
	T3	78.41	12.4

Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated,  $\chi^2(2) = 4.411, p = .110$ . Using a one-way RMANOVA with sphericity assumed, data analysis revealed a non-significant model,  $F(2, 105.969) = 2.450, p = .095$ . Exploratory paired samples t-tests (alpha controlled via Bonferroni correction:  $p = .05 / 2$ ) indicated significant patterns that will be further discussed in the next chapter of this paper. Specifically, participants showed significant improvement in overall social skills as rated by parents on SSIS standard scores between T1 and T2 (Mean difference = 3.625,  $t(31) = -2.646, p = .013$ ). Gains observed were maintained somewhat, as no significant differences were observed between T2 and T3 scores. However, T3 improvements were not significantly different from T1 measures (Mean difference = 2.094,  $t(31) = -1.103, p = .279$ ). Though participants did improve initially in overall social skills through participation in PEERS and these gains were somewhat maintained over time, the overall improvement was not significant from pre-test ratings and the model was not supported; Mean difference = -.875,  $t(31) = -.56, p = .579$ .

### Research Question 2: Will secondary improvements be observed in participants' EF in the domains of inhibition and cognitive flexibility?

In regard to inhibition and flexibility as measured by the CEFI, a total of  $N = 35$  participants completed T1, T2, and T3 measures for analysis. Descriptive statistics for measures of inhibition and flexibility can be seen in Table 4.

Table 4.

*Parent-Reported Inhibition and Flexibility Standard Score Descriptive Statistics*

Variable		<i>M</i>	<i>SD</i>
CEFI Inhibition	T1	91.03	11.625
	T2	92.00	12.553
	T3	95.89	13.143
CEFI Flexibility	T1	81.91	9.166
	T2	84.77	7.829
	T3	85.14	8.62

For inhibition, Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated,  $\chi^2(2) = 3.358, p = .187$ . The overall model for inhibition, using a sphericity assumed RMANOVA, showed a significant effect over three time points,  $F(2, 231.2) = 4.817, p = .011$  with a medium to large effect size ( $\eta^2_p = .124$ ). Post-hoc paired samples t-tests revealed that participants did not show significant improvement on parent-rated inhibition between T1 – T2 [Mean difference =  $-.875, t(31) = -.56, p = .579$ ] or T2 – T3 [Mean difference =  $-3.56, t(31) = -2.015, p = 0.53$ ]. However, participants showed improvement between T1 – T3 [Mean difference =  $-4.438, t(31) = -2.196, p = .036$ ]. Given the multiple post hoc analyses, the  $p$  value of .036 may be considered too high to be considered significant. Further discussion will focus on the clinical implications of this finding.

Results for flexibility were different. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated,  $\chi^2(2) = 8.434, p = .015$ . The overall model was not significant when using the Greenhouse-Geisser correction for sphericity,  $F(1.632, 133.864) = 2.983, p = .069$ . Exploratory paired samples t-tests (alpha controlled via Bonferroni correction:

$p = .05 / 2$ ) revealed a significant pattern that will be discussed further in the next chapter. Specifically, participants significantly improved in overall flexibility between T1 and T2 (Mean difference = 3.071,  $t(41) = -2.326$ ,  $p = .025$ ). Gains observed were maintained somewhat, as no significant differences were observed between T2 and T3 scores. However, T3 was not significantly different from T1 (Mean difference = 3.229,  $t(34) = -1.943$ ,  $p = .060$ ). Though participants did improve initially in overall flexibility through participation in PEERS and these gains were somewhat maintained over time, the overall improvement was not significant from pre-test ratings and the model was not supported.

**Research Question 3: Will completion of PEERS result in a reduction of internalizing mental health issues?**

Internalizing mental health was measured by participant self-ratings on the BYI-II, with a total of  $N = 34$  participants supplying data. Descriptive statistics for measures of anxiety and depression can be seen in Table 5. In regard to anxiety, Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated,  $\chi^2(2) = 1.225$ ,  $p = .542$ . The overall model assuming sphericity was not significant,  $F(2, 66) = 1.663$ ,  $p = .197$ .

Table 5.

*Anxiety and Depression T-Score Descriptive Statistics*

Variable		<i>M</i>	<i>SD</i>
BYI-II Anxiety	T1	53.12	10.024
	T2	54.00	12.078
	T3	51.56	11.851
BYI-II Depression	T1	53.88	10.736
	T2	53.59	11.111
	T3	53.68	12.409

In regard to depression, Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated,  $\chi^2(2) = 1.913$ ,  $p = .384$ . Participants did not show significant

changes in depression symptoms on the BYI-II in the overall model with sphericity assumed,  $F(2, 66) = .044, p = .957$ .

**Research Question 4: Will the parent-child relationship factors of attachment and communication be related to individual improvements in social skills seen through PEERS?**

For each participant who provided T1, T2, and T3 data, the Area Under the Curve (AUC) was calculated for data from the parent form of the SSIS. AUC therefore represented the total amount of SSIS Standard Score over the three time points for each individual, taking varying time passed into account. Please see Appendix B for a representation of how the AUC was calculated graphically and mathematically. The  $x$  axis values consisted of the total SSIS Standard Score, while the  $y$  axis represented total time in weeks. Time ranged from “0” (T1 ratings when participants started PEERS), to “14” (where participants completed PEERS and provided T2 ratings), and ending at “40” (where participants, on average, completed T3 questionnaires). The PRQ asks parents to mark the response that best describes their recent experiences over the last several months (Kamphaus & Reynolds, 2006). Unlike other measures asking for ratings over the past few weeks, these summary ratings are likely to be more stable over time. It was decided, a priori, that parent T2 ratings of attachment and communication would be used for data analysis. Though no convention exists for determining which score to choose in this scenario, a measure taken at the end of intervention where the families have had time to establish a relationship in the context of the intervention seems most appropriate. In particular, as parents are the primary force behind encouraging their child and practicing with them, measuring aspects of the relationship after they have practiced these skills and set off to use them independently seems suitable. However, to ensure consistency, exploratory analysis revealed that, nonetheless, there were no

significant differences across time points for parent ratings on the PRQ Attachment scale,  $F(2, 24) = .092, p = .912$ , or Communication scale,  $F(2, 24) = .007, p = .993$ ). Descriptive statistics for measures of attachment and communication can be found in Table 6.

Table 6.

*Descriptive Statistics for Attachment, Communication, and Social Skills AUC*

Variable	<i>M</i>	<i>SD</i>	<i>N</i>
PRQ Attachment T-Score	50.74	7.053	23*
PRQ Communication T-Score	42.00	8.491	23*
AUC for SSIS Standard Score	3144.87	100.20	23*

\* 34 cases were available. For analysis, cases were excluded pairwise, resulting in 23 matched.

One-way Pearson correlations were conducted to determine whether a positive association existed between T2 attachment and communication t-scores scores with the AUC for social skills standard scores. Cases were excluded pair-wise as necessary based on missing data. In regard to attachment and social skills AUC, the two variables were significantly moderately correlated,  $r(21) = .49, p = .008$ . Similarly, a significant and moderately strong relation was observed between communication and social skills AUC,  $r(21) = .53, p = .004$ .

## Summary of Results

After appropriate data cleaning procedures, the sample consisted of  $N = 42$  participants (33 males) with a mean age of 16.03 years. Outliers were Winsorized and variables for which less than 10% of data was missing had values imputed through the Estimation-Maximization method. For participant social skills, the overall model was not significant, and the hypothesis was not supported. Exploratory analysis showed that participants did make significant gains from T1 to T2 that were maintained over time, but simply did not improve more over time. Though this was not a study hypothesis, its clinical significance will be put forth as worthy of consideration in the discussion chapter below. Parent ratings of participant inhibitory ability

revealed a significant overall model, reflecting improvements from T1 to T3 of medium to large effect size. Participants did not show significant changes in flexibility in the overall model, though exploratory analysis revealed a pattern of improvement from T1-T2 worthy of further discussion. No changes were seen in participant anxiety or depression. Relations were seen between the overall social skills changes of individual participants and various parent-child relationship factors. Specifically, significant and positive relations were seen between both attachment and social skills (moderate), as well as communication and social skills (moderate to strong).

## **Chapter 5: Discussion**

### **Research Question 1: Did completion of PEERS result in improved social skills?**

The hypothesis that participants in PEERS would show significant improvements on measures of social skills that would be maintained at follow-up was not supported. Though significant gains were made during the 14-week intervention period, these were not sustained after 6 months had passed post-intervention. This may initially seem to suggest deficiencies in the program; however, a closer analysis is required regarding both these results and the overall aim of PEERS. PEERS was designed to meet specific curricular objectives that allow participants to gain skills to use in a day to day context. The program authors do not make claims suggesting that participants will necessarily be successful in generalizing learned skills or that they will learn additional skills once the 14-week program has concluded. Many of the studies evaluating PEERS utilize the Test of Adolescent Social Skills Knowledge (TASSK: Laugeson & Frankel, 2006), which is a 22-item questionnaire specifically designed to determine whether curricular objectives were met and that a participant retained knowledge of PEERS concepts. Not surprisingly, a wealth of evidence supports that adolescents who participate in the program show significant improvements from pre- to post-intervention scores on the TASSK (Laugeson, Frankel, Mogil, & Dilon, 2009; Laugeson et al., 2012; Schohl et al., 2014; Van Hecke et al., 2013; Yoo et al., 2014). Analogous to the current study, there have been others that evaluated whether more general improvements were made in social skills beyond simply knowledge of curricular addressed concepts.

To determine whether additional and generalized gains in overall social skills were made, many studies of PEERS utilized the Social Skills Rating System (SSRS: Gresham & Elliot, 1990). In the original pilot study, Laugeson and colleagues (2009) found significant

improvements on the SSRS total standard score for those who completed PEERS when compared to a waitlist-control sample with 33 adolescents. Conversely, Schohl and colleagues (2014) did not replicate these findings in their sample of 58 adolescents utilizing the same measure. Two studies further employed the SSRS to determine whether any gains could be maintained at follow up. Laugeson et al. (2012) administered the SSRS at pre-, post-, and 14-week follow up and noted significant improvements across these time points. Likewise, Mandelberg and colleagues (2013) found significant differences between pre- and post-intervention were maintained at follow up when the SSRS was completed between 1-5 years after PEERS participation.

Though a cursory examination appears to reveal that the majority of studies support improvements in general social skills as a result of PEERS at post-intervention (Laugeson et al., 2009) or at post-intervention and long term follow up (Laugeson et al., 2012; Mandelberg et al., 2013), important differences should be noted. At this time, the current study is the only one that has evaluated PEERS by utilizing the SSIS. Despite being created by the same developers, this measure was a significant update on the 18-year old SSRS. Based on current research, the developers of the measure started with a 400-item pool, 90% of which were completely new from the SSRS. Fewer items were required on the final measure due to the updated items and factor structure (46 items vs. 52 items on the SSRS). On the SSRS, parents only rated the frequency of behaviour as “never”, “sometimes”, or “very often”. The SSIS expanded this frequency to “never”, “sometimes”, “often”, and “almost always”. Further, the measure includes a parent’s perceived value of the skill as they indicate whether they believe it to be “not important”, “important”, or “critical”. These alternate response formats increase the sensitivity (via frequency) and alter the scoring of the measure. Social skills and expectations vary widely



by culture and family, and the inclusion of this parent expectation on the SSIS is a major and important expansion over the SSRS. Therefore, there may be some implications for previous research on PEERS in selecting the SSRS. As our understanding, definition, and expectations of “social skills” changes, the SSIS has been developed to be a better assessment of the construct. The non-significant changes in overall social skill acquisition by follow-up measure in the current study may partially reflect a more appropriate and valid measure reflecting an updated conceptualization of generalized social skills.

Gresham and Elliot (2008) reported in a special population study that children with ASD typically score 1.5 standard deviations below the mean on the Social Skills standard score of the SSIS. Ratings provided by parents of their children’s social skills in the current study fell closely in line with this expectation ( $M = 76.31$ ). Three of the other studies of PEERS with a similar outcome measure (i.e., SSRS) had baseline social skills scores close to this range (Laugeson et al., 2009; Laugeson et al., 2012; Madelberg et al., 2013). These were also the studies that reported significant improvements in social skills. However, Schohl and colleagues’ (2014) study, which found no improvement, had atypically high baseline social skills scores ( $M = 112$ ). Consequently, the present study is unique in having utilized an updated measure, demonstrating a participant baseline social skills score in a range typical of those with ASD and not showing significant improvements between pre-, post-, and follow-up measurements taken together.

In addition to the current study, two others have investigated follow-up measurements of social skills; albeit with highly differing follow up timelines. These included a 14-week follow up (Laugeson et al., 2012), the current study which chose a 6 month follow up (26 weeks), and a follow up that ranged from 1-5 years of aggregated data ( $M = 29$  months: Mandelberg et al.,

2013). These varying timelines, particularly in the case of the Mandelberg study, reveal an inconsistent concept of “long-term” follow up.

A final, and potentially critical, difference between the current study and those previously conducted on PEERS involves the way in which data was collected on questionnaires, particularly of social skills. For all post-intervention data collected, studies indicate that participants completed questionnaires in the presence of the researchers / research team on site (Laugeson et al., 2009; Laugeson et al., 2012; Mandelberg et al., 2013; Schohl et al., 2014). Follow up social skills data was also gathered by having participants return to site (Laugeson et al., 2012) or was collected over the phone (Mandelberg et al., 2013). Limitations of the current study’s approach to data collection will be discussed below; however, advantages to having participants complete questionnaires on their own accord and in their own environment may be two-fold. First, parents were given a questionnaire package on the final day of intervention and asked to complete the questionnaires and return them (by pre-paid mail or in person) within approximately 2-4 weeks of being given them. Behavioural questionnaires such as the SSIS and others in this study require raters to reflect on a past time (e.g., “in the past month”, “in the past few weeks”) when rating behaviours. The SSIS asks parents to “think about [your child’s] behavior during the past two months. Then, decide how often [your child] displays the behavior.” (Gresham and Elliot, 2008, p. 11). Should parents have rated behaviour on the last day of intervention, their memory may have been influenced by reflecting on the actual experiences and changes during the intervention as this would include the last 8 weeks of the 14-week intervention timeline. Further, they may not have had a realistic behavioural sample to reflect on during which their child was expected to use the social skills outside of direct involvement in the intervention. Having parents complete measures on the final day of

intervention, as was done in previous studies, may result in parents rating improvements and behaviours they are seeing during the intervention itself versus improvements from the intervention used in day to day functioning. Second, problems may arise from having outcome measures completed in the presence of researchers or via phone call with a researcher. Parents are not blind to the fact that the PEERS intervention focuses on social skill improvement and wanting to see improvements in their child is a demand of the intake interview. Thus, there is potential for outcome measures to show inflated improvements, particularly in the presence of a researcher as an authority figure. A number of theorists and study results have indicated that participants in research studies often attempt to be “good subjects” and may be prone to modify their performance in the presence of an authority figure. Moreover, simply being a part of an experiment and being invested in the outcome may lead to similar results (i.e., demand characteristics: Blass, 1991; Milgram, 1974; Orne, 2002). In a recent empirical investigation, Nichols and Maner (2008) explored this phenomenon and found that in their sample, participants who had some knowledge of the hypothesized outcomes with positive attitudes to the study and experimenter were more likely to act in a way that would benefit the experimenter. Though no literature suggests a direct effect when participants complete behavioural rating scales, the comparison remains relevant. Allowing participants in the current study to complete questionnaires off site led to some level of uncertainty further discussed below. However, the quality and validity of information, as well as the timeline of behavioural sampling, is likely to allow for a reflection of externally valid social skills scores.

This study did not find the same level of improvements in overall social skills as others have from participation in PEERS. Even so, the results help to shed light on the efficacy of PEERS in a Canadian sample, with program delivery facilitated by certified and trained graduate

students not run at the UCLA site where most of the research has been conducted (Laugeson et al., 2009; Laugeson et al., 2012; Mandelberg et al., 2013). Furthermore, the current study was unique in the use of an updated measure of social skills, allowing parents to complete questionnaires independently without pressure from researchers and having ratings of behaviour attempt to represent a retrospective timeline that better considers learning and application of PEERS skills (i.e., 4 weeks after intervention completion vs. immediately). Notably, with these more rigorous modifications to data collection, the clinical significance of the improvements from pre-to post-intervention should be considered. Generalized social skills did improve significantly over the course of the intervention; however, the current sample did not maintain gains at 6-month follow up. Implications and future directions will be further discussed below.

**Research Question 2: Were secondary improvements observed in participants' EF in the domains of inhibition and cognitive flexibility?**

Analysis revealed that the hypothesis that PEERS participation would improve adolescents' inhibition was supported. Importantly, medium to large effect sizes were identified, suggesting that program participation had substantial impact on the improvement of a crucial daily living behaviour of adolescents not directly addressed by the program. On the contrary, ratings of cognitive flexibility did not significantly improve across time points and therefore this hypothesis was not supported. Similar to parent ratings of adolescent social skills however, exploratory analysis revealed that cognitive flexibility did improve between pre- and post-test ratings. This is the first study to investigate whether PEERS has indirect effects on aspects of EF. Further, few studies have explored the link between social skills intervention and improvements in EF. Nevertheless, other studies have explored whether similar gains may be made through

interventions specifically tailored to EF in children and adolescents with ASD, though very few have investigated potential improvements due to participation in social interventions.

Based on their review of the literature and a study with young adults with ASD, Brady and colleagues (2017) posit that a significant lack of consistency appears in regard to the nature of IN performance. Moreover, Lai and colleagues (2017) reviewed 42 studies examining IN and 37 studies examining CF in ASD, with clinical measures. Their conclusion was that only a small to medium effect size supported a deficit in IN when co-existing ADHD was included in analysis. However, their review supported a core deficit in CF regardless of co-existing ADHD or level of intellectual functioning. Unfortunately, neither of these studies focused on real-world ratings of behaviour associated with EF but instead solely reported clinical measures. In their review of 72 studies examining CF in those with ASD, Leung and Zakzanis (2014) included information from one of the few behaviour rating scales for EF: The BRIEF (Gioia et al., 2000). Despite literature consistently pointing to a deficit in CF in this population, Leung and Zakzanis (2014) highlight that no single clinical test appears to be a valid clinical marker of the deficit. However, the “Shift” scale on the BRIEF, which measures CF, showed approximate absolute discriminability. The BRIEF factor structure was confirmed in a population of 411 children with ASD without intellectual impairment from ages of 5-18 by Granader and colleagues (2014). They similarly found a pattern of elevated ratings indicating poor flexibility in the population. Though clinical measures do not appear to result in an overall reliable estimate of flexibility in those with ASD, this evidence supports the use of behavioural ratings as an ecologically valid indication of employment of EF in daily tasks. A small number of studies have employed the use of behavioural ratings of EF as outcomes measures. These scales are typically the BRIEF, but one recent study utilized the CEFI, as was done in the current study.

Evidence supports that behaviour ratings of IN may be improved by programs specifically targeting EF. With a small sample of children ages 5-12, Acero-Ferrero, Escolano-Perez, and Bravo Alvarez (2017) delivered an EF intervention that consisted of 36 sessions over 3 months. Behaviour ratings by parents pre- and post-intervention on the Childhood Executive Function Inventory (Thorell & Nyberg, 2008) indicated significant improvements in a total IN score. In the same way, Kentworthy and colleagues (2014) conducted a randomized control trial of an EF training program called *Unstuck and On Target* (Cannon, Kentworthy, Alexander, Werner, & Anthony, 2011) with 67 children in 3<sup>rd</sup> – 5<sup>th</sup> grade. Similar to PEERS, the intervention is meant to provide contextually based lessons, in this case at home and school, through visuals, discussions, practice, as well as concrete experiments and videos. Results supported the effectiveness of the program in improving CF as rated on the BRIEF. Notably, their intervention for EF also improved ratings of social responsiveness. In an opposing comparison, the current study found a social intervention may have secondary effects in improving some aspects of EF (i.e., inhibition over long term, cognitive flexibility initially). The potential causes of this will be described further in this section. Finally, de Vries and colleagues (2015) attempted to use computer-based EF training to improve the skills of children 8-12 with ASD without intellectual impairment. Despite study hypotheses, their intervention did not improve scores of inhibition or cognitive flexibility on either clinical measures or behaviour ratings on the BRIEF. It is important to note that these studies were conducted with children younger than those targeted through PEERS, and no evidence currently exists to support programs directly training EFs in adolescents or adults with ASD. Though group and contextually based interventions appear to have implications for improving EF, computer based direct training of specific skills does not show transfer. Despite a dearth of literature exploring

the effects of social skills training on real-world EF as was done in the current study, some promising and comparable evidence has been gathered.

The Social Competence Intervention (SCI: Stichter et al., 2010) utilizes a cognitive-behavioural framework to improve ToM, emotion recognition and understanding, and EF with a focus on impacting social interaction positively for those with ASD. The SCI has been evaluated for efficacy with children with ASD between 11-14 years old who do not have intellectual impairment (Stichter et al., 2010), six to 10 years olds (Stichter, O'Connor, Herzog, Lierheimer, & McGhee, 2012), and was recently manualized for adolescents aged 11 to 15 years old (Stichter, Herzog, Owens, & Mulagen, 2016). In regard to EF, the premise of the SCI program is that EF (e.g., impulse control, inflexibility, planning, and self-monitoring) is an area of deficit that impacts the utilization of contextual cues to problem solve socially and relate successfully with peers and others. For all studies on the SCI, the BRIEF was used as one outcome measure with somewhat conflicting results. In pre- and post-intervention comparisons, improvements were seen in overall behavioural regulation and metacognition for both 6- to 10-year-olds (Stichter et al., 2010) and 11- to 14-year-olds (Stichter et al., 2012); however, no analysis of specific subscales (e.g., inhibition or cognitive flexibility) was conducted. With a larger sample of children aged 11-15 ( $N = 34$ ), pre- to post-intervention comparisons also supported overall improvements in parent-rated behavioural regulation. However, further analysis revealed that while significant improvements were seen in emotional regulation and cognitive flexibility, no changes were seen in regard to inhibition (Stichter et al., 2016). Granted the SCI has been studied with a largely younger population than PEERS, a contrast remains in that behavioural improvements in cognitive flexibility were noted for the SCI with no changes to inhibition, where the current study supported long term changes to inhibition and initial gains in cognitive

flexibility. Furthermore, the SCI program has changed somewhat over each iteration while PEERS has been manualized for some time and was delivered with fidelity and consistency during this study. The research on the SCI also included only pre- to post-intervention differences and did not include a long term follow up as was utilized in the current study.

There may be multiple possible explanations as to why social interventions such as PEERS appear to have some promise in improving EF and why the current study did not find sustained improvements in cognitive flexibility yet a novel improvement in inhibition. First, the majority of social interventions including PEERS aim to include aspects of perspective taking, and thus ToM, whether directly or indirectly. PEERS focuses on the use of perspective taking questions for processing the emotions of self and the other due to a behaviour (e.g., “what do you think they feel when you do that?”). Given the bi-directional relation established between EF and ToM in general (Pellicano, 2007), it may be that improvements in one domain affect the other. Though ToM was not evaluated in the current study, it may be that adolescent participants improved in their ability to inhibit their own ideas, thoughts, and emotions to take the perspective of others. The overall improvement of inhibition may have then been seen in behavioural measures as a secondary outcome.

Second, this improvement in behavioural inhibition may require time beyond a typical post-intervention measurement, explaining why the overall gains in inhibition were observed after long-term follow up. Parental involvement is crucial in PEERS and it is assumed that parents and adolescents continue to work on skills and pursue more opportunities for socializing after the program terminates. Assuming families are able to continue with the skills, ongoing development is likely supported through more and more peer interaction; this takes time, and the 6-month follow up may have encapsulated a greater chance to generalize skills supporting



inhibition and have adolescents use them within the context of meaningful and longer lasting friendships and daily living activities. Interestingly, though inhibition improvements were seen to increase over the follow-up period, this was not seen on the SSIS social skills scores.

Third, it may have been the case that items from the CEFI were collecting behavioural information that has some crossover with social skills targeted in the program, or other measurement concerns are present. An examination of the items on the Inhibition subscale from the CEFI appear to support the idea that the overall improvements in inhibition measured by the scale represent unique improvements and not just simply measuring general social improvements). Moreover, the fact that long-term improvements in generalized social skills were not seen in this study support improvement in inhibition over time as a partial result of participation in PEERS and not only an improvement in social skills. Similarly, cognitive flexibility as measured by the Flexibility scale on the CEFI also appears to be a separate construct than social skills. Items on both scales do not ask questions about behaviours directly addressed by the curriculum of the program. In their initial validity investigation of the CEFI, Naglieri and Goldstein (2013, p. 79, 163) found their sample of children with ASD had a mean score of ~81 on the Flexibility scale and ~82 on the Inhibitory Control scale. PEERS participants in the current study started with a mean Flexibility score close to the validation sample; however, their mean Inhibitory Control score of 91 was much higher. Given this difference and the tendency of some samples to regress to the mean, the small positive changes in inhibition and cognitive flexibility may be considered even more clinically noteworthy.

Fourth, some evidence seems to point to the possibility that participation in any intervention with a social and problem-solving component may have impacts for improving EF. Though they utilized largely clinical measures of EF, Pan and colleagues (2017) found that a

motor skills curriculum within the sport of table tennis improved both inhibition and cognitive flexibility as a secondary outcome for children 3-14 years old with ASD. They suggested that some of the physical and cognitive aspects of the intervention, including increased social interaction, had implications for EF. In PEERS, adolescents spend 14 weeks working as a group to problem solve, listen and follow rules, practice skills with feedback, and plan and organize their behaviour to fit with the suggested PEERS strategies. Adolescents also learn many “do’s” and “don’ts” of behaviour (e.g., do not police, do not be an interviewer, etc.), all of which involve inhibitory ability to “stop and think”. Unintentionally built in to the program itself is a requirement to use EF and therefore potentially improve it. Adolescents may not have worked to inhibit behaviour in a large number of areas of social behaviour in the past. Improvements in inhibition may somewhat reflect the constant message of PEERS to stop or alter behaviour to accomplish new goals (i.e., making and keeping friends), and the reinforcement from social coaches when they took another’s perspective, waited their turn, and/or applied a rule.

Fifth, the lack of long term improvement in cognitive flexibility for adolescents who participated in this study may reflect the nature of cognitive flexibility as a core deficit in ASD (Granader et al., 2014; Lai et al., 2017; Leung & Zakzanis, 2014). Many studies have attempted to show lasting improvements in cognitive flexibility due to intervention in this population with variable results (Kentworthy et al., 2014; de Vries et al., 2015). Though PEERS includes lessons that may require changes in cognitive flexibility (e.g., taking perspectives, taking conversational turns, etc.), this does not appear to be enough to improve cognitive flexibility as a secondary outcome that is detectable on measures of the construct at long term follow up. Interestingly, though not statistically significant, minor improvements were observed between T1-T2 ratings of cognitive flexibility that may be an area of future investigation.

To summarize, behavioural ratings indicated short- and long-term improvements in inhibition. Though exploratory analysis showed initial improvements in participant cognitive flexibility, the overall effect was not significant. This was a novel investigation as EF has not been explored as an outcome of PEERS participation nor has the CEFI been used to quantify this. Moreover, there has not yet been a study examining how to improve EF skills in this population in later adolescence and early adulthood using either social interventions or specific EF interventions. Results suggest that working to teach social skills may improve IN and this relation may be bi-directional as other studies support that improving EF improves ToM and social skills. PEERS includes components that, with additional time and parent involvement, appear to improve behavioural inhibition that generalizes beyond the “stop and think” rules for social behaviour taught. Maturation effects may be considered; however, the data from the CEFI continued to be scored in relation to age-expected skills. It is unlikely that the increases seen over the 6-month period across a range of adolescent ages were due only to maturation. Though improvements in cognitive flexibility approached significance, the lack of clear maintained improvements supports the ongoing nature of this EF as a core deficit for those with ASD.

**Research Question 3: Did completion of PEERS result in a reduction of internalizing mental health issues?**

Contrary to hypotheses, participation in PEERS did not lead to significant improvements in adolescent anxiety or depression. Encouragingly, the sample in this study reported average levels of anxiety and depression on the BYI-II which were consistent across all time points assessed. Given the high prevalence of anxiety and depression in children and adolescents with ASD and without intellectual impairment, these results may be considered reassuring (Matson & Nebel-Schwalm, 2007; Simonoff et al., 2008; van Steensel, Bogels, & Perrin, 2011).

Additionally, the findings regarding parent-child relationships in the current sample may have implications for these mental health outcomes, which will be addressed in the discussion of research question four.

To this point, two studies have been conducted that have included some aspects of mental health in examination of PEERS outcomes. In a cross-cultural validation of PEERS, Yoo and colleagues (2014) modified the PEERS curriculum to be culturally sensitive to Korean culture and collected pre- and post-intervention data on 47 participants with ASD between the ages of 12-18. Their secondary outcome measures included the Korean version of the Child Depression Inventory (K-CDI; Cho & Lee, 1990), despite the measure being normed for 8-13 year old's. They also used the State and Trait Anxiety Inventory for Children (K-STAI-C-T and K-STAI-C-S Korean; Cho & Choi, 1989) and the Korean Child Behavior Checklist (K-CBCL; Oh, Lee, Hong, & Ha, 1997). Results of the study showed no improvements on the K-STAI-C-T or K-STAI-C-S; however, improvements were seen on the K-CDI and the K-CBCL suggesting significant changes in scores of depression and anxiety. Schohl and colleagues (2014) ran PEERS with 58 adolescents between the ages of 11-16 and used the Social Interaction Anxiety Scale (Mattick & Clark, 1998). Their results supported a significant decrease in social anxiety for the treatment group; however, a potentially significant difference between the ratings of social anxiety were present between the treatment ( $M = 32.28$ ) and the waitlist control group ( $M = 26.83$ ). The treatment group's improvement in social anxiety approximated the starting level of the waitlist control group. In general, it appears that results support some potential improvements in mental health within a modified Korean PEERS (Yoo et al., 2014) and improvements in social anxiety using the originally designed program (Schohl et al., 2014). Improvements in social anxiety make some intuitive sense, as adolescents spend significant time in PEERS being exposed to

social interactions and being provided support to utilize new skills they did not previously have. Further investigation into long term maintenance of social anxiety improvements would be useful as adolescents leave the direct practice sessions included in PEERS. The current study was the first to examine generalized improvements in anxiety and depression as measured by an appropriately chosen measure from participation in the original PEERS appropriate to a Canadian population. Though improvements in self-confidence and social anxiety may result from the increased and supported exposure to social interaction with peers, these may not generalize to changes in anxiety or depression.

Given that the current sample had average scores in the domains assessed, it may be the case that another sample would benefit from PEERS through mental health improvements more so than the population in this study. With baseline scores in the average range, the potential for improvement was limited due to the floor of the measure. The reduction seen in social anxiety in Schohl and colleagues (2014) study may support this notion. Their treatment sample had significantly higher scores on a measure of social anxiety, allowing for more room for improvement as a secondary outcome of intervention. In comparison, their waitlist sample had lower levels of social anxiety and less improvement was seen when they were given treatment. Though not extreme score differences, the regression to the mean may impact some ratings especially when only pre- and post-intervention measurements are considered. In the current study, measurements over three time points and spaced over approximately 40 weeks showed stable anxiety and depression that was not affected by PEERS. It may be the case that PEERS would go a long way in supporting improvements for a sample with more severe and identifiable problems with anxiety and depression, especially if that mental health was clearly tied to social difficulties, which was not taken into consideration in the current sample.

Though PEERS inclusion requires the desire to improve in social skills, the desire to “make and keep friends”, and parent reported social skills deficits, the relation between entrance level skills and mental health was not explored. The majority of evidence supports that lower social skills and friendship quality in those with ASD and without intellectual impairment correlate to higher levels of anxiety and depression (Eussen et al., 2013; Lee, 2010; Mazzone et al., 2013; Vickerstaff et al., 2007; Whitehouse et al., 2009). This finding was supported in a recent study using ratings of social skills from the SSIS in a study of younger children and adolescents six to 13 with ASD. Ratcliffe and colleagues (2015) found poorer SSIS Social Skills scores correlated to increased mental health problems. Their sample also had a similar baseline level of social skills scores as rated by parents when compared to the current study. Though no overall sample improvements were seen, there may be a relation present that suggests those with lower social skills have lower mental health at the start of PEERS and may experience positive improvement. Given this relation, further research and analysis may determine which PEERS participants are more likely to improve in mental health.

Difficulties in understanding mental health in children and adolescents with ASD, including anxiety and depression, have led to some debate in regard to their measurement. Lecavalier and colleagues (2014) highlight that anxiety may be a co-occurring condition with ASD, an aspect of ASD, or separate but not independent of ASD. In TD populations, there is a clear understanding of symptoms of anxiety and depression that have allowed for a method of measurement that delineates dysfunction from normal function. For those with ASD, there may also be symptom overlap (e.g., unusual fears and worries, psychosomatic symptoms, social challenges and avoidance, etc.) that make valid measurement difficult (Kim et al., 2000; Mayes et al., 2011). Moreover, parent-child agreement on measures of internalizing symptoms tends to

be poor in TD populations (Achenback, McConaughy, & Howell, 1987; Perlstein, 2004).

Evidence suggests that even when parent or clinician report shows significant treatment effect on anxiety, self-report does not show the same improvement in those with ASD (Storch et al., 2013; Wood et al., 2009). Typically, studies in ASD often focus on parent report (Grondhuis & Aman, 2012; Lecavalier et al., 2014). In a recent evaluation of the well-established Revised Children's Anxiety and Depression Scale (Chorpita et al., 2000) and the Multidimensional Anxiety Scale for Children, Second Edition (March 2012), Kaat and Lecavalier (2015) supported poor inter-rater reliability between parents and their children and adolescents with ASD and without intellectual impairment. They further found that those with less severe ASD symptoms and greater social cognition were more likely to have scores on ratings of mental health that agreed with their parents.

Some studies suggest that children and adolescents with ASD may have difficulty accurately reporting anxiety and other internal emotional states due to limited insight or accurate emotional language (Baron-Cohen, 2002; Losh & Capps, 2006). A difficulty describing and identifying an individual's own emotions and thoughts, termed alexithymia, co-occurs in approximately 50% of those with ASD (Griffin, Lombardo, & Auyeung, 2015; Hill, Berthoz, & Frith, 2004). Problems describing internal states and body signals, also termed interception, is thought to underlie alexithymia (Herbert, Herbert, & Pollatos, 2011). Interestingly, recent evidence points to the potential that alexithymia, not ASD, is related to difficulties that individuals have with describing internal states (Shah et al., 2016). Given that anxiety and depression are largely identified by descriptions of internal states, alexithymia may have contributed to ratings that were not reflective of actual emotional and physiological states of the

sample. Parent ratings, as an “outsider” perspective, may have added to a greater understanding of the adolescents’ mental health.

On the other hand, others have reported that parents and children may not disagree on certain aspects of mental health identification such as social or general anxiety (Ooi et al., 2016). Some suggest that child and adolescent raters with ASD may even be better at reporting internal states than their parents when matched with biological markers of anxiety (i.e., cortisol; Bitsika et al., 2015). With these challenges in both the understanding and measurement of mental health in children and adolescents with ASD, it is difficult to determine whether differences in mental health may have been found with either a different measure than the one used or with the inclusion of parent ratings. Assuming adolescent raters had good insight into internal states and thought processes, the results of this study are somewhat encouraging in that they support a sample with clear social challenges who are not reporting significant generalized anxiety or depression concerns.

To sum up, participants in the current study did not report issues with anxiety or depression beginning the program and no significant changes were noted through PEERS participation. The measures chosen were age-appropriate; however, difficulties in measuring mental health in this population may impact the results. The inclusion of parent-ratings or other measures of these constructs may have led to different results. PEERS uses cognitive and behavioural techniques to teach social skills and may be well suited to also addressing some challenges participants face with mental health when entering the program. Future research may determine whether participants who enter the program with higher levels of anxiety and/or depression improve in these domains, and if programmatic changes may be made to address these co-occurring conditions.



#### **Research Question 4: Were the parent-child relationship factors of attachment and communication related to individual improvements in social skills seen through PEERS?**

Exploratory statistical analysis revealed that parents rated their levels of attachment and communication with their adolescent children as similar across all time points. The post-test score was chosen for analysis as it was determined to be a likely stable score that would represent an average level of the characteristics that would carry forward through to long term follow up and may enhance intervention effectiveness through the parent support component. Though not an initial research question, encouraging results for these constructs were present in the current sample. Parents' mean ratings of attachment and communication both fell in the "Average" range on the PRQ. To this author's knowledge, no studies have provided data on typical scores on the PRQ in a population of parents rating relationships with their children with ASD. Kamphaus & Reynolds (2006) provide data from a clinical sample of children and adolescents with Mental Retardation and Developmental Disorders, which may have included some individuals with ASD. Mean *T* scores on the Attachment and Communication subscales were similar to the current study, falling at 48 and 41 respectively.

These average ratings of attachment and communication may shed light on the adolescents' self-rating of average levels of anxiety and depression. In TD populations, strong parent-child attachment is associated with protection from internalizing and externalizing problems later in life (Fearon et al., 2010; Groh et al., 2012; Groh et al., 2014; Madigan et al., 2013). Though Bauminger, Solomon, and Rogers (2010a) did not find parent-child attachment to be related to emotional problems in children with ASD, there remains very limited research in this area to draw conclusions from (Teague et al., 2017). In the current sample, the lack of intellectual impairment may have protected against attachment and parent-child relationship

problems (Naber et al., 2006; Rutgers et al., 2007), that in turn supported stronger socio-emotional development. Interesting as the results from the current study are, much more research must be conducted regarding the parent-child relationship in ASD and associated mental health outcomes in adolescence.

Importantly, the primary hypothesis in this case was supported. There was a significant moderate positive correlation between parent-rated attachment and overall social skills improvements, and a significant moderate-strong positive correlation between parent-rated communication and social skills improvements. Despite the lack of overall statistical significance for adolescents' long-term maintenance of general social skills after post-test measurement, these results reinforce the importance of parent-child relationship factors in contributing to what social skills the adolescents did learn during PEERS.

Though analysis was only conducted in a correlational manner, the relation provides some fascinating insight into the value of parent participation in PEERS and potentially other social interventions as well. Thus far, only one other PEERS study has incorporated factors related to parents' experiences in understanding outcomes. The results of the current study are fascinating when compared with features of the study conducted by Karst and colleagues (2015). They attempted to determine whether home factors (i.e., "household chaos"), parenting stress, or parenting self-competence could be improved through the parent's participation in PEERS. Their results did not support a significant improvement in these variables. Based on trends in their data, they concluded that family involvement in PEERS may somewhat improve structure and order in the home as well as improve aspects of parenting self-competence or self-efficacy. The current study did not explore the effect of PEERS participation on family factors such as parent-child relationships. However, in contrast to the effect hypothesized by Karst and colleagues

(2015), these results highlight that aspects of the parent-child relationship may have significant implications for the primary outcome of the intervention.

The mechanism through which this relationship is facilitated is likely through manualized components of the program. Parents and children practicing together, negotiating and organizing homework assignments, communicating successes and challenges, and navigating daily application of PEERS skills would clearly be more successful with stronger relationships and communication skills between parents and their children in the program. Future research may delve into additional parent-child predictors of success in the program with the potential of including relationship building components to PEERS to improve outcomes and skill generalization.

Few studies have explored the influence of parent-child relationships on development of various child skills. Even fewer have investigated the impact of these relationships on social skill development; most studies only focus on early intervention. Similar to the parent ratings seen in the current study, a number of researchers have concluded that parents of children with ASD rate their attachment with their child largely similar to parents of TD children (Bauminger et al., 2010b; Chandler & Dissanayake, 2014; Wu et al., 2015). This finding was further supported in a recent study by Keenan and colleagues (2016) who showed that parents of children with ASD (between 7.2 to 14 years of age) rated similar attachment to their children. Interestingly, Keenan and colleagues found that there was a unique relation between feelings of attachment and caregiver wellbeing in the ASD group. Though parents of children with ASD had more anxiety when there were issues with the parent-child relationship, this was less true for the TD group where the caregiver's wellbeing was less tied to feelings of attachment. It follows that some

efforts have focused on the possibility of improving the parent-child relationship as a factor in improving parenting stress as well as child developmental outcomes.

The potential to improve parent-child relationships in families with a child with ASD is appealing, especially due to characteristic deficits in social reciprocity that impact the relationship. In a large-scale review of attachment in ASD, Vivanti and Nuske (2017) summarize that interventions that focus on improving the attachment relationship can indeed improve parent rated sensitivity to their child and overall social responsiveness; increasing the level of attachment. However, despite evidence that stronger attachments between parents and TD children are related to developmental gains, little evidence supports the same in those with ASD. Some intervention attempts have been made to improve the attachment of younger children with ASD to their parents. Though parent behaviour appears to improve, inconclusive results have been found regarding improvements to the actual child attachment to parents (Poslawsky et al., 2015; Siller, Swanson, Gerber, Hutman, & Sigman, 2014). Vivanti and Nuske (2017) further describe that child social behaviour does not appear to be influenced by a stronger attachment relationship. In contrast, the current study found some support for the positive effect of strong parent-child relationships in adolescent learning and application of social skills. Though conducted with a much younger sample than the current study, Haven and colleagues (2014) also found some support for the importance of the parent-child relationship in child development. Higher levels of emotional support and cohesiveness (family closeness, affection, warmth, comfort, concern: Lindahl & Malik, 2001) was related to greater social skills for children 3 to 6:11 with ASD. Interestingly, despite higher levels of cohesiveness in comparison families with a TD child, this same relation was not observed. The authors highlight that when working towards a common goal, warmth and connectedness is important. The same can be said for

improvements made in PEERS. Parents who rated themselves as having better communication and a stronger relationship with their children likely experienced more positive interactions with their children, which facilitated the coaching and supporting relationship parents play throughout PEERS and long after.

In summary, a lack of research has investigated the nature of the parent-child relationship in families with an adolescent with ASD. This is the first study to utilize the PRQ to help explore this question. In the current sample, important components of this relationship, including attachment and communication, were encouragingly rated by parents to be comparable to other families. Though further research needs to be pursued, these relationship components may have protective qualities for adolescent's mental health, as seen in average ratings of anxiety and depression. Additionally, attachment and communication were positively correlated to the social skill improvements made by adolescents, supporting the importance of the parent-child relationship for PEERS. Future research may consider how PEERS or other social interventions impact the parent-child relationship and whether this relationship has implications for additional domains of functioning (e.g., EF, mental health, etc.).

## **Implications**

The findings from this study support several practical and theoretical applications regarding PEERS and teaching social skills to adolescents with ASD who do not have intellectual impairment. Evidence contradictory to that from previous studies suggests that though participation in PEERS likely continues to meet curricular goals, generalization to long term improvements in social skills may not occur. Consequently, families should be aware that participation in PEERS is likely to address the needs targeted by the program mandate. However, in a population with core social communication deficits, generalization beyond these specifically

taught skills may not be expected and further intervention may be required. For example, the use of booster sessions or follow up with program facilitators in the months after the program has finished may be valuable. In general, parents who wish to have their child continue to use or gain additional skills after PEERS would likely need to practice PEERS skills in an ongoing manner. The addition of more offered support to parents, as outlined above, may facilitate this.

Adolescents who have spent much time struggling to initiate and sustain friendships may be unlikely to acquire independence in this area even after learning skills during the course of PEERS. Parent-facilitation remains an ongoing requirement and would include pushing their child to organize get togethers and revisiting skills from PEERS as needed.

Furthermore, no clear positive or negative outcomes were indicated for changes in anxiety or depression in the current study. This may have been a result of the sample characteristics, though future research should continue to explore how improving skills related to making and keeping friends might alter mental health in these adolescents. Notwithstanding, participants and families should be encouraged that other areas of development, including social anxiety, may be supported by the program. Adolescents who come to PEERS with significant mental health concerns should be referred for an evidence-based and supportive service to meet this need (e.g., Cognitive-Behavioural Therapy). It is unknown based on the current study whether participants with mental health problems would benefit from PEERS participation. Minimally, parents should in this case seek concurrent services for mental health should they desire to have their child participate in PEERS.

The results regarding improvements in inhibition potentially provide support for the bi-directional link between EF, ToM, and social problem solving. For adolescents with ASD and without intellectual impairment who also struggle with aspects of EF, particularly inhibition,

participation in PEERS or other social interventions may be seen as valuable learning opportunities for behavioural regulation in addition to social skills. Given the significant lack of research into EF interventions for adolescents and adults with ASD, the potential for one intervention to support two areas of functioning deficits (i.e., social skills and EF) is significant. The lack of long term improvements in cognitive flexibility in the study population provide further indication that this EF is a core deficit in the population and, unlike inhibition, is resistant to change through social intervention. Further research may investigate how initial gains in cognitive flexibility may be maintained or increased over time.

Parental involvement in PEERS is a requirement and the current study supports the importance of this component. On the whole, parents reported strong communication and attachment with their children, a factor that was related to many of the improvements that adolescents made. Though not explicitly explored, participation in PEERS may improve or at least work to sustain family cohesion and parental self-efficacy in such a way that supports the ongoing improvement of skills. It may be the case that families would benefit from a focus on improving aspects of communication and feelings of connectedness before or during the intervention. This would of course have positive implications for the family on the whole but may also increase the likelihood of successful outcomes from participation in PEERS. Given the significant requirement of parent-child interactions during PEERS, a strong relationship would both protect against potential conflict during the intervention and improve generalizability of skills as parents may be better able to support their children long after the intervention has concluded. Overall, parents should be encouraged that their hard work and participation are a core component of their child's ongoing success in PEERS and in the application of the skills.

## **Strengths**

The current study had a number of noteworthy strengths. In particular, efforts to support external validity and generalizability were put forth. A natural recruitment plan, including accidental and snowball sampling (Sahu, 2013), led to the inclusion of interested participants representing typical families who would pursue PEERS when offered. Very few participants in the program declined research participation, thus avoiding many potential confounds of selection effects or unique attrition. The intervention was delivered as outlined in the PEERS manual by service providers with adequate training, and with graduate backgrounds in applied child psychology. Fidelity was ensured by having graduate trainees follow along in the treatment manual during service delivery to ensure no significant changes or modifications.

Participant intellectual functioning and ASD diagnosis were evaluated through the use of rigorous measures and only those who met these criteria were included in analysis. The use of  $VCI \geq 70$  allowed for a potentially wider range of participant functioning that represents the same range of those who may typically qualify for PEERS in non-research settings, where this testing is not employed. Different than many other studies, researcher influence was likely minimized in participants' completion of questionnaires as they finished them in the privacy of their own homes. The reduced impact of researcher influence potentially led to more reliable and valid data on a range of up to date, generalized measures with appropriate normative populations that well represent their constructs. Furthermore, a realistic follow up time period was explored. PEERS has been previously studied largely in the United States; the current study is the first that extends this line of inquiry to a Canadian population.

The research program helped to not only focus on replication but extend previous research to explore additional domains of functioning. Domains of mental health, EF, and parent-



child relationships not previously explored were examined in various capacities. In particular, significant support was seen for the importance of the parent-child relationship in adolescents' acquisition of skills. Though PEERS relies heavily on caregiver involvement, this had not previously been a component of research. Additionally, the running of PEERS met a number of needs of the community during the research program. Many graduate students received official training and may be able to continue offering the program in the future. Collaboration and opportunities for knowledge translation were facilitated through partnerships between the University of Calgary and various community organizations serving families of children with ASD during the process. Finally, and most importantly, an established social intervention was provided to over 60 families through the course of this study.

### **Limitations and Future Directions**

Despite many strengths, the current study presents with a number of limitations that may be addressed by further research or program considerations. Information on SES, ethnicity, or co-occurring conditions was not collected in sufficient capacity for data analysis; these factors can potentially have a significant impact on program outcomes. Moreover, the individuals who participated in PEERS were unlikely to be representative of the broader ASD population for which PEERS would be appropriate. All participants passed screening procedures to ensure they were suited to the intervention; however, the accidental and snowball sampling procedures were likely to introduce a narrow and/or specific subpopulation that actually participated in this study. For example, different results may have been found should the program have been run in different areas of the city, or at different community organization, etc. Collection of additional participant data during the LAU time and the course of the intervention would have been particularly important to understand the possible effects of other unique participant variables. For

example, families may have been concurrently accessing other resources (e.g., family counseling, in home supports, etc.) or going through significant life changes (e.g., house or school moves, a death in the family, etc.) that would impact the parent-child relationship and/or the ability to work on weekly socialization assignments.

Though valid and reliable questionnaires were used, only parent-ratings were used for many constructs (i.e., parent-child relationships, social skills, EF). The inclusion of additional adolescent ratings or behavioural observations may have yielded additional information.

Additionally, many parents reported improvements and satisfaction verbally that may have been better captured using qualitative methods such as brief interviews or open-ended questionnaires. Finally, in regard to data collection, teacher ratings were not used despite many program evaluations inclusion of behaviour ratings in a school environment. Though future research may include this additional perspective, the timeline of the current study would not have allowed for the same teacher to provide ratings of behaviour over the three time points.

The most detrimental limitations to the current study involve aspects of its methodology. The lack of true randomization and delayed treatment control data limits the conclusions that can be drawn, and the possibility of developmental effects are not easily ruled out. Initially, delayed treatment control data was gathered from as many participants as could be registered 14+ weeks before the start of the intervention. However, as time passed, it became difficult to organize groups 14 or more weeks in advance and turn away families who otherwise met inclusion criteria but did not contact researchers in time for the next group. These practicalities may be considered in future research that could involve both delayed treatment control data and a long-term follow up. A detailed understanding of the LAU time before the start of the intervention would allow for a more specific analysis and consideration of pre-existing factors that contribute to participant

success. Not only would control data have been available, but more categorical (e.g., demographic) and qualitative (e.g., other supports being accessed) information would have provided a richer understanding of individual differences. Additionally, it is difficult to say whether the study sample represents the true population of those with ASD who do not have intellectual impairment in the study's location or other areas of Canada due to recruitment and sampling procedures (Royse, Thyer, & Padgett, 2010).

Finally, a smaller sample size than hoped was available for data analysis and statistical power. Over 60 families participated in PEERS during the research, and 55 families provided consent for research. Though having participants complete questionnaires in the comfort of their own home and during realistic timelines may have provided externally valid data, it also resulted in several research packages not returned. This was especially problematic for long-term follow up data, which limited the number of participants for which all three time points could be analyzed. There is the potential for an unknown selection bias to be present in the families that did not return packages for which data would be important to include. Additionally, there was no direct control over who completed the research questionnaires. However, participants were instructed in the importance of completing their own questionnaire and provided basic identifying data (e.g., name, date, etc.) in their own writing on the physical forms. In regard to the lower numbers of PRQ data, this questionnaire was not initially available to the researcher and included until some groups of PEERS had already been run, further limiting the power for the related analysis.

In addition to filling the gaps seen in these limitations, future research and practice regarding PEERS and other social interventions has many possible avenues to explore. The current sample self-rated average levels of anxiety and depression. Exploring how PEERS

participation impacts these factors for individuals with low scores would be a valuable addition to the literature. The inclusion of parent-ratings of mental health may also be useful given the potential discrepancies between parent and child perspectives on this matter, and the problems those with ASD appear to have in reporting internal states involved in internalizing conditions. The use of more sensitive measures or different populations may allow for this investigation.

Results supported initial improvement in social skills from program participation that was not maintained long-term. It is possible that should families who participate in PEERS be supported for additional time after the initial intense intervention, the observed improvements would not be diminished. This may be accomplished through the use of optional booster sessions that families attend, which could allow for re-visitation of important vocabulary and practicing of crucial skills. Moreover, current trends in technology may also allow for remote support or ongoing learning. Follow up coaching sessions could be provided via video conferencing at regular intervals, or an online repository of information and videos could be provided for families to access when they want (e.g., web pages, apps, etc.). In general, though parents are included in PEERS to facilitate maintenance of adolescent skills, the results of this study suggest a model that continues to provide both parents and adolescence with ongoing support to maintain important skills learned.

Given the improvements seen in inhibition over the long term, further exploration of EF as an outcome and predictor for PEERS participants would be an important addition to the literature. To this date, no exploration of ToM has been added as a research component. Due to the relation between EF, ToM, and social skills, the study of how these factors interplay and are influenced by PEERS participation would be fascinating. Additionally, the above-mentioned

program additions that may improve social skills over the long term may also be applied to maintain gains made in cognitive flexibility.

Parent-child relationships were only explored in this study yet remain an area of great importance for further study in interventions where parent participation and coaching are a component. Additional study of parent-child relationships during adolescence in this population is an under researched area. Adolescents themselves may also have valuable insight into how they work with and relate to their parents during PEERS, leading to further understanding of positive family factors that lead to change through this and other programs.

The results of this study provide the basis for some small areas of change that may be made to PEERS. A minor focus on general problem solving and methods to support goal directed behaviour at the outset may prime improvements in EF that then continue to support social skill development. Early on in PEERS, activities to improve and/or support the parent-child relationship may be crucial to increasing gains and long-term generalization of learning as these relationships remain the basis for practice and coaching of skills long after program completion. Parents and adolescents spend time in PEERS in separate rooms and reunite at the end of every session for a short wrap-up. It may be beneficial to have parents and their children work together during PEERS sessions for some practice components to allow staff to provide direct coaching and feedback for parents themselves. Check-ins such as booster sessions or home visits may be an offering to re-connect with families some time after the initial program has ended. Resources in this digital age may include materials such as apps, videos, or video-conferencing with families to continue to support learning, practicing, and knowledge of skills taught in PEERS.

## **Conclusion**

Adolescents with ASD and without intellectual impairment are likely to struggle with making and keeping friends despite typically having a desire for these positive and protective relationships. PEERS was designed to address these needs and has previous evidence to support its effectiveness in targeting specific skills to help this population with these challenges. To date, the current study is novel in its exploration of additional factors that could be impacted by PEERS participation, including anxiety, depression, inhibition, cognitive flexibility, and general social skills utilizing an up to date measure of the construct. The findings suggest that program participation may have valuable secondary impacts on aspects of EF that are important for daily functioning and ongoing acquiring of prosocial behaviours. Furthermore, this is the first study of PEERS to include a pivotal examination of the impact of parent-child relationships on program outcomes. It will be important for future research and practice with PEERS to address parent-child relationships in a more straightforward manner. As individuals with ASD develop past childhood, less support and intervention are available to address a wide variety of needs. Though social skills and peer relationships are a core area of need during this time, other challenges are clearly present. PEERS not only addresses skills required for peer friendships but may have the potential to encompass other domains for which intervention can be difficult to find and access for families during this time. Adding components to further support EF development and positive parent-child relationships may be simple yet have far reaching implications for the development of social skills and resilience.

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## Appendix A

### PEERS Initial Interview Schedule

*[parents can be present / prefer majority of questions with teen alone]*

1.) What do you know about the program we're offering (PEERS) / What did your parents tell you?

2.) We have sessions that teach teens how to make and keep friends. Is this something you might be interested in?

*[explain sessions and answer any questions as necessary]*

3.) Have you done anything like this in the past?  
What was that/it like?

4.) Can you tell me about some of your interests?

5.) Are there teens that you usually hang out with? (If YES – What are their first names / Are they older or younger / How do you usually meet up / What kind of things do you do with them?)

6.) Have you had any difficulties in with making or keeping friends – Tell me about this?

7.) What sort of things would you like to work on in making / keep friends? Anything in particular?

8.) Our structure (describe): Lesson, and then get to practice what you learn – homework/home practice

Would you be willing to do "homework" tasks, sometimes with your parents, sometimes with people that you know from school or other places?

9.) Attending all sessions is highly stressed. Would you be willing to attend all of them?  
*[describe nature of research and procedure / will be sent forms and consent discussed / participation encouraged but not required]*

#### Global Impressions:

Oriented to interviewer? \_\_\_\_\_ How many times? \_\_\_\_\_

Mood and affect appropriate to situation? \_\_\_\_\_

Describe: \_\_\_\_\_

Established rapport with examiner? \_\_\_\_\_

Notes: \_\_\_\_\_

Cognitive abilities impression \_\_\_\_\_

Social maturity: \_\_\_\_\_

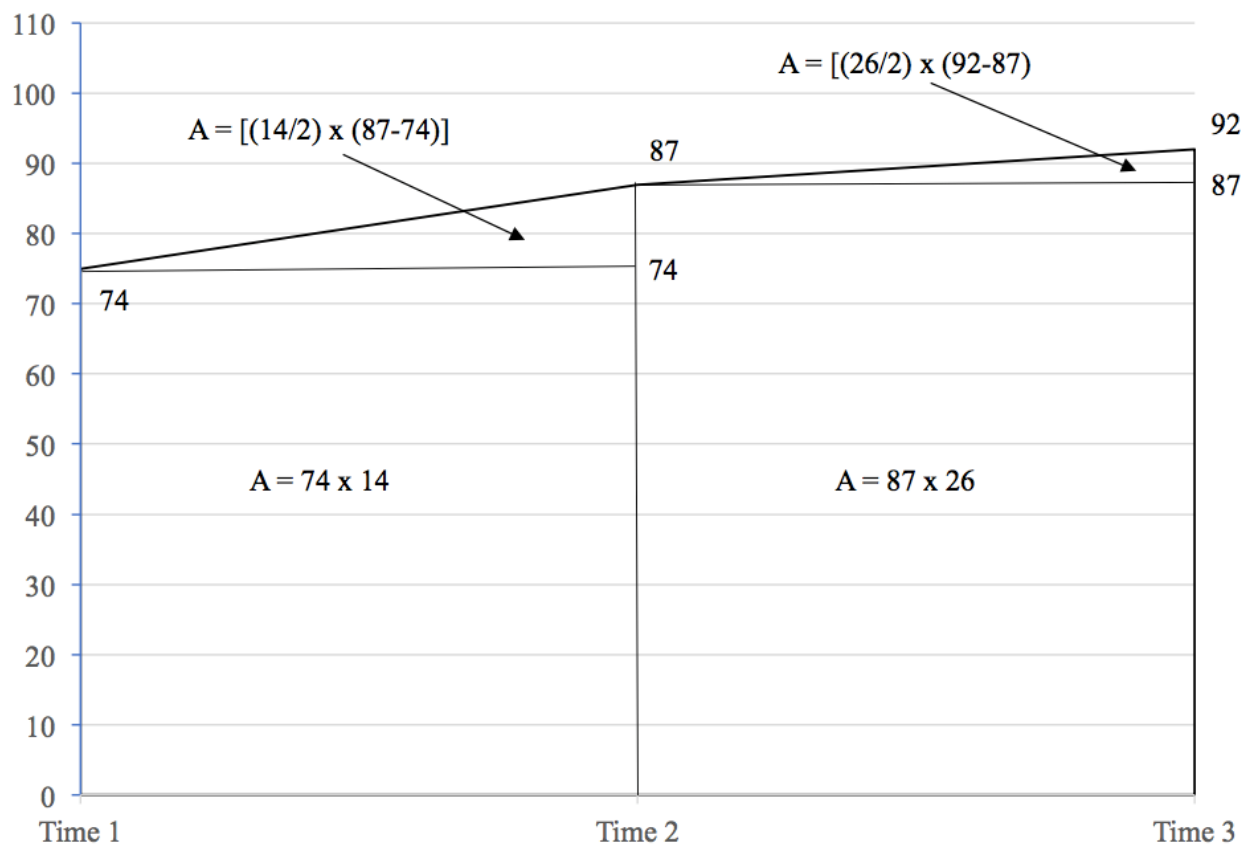
Interest / Motivation in Program?: \_\_\_\_\_

Some awareness of need for friends?: \_\_\_\_\_

Other Notes: \_\_\_\_\_

## Appendix B

Example AUC calculations for a participant with pre-test, post-test, and follow-up SSIS scores of 74, 87, and 92 respectively.



Time 1 = 0 weeks, Time 2 = 14 weeks, Time 3 = 40 weeks (14 weeks + 26 weeks)

AUC Formula: (Time 1 x 14 weeks) + [(Time 2 – Time 1) x (14 weeks / 2)] + (Time 2 x 26 weeks) + [(Time 3 – Time 2) x (26 weeks / 2)]

$$= (74 \times 14) + [(87 - 74) \times (14 / 2)] + (87 \times 26) + [(92 - 87) \times (26 / 2)]$$

$$= 1036 + (13 \times 7) + 2262 + (5 \times 13)$$

$$= 1036 + 91 + 2262 + 65$$

$$= 3,454$$